

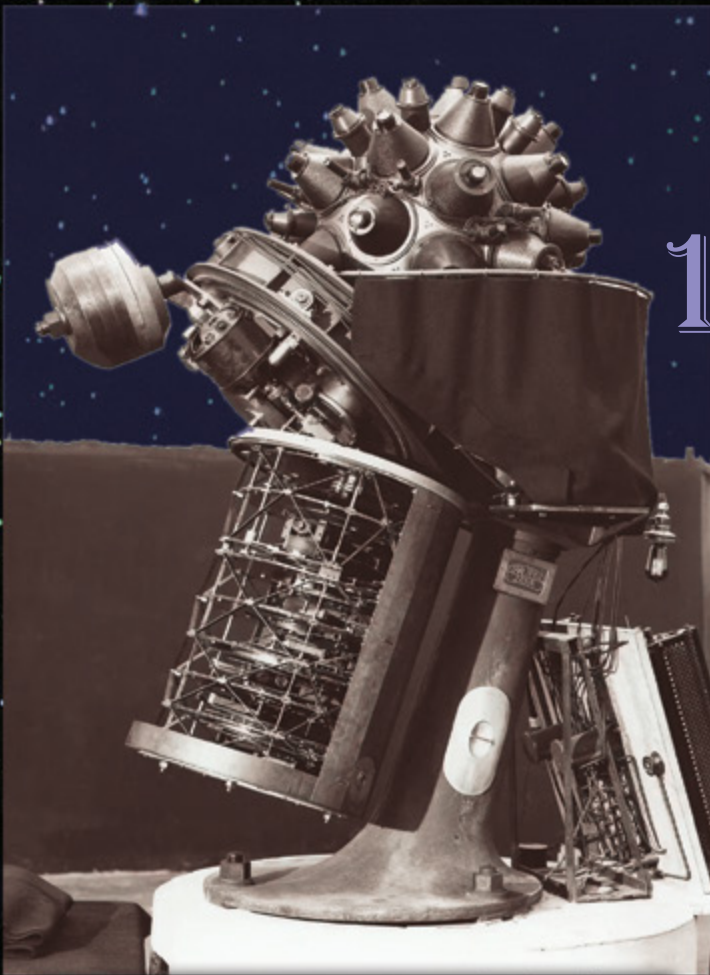
Vol. 52, No. 4

December 2023

# PLANETARIAN

Journal of the International Planetarium Society





# 100 YEARS

With great pleasure and respect, GOTO, Inc. would like to honor the celebration of the 100<sup>th</sup> anniversary of the first optical star projector and the creation of the public planetarium.

The innovation that began with the invention of the Zeiss Planetarium in Jena 100 years ago has transformed into a culture of education that transcends borders and continues to evolve to this day. Even though planetariums use different brands of equipment, we believe that the excitement and satisfaction that visitors receive from the wonderful experience they gain inside the dome is a universal value.

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## PLANETARIAN

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### ON THE COVER

Robin and I jokingly said to each other this morning during breakfast (on Oct. 13, 2023, the day before the annular eclipse) that it would great to see the crescent Moon. Well, it became a reality! I went out on the back deck and noticed how clear the sky was. Walking to the far end of the deck, I was able to see in a low dip in our mountain range horizon, the super-thin crescent Moon! In binoculars, about 5 minutes before this image, I could see a ring of light all around the Moon, not just the bottom as seen in this image. The image was taken at 7:11a EDT in East Tennessee. The Moon was 28.4 days old (1.1 days to new) with 1.4% illumination. Notice that the crescent is not solid, but has gaps from crater rims causing shadows.

Have an image you would like to see on the cover of the Planetarian? Submit your photos to [editor@ips-planetarium.org](mailto:editor@ips-planetarium.org) with the subject line "Cover Submission". We love to showcase the work that our fellow planetarians are doing!



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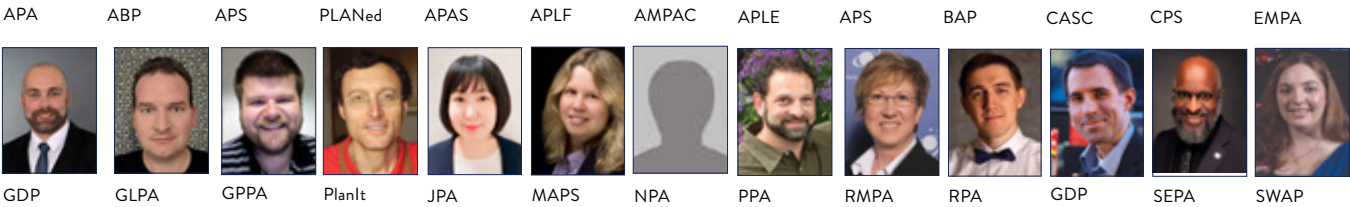
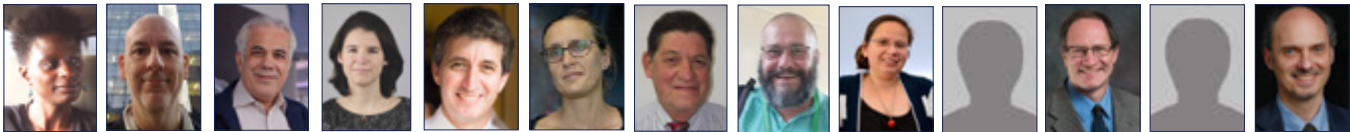
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heritage, we are inspired to dream  
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# The Power to Present





## A FINAL NOTE PRESIDENT'S MESSAGE

At long last, the Centennial has begun! We are very fortunate in the planetarium community to have so much to celebrate from this past century, and it was a true honor to help ring in the Centennial as part of the opening ceremonies that took place concurrently in Jena and Munich, Germany. It was an evening of both looking back and looking forward - appreciating where we have been as a community, and inspiring us to a better future.

To the teams at the Zeiss-Planetarium Jena and the Deutsches Museum - a most sincere congratulations on a highly successful event, and please accept my deep gratitude for representing the planetarium world so well. The same can be said of Volkmar Schorcht and the entire ZEISS team, who have been indispensable in planning and executing not just this event, but so many projects throughout the larger Centennial celebration. But on an almost daily basis, I am most grateful for the incredible duo that leads our IPS Centennial committee: Bjorn Voss and Guilherme Maranghello. It's been a shining example of how wonderfully our community can come together.

The highlight of the evening's festivities, however, was the keynote address given by Dan Tell, titled "Ghosts Among the Stars." Dan is a very close friend and a colleague I hold in the highest regard, and I knew that his talk would be insightful and wise. As is always the case with Dan, he spoke truth to power and to privilege. His speech was a reminder that what we do matters greatly - we so often provide the spark of inspiration to our audiences. Our domes show an Earth and a Universe that transcends borders and divisions, and we have the power in our stories and interactions to help make a more just, equitable, and peaceful world.

I hope all of you give the transcript of Dan's speech a read later in this issue

of Planetarian, and that you find it as moving as I did.

Our next major gathering of the Centennial will, of course, be the biennial conference held in Jena and Berlin in July 2024. By the time that many of us make our way to Germany next year, it will have been more than six years since the Toulouse conference, and I'm anticipating an incredible variety of papers, workshops, and presentations from our members around the world.

Several of the officers stopped in Berlin after the opening ceremonies for a walkthrough of the domes and conference spaces, alongside a number of vendor representatives, and all I can say is that we are in for a wonderful experience at the conference next year. For those who attended the Pleiades U.S. national conference in 2017, you know what great work Anna Green can do as a conference organizer, and 2024 will be no different. Anna and the Stiftung Planetarium Berlin team provided incomparable hospitality to us who could attend, and the venues for next year will allow all of our delegates and sponsors to showcase their best work. Keep your eyes open for more updates on the conference from Jena and Berlin in the weeks and months ahead.

In the midst of all of the celebration the past few months, we lost a luminary in our planetarium field. Dale Smith was an integral part of the history of IPS, serving as President (1999-2000), proceedings editor, Publications committee chair, and more. His work extended into similar roles with the Great Lakes Planetarium Association (GLPA), and was deservedly lauded by both organizations during his career - to say nothing of his storied tenure as planetarium director at Bowling Green State University.

Dale was always a prominent presence at conferences, a planetarian convinced



Michael McConville  
Evans & Sutherland/Spitz Inc.  
president@ips-planetarium.org

of the importance of sharing knowledge whenever possible. IPS, GLPA, and all of our organizations are only as effective as the volunteers who devote their time and effort, and Dale's devotion and dedication were second-to-none. To me, he is a reminder that a passion for our dome world is one of the things that binds us together. His influence on IPS is inestimable, and he will be dearly missed by the friends, colleagues, and mentees that carry on his memory.

Here at the end of 2023, and the first year of my presidency, I am more hopeful than ever. The Centennial, the conference, watching my peers do great things - they all inspire me to do better, to be better. I am so proud of our organization, of the affiliates, of my fellow officers and board representatives. There are new leaders emerging with startling rapidity, and I can't wait to see what this next planetarium century has to offer.

To all of you...thank you.

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## FOR ALL THE THINGS IN FRONT OF THE CONSOLE

I don't know how it's been for everyone else, but at least for myself and those I've talked to, this has been an incredibly fast and furious fall. Kept busy with events, meetings, and more, people no doubt are looking forward to a little bit of downtime (and maybe some holiday cheer).

I would like to take this moment to really send a heartfelt thank you to the team that helps me put out the *Planetarian*. I know it is a bit late this month (which is not new, I know, but I do always feel bad about it), but I really must shout out the columnists who volunteered their time and energy to write their columns, Beth Moger for technical editing, and Julia Plummer for peer-reviewing and more. I would also like to thank the officers for being so supportive in all aspects!

Although this semester is winding down, I am already beginning to

prepare for comprehensive exams most likely in the summer. Trying to find a work/school/life balance has been

DO ALL THE THINGS!



very difficult, especially as I have a tendency to want to "do all the things". I suppose that is one of the fun "features" of ADHD. It's not just in school either - things at the planetarium have been incredibly busy. There are so many things I want to work on and do, and trying to determine what we should prioritize is tricky.

Our "Science at Sunset" series wrapped up with a presentation on PFAS (Per- and polyfluoroalkyl substances), a topic that is both fascinating to learn about and relevant for so many people. We received positive feedback, and we now are in the process of setting a series lineup for this spring.

We also begin to prepare for our graduating seniors during the spring. We employ undergraduate students with the science outreach bug as our planetarium operators, and every May we lose a few of them to graduation. It is always bittersweet, but it is always an honor to watch them grow in their skills from beginning to end. It *also* means training is a constant cycle (we are fortunate that Uniview's panels make the process fairly pain-free). One advantage to having students in these positions is that it allows our K12 visitors to potentially see their future selves in a different light. Having students in these positions also gives us insight into what is of interest to the student population. They play a large role in deciding which music laser shows we bring in, and I consider that a large factor that has translated into sold-out laser shows for the last year and a half straight.



Shiloe Fontes  
Flandrau Science Center  
& Planetarium  
University of Arizona  
Tucson, Arizona  
editor@ips-planetarium.org

With the 100th anniversary of the planetarium coming up, I can't help but ponder where we are going - not just the profession at large, but Flandrau specifically. Our own 50th anniversary coincides with the planetarium centennial. The big question (besides how will we celebrate, of course) is how will we continue to grow and create as we move forward? How will we create interdisciplinary relationships? How will we inspire audiences? How will we teach people to imagine, laugh, and think critically?

I encourage, rather, implore you, to read Dan Tell's "Ghosts Among the Stars", which follows my column. I envy those who were fortunate enough to hear it in person. He states early on that "we still learn so much of what we need from each other, in relationships of mentors and proteges; masters and apprentices." I did not come into this field with any formal training in astronomy; as I have mentioned before, I was steered away from the sciences due to a learning disability. But it never dulled my passion, and from the first time I stepped behind the console, I knew it was a part of what I was missing. I have learned so much from so many of you, not only in reading your columns or seeing what you are doing via Dome Dialogues and more. I have learned decades of information from my predecessor Michael Magee. I have learned and continue to learn so much from my students. The learning never ends, and I for one am glad for it.

So much of what Dan said rings true for me as a planetarian. I would think it would ring true for many of us.

Along with wanting to do all the things, and wanting to want to ask all the questions, just maybe, I'll take a nap over the holiday break.

I wish you all warm holiday wishes and a wonderful new year.



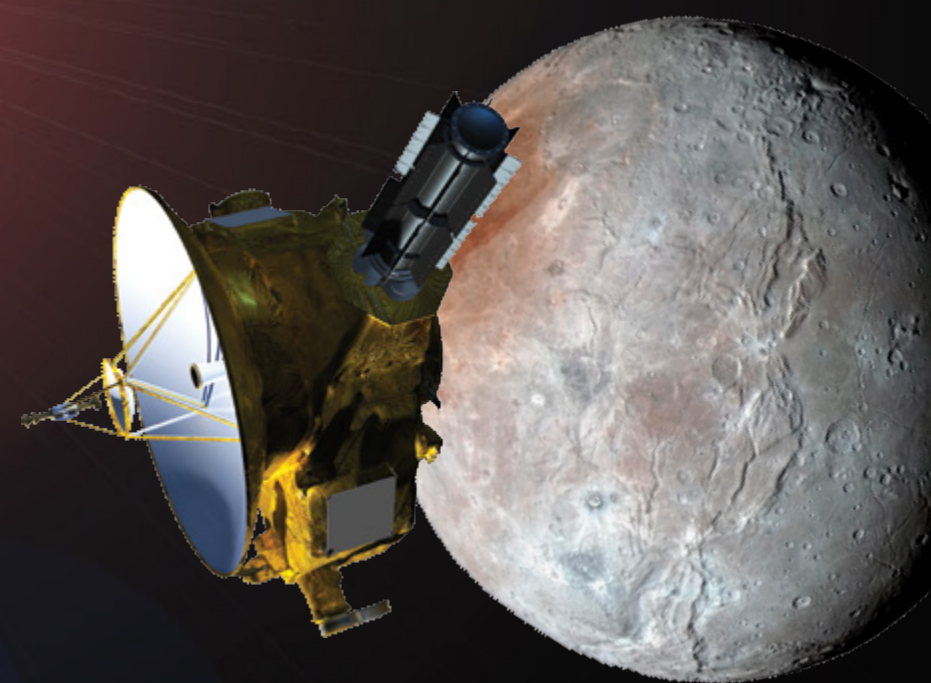
Above, the final Science at Sunset presentation for the year. Below, the crowd early on October 14, 2023, for the eclipse.

## SHOWS

### THE EDGE

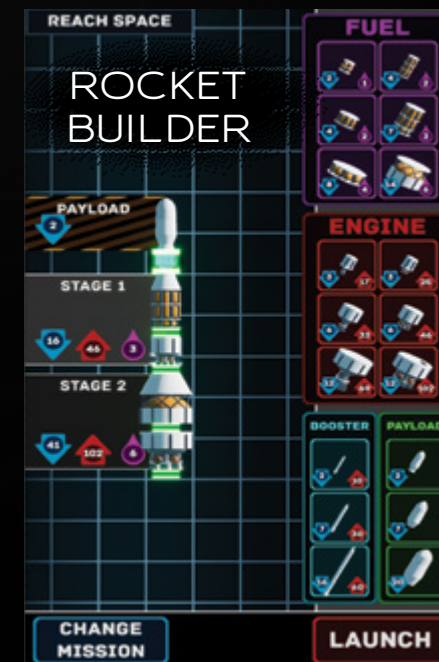
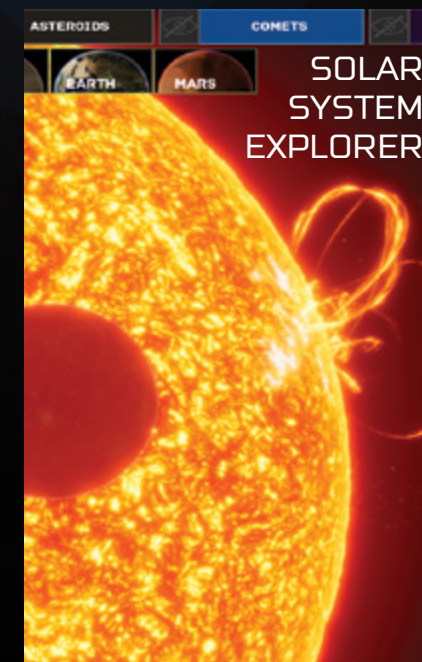
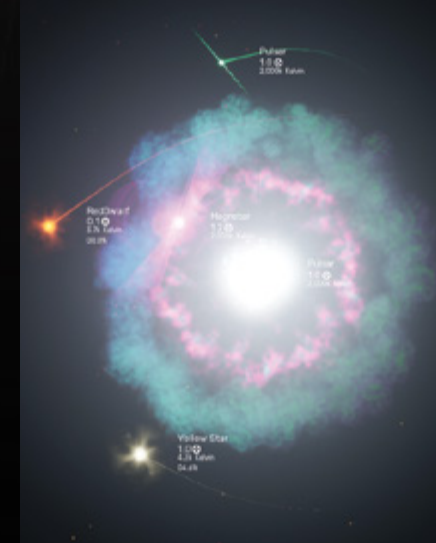
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## INTERACTIVES

### STELLAR PLAYGROUND



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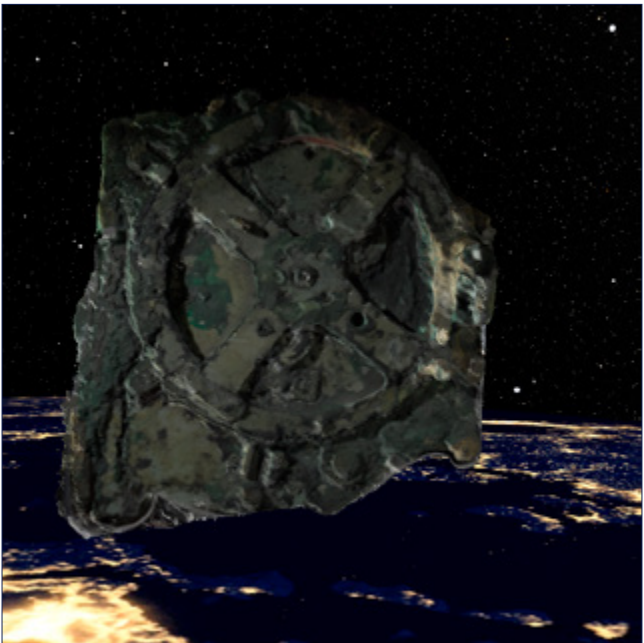
INTERACTIVE EXHIBITS | FULLDOME SHOWS | MUSIC SHOWS





# GHOSTS AMONG THE STARS

By Dan Tell



*These remarks were presented as a keynote speech for the Planetarium Centennial launch event in Jena, Germany, October 21, 2023.*

Thank you to the International Planetarium Society, the Society of German-speaking Planetariums, ZEISS, and the global community of planetariums for inviting me to give this talk to you tonight. It is one of the greatest honors of my career to have been asked to reflect on the Centennial of the Planetarium for you. The planetarium has shaped my life across my twenty years in this field and influenced my philosophy on the relationship between technology and human imagination. Tonight, I would like to share some of these personal reflections with you.

I like to think of myself as someone with a “big tent” definition of a planetarium, incorporating the traditional meaning of the word to include armillary spheres and mechanical orreries, a tradition that stretches back at least a full 2000 years before the projection planetarium, to devices like the Antikythera Mechanism of ancient Greece.

An even more generous definition of planetarium to include all artificial depictions of the sky could take us back at least another 1500 years to include the Nebra Sky Disk, the oldest concrete depiction of the sky, found here in Germany, and perhaps a fitting precursor to why Germany should be the birthplace of the modern planetarium. But, of course, none of these are what any of us mean when we casually use the word planetarium; we generally mean the dome theater and the projection technology that simulates the heavens.

The projection planetarium was a unique shift from the planetariums of the past. Some had been research tools, others simply curiosities for royalty, rarely exhibited for the public. And none of these past machines could achieve the spectacle of bringing the stars to the Earth.

However, much as it may have been a dream of past generations, the projection planetarium could only be realized in the time and place it was. It surely followed from western societies’ new interest in universal education in the 19th century, which also saw public schools and museums come into existence and increase in popularity. The planetarium created a new shared experience for the public, and the opportunity to educate hundreds of people at once on the wonder of the Universe.

The planetarium could also only exist because of the Industrial Revolution, which allowed for mass production and precision machining of the steel necessary to build a machine of any size, scale, and mass, replacing the fine, soft brass and bronze of earlier generations. And it could only happen in Jena, where Ernst Abbe and Otto Schott, collaborating with Carl Zeiss, had made optical glass manufacture a predictable science rather than haphazard alchemy, setting up the Zeiss company as uniquely capable of engineering such a device.



**Top:** 3D scan of Fragment A of the Antikythera Mechanism. Model: Alexander Jones. New York University, Distributed under the terms of the Creative Commons Attribution 4.0 International (CC-BY) license. Athens National Archaeological Museum X 15087. *Rendered in Uniview 3.0.*; **Above:** 3D Model of the Nebra Sky Disk. Model: CG Trader user extrudy, royalty free license. Texture: Frank Vincentz, CC Attribution Sharealike 4.0. Distributed under the terms of the Creative Commons Attribution-Share Alike 4.0 International license. *Rendered in Uniview 3.0.*

It is probably also because of the Industrial Revolution that the need for the planetarium arose. The stars have been humanity’s constant companion throughout history, but as society urbanized, gas lamps, and then electric lights, illuminated our cities at night, and the twinkling stars began to fade from public view and consciousness.

The Miracle of Jena brought the stars back to Earth, and also granted humans our eternal ambition: the illusion of control over the natural world. We could now direct the motions of the sky, no longer limiting our perspective to our local geography, nor the sluggish motions of the heavens.

Planetariums were a totally new experience, unlike anything that came before. Who was to be tasked with the use of these theaters? Astronomers seemed a logical choice, but to me, one that invokes the American poet Walt Whitman:

*When I heard the learn'd astronomer,  
When the proofs, the figures, were ranged in columns  
before me,  
When I was shown the charts and diagrams, to add, divide,  
and measure them,  
When I, sitting, heard the astronomer where he lectured with  
much applause in the lecture-room,  
How soon unaccountable I became tired and sick,  
Till rising and gliding out I wander'd off by myself,  
In the mystical moist night-air, and from time to time,  
Look'd up in perfect silence at the stars.*

Yes, the planetarium is a tool for astronomy and needs the research and insights of astronomers. But it needs something else as well, that researchers cannot always offer. It needs a spirit of life blown into it, to ignite imagination more brightly than the central lamp ignites the stars.

I think we planetarians, including those of us with formal astronomy training, owe the roots of our tradition



Armand Spitz with Model A Projector, courtesy Spitz Inc.

not just to the astronomers. We are the *interpreters* of the stars, our ancestors as much the court astrologers, the priests on the ziggurats, the druids of the henges, and the ancient mythmakers who told stories of the sky around long forgotten fires.

In a recent meeting I had with our IPS President-Elect, Shannon Schmoll, she used the word “guild” to describe our profession. I found it apt. Although we benefit from formal training in many disciplines, and there have been attempts to formalize training for the planetarium, we still learn so much of what we need from each other, in relationships of mentors and proteges; masters and apprentices.

Even a century into this profession, I see this firsthand daily. We cannot canonize this information because we are still discovering how to use the planetarium. At our Great Lakes Planetarium Association Conferences, we annually read a letter penned to that organization by Armand Spitz, whose affordable planetarium projectors swept over the United States in the mid-twentieth century. In it, he says, “*You may have heard me say many times that, in my opinion, the full potential of planetarium (and I use the word in its broadest possible connotation) has yet barely been scratched.*”

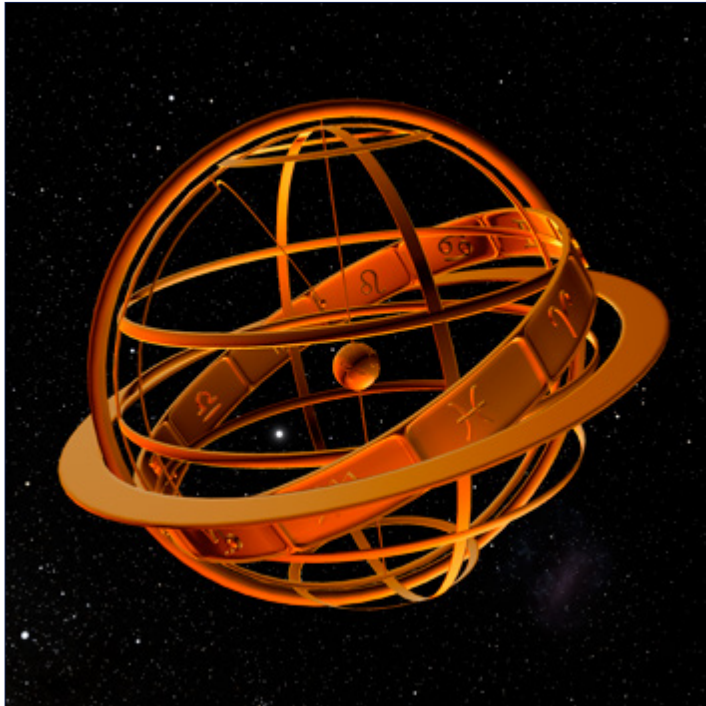
I believe those words are no less true now than when they were written 56 years ago. As new technologies have entered the planetarium, we find our potential only increases, and we see further horizons we have to discover.

I think an irony of this potential is what our governments see in it. Armand Spitz’s success was inextricable from the United States’ National Defense Education Act. Passed in 1958, in reaction to the Soviet launch of the Sputnik satellite and sought to improve science education in the US to better compete with the Soviet system. Money from the act was



Sputnik 1 satellite, rendered in Zeiss Uniview.





An armillary sphere, rendered in Uniview 3.0.

used to build planetariums across the country, including in many primary and secondary schools. This proliferation of planetariums has given the US an outsized proportion of the planetarium population (and please pardon my persistent alliteration) and led to the founding of our professional organizations to help educators make use of these tools. But the funding source belies a dark motive: we were educating our children so the US could have specific scientific advantage it hoped would achieve victory in the Cold War. Arguably, the act had great success, but when a more educated generation objected to US engagement in war, especially the US action in Vietnam, political tides turned against this kind of education. Over the decades, federal support for US planetariums (and education in general) has evaporated, and many school planetariums have become relics of their time, while others are mothballed or converted to storage rooms.

The ambition to use scientific intellect for military advantage is not new. I have reflected on it much this summer with the release of Christopher Nolan's film *Oppenheimer*. As a Jew, it resonated with me how outsized the influence of Jewish physicists were on the Manhattan Project, including Robert Oppenheimer himself. The intellectual traditions of my people had brought many of our minds to physics, and the threat of our extermination at the hands of the Nazis reluctantly motivated the creation of the most destructive weapons in history out of desperation for self-preservation and the naïve hope that such a terrible weapon would end all war. Instead, it placed us under eternal threat of total annihilation.

We could even trace this trend back to the ancient scientist, Archimedes, a prototype of our profession, who is said to have built some of the earliest armillary spheres and mechanical planetariums. When Romans, under General Marcellus, invaded his home of Syracuse in the second century BCE,

Archimedes designed many war machines to aid in the city's defense. When the city fell, Marcellus ordered Archimedes captured, so that Rome might use his intellect to enhance its military strength. Supposedly (although all accounts come from centuries later) when soldiers went to capture Archimedes, he refused to go, saying "do not disturb my circles!" This is variously interpreted as either a mathematical problem he was solving, or even the planning and construction of an armillary sphere he was engaged in. For this refusal, he was killed on the spot. Archimedes' orreries were carried off to Rome as wonders but fell into disrepair with no minds left able to understand their mechanics.

Even if the specifics of that story are myth, they have become myth because of how they resonate with us. There have always been those who seek to turn intellect and scientific discovery towards destructive purpose, but scientific knowledge often turns its students against war. For this reason, whenever fascism rears its head, as it did in Germany not long after the invention of the planetarium and as it tries to again now in the US and around the world, it is always accompanied by anti-intellectualism.

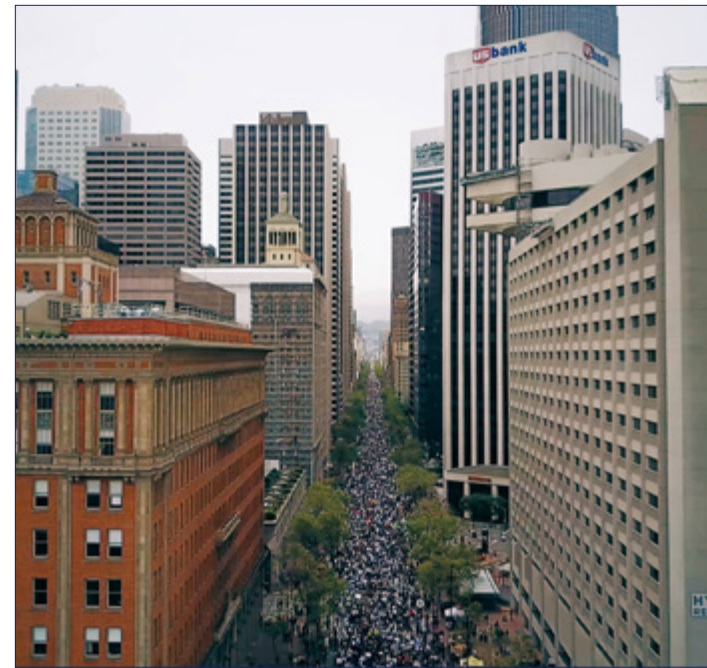
As I mentioned already, I am Jewish. Although I have wrestled with what that means for my identity for my whole life, it is central to much of what I do. I have come to Germany and Austria many times now in my career, and each time there are prominent reminders engraved into the architecture of the land of the attempt to exterminate my people, among many others, in the Holocaust. At the same time, I think there is significance to my presence and invitation back to these lands.

Fortunately, my immediate family was not directly touched by the Holocaust. My ancestors, the Tolkovskies, Zietzes, Moskowiczes, and Levines fled Russia, Belarus, and Ukraine during the pogroms of the late 19th century. But my grandparents came of age in the US during World War II, and afterward believed there could be no forgiveness, no friendship between Germans and Jews.

I have not let this wound fester into prejudice for myself. This career, and the inescapable Germanness of the planetarium, has given me many German friends and colleagues. Earlier tonight we heard from Tim Horn. He and I first learned of each other through the Digistar Users Group 15 years ago when he won the demo award that year, while I was runner up. When I joined the California Academy of Sciences, I was privileged to work with him, and our mutual respect has become friendship.

For me, personally, the planetarium is an instrument of peace and healing. I think this is just one small example of where shared appreciation for science, art, intellect, and imagination can unite all people, for all of these are the enemies of fascism.

In 2017, after the election of Donald Trump, his elevation of anti-science ideologues to national leadership, and their attempts to significantly cut federal science funding, I joined, and ended up helping to lead, the March for



55,000 people assemble for the March for Science – San Francisco, April 21, 2017. Anonymous photographer, courtesy March for Science – San Francisco.

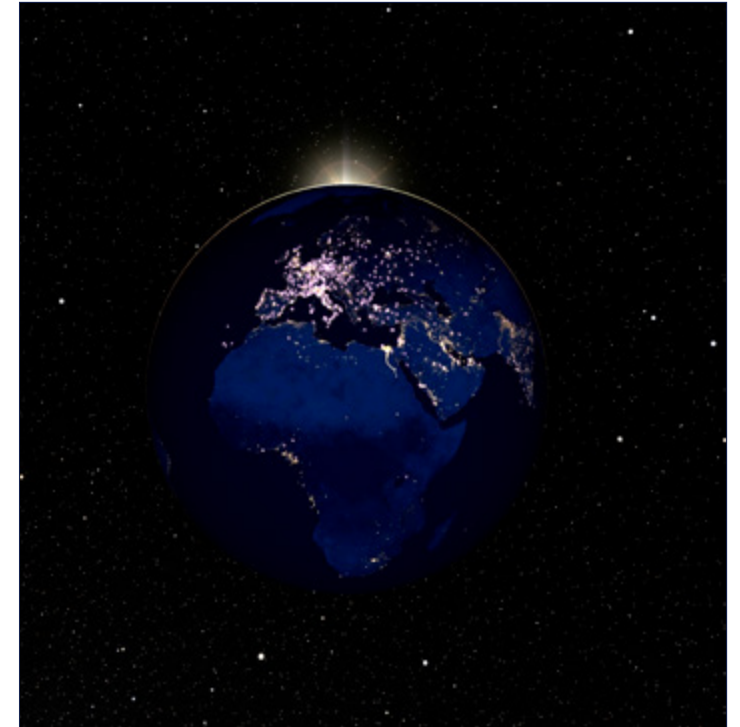
Science, the largest pro-science demonstration in history to-date. I learned first-hand just how hard it is to organize peaceful resistance to oppressive governments. And in that hardship, I could see what my grandparents did not: that the German people *as a whole* were not culpable, they too were victims of an oppressive government that made resistance fatally difficult.

Part of our ambition in March for Science was to remind governments that science is essential to inform good policy and benefit society—but also to remind scientists that their work must connect with and reach the public. The full good that science can achieve when open and accessible has yet to be truly manifested in our world.

The potential for the planetarium is intimately tied to this. What is the planetarium but a vessel for human imagination? It can take our imagination across the universe, faster than the speed of light. It can take us from the largest to the smallest scales of the universe. Backwards in time near the origins of the cosmos, or forwards to see the final fate of our Earth.

When realized to its full potential, we will help the imaginations of children and adults to feel even the tiniest awareness of the vastness of the Universe and inspire them to feel the ultimate miracle that is the existence of every living being on our Earth and the desperate necessity to respect and preserve our jewel of the universe.

The 20th century gave us a universe ruled by uncertainty and probability. Physics gives us two likely possibilities to the structure and course of time. One is a world entirely of uncertainty, where each exchange of energy between the fundamental building blocks of the Universe opens and closes an infinite number of possibilities around us. In such a world, how fortunate we are that we exist in such a time, with such a



Global planetarium locations highlighted in purple. Data: World Planetariums Database, Daniel Audeon, Lionel Ruiz, ©2023 WPD. Rendered in Uniview 3.0.

tool as we have, and such a community with which to discover its possibilities.

Alternatively, our universe may be superdeterministic—to manipulate a quote from Einstein: perhaps god does not play dice with the Universe, he plays Candyland, and the deck of probability was shuffled for all of time when the cosmos was born and we are merely moving through it.

I, for one, prefer the latter in many ways. Not because I wish to be helpless at the whims of fate, but to see myself—to see all of us—as the active agents of fate. I believe that a better world already exists in our future, and each of us has our role to bring it about. The planetarium came into existence in the time it was needed, and we each came to it because it is our necessary role for the world we will create.

I grew up in the traditions of Reform Judaism—a movement that also began here in Germany. I believe strongly in the central ethos of this branch of Judaism we call *tikkun olam*—the healing of the world. And of course, I do not believe this is any special domain of my people, although I feel it as my obligation. All humans can work together to heal this world.

The wounds of our world are tremendous, and this work will *never* be finished. But each contribution we make matters. Every person you give a gasp of awe and wonder to is a dab of salve to this world. We see our audiences for only a few minutes, but the impact we *can* have *has* changed lives forever, and we rarely know the fulfillment of the reactions we catalyze.

Many thinkers before me have hoped that our wonder and awe at the Universe could cure our world of cruelty and prejudice. I cannot think about those evils without thinking



of a quote from the biologist, Stephen Jay Gould: “I am, somehow, less interested in the weight and convolutions of Einstein’s brain than in the near certainty that people of equal talent have lived and died in cotton fields and sweatshops.”

What science education should teach us is that there is almost unlimited untapped potential in everyone all around us. One of the chief cruelties of our world is stamping out curiosity in children, and depriving people of their ability to wonder by forcing them to suffer and toil. In my country, we certainly see this in the persistent legacies of slavery and discrimination towards Black Americans. Around the world these prejudices present in many forms, discriminating against people because of their race and the mere adaptation of human skin to sunlight and environmental conditions. Discrimination because of religion—antisemitism did not disappear at the end of World War II and islamophobia burns intensely in many nations, and sadly, both of these prejudices pit our peoples against each other. There is discrimination against migrants and refugees, who come to developed nations looking for hope and opportunity, or to escape the risk of death in their homelands and the destruction of war. There is discrimination against people because of their love and attraction to their own gender, or because they know the gender identity of their spirit does not match the body that they were born into. There is discrimination against women, an entire half of humanity and source of all human life. There are as many prejudices as there are identities. When prejudice and hatred deprive people of their ability to fully take part in the world, we lose their contributions, and we fail ourselves in our purpose to make a better world.

We can see the legacy of this still in the global distribution of planetariums. Planetariums are most concentrated in Europe, North America, Japan, and have spread to East and Southeast Asia, India, South America, Oceania, and the wealthiest nations of the Middle East. But Africa, the second-most populous continent, has only a sparse few planetariums. This is part of the ongoing damage of centuries of colonialism that have monstrously exploited Africa for its natural and human resources without returning that wealth to the people it was taken from.

My hope for the next century of the planetarium is that we, as a community, will use our tools and our powers to heal the world. As global urbanization and industrial development continues, the companionship of the stars will fade in more and more parts of the world, and it will be the place of planetariums to remind us of our connection to the stars. All people in the world are connected to the sky and are connected to the Universe. All people deserve to have the tool of the planetarium in order to wonder at this connection and to explore their own stories and perspectives through this instrument. I hope that by the bicentennial of the planetarium, we will have welcomed a robust, multi-national African planetarium community into our global guild.

Earlier this year, at the *Stars for All* planetarium conference in the US, my friend, Dayna Thompson, shared a thought with us that I have not been able to shake: “Awe is a reminder that I am



Ophiuchus and Serpens constellations as depicted by Johannes Hevelius in *Firmamentum Sobiescianum sive Uranographia*. Rendered in Uniview 3.0.

*alive in a universe bigger than myself.”*

Inspiring a sense of awe is at the heart of why the first planetarium projector was called the Miracle of Jena. Awe is at the very heart of what we achieve when we apply the planetarium. And it is a feeling everyone in this world deserves, perhaps needs, to experience. If we do not inspire awe, we are just teaching trivia. Our work must fill our audiences and ourselves with awe that we exist in this cosmos.

The planetarium is a truly special machine, but it needs us to give it life. To bridge the connection between the individual and the cosmic.

And this bridge exists without the planetarium. After all, the planetarium is just a simulation of reality. It is but lights and shadow dancing on a cave wall. It does not replace the real sky; it simulates and even augments it, but it is always a mere facsimile of reality.

We must fill our audiences with awe for their real connection to the cosmos and encourage them to experience it beyond the planetarium, embracing the reality of the heavens.

Since I am giving this talk in a planetarium, it seems fitting to include one of the most traditional elements of the planetarium experience: a star story - the type of story humans have told to build our connection to the stars from our earliest days, before we understood what the stars really were.

One of my favorite constellations, a subtle centerpiece of the summer sky, is Ophiuchus, the serpent-bearer. This constellation sits opposite Orion in the sky but lacks the prominent brightness of its antipode. Ophiuchus, in the myths passed down since the time of the ancient Greeks, represents Asklepios, the healer. The ancients believed

*(Continued on pg. 73)*

Everything we know started in the stars.

# SPARK

## The Universe in Us

A new planetarium show narrated by Diego Luna



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# TOWARDS A MORE ACCESSIBLE PLANETARIUM: TESTING CAPTIONING OPTIONS WITH MEMBERS OF THE DEAF AND HARD HEARING COMMUNITY

By Jesica L. Trucks, Shannon Schmoll, & Kathleen A. Hinko

## Introduction and Motivation

Around the world, institutions are recognizing the need for more inclusive environments that increase the accessibility to science, technology, engineering, and mathematics (STEM) (Committee on STEM Education, 2018; Freeman & Huang, 2014; Impey, 2012; Phillips, 2014). The International Planetarium Society (IPS) has also made a step forward toward this goal with the creation of the Committee on Equity, Diversity, and Inclusion (Equity, Diversity and Inclusion Committee - International Planetarium Society, Inc. (2023)). Planetariums have recognized the need to make their environments accessible and more inclusive (Captioning for hearing impaired - International Planetarium Society, Inc. (2014 - 2022)).

A serious concern in the accessibility of planetariums is making them accessible to the d/Deaf and hard of hearing (DHH) community. Throughout this paper, we use d/Deaf to be inclusive to both those who identify themselves as culturally Deaf and those people who do not. Captioning is a key method to address this (National Association of the Deaf - NAD, 2023; Captions for Deaf and Hard-of-Hearing Viewers, 2017). Yet this is a major area of work as most planetariums do not have a standardized means of captioning their shows, and those that exist are idiosyncratic. The goal for the future is for planetariums to be fully inclusive spaces, captioning is an important step towards this goal for the DHH community.

The technology options for captioning in planetariums are varied and often require some upfront investment that needs to be budgeted for. Considerations might include costs as well as technologies that are easy to use, reliable, and harmonize with the immersive nature of the planetarium. Overall, there is little work done around these captioning options in planetariums and opinions on these options from the d/Deaf and DHH community. This work explores three different technologies that can be used in a planetarium. While planetariums also include either fully live programs or a live portion in addition to a fulldome show, this work only addressed pre-recorded content.

## Big Astronomy context and captioning plan

Big Astronomy is a National Science Foundation (NSF) funded project (award # 1811436) whose goal was to create a planetarium show and extended engagement activities that support learning beyond the planetarium dome, including a web portal, social media live events, and hands-on activities. As part of the Big Astronomy Project, we performed a test case to research accessibility for those in the DHH community. This paper highlights a test case for three captioning options open to planetariums: a handheld device, AR glasses, and captioning on the dome. Some challenges for captioning in the planetarium are finding options that will maintain the immersive nature of a planetarium show yet not negatively impact the experience of other visitors. We ask the following questions:

What do members of the DHH community report about the accessibility of the planetarium experience with each captioning option?

What do members of the DHH community report about the immersive nature of the planetarium experience with each captioning option?

What is the reported difficulty of implementing captioning for an already-created planetarium show by planetarium professionals?

## Literature review

Many museums provide text descriptions for their exhibits to enhance a visitor's learning experience (Gazi 2018, Ravelli 2007). Some museums supply DHH visitors with sign language content on digital devices as well (Constantinou et al. 2016, Goss et al. 2015, Martins 2016, Milicchio & Prosperi 2016, Namatame et al. 2019, Ruiz et al. 2011). Museums that offer text descriptions or sign language content on devices allow visitors from the DHH community to be able to engage not only with the visual exhibits but also with the educational content of the exhibit that they may have otherwise missed. There are three terms associated with captioning: open, closed, and subtitles. Open captions are burned into the video content and cannot be turned off, while closed captions can be turned on and off easily by

the user. Subtitles are captions in a different language than the one being spoken (National Association of the Deaf - NAD, 2023; Captions for Deaf and Hard-of-Hearing Viewers, 2017).

We also need to look at how theaters caption their movies. Kuo (2004) and Waldo (2011) focus on the United States-based Americans with Disabilities Act and how that has impacted movie theaters to provide captioning (Americans with Disabilities Act 1990). Teófilo et al. (2018) investigated using Virtual Reality (VR) technology combined with artificial intelligence (AI) for automatic speech recognition for live-action plays. Butler (2019) gathered data from focus group interviews to determine the perspectives of the DHH community on captioning in media. Butler's analysis determined that the DHH community interviewed indicated the importance of captions in various social, educational, and public spaces (Butler, 2019).

Captions allow the DHH community to not only follow the action seen on the screen but provide access to the dialogue in real time (Captions for Deaf and Hard-of-Hearing Viewers. (2017). Captioning can benefit more than just the DHH community (Deaf and Hard of Hearing Services Division, n.d.). There are disorders that also benefit from captioning which include Autism, Auditory Neuropathy Spectrum Disorder (ANSD), Attention Deficit Hyperactivity Disorder (ADHD), Dyslexia, and Down Syndrome (Downey, 2022). Captioning is also important not just for both on- and off-screen dialogue but also for other sounds like on- and off-screen action noise, background noise, soundtrack, in-story media, and sound effects (Multilingual, 2023). Therefore, captioning provides the context, and content, that those who cannot hear the audio will otherwise miss out on.

There are a number of resources available for teaching astronomy to the DHH community from the International Astronomical Union and Astronomers without Borders (Astronomy Accessibility Guidelines and Resources - Astronomers Without Borders, n.d., Astronomy for Deaf

and Hard-of-Hearing – Astronomy for Equity and Inclusion / IAU-Executive Committee WG, n.d.). These resources provide digital resources specifically designed for the DHH community and tips to design events that specifically target specific disabilities. The Skynet Junior Scholars also collaborated with the Wisconsin School for the Deaf to bring astronomy to the DHH community by creating a curriculum and allowing DHH students access to telescopes, data analysis tools, inquiry-based modules, and professional astronomers (Meredith et al. 2016). The University of California Riverside created a workshop in partnership with the California School for the Deaf, Riverside to create a workshop where they transformed sound from recordings of astronomical phenomena into sounds and vibrations that the students could then feel (Cartier, 2023). There is currently no universal method for planetariums to accommodate the DHH community, the efforts are individualized to each planetarium.

There are a few planetariums that offer options for the DHH community. The text descriptions used by museums as stated above enhance the understanding of the material and further support the educational understanding of the DHH community. Adding text descriptions and captioning to the planetarium could enhance the experience for everyone, not just the d/Deaf communities. Providing text descriptions, captioning, and/or sign language interpretation to planetariums will allow visitors from the DHH community to engage with the content of the planetarium shows, rather than only getting the visual experience without the content. Studies conducted at Brigham Young University research head-mounted displays of American Sign Language (ASL) used by members of the DHH community (Hintz et al., 2015; Jones & Lawler, 2019). Adler Planetarium has “AdlerCaps,” an open-source web-based software that broadcasts the captioning to the visitor's own device (Burkland, 2017). The Bell Museum also offers assisted listening devices as well as live American Sign Language (ASL) interpretation, and live captioned shows using a CART

(Communication Access Realtime Translation) board (Komperud et al. 2020). The IPS webpage has a message board that has discussions and updates from 2014 to the present related to United States-based Americans with Disabilities Act (ADA) compliance and closed-captioning (Captioning for hearing impaired - International Planetarium Society, Inc. (2014 - 2022)). The ADA outlines the requirements for businesses (including movie theaters) to provide accommodations to ensure those with disabilities can fully participate in the services that they offer (Americans with Disabilities Act 1990). Our project is based in the United States and therefore efforts focus on ADA compliance. However, the results should be considered for any planetarium trying to be more accessible.

Planetarium shows that are captioned require a SubRip Subtitle (SRT) file. This is a plain text file that contains the start and end times for the text provided that is synchronized with the audio for the video. Another available resource for accessible audio components is a sign language video with a transparent background that can be layered on the dome. Planetariums can also use augmented reality glasses to provide captioning and overlaid videos. Many planetariums also include live star talks as part of their program, so live (or in-person) sign language interpreters or live captioning options are necessary (i.e. CART boards, etc.).

## Methodology

The Big Astronomy Project was uniquely positioned to research a test case, as the team includes show developers, writers, and researchers. We tested three different options for this test case: a handheld device (LG phone), Epson Moverio BT-30C glasses (supported by LG phone), and captions on the dome (see Figure 1). We tested these specific options because all three options were readily available at our test site. During our investigation, we did not have a live portion of the planetarium program, it was only a fulldome show. Therefore, we did not test captioning during a live planetarium program.





Figure 1: A) Handheld device (LG Phone); B) AR glasses (Epson Moverio BT-30C supported by LG phone) C) On-Screen Captions.

Our research included focus group interviews with members of the d/Deaf and hard-of-hearing communities and one-on-one interviews with planetarians and show developers. We tested three different captioning options available at a large planetarium with a considerable tilt in a science museum on the west coast. Each year the museum has approximately 1.4 million visitors. Visitors have the option to go to a planetarium show during their visit.

We invited people from the d/Deaf and hard-of-hearing communities in and around the area to come to test the devices; each individual was compensated for their time with admission into the museum as well as \$100 for their interview participation, which is the standard amount for this institution. During these interviews, we spoke to 10 individuals who are members of the DHH community (see Table 1 for an attendance breakdown).

Table 1

Table of participant and interpreter attendance

	DAY 1	DAY 2	DAY 3
Captioning option	Handheld Device	AR Glasses	On-screen
ASL interpreter	Interpreter 1	Interpreter 2	Interpreter 2
Participants Show 1	None	B	H
Participants Show 2	A	C, D, E, F, G	G, H, I, J

In Table 1, participants are described as A through J, and the interpreters are described as 1 and 2. These individuals were recruited through local partners who work in and with the DHH community. We conducted focus group interviews over three weekdays to test one of the captioning options each day. On each day the same planetarium show was run twice with the captioning option and interviews were conducted post-show. We also wanted the DHH audience members' opinions on the captioning device they utilized during the show. This included what they liked and disliked about it, as well as any comments or suggestions for improvement of how the option was presented, the option itself, and the words of the captions. We hired two American Sign Language (ASL) interpreters to assist with the interviews as well as during the pre-show introductions. One interpreter was present for the first day, and the second interpreter was there for the second and third day. We interviewed both interpreters separately about their thoughts and insights on each captioning option as both of them were children of d/Deaf adults (CODA). Each interview was videotaped so we could track who was speaking through ASL.

Our interview protocol included questions related to the captioning option specifically as well as questions that mirrored what was asked in previous interviews with hearing viewers in the evaluation of the Big Astronomy Project to assess if the experience was similar for both the DHH and hearing communities.

We interviewed a total of 10 DHH participants and 2 ASL interpreters. Our interviews for each captioning option had varying numbers of individuals participating. During the test of the

handheld device, we spoke to one DHH person and an interpreter. During the next two tests of the AR glasses and on-screen caption, we spoke to 6 and 5 individuals respectively. We also had one individual who attended both the AR Glasses and the on-screen captioning test. We also had the same interpreter for both the glasses and onscreen tests, as well as a DHH participant who came to test the captions on both days.

We also interviewed seven planetarians and show developers about the captioning process and implementation in their dome. We asked individuals with different roles during the process about challenges, cost, and their thoughts on the setup and use of each option in their dome, as well as how flexible each option is to accommodate different dome systems. We also inquired about their thoughts on the value of having captioning in the dome and the potential value for their audience members.

Results

From the interviews, participants indicated several pros and cons for each captioning option which can be seen in Table 2.

DHH Community

Handheld Devices

We spoke with one hard-of-hearing individual during this test, who also works with a corporation for the blind and has experience with other disabilities. They had decided to come to the show because they had come to the Academy for years but never experienced captioning as an option, so they were interested in seeing how it worked. When asked what the participant thought about the captioning option, they stated "Visually

Table 2:

Captioning Options pros, cons, and recommendations from the DHH community

CAPTIONING OPTION	PROS	CONS	RECOMMENDATIONS
Handheld Device	Can change the size and location of text on the device  Ability to caption in multiple languages (including ASL)  Ability to move the device	Some uncertainty about where to hold the device  Takes away from looking at the show, loses the immersive experience  Arms/shoulders uncomfortable for extended periods holding the device	Something to hold the device or a mounted device
Epson Glasses	Captions move to wherever one looks, keeps the immersive nature of the planetarium  Ability to caption in multiple languages (including ASL)	Had a high failure rate during our test, 2/5 in the second show didn't work  Didn't work well with individuals who wear glasses or have implants  Black frame obstructed the view of the screen, image quality through the glasses diminished compared to onscreen  Makes people feel exposed and uncomfortable	Glasses with a different design (clear frames, not as bulky, etc.)
On-screen captions	Easily available to everyone even those who do not identify as DHH	Only available in one language at a time  The white color made it hard to read at times  Captions were small  Captions were at the bottom of the screen which loses the immersive quality of the show	Captions in yellow/amber color  Larger captions  Possibly place them higher on the screen or off to the side.

Practitioner value and audience value of captioning

it was fine, but I couldn't figure out where I should hold the device." The user also mentioned the difference between a planetarium (immersive and screen all around) and a movie theater (screen directly in front) and talked about having to move the device frequently to watch the planetarium show and see the captions as well. The participant also thought the contrast (white letters on black background), that they could change the size and location of the text on the device was "really nice". The participant also stated that it took them a while to find where to change the options. They spoke about it being "difficult to concentrate on both the captioning and what's happening on the screen. Because there's no one visual focus, like at a movie theater where everything is in your visual field." When asked if the captioning option allowed them to still experience the immersive

nature of the show, the participant said they still got it because they can hear somewhat. The participant also mentioned that it would be better for captions to indicate when the voices are changing in the captioning itself because the members of the d/Deaf community would not know that the voice changed.

We also spoke to the ASL interpreter about their thoughts on the captioning with the device. The first comment the interpreter made was about the pacing of the show itself concerning captioning, "I thought the pace was wonderful and the way it worked on captioning is so that there were no words on the screen. The screen went black. That lets me know that I'm looking. I had the opportunity to look around and then I'd see something pop up in the corner of my eye." The interpreter did comment on the wish

to be able to look around longer. The interpreter also commented on having shoulder pain from holding the device up for an extended period and suggested having something else to hold the device. The interpreter also stated that if faces are speaking on screen with no captioning, this could be a trigger for d/Deaf people who may assume that they were missing something that the hearing people did not.

Glasses

The glasses are connected to the tablet and echo the same display, so the captions are presented as white text on a black background similar to the tablet. When looking through the glasses the captions appear in the view as overlaid on top of the show.

We spoke with one hard-of-hearing person who stated that they preferred



the glasses to look at the tablet. The participant liked the ability for the captions to follow where their eyes were focusing on the screen. It kept the immersivity of the show. We also conducted a focus group with five d/Deaf individuals. For this group, we had two individuals whose glasses stopped working during the show. At least one person tried to use the tablet attached but got tired and stopped watching altogether. Also, three people commented that since they wear glasses themselves, using the glasses for captions was difficult since they couldn't get them adjusted properly throughout the show and it made them harder to use. Another had an issue with the glasses themselves; the glasses had black frames, which obstructed the view of the show, and caused them to lose the feeling of immersion. One individual stated "I wanted to experience the movie like anybody else, putting the glasses on, [instead, it made them] feel like a robot. So [I would] much rather be able to watch it just like everybody else." The others in this group emphatically nodded to agree with this statement.

We interviewed the interpreter for this day separately from our DHH interviewees. During this interview, the interpreter stated that "the glasses were a good [option] because I am not stuck focusing on one fixed spot on the screen. I'm able to track the entire screen, and I'm allowed to take the captions with me." The interpreter also indicated a dislike of "having to depend on another piece of technology, [having] to hold the tablet and wear the glasses at the same time as I'm trying to watch this."

On-Screen Captions

During the on-screen captioning test, we spoke with one d/Deaf person in the first interview and four d/Deaf individuals in the second which included one individual from the day before and one individual from earlier in the day. On-screen captions are what most individuals are used to for TV and online videos. One limitation is that this form of captioning can only be offered in one language at a time. Everyone we spoke to during this test

mentioned the color of the captions, for example, one person stated: "white on white was hard to read". During the first interview the individual, who is a member of the d/Deaf community, mentioned that "people in the d/Deaf community are not completely literate in English, [in this show] the language and vocabulary weren't complicated, which was nice. [...] I am concerned that students or people who are not literate [...] might not be able to read the captions very well. Might not be accessible for them as much." This individual was advocating for an ASL option for the d/Deaf community for those individuals. During this interview as well this individual also brought up the introduction before the show about safety and procedures and stated "This [would not be] accessible at all." Each day during our investigation of the captioning options, we had an ASL interpreter present for each show, but this is not standard procedure. This individual stated, "I would have been lost without [the interpreter]." During the second interview when asked what they thought about the captions, the first individual stated that the captions were very low and "sometimes I was looking all over the screen, but I was missing what the captions were saying and sometimes especially when it came on a white background it became very hard to read." They also stated that the captions should indicate who is speaking because the show has voiceover and does not show talking heads - this means they cannot tell when the person who is speaking changes. The group also reiterated that the fact that the captioning was there was "better than nothing" even if the captions could use improvement.

During our interview with the interpreter, their opinion of the on-screen captions was that it "is always a plus because that way it's a [extra] layer of access to grant to a bigger audience." Both the interpreter and all of the individuals we interviewed for the on-screen captions indicated that the ones we used during the test were small and hard to read. When asked if there was anything that could be done better, they indicated they wished the

captions had been available sooner. We also asked them if the captioning allowed them to get an immersive experience, and their response was: "I feel yes. Because without the captions here, basically leaving an entire population in the dust. It's not, it's giving you the picture, but the picture means nothing without the substance. And the substance is the words."

Practitioners

We spoke to the show developers to talk about their role in the captioning process, any challenges that arose, the setup in their dome, and their thoughts on the value of captioning and on the value it adds to the audience experience. We interviewed individuals separately.

Development of the SRT file

We interviewed the individual who wrote the initial script and decided to take the step of creating the SRT files. The individual used a tool that was able to sort line length and duration of screen time. The tool would highlight lines that were too long, or the on-screen duration was too short, it would highlight that there was an issue there with the words per second, so that it would optimize the captions for readability. During this portion of building the SRT file, there was a need to shorten what was being said on-screen, due to line lengths and words per second, which required editing of the script to match the timing constraints in order to balance readability and content.

Set-up

The setup for the captioning options was two-fold: one setup for the device and glasses and another for the on-screen captions. The team was responsible for setting up and integrating the device/glasses hardware into their system. The device and glasses ran off a playback system called the Hana Caption AR Subtitler. For this option, the SRT file was sent to the company to get the proper caption files for the system. Then the planetarium could upload the files to the system, and the system uses a technology called an audio fingerprint, where the system listens to the show's audio track which

then brings up the queued captions. The glasses are plugged into the handheld device and get captions from the device to the screen in the glasses.

The on-screen caption was a challenge. The show playback is in individual frames, and their playback system does not have captioning built in. They had to create a separate video production for the captions and then overlay that video as a separate layer to the show. This was a time-consuming process. Once this overlay video has been rendered it can be turned on and off easily.

When asked about advice for someone in a similar role, they stated "I think more of us just need to be open to the idea that open captions displayed on any piece of media is going to become the norm and something that I think you should embrace and accept. And it makes sure it is a good experience for everybody. [...] I think we all need to be creating an environment where everyone's needs can be met so they can have a good show experience."

Testing the Caption Options

We also spoke to the person who facilitated our tests on the planetarium side. The individual we interviewed was responsible for paying the participants, making sure the participants were recruited, answering any questions that came up, reserving rooms, parking, etc. We also asked how captioning on-screen with the dome compares to captioning for videos. The individual stated that captioning on-screen is a shared experience in a theater full of visitors while captioning for videos is a more solitary one. This individual also stated that "individual captioning on a video is easy to do and a really easy solution for most viewers. But in a dome setting where it's a large, large, or larger audience with different people with different needs. I think it's very different."

Our facilitator also shared advice for anyone wanting to research in the dome: "Realize how valuable the time is of the participants who are part of the study. And to make every accommodation you can to help them between helping them get to the

location, help to pay for their time, and helping them when they're at the location."

Cost

The Hana Captioning rig including the glasses costs around \$10,000–\$12,000 plus employee time and other hardware for the set-up like audio cables and such. This also included the capturing conversion of several shows to get the audio fingerprinting to work. These two options were the most expensive to set up. The on-screen captions when supplied with the SRT file the only expense required was staff time to adjust the SRT to something that they could use on the dome.

Planetarians

We also interviewed two planetarium show presenters whose jobs include handing out the devices/glasses. Most of their role is to show individuals how to use the devices, ensure they are all working, and be available during the show if any problems arise.

We also spoke with a user who set up captions on the dome for Big Astronomy which has an option within the software. We did not test using this system with the DHH community but wanted to understand the setup from a different system perspective. The user indicated that it was fairly trivial to set up, as there is a program to transform an SRT file into an easily implemented file to caption a show. However, this user indicated that there were some challenges with the timing that needed to be fixed manually before the program ran smoothly. The software also can easily change the size, color, and location of the captioning. With newer versions resulting in even easier experiences for the user.

All of the planetarium professionals we spoke to indicated that the value they place on captioning is high. Although one stated there were two ways to answer how much value is placed on captioning: "One is the hypothetical [value], which is high, and one is the practical [value], which, based on where we are now, [...] and the fact that we don't offer [standardized captioning in

planetariums], clearly means it's not as high as I'd like." The overall sentiment from our interviews is that everyone wants to be able to offer captioning to their guests who require it. The IPS message board also indicates that captioning is something many planetariums are looking to offer and are trying to overcome the challenges to be able to offer this to visitors.

We also asked our interviewees about the value they believe captioning presents to their audience members. The value for the DHH members is high as they are unable to fully experience the show without them. Without captioning those members are missing out on the content of the planetarium shows and the shows and the experience becomes a "visual experience" only. The planetarians also indicated that those members of the audience who do not identify as DHH can also benefit from the captioning for clarification of vocabulary or even assistance for those who have trouble understanding with different accents than their own.

Discussion

Our test case showed that each option for captioning (device, glasses, and on-screen) had its own pros and cons. During the test case, we also determined that captioning on the dome is the preferred method of the members of the DHH community we interviewed because it is something they are already accustomed to with TV, streaming, and movie theaters. This research was a test case and had a small sample size of individuals, and our testing was during the day in the middle of the week which made it harder to recruit individuals. We also did not research any testing with the live aspect of planetarium programming for this paper, but we believe it should be tested in the future. Considering these limitations of our study, this type of work needs more testing and extensive studies.

From our analysis, the glasses could be a preferred option in the future, but in our case, the technology we tested has significant design flaws. As technology advances and improvements



are made to glasses this option should be retested. There should also be future research with audience members to explore how captioning supports everyone. Captioning even for those who do not require it can be used for clarification of the topic covered as well as understandability of any science vocabulary that is generally unfamiliar to general public audiences.

For planetariums to become more accessible to the DHH community SRT files should be included as a standard part of all show license packages. While not perfect for all systems or audiences, SRT files can be used in many cases. Additional files provided by the show developers could also include videos of sign language interpretation, as sign languages are different around the world, with a transparent background that can be overlaid onto the dome video or used on a device. SRT files should be created and released by the show producers as they have the script as a starting point, instead of the current situation where individual planetariums spend time and resources trying to caption shows independently. The more that captioning is standardized the easier it will be for planetariums to caption shows in the future. Another concern is for introductions and safety procedures before the fulldome show, providing some method of captioning or sign language version of these procedures is needed. Another option that deserves research is using sign language for students and members of the DHH community who are less literate in English.

Our research shows that, while what we have the ability to do at this time is not perfect and is limited, something is better than nothing. Towards the goal of making the planetarium an inclusive space for the DHH community, some form of captioning or ASL interpretation is a must.

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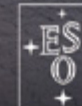
# BLACK HOLE

## FIRST PICTURE



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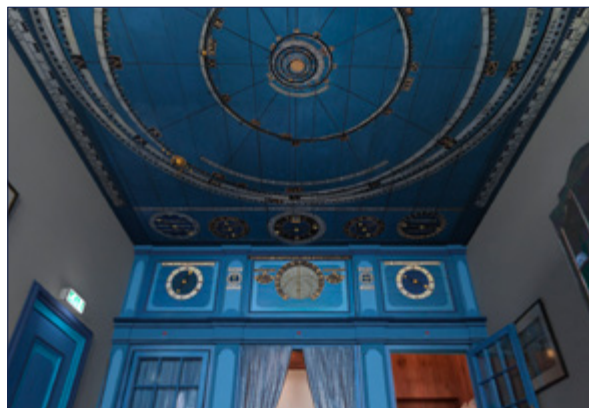
# CRAFTING A GRAND PLANETARIUM: AN EXERCISE IN SIMPLICITY

By Frans van Hoesel



Three years ago, my journey into the cosmos began with a visit to the world's oldest working planetarium in Franeker, a charming town in the Netherlands ([eisinga-planetarium.nl/en](http://eisinga-planetarium.nl/en)). Crafted by Eise Eisinga between 1774 and 1781, this historic gem was just recently recognized as a World Heritage Site and became the inspiration for an innovative adventure.

At the request of Arjen Dijkstra, then director of the University Museum in Groningen, I took on the challenge of bringing Eisinga's legacy to life as a full dome experience. Thanks to the generosity of Adrie Warmenhoven, the director of the Franeker planetarium, I gained rare access to the inner workings and captured immersive video using a simple 360 camera.



**Figure 1:** 3D model of living room with planetarium.

In addition to these unique shots, I created a 3D model of the living room where the planets are hanging on the ceiling. This allowed me to create full dome content with the planets in motion, moving them back to the time of Eise Eisinga.

## The Brass One

Fueled by this success, I couldn't resist the urge to create my own celestial marvel. Although I love the historic mechanical solution used in many planetariums and orreries, I wouldn't be able to make such complicated contraptions. Inspiration came from the mechanism used in old safes. It needs only one axle and puts various dials in the right orientation by repeatedly turning the knob left and right.

With that idea in mind, I made a dozen prototypes and finally build my first working Planet Spinner. It is made of brass and has a hollow oak base. At its core lies a stepper motor connected to Mercury via a hollow shaft – the sole planet subjected to active propulsion. The remaining planets, in contrast, enjoy unrestricted rotation around the central shaft. When Mercury starts moving, at some point its pin will catch the arm of Venus, so that starts being pushed around. Subsequently, Venus impels Earth, setting off a cascade effect. The rotation stops when Saturn makes an electrical connection with a small pin on the base between Sagittarius and Capricornus. This defines the zero position of the system. Now Mercury switches direction and starts grabbing the planets one by one, until it finally grabs Saturn again. This time it stops the rotation of Saturn upon achieving the correct orientation. The cycle repeats as Mercury changes direction, this time not stopping until Jupiter is set in its proper alignment. This continues until all the planets are done. You can watch it in action at [tinyurl.com/brass-one](http://tinyurl.com/brass-one).

## What's in the name?

Many people would call this an orrery, but it isn't. All orreries show the relative speed of motion of the



planets and most of them don't even show the correct orientation in real time. Planetarium could be nice but that comes from the Latin planeta + -arium "a place for" and this isn't a room with planets. That's why I call this a Planet Spinner as once a day, it spins the planets in the correct orientation.

## Grand Planet Spinner

After refining the design through a dozen prototypes, I've created a version that showcases all the planets and is easily replicable by anyone with a laser cutter. Constructed from basswood, toothpicks, an ESP32, controller, and a small stepper motor, this iteration eliminates the need for electrical contacts to establish the absolute zero position. None of the planets are mechanically linked to the motor; only the zodiac disc rotates, featuring a pin that nudges the planets into motion. With a diminutive diameter of 42mm, akin to a watch, it's a compact marvel complete with a small display. As the clock strikes midnight, the embedded ESP32 processor springs into action, fetching the precise orientations of the planets directly from NASA. This nightly ritual unveils a fresh and updated solar system perspective each morning. Should you wish to create your own, you can find the plans on [instructables.com/Grand-Planet-Spinner](http://instructables.com/Grand-Planet-Spinner), or alternatively, watch it moving at [tinyurl.com/grandplanetspinner](http://tinyurl.com/grandplanetspinner).

## A real planetarium

Crafting a downsized version proved to be no small feat, but the real challenge arose when I decided to install a 2.1-meter celestial display on the ceiling of my living room. This larger iteration maintains a mechanism akin to my initial design, where Mercury alone is affixed to the motor via a hollow shaft. The motor, USB power supply, and electronics are concealed inside the Sun and mounted onto a 3D-printed frame. The Sun and planets were bought during the visit to the museum shop of the planetarium in Franeker. They each suspend from aluminum tubes, anchored into oak parts with internal ball bearings, allowing free rotation around the axle. The small pins, responsible for propelling other planets, are also mounted on the oak part.

As if this weren't challenging enough, I decided to introduce a moon into the solar system. Inside the oak part for the Earth, I added a gear that gets pushed around just like the other planets. That gear makes the aluminum tube spin around the horizontal axis. At the end of the tube are two tiny, 3D-printed bevel gears that turn the horizontal rotation into a vertical one, which makes the moon spin in the desired rotation. Unfortunately, I had to add a bit of friction to the rotation of each planet, as even the slightest misalignment of the vertical shaft would rotate the planet to the lowest point. This additional friction, however, made the motor too weak, prompting the addition of a planetary gear reduction – a fitting solution. This makes it go very slow, and after midnight it takes about two hours to spin the planets and the moon in the correct orientation. Explore the intricate workings at [tinyurl.com/planetspinner](http://tinyurl.com/planetspinner) (consider subscribing if you like to see future builds).

In the end, I've created "a space" for my planets. This time, it's more than just a collection – it's a room housing my celestial ensemble, earning it the rightful title of a planetarium.

From top: **Figure 2:** Reframed image from unique 360 footage. **Figure 3:** The brass one; **Figure 4:** Grand Planet Spinner; **Figure 5:** Planet spinner with Mars, Sun, Moon, Earth, and Uranus all aligned.



# ACTIVITIES AT PLANETARIUM NOOSPHERE IN UKRAINE



Planetarium Noosphere in Dnipro, Ukraine. CREDIT: Planetarium Noosphere

An IPS member in Ukraine has a special way to bring some happiness to internally displaced people. It is Planetarium Noosphere in Dnipro, which has managed to stay in operation even during the war that has been facing the country over nearly two years.

Dnipro is about 500 kilometres south east of Ukraine's capital city Kyiv. It is one of many planetariums in Ukraine of which the IPS International Development Committee is aware. The Committee has been keeping up with news from them wither directly or indirectly since early 2022.

In 2022 IPS offered free membership for one year to planetarians in Ukraine, and a few took up this offer, including Yuliia Prybytkova, Executive Director of Planetarium Noosphere in Dnipro. This has recently been renewed.

Indeed, some of the Committee's most recent contact has been with Planetarium Noosphere, with Committee Chair Martin George holding Zoom meeting with Yuliia and her colleague Ganna Nikitina. The Planetarium is currently opening every day and is offering a wonderful experience for visitors, concentrating on people displaced from other areas of the country and who have found refuge in Dnipro.

Planetarium Noosphere has titled its work 'mental health recovery', and these are very fitting words. In addition to their regular astronomy shows, they are providing a weekly 'space retreat' in which they run simulations, on their dome, of journeys through space with soothing music and an acoustic environment shielded from any noise outside.

Planetarium Noosphere is presenting its visitors with a peaceful and exciting environment from the devastating situation that is affecting the country. Audiences are immersed in an environment that is giving people a sense of freedom from danger, taking the on a trip to planets, nebulae, and other celestial objects human beings have never visited. This is also benefiting the staff themselves, who see this as a 'spiritual retreat'.



A happy group in the exhibit area at Planetarium Noosphere. CREDIT: Planetarium Noosphere

Their 'retreat' sessions have attracted many thousands of people, with a significant proportion – well over 50% of them – being children.

In their own words, 'Planetarium Noosphere is developing an outstanding socially responsible project, inviting [people] to rethink and reload worldwide the mission of a planetarium in a community, not only as a center for astronomy but also as a center for mental health recovery'.

It is especially notable that the staff themselves are getting something positive from the experience: while their great efforts are aimed at the displaced people, there would be little doubt that they are greatly affected by the situation in their country. We can all be especially proud of colleagues who continue to present wonderful planetarium content under trying circumstances.

Currently, only some Ukrainian planetariums are known to be operating. As of mid-October, the planetariums in Kyiv and Odessa were also known to be active, but the Committee has been informed that the planetarium in Kharkiv, formerly known as the Gagarin Planetarium, has been closed for some time, with the staff there unable to do their astronomy work and having difficulty finding employment. That planetarium building is still standing, but like the planetarium in Donetsk (which is also closed), damage has been sustained by nearby bombing.

Offers of assistance to Ukrainian planetariums have been made by several IPS members, and the Committee continues to encourage this, preferably channeling offers through the Committee itself.

I hope to bring you more news from planetariums and planetarians in Ukraine in future issues of *Planetarian*.

**Martin George**

**Chair, IPS International Development Committee**



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# IMMERSIVE MATTERS

## CAVES IN THE DOME

Imagine going on a virtual voyage that starts with walking down a paved path past looming limestone walls. The brightly illuminated geological forms surrounding you gradually darken as you descend into a twilight zone where the sunlight wanes. Gradually, the bright entrance disappears behind you. Next, you are further underground, in a cavern so vast that it's difficult to tell how big it is. There is no atmospheric perspective to provide depth cues, so distant background features look just as sharp as objects in the foreground. The room is filled with organic-looking, mineralized structures stretching from and to the ceiling, illuminated with LED bulbs. Because we are witnessing a live, interactive digital planetarium program and not a movie playback, we can traverse the scene following the flow of the story from the presenter, seeing features from different directions, with the camera moving to locations that would be impossible to be at in real life. Instead of the computer-generated "look" that we are familiar with in many astronomical programs, we are immersed in a visually rich landscape that looks photoreal. Overhead is not blank sky, nor a field of distant stars, but a ceiling reinforcing the illusion that we are in a real place: a cave, in this case, Carlsbad Caverns, located in the United States in southeastern New Mexico.

What I have described is now possible because the process for capturing real-world environments is getting easier, along with computer graphics hardware ever more capable of rendering 3D models built from millions of polygons in realtime. We can now immerse audiences in simulacra of locations that they are familiar with, without the scene looking fake or computer-generated. How do we go from astro-visualizations to experiencing a cave inside a dome? As it turns out, by using tools developed for visual effects, gaming, and virtual reality. To understand how this works, let's look back at history.

### A Common Heritage

Common roots exist between digital fulldome theaters and other immersive technologies. For example, one of the founding fathers of virtual reality (VR) was Ivan Sutherland, who created a head-mounted display in 1967, and who later went on to found a computer graphics company familiar to many planetarians, Evans & Sutherland. The first heyday of VR started in the late 1980s. Throughout the 1990s, university and corporate researchers did pioneering work on VR and produced early applications, including cubic CAVE displays and flight simulators that were the forerunners of multi-channel fulldome projection systems.

Although the technologies of the past were far less capable than the rendering engines of today, there was still an intense interest by the research community to experiment with VR in different contexts. Over the years, the research has shown that experiencing and interacting inside a simulated virtual environment can be useful for training, therapy, and tasks that require spatial awareness (Bowman & McMahan 2007). Cultural preservationists have also discovered that fragile or remote real-world sites can be recreated digitally to be explored by the public, without the risk of physical damage from tourists (Guttentag 2010).

Since their advent at the turn of the millennium, digital planetariums have also turned out to be natural venues for exploring places on Earth. Since 2008, Digital Earth presentations at the Denver Museum of Nature & Science (Yu, Raynolds, & Dechesne 2008; Yu 2009) have taken audiences on tours of our home planet using high resolution satellite imagery from above, and 360° spherical panoramic photography that inserts audiences into scenes on the ground. Fulldome theaters have been used to present an assortment of geoscience content, whether they are educational programs (Shipway 2023), visualization tools for research

(Kwasnitschka 2008), or 3D corporate datasets (Neafus & Yu 2007). Highly realistic depictions of locales brimming with computer-generated life have also shown up in many pre-rendered films, such as those from the California Academy of Sciences (Wyatt 2019).

In late 2021, the Denver Museum of Nature & Science began discussions with the National Park Service to determine what types of educational events could be created to celebrate the 2021-2022 "International Year of Caves and Karsts." Knowing the capabilities of today's capture technology, we decided to proceed with recreating Carlsbad Caverns in the dome. Although multiple technologies exist for digitizing real-world environments, one that has become more popular in recent years is photogrammetry. It starts with shooting overlapping, digital photos of an object or scene from multiple angles, so common features can be identified between them. Photogrammetry software identifies commonalities between image pairs to create a virtual 3D model. Because the color and lighting information about the object already exists in the original images, the photogrammetrically derived model can be textured with the same pictures used to create the geometry of the model, resulting in a highly realistic scene. The 3D model files can be used in animation software and rendered for movies. They can also be simplified by reducing the number of polygons to the point where they are compact enough for use in real-time planetarium visualization software.

### Carlsbad Captured

Originally documented by European Americans in 1898, the set of interconnected chambers that make up Carlsbad Caverns first became a United States National Monument in 1923, then a National Park in 1930, and a World Heritage Site in 1995. The cave system is located in the Guadalupe Mountains, which are the fossil remains of an ancient reef perched offshore in a



Fig 1: Rock of Ages (left) and Caveman Junction (right), features inside the Big Room, as visualized with OpenSpace.

prehistoric inland sea 260-270 million years ago (Palmer 2013). Over these millions of years, reef building animals lived and died, with their remains compressed by the weight of newer reef layers above. The crushed, older reef combined with calcium carbonate in the water to create layers of limestone, which was subsequently surrounded by ocean sediment. After the sea dried out 20 million years ago, tectonic processes pushed the reef up, and the surrounding sediments were eroded away to expose the fossil reef as the Guadalupe Mountains today.

Elsewhere in the world, running water dissolves limestone to form caves. In the Guadalupe Mountains, hydrogen sulfide-rich brine reacted with oxygen in fresh water to form sulfuric acid, which was the main agent of dissolution. As the mountains continued to uplift, older caves were pushed up, and younger caves formed below them. If the groundwater table settled at a fixed elevation for a long period of time, the sulfuric acid would etch out a large cavity at that level. The chemical process of dissolution results in gypsum as a byproduct, many large blocks of which can still be found within the caves. In the last 800,000 years, rainwater trickled underground, picking up dissolved calcium carbonate on its way into the subterranean chambers. As the water flowed, drop by drop, it evaporated leaving behind a mineral deposit. Stalactites (formed from deposits descending from the ceiling) and stalagmites (growing from the ground up) are just two of a host of different mineral formations created by the evaporating water.

Carlsbad Caverns is one of the most accessible examples of a large cave system with numerous spectacular rock formations, yet its remote location (about a 2-hour drive from the nearest large airport in El Paso, Texas) means that it is still difficult to get to for many people. The U.S. National Park Service (NPS), which operates the site, has carefully illuminated the cavern and built accessible trails to accommodate visitors. These attributes make it easy to set up equipment for image capture, making Carlsbad Caverns an ideal candidate for a virtual recreation.

After considerable discussions with the NPS, DMNS contracted with Eric Hanson of Blueplanet VR, who went to Carlsbad Caverns in March 2022 to begin two days of photogrammetric image capture, including permission for after-hours work with the assistance of a park ranger. There are 2.5 miles (4 km) of paved trails accessible to visitors for unguided tours that have been built by NPS through the caverns. Visitors cannot wander off these trails, which are bounded by guide rails on either side. The largest chamber is simply called the Big Room, which has a maximum ceiling height of 255 ft (78 m) and covers 8.2 acres (3.3 hectares or big enough to hold 6 football fields/pitches). Eric took images from the trail at several dozen sites. The largest models (e.g., at Caveman Junction and Rock of Ages; Fig. 1) required ~1500 pictures for the photogrammetric model, while the smaller sites needed only a few hundred. Although the caverns are lit to highlight spectacular rock formations, the lighting is kept intentionally dim, which meant a tripod was required to

mount the camera for the bracketed HDR exposures. Photography taken during the regular visiting hours was often delayed because Eric had to wait for other guests to move out of the long exposure shots. After hours, when all other visitors had left the cavern, the work proceeded much faster.

Eric created the final textured 3D models using RealityCapture<sup>1</sup>, which is commonly used in the entertainment industry to create models for visual effects work in film and for video games. Like other photogrammetry software, it is based on the "Structure from Motion" procedure that allows a scene's 3D geometry and the different camera positions taken to acquire the imagery to be solved iteratively (Ullman 1979). Common features are matched and found in images taken at one position to determine the camera position for those images. Using sets of images from multiple camera positions allows common tie points to be found that connect pictures from those positions. A polygonal mesh reconstruction is built from the point data describing the object. Textures generated from the original camera images are projected onto the mesh in the final model (Fig. 2). Because the size of the output is not limited by the user's computer RAM (Dhanda et al. 2019), RealityCapture has the ability to create models with billions of polygonal faces. A scene can be broken into smaller chunks that are worked on separately before they are recombined into the broader model. The output model can

<sup>1</sup> <https://www.autodesk.com/autodesk-university/class/Power-Reality-Rich-Volumetric-VR-Real-Time-Experiences-2020>





Fig. 2: The polygonal mesh of the Hall of Giants that was outputted from the RealityCapture photogrammetry software (left) and the model with textures applied (right). The textures preserve the lighting in the original environment, resulting in a highly realistic recreation. (Image Credit: Eric Hanson, Blueplanet VR)

be further simplified into one with fewer polygons using 3D modeling software like Autodesk Maya. The models that were loaded into the OpenSpace2 planetarium software typically had about 1 million polygons.

The Carlsbad models were highly realistic when viewed with OpenSpace. Real-life lighting was baked into the textures that mapped the models, so that the 3D models appeared to the eye as they would if the viewer was seeing them in real-life (Fig. 3). The illusion was further enhanced with image backdrops created from the on-site photography, so that the distant backgrounds were not blank spots but contained visual hints of a world beyond the immediate model.

I worked with Patricia Seiser, Director of Cave & Karst Management Science at the National Cave & Karst Research Institute, to develop a series of public visitor programs that she delivered at the Denver Museum of Nature & Science's Gates Planetarium. In addition to the 3D photogrammetric models, we also showcased multiple 360° panoramic images taken by Ben Gondrez at locations that Eric had not captured. Diagrams explaining the geology of the region and historical photography documenting the exploration of

the Cavern helped complete the story that was delivered in the public programs.

Although the photogrammetric capture was done from the visitor trails, the exploration of the digital models was unconstrained. The camera could be manipulated to be placed anywhere inside or around the model. The audience could therefore virtually travel to locations that would be inaccessible in real life. For instance, the Natural Entrance to Carlsbad Cavern is a 1.25 mile (2 km) long, steep trail that was the only way for the public to enter before elevators were built in the 1930s. It starts off at a wide cave entrance at ground level near the Visitors Center. The trail descends via multiple switchbacks that are visible from above in daylight, before disappearing into the twilight ingress into the cavern, where there is progressively less sunlight to see by the deeper you travel.

An overhanging rock shelf lies about 30 m above where the trail enters the twilight zone. In real life, one would need rope and climbing harnesses to access this wall. But we can take audiences on vertiginous flights to this and other areas of the Natural Entrance in OpenSpace. Among the details that Pat could see in the planetarium was a raptor nest, consisting



Fig. 3: A comparison of a photo of the Natural Entrance to Carlsbad Cavern (left) with the photogrammetric model of the Natural Entrance as visualized with OpenSpace (right). (Left image credit: Urban Versis 32, CC BY-SA 4.0.)

<sup>2</sup> <https://www.openspaceproject.com/>



Fig 4: Looking down upon a raptor's nest built from sticks located in an alcove high above the Natural Entrance trail at Carlsbad Cavern, as visualized with OpenSpace.

of large twigs and sticks on the ledge of a small alcove. This would have been impossible to witness in real life from the trail, except with binoculars from afar. In the fulldome theater, we could fly to this locale and examine it up close.

Many smaller features in Carlsbad Cavern have also been modeled in photogrammetry. "Bacon drapery" looks like its culinary namesake because of impurities left behind by evaporating lines of water, building up over time into thin, delicate, rippling sheets. These are found off-trail and often located many meters overhead where they would be difficult

for visitors to examine in detail. But using OpenSpace, the planetarium audience can be flown around larger-than-life versions of these features to inspect their three-dimensional structure while learning about how they were formed.

### A View to the Future

Virtual recreations with photogrammetry and other capture processes are now common in the realm of cultural and natural heritage preservation (e.g., Kingsland 2020). Even the idea of a virtual version of a cave is not new, with the earliest examples at least 20 years old (Lutz & Weintke 1999). Eric started working with photogrammetry in visualization projects with Greg Downing more than

a decade ago. His current pipeline was developed to create content for a VR app<sup>3</sup>.

The way that photogrammetric models are explored in VR with a head-mounted display is very different from that of a fulldome theater. The VR HMD is a single-person experience where the user, isolated from the outside world, can actively navigate around the model with the hand controls and shift their head and body to view the model from different

<sup>3</sup> <https://www.capturingreality.com/discovering-unique-world-locations>



Fig. 5: Bacon drapery inside Carlsbad Cavern as visualized with OpenSpace.



perspectives. Although the headset gives a somewhat constrained view at any given moment (e.g., the Oculus Quest 2 has a field-of-view of 89°4), the user can turn and look at the virtual environment in all directions.

The fulldome theater, on the other hand, is both simultaneously more immersive (with a hemispherical display that shows an instantaneous 180° field-of-view) and less immersive than VR (the audience can't turn to see anything beyond the edge of the dome). The audience experience is a guided collective tour, as opposed to an individual exploring on their own. Although being able to have autonomous excursions is a selling point for VR, not all users prefer this mode of interaction. Interviews reveal that many people preferred passively sitting through live fulldome presentations showcasing high-resolution satellite imagery of Earth versus interacting on their own with similar types of visualizations from Google Earth (Yu 2009). These visitors explained that since they had little knowledge about the topics presented in the digital dome, they welcomed the guided experience. Even though Google Earth allowed them to travel wherever they wanted to go and to explore at their own pace, they felt they had little to no understanding about what they were seeing, which made that experience less valuable.

The positive visitor feedback we have received from our past Digital Earth and more recent Carlsbad programs shows the promise of fulldome theaters for virtual expeditions into cultural and natural landscapes. With powerful software like OpenSpace making it easier to visualize non-astronomical 3D content, and growing numbers of practitioners of photogrammetry in archaeology, architecture, and other preservation-minded fields, planetarians now have new opportunities for collaboration. There are now many commercial and open-source photogrammetry tools to choose from (Kingsland 2020; Rahaman & Champion 2018). Even free mobile phone apps are now available<sup>4</sup>, making it possible for more people to pick up these skills and increase the talent pool for creating content. This project also shows the promise of sharing visually rich, 3D content between the mediums of fulldome theaters and VR. With little or no modification, the same model files can be used for two very different audience experiences. Finally, the Carlsbad Caverns project is an example of how image capture and virtual reconstruction workflows from the visual effects and gaming worlds can be adopted and repurposed for fulldome cultural and educational programs. These tools have been refined by billion-dollar entertainment industries, and it would be a shame for us not to take advantage of them.

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<sup>4</sup> <https://smartglasseshub.com/oculus-quest-2-fov/>  
<sup>5</sup> <https://www.unrealengine.com/en-US/realityscan>

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# UNDER THE CLASSDOME ECLIPSE LESSON WRITING

APRIL 8, 2024



Only a few months remain until our total solar eclipse in the USA. My planetarium is a mere seven miles from the centerline, and I'll bet that everyone reading this understands what a big deal that is. As expected, my email inbox is exploding with requests for eclipse related programming. This should be the busiest year ever for our school based planetarium.

I scheduled lesson writing workshops with teachers during the fall. I realized that despite my nine years in a regular classroom, I might not be the best person to write a lesson plan for a 2nd or 6th grade teacher to use. The plan is to gather during two hour long sessions that are divided up by elementary and secondary levels. I will run through about 30 minutes of simulations and discussions to make sure that they understand the hows, whys and whats of the eclipse. We will then take a close look at all the resources that I and several others have collected and we'll put the teachers to work preparing specific lesson plans to share.

For the youngest learners, lessons will be focused on basic understanding of how the moon would move right in front of the sun and reinforcing the message about not looking at the very bright part of the sun without proper solar viewing glasses. Building vocabulary and sight recognition of eclipse related words will also be important. I teach these kindergarten through second grade students all the time, but I've never had to work with their basic reading skills. The teachers that do work with these kids want to use the excitement about the eclipse as they work on their reading acquisition objectives.

By later elementary grades, students in many US states are doing a lot of work with the Next Generation Science Standards (NGSS). Their learning objectives involve making observations about the weather. We will encourage teachers to turn their students into scientists on eclipse day. Data tables for kids to record cloud cover, temperature, wind as well as sounds will be formatted for easy use by other teachers. Working with scale models is another objective in the NGSS. Numerous scale model activities already exist so we will sort out the best versions to distribute to our teachers.



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Middle and High School level students are ready for more thorough explanations about the mechanics of an eclipse, the umbra and penumbra and working with models to simulate eclipses. These students really need clear safety messaging as well. Their age groups tend to engage in riskier behaviors.

I am also trying to find ways to incorporate the eclipse into other subject areas and here are a few things I came up with. Students in New York State learn some local history in later

elementary grades, including learning about our local indigenous communities. I'll task some of the teachers with incorporating a legend from the The Hodenosaunee people. They tell of how America's first democracy was formed under an eclipse when Hiawatha met a prophet called the Peacemaker. With the help of the first clan mother named Jigonsaseh, they assembled representatives of each nation and joined together to abandon war. The legend says that this pivotal moment occurred under a total solar eclipse. Historians and archaeologists have researched possible dates for this moment and it may have been as early as 909 CE. This would indeed make the Hodenosaunee confederacy the world's longest continuously functioning democracy. (Aveni, 2017, p.169) With that, we'll have a social studies lesson with a relevant connection to the upcoming eclipse.

As a bit of a history buff, I read a few books for more ideas. I learned about the 1806 total eclipse that swept across North America. Shawnee chief Tecumseh forged an alliance to resist encroachment by white invaders and used this eclipse as a sign that other tribes should also join together. A few decades later, the 1831 total eclipse and a partial eclipse that followed 6 months later were said to be a sign that enslaved Africans should join what came to be known as Nat Turner's rebellion. These events also provide us with connections to US history that is taught in high school, but also opportunities to discuss eclipse seasons thanks to the pair of 1831 events.

World history has stories about Chinese astronomers who lost their heads because of failure to predict an eclipse, warring armies that laid down their arms after an eclipse, the crucifixion of Christ under an eclipsed sun, and the birth of the prophet Muhammad during an eclipse. Careful analysis of actual eclipses casts some ambiguity on the particular circumstances, but our Global Studies teachers will be able to use these connections to reinforce their lessons.

Astronomy and Physics teachers are well acquainted with the story of how deflection of starlight during the 1919 eclipse was used to verify Einstein's general relativity. A deeper

investigation of the events reveals that Einstein's original calculations of the deflection of star positions were incorrect. An expedition by William Campbell of Lick Observatory to photograph the 1914 total eclipse in eastern Europe was derailed by the outbreak of the first world war and bad weather.(Dvorak, 2017, p. 211) During the wait for the next total eclipse, new advances in mathematics allowed Einstein to revise his calculations and his estimate of the deflection of starlight. His revised prediction closely matched the 1919 data. His worldwide fame may not have come to be without a world war intervening and providing time for the revisions. Here again, we have a lesson that fits in the context of history class that relates to eclipses.

A lot of the work organizing more traditional eclipse related lessons was done by a frequent contributor to this column, Lisa Swaney of the Horowitz-DeRemer Planetarium in Wisconsin, USA. She graciously shared the fruits of her summer work to collect and sort out activities for different grade levels. The STEM Coordinator for the City of Buffalo's Public Schools, Katie Agen, also made assembling and categorizing eclipse lessons her summer project. Thankfully we all had a lot to work with thanks to the 2017 solar eclipse that also traversed North America. We combined our collections, but the task was not complete. An important goal of my teacher workshops was to distill the best out of this plethora of resources for our teachers. Classroom teachers just don't have the time to look through 47 web links or 7 versions of Sun-Earth-Moon scale model activities. I'll be asking the teachers that come to the workshops to put the best resources together, perhaps revise and rewrite them, and make sure they are in a format that can be shared across the region. We'll share them with you too by way of the IPS website. Use this link to access what we've put together: <https://www.ips-planetarium.org/page/classdomesolareclipse>

Lastly, I would like to share our school district communications plan. One of my biggest assets in the Williamsville Central School District is our Communications Director, Nick Filipowski. He has been an incredible ally in my effort to get our administration to understand the magnitude of this event. He has also been helping us lead the way for neighboring school districts. While some of these will have passed by the time you read this, they're still important steps to consider.

- Summer 2023 - Order 2024 Total Solar Eclipse Glasses
- Sept 2023 - Informational video for staff at opening of school
- Nov 2023 - Recruit volunteers to package eclipse glasses and flyers
- Dec 2023 - Athletics communications reminder: No athletic events on April 8, 2024
- Jan/Feb 2024 - Package eclipse glasses and flyers after school at North HS
- Feb 2024 - Send out Total Solar Eclipse Informational Flyer by email and newsletter

- March 6, 2024 Message to Students and Families Regarding TSE Informational Packets coming home on March 20th
- March 6, 2024 Message to Faculty and Staff Regarding TSE Informational Packets coming home on March 20th
- March 4-15, 2024 - Assembly at each school: Eclipse overview and safety, inform students that they will be receiving package with glasses and a flyer
- March 18, 2024 - Distribute glasses/flyers to buildings
- March 20, 2024 - Distribute glasses/flyers to students/staff at each building
- March 20, 2024 - Reminder to Students and Families via email/text message
- March 20, 2024 - Reminder to Faculty and Staff via email
- March 25-29, 2024 (Last week before spring break) - Solar Eclipse Graphics and Information on school websites, morning announcements and infomational TVs in schools including:
- No school April 8, 2024
- No athletic events April 8, 2024
- Video - Dos and don'ts of using eclipse glasses
- Video - Stages and timing of the TSE
- Include subtitles - Create in Adobe After Effects, not relying on YouTube CC

If you're interested and also a fan of history, here are the books I used as my resources. There are SO many more good stories in these books. In the meantime, let's hope the weather cooperates on April 8th!

Aveni, Anthony. *In The Shadow of the Moon: The Science, Magic, and Mystery of Solar Eclipses*. New Haven and London: Yale University Press, 2017

Nordgren, Tyler. *Sun, Moon, Earth: The History of Solar Eclipses from Omens of Doom to Einstein and Exoplanets*. New York: Basic Books, 2016

Dvorak, John. *Mask of the Sun: The Science, History, and Forgotten Lore of Eclipses*, New York: Penguin Books, 2017





# GUEST UNDER THE CLASSDOME

## GETTING READY FOR THE BIG DANCE

Lisa Swaney

First, you save the important date (4/8/2024). Next, you plan programs/events leading up to and on that date. And, in between, you do all sorts of things to prepare, like research the topic, write grants, share information, etc. But, in the back of your mind, you have this worry or doubt that it may not even happen at all...because it all depends on something we can't control...the weather. I am sure I am not the only one with these thoughts regarding the upcoming total solar eclipse!

So, what are we doing here in Waukesha, Wisconsin to prepare? Well, we started over 24 months ago with the writing of a Wisconsin Space Grant- Aerospace Outreach. The grant was written to purchase solar eclipse glasses that are currently being handed out at our special events leading up to the two different eclipses. Besides our planetarium, three other Wisconsin planetariums were also part of this grant- UW-M-Manfred Olson Planetarium, UW-Stevens Point- Allen F. Blocher Planetarium, and Madison Metropolitan School District (MMSD) Planetarium. Year to date, we have distributed over 1500 glasses during a variety of events like girl scout night, Apple Harvest Festival, Sustainability Fair, etc. We have at least 6 more special events planned where we hope to give out a few thousand more.

Besides the Wisconsin Space Grant, two other grants were written to purchase equipment that can be used on April 8. We have items such as a sun spotter, solar oven, solar filters, and a hydrogen- alpha telescope. This equipment has already been utilized for a variety of our events and public programs. Our long-term goal is to utilize these items as part of the 5th grade program to provide students with first-hand experience using science equipment. Our newly obtained equipment was made possible by a Wisconsin Society of Science Teachers grant, Foundations Stem Grant, and a Waukesha Education Foundation grant.

As the 2023-2024 school year started, the planetarium staff worked diligently to create an eclipse folder that was filled with a variety of activities and resources for educators and families to use to prepare them for the upcoming eclipses. We previewed many resources and organized them in ways that many different patrons would find useful. Once complete, the folder was shared with all Waukesha teachers and area groups who have booked either a nature center program or planetarium program in the last year. Obviously, this folder will continue to be updated as new resources are discovered or shared.

Also, during the summer we developed a 2023/2024 eclipse star talk script. Our intention is to use it for all school groups that visit the planetarium, so they can be educated about this upcoming event. Our abbreviated script lesson plan is as follows:

- Talking about our present sky at our location then moving to the sky of our location on April 8th, 2024.
- Exploring the visible objects in the daytime sky along with the invisible objects that are present in the sky, even though we don't see them.
- Simulating the eclipse from our location in Waukesha, WI
- Eventually, we move locations, specifically to a location on the path of totality, Carbondale, IL
- From Carbondale, we show students what and how things happen as totality approaches.
- Of course, we also emphasize the importance of solar observing safety.

For younger audiences, we emphasize patterns, shapes, orientation, and shadows. Though it is early in the school year, this talk seems to be well received, and you can sense the excitement brewing in the planetarium.

On October 14, 2023, we were ready to observe and educate about the annular eclipse! We had a big day planned. Items such as Ritz crackers, colanders, sidewalk chalk, and hula hoops were purchased to have a wide variety of outdoor activities for kids while the eclipse was happening. We were excited about using our new equipment with our community. However, Mother Nature had other plans for us. Still, a few hundred people came to our facility for all (indoor) eclipse activities, and each walked away with a pair of eclipse glasses that they will be able to use on April 8, 2024. Because we were not able to see any part of the eclipse, the eclipse was streamed on a TV in the lobby, as well as on the dome. We were thrilled to have such a great turnout and loved the enthusiasm that many expressed.

Three different eclipse planetarium shows are featured each month for different special events starting in January 2024. Lights Out! Eclipses- Whys, Wonders, and Wows will be used for the Waukesha Janboree event held on January 20. Totality! is the Saturday afternoon public show for the month of February and Totality- Explore the Wonders of Eclipses is the Saturday morning public show for the month of March. Besides these scheduled programs, these shows are available to any group that wants to attend the planetarium. We also have these shows scheduled sporadically during our weekday public show schedule.

We are bringing a new type of March Madness to our planetarium in 2024! Each Saturday in the month of March, we have planned eclipse activities (how to make pinhole projectors, eclipse glasses decorating, eclipse glass holders, etc.) for noon. Similar events are also planned during our area's spring break week.

Plans for April 8, 2024 are underway. A similar program is planned for this date as what was planned for

(Continued on pg. 56)

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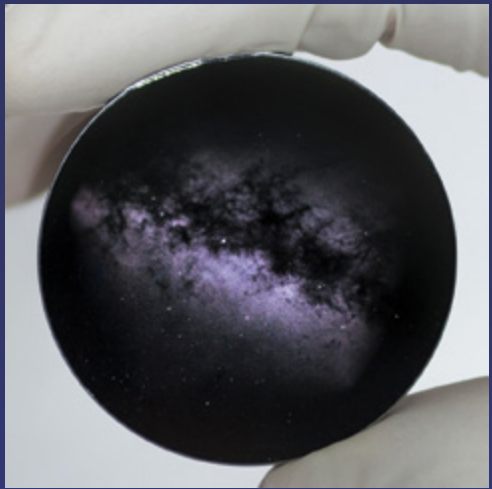
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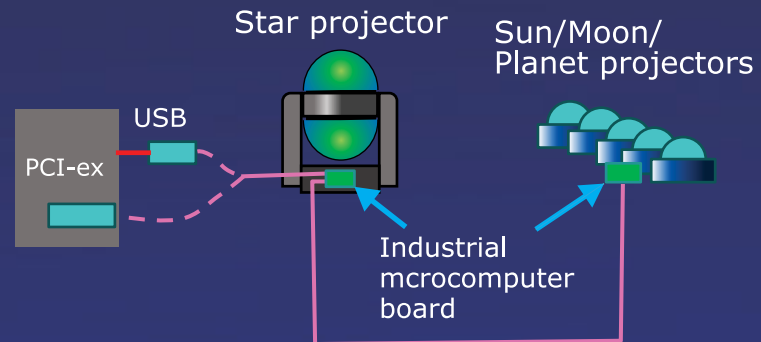


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- More than 1 billion stars from 1st to 20th magnitude World's first!
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### **New Control System**

- Flexible & Simple Connection
- Long-Term Support for 20 Years



### **SWING AXIS**

- Cradle type 4-axis control
- Gimbal lock free!
- No more unnatural movements



### **Solid-State Shutter (Electronic)**

- Custom masking of optical stars
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- Twinkling can be adjusted for each area
- Can dim stars near the horizon
- No movable parts = Reliable



## **MEGASTAR-IIA**

Dome: 10-25 m, flat / tilted



## **MEGASTAR-IIA**

with SWING AXIS & GIGAMASK

Dome: 10-25 m, flat / tilted



## **MEGASTAR-Neo II**

Dome: 4-10 m, flat / tilted



# **MEGASTAR**

Natural yet Majestic

## **Ohira Tech**





# INTERNATIONAL NEWS

## Dear fellow planetarians...

All around the globe, planetariums are gearing up for the Centennial of the Planetarium, and in the USA preparations for the 2024 solar eclipse are well under way. Below, you'll also find good examples of new fulldome shows, radio programs, special events and, last but not least, renovations and opening of new domes.

For this section, I'm indebted to contributions from Ignacio Castro, Andrew Kerr, Anna Arnasdottir, Andreas Schmidt, Loris Ramponi, and Alexis Delivorias.

Let's start this tour around the world in Mexico.

### ASSOCIATION OF MEXICAN PLANETARIUMS

On 5-6 October, 14 planetarium representatives attended AMPAC's XL regular meeting held in two planetariums in the State of Aguascalientes, sharing their experiences in the field including the upgrading of their facilities and presenting their educational programs and equipment.

The renovation of the Museo Descubre Silvia Torres Castillejo Planetarium included a new 4K laser projection system and the presentation of two dome shows produced by themselves: *Gravity Limit* and *Eclipse a Millennial Spectacle*. Also shown was a remote zoom interview with Alejandro Bascuñan Limon, from the University Planetarium of Santiago de Chile, on how they produced the movie *Eclipse, a Game of Shadows* currently shown on lease in some Mexican planetariums.

The second part of the meeting included the inauguration of the Hipatia Astronomical Observatory and Planetarium, named after the Greek astronomer and mathematician. The ceremony was presided over by the governor of the State of Aguascalientes, Maria Teresa Jimenez Esquivel, the mayor of the city of Tepezala (Tepezala Lugar entre Cerros meaning A Place between Mountains), Leticia Olivares



**AMPAC:** (Top) Hipatia Astronomical Observatory and Planetarium. Courtesy of Ignacio Castro. (Above) AMPAC members at Hipatia Planetarium. Courtesy of Ignacio Castro.

Jimenez, the newly elected President of AMPAC, Eduino Hernandez Carrillo, and Julian Potier. During the meeting, other officers were elected: Humberto Rios Pffiffer as secretary, Julian Potier as treasurer, and Ramon Vargas Salas as president-elect.

Other works were also presented: *Kana* by the Planetarium of Veracruz, El Trompo Planetarium of Tijuana and Enrique Fonte with a brief history of *Development, Contributions and New Tendencies* of planetariums worldwide and in Mexico.

### PACIFIC PLANETARIUM ASSOCIATION

In preparation for the eclipse-of-the-Sun "double-header," visible across the U.S. this past October and coming again in April, about thirteen thousand public libraries will make 6 million

safe solar-viewing glasses (and information packets) available to their communities thanks to a major grant from the Gordon and Betty Moore Foundation. The librarians, most of whom do not have science training, are looking for help from people who know about eclipse science and safe solar-viewing techniques.

In the months before the total eclipse on 8 April 2024, many libraries would like to host eclipse talks with scientists, science educators, or amateur astronomers, safety demonstrations, solar observing sessions, and family sessions with hands-on activities (such as making safe solar viewers and pinhole projectors for when the supply of glasses runs out). Also needed are people who can answer questions from library patrons and do virtual programs long distance to reach libraries with no experts nearby. To learn more and volunteer to help your local library (or virtually support any

library across the state or the nation!), please go to: [www.starnetlibraries.org/eclipse-expert-application/](http://www.starnetlibraries.org/eclipse-expert-application/). The free information booklet for librarians and their patrons can be found at [bit.ly/eclipsesforlibraries](http://bit.ly/eclipsesforlibraries).

The free, open-source textbook *Astronomy*, published by the nonprofit OpenStax project and written by A. Fraknoi, D. Morrison, and S. Wolff, has reached a milestone and is now the most frequently adopted general astronomy textbook in North America. Anyone can use or read it online at: [openstax.org/details/books/astronomy-2e](http://openstax.org/details/books/astronomy-2e). Its Open Education Resources Hub contains several dozen free teaching materials and aids, from the publisher, authors, and community of adopters. Anyone can access them at: [oercommons.org/groups/openstax-astronomy/1283](http://oercommons.org/groups/openstax-astronomy/1283).



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The Silicon Valley Astronomy Lectures now has 23 years running and counting. This series consists of public talks on recent developments in astronomy by noted scientists, professionally recorded and free on YouTube. Speakers have included Nobel laureates, astronomers who have won teaching awards, articulate young researchers, and more. Videos can be seen at [youtube.com/svastronomylectures](http://youtube.com/svastronomylectures). Recent talks are also available as audio podcasts at [www.buzzsprout.com/1805595](http://www.buzzsprout.com/1805595).

The American Astronomical Society has a new education newsletter. Thanks to the energetic efforts of Education Specialist, Tom Rice, the AAS now has a regular education newsletter to which anyone can subscribe. Join the AAS Education List at [lists.aas.org/AASeducation/subscribe/](http://lists.aas.org/AASeducation/subscribe/). You will be sent an email with a link to click to confirm subscription.

Dome Fest West 2024 submissions are now open. The Dome Fest West team is excited to invite you to submit your films to the Dome Fest West 2024 Film Festival! Mark your calendar for 2-5 May 2024 and join the team at the historic Fiske Planetarium in Boulder, Colorado for *The Next 100 Years of Fulldome Creators*. As the only dedicated fulldome film festival in the entire United States, Dome Fest West provides a platform for you to showcase your creativity and captivate audiences with your immersive films. This year, the team is seeking unique and awe-inspiring fulldome films and interactive experiences that push the boundaries of storytelling and visual effects. Don't miss this opportunity to be part of an extraordinary cinematic experience. Submit your films now to be considered for the Dome Fest West 2024 Film Festival at [FilmFreeway.com/DomeFestWest](http://FilmFreeway.com/DomeFestWest).

PPA continues to host Planetarians' Zoom Seminars. Some recent ones were 29 September - *Activities for the Centennial of the Planetarium (discussion)*, 25 August - *Professional Development for an Early Career Planetarian* (moderated by Ellen Thompson), and 28 July - *Two North American Solar Eclipses in Two Consecutive Years!* (moderated by Jim Todd). You can view recordings of these and all past

Planetarians' Zoom Seminars at the PZS archive page: [www.ppadomes.org/events/online-seminars/pzsarchive](http://www.ppadomes.org/events/online-seminars/pzsarchive). You can also see upcoming seminars on the schedule page [www.ppadomes.org/events/online-seminars/pzs-schedule](http://www.ppadomes.org/events/online-seminars/pzs-schedule).

### NORDIC PLANETARIUM ASSOCIATION

The planetarium community in the Nordic countries is thriving, with several new domes being built. The 2023 NPA conference was held on 6-8 September at Tekniska Museet in Stockholm, where one of the "soon-to-be opened" domes is located. With over



**NPA:** (Top) Group photo in front of Tekniska Museet in Stockholm. Courtesy of Anna Arnadottir. (Middle and above) Delegates active at the NPA conference in Stockholm. Courtesy of Anna Arnadottir.

70 planetarians gathered, discussions were lively, new connections and collaborations were formed, and new ideas were generated. The theme of this year's NPA conference was *Astronomy and Space Education*.

As there are a variety of languages spoken in the Nordic and Baltic countries, the NPA conference is always held in English, which attracts a few welcomed visitors from outside the region. Aside from attending the program at the Technical Museum in Stockholm, conference participants got to visit the dome at Visualisationcenter C in Norrköping, had dinner at the Swedish Space Cooperation, and spent an afternoon at Vetenskapens Hus, which is a small university science education center in Stockholm with an observatory and a mobile planetarium.

At the general meeting, Üllar Kivila from Estonia was elected new president, while Anna Arnadottir of Sweden took up a new position as managing director. The NPA web page has been updated and greatly extended. To learn more about NPA, please visit: [npa-planetarium.org](http://npa-planetarium.org) (note the resemblance to the IPS URL).

### SOCIETY OF GERMAN SPEAKING PLANETARIA

#### Berlin

The Planetarium am Insulaner held a cosmic farewell party before renovation. With the free Long Night of the Insulaner, the Planetarium am Insulaner bid farewell to its visitors to close for renovations on 8 July. "The Long Night of the Insulaner marks the beginning of the modernization of the Planetarium am



Insulaner into a future-oriented educational location, where the Stiftung Planetarium Berlin will make scientific content even more tangible and understandable. “Together with our neighbors, we bid farewell to our wonderful planetarium in Schöneberg with a cosmic summer festival of astronomy, sports, and culture, and show the diversity of the Insulaner site” says Tim F. Horn, president of the Stiftung Planetarium Berlin (Planetarium Berlin Foundation). The Long Night of the Insulaner, jointly organized by the Stiftung Planetarium Berlin, the Sommerbad am Insulaner,

and the Shakespeare Company Berlin, offered a program for the whole family. There were events in the planetarium hall, sky observations at the Wilhelm Foerster Observatory, performances in the Theater am Insulaner, and night swimming in the outdoor pool.

The Planetarium am Insulaner has stood at the foot of the hill of the same name since 1965 and offers impressive 360° events, live astronomical lectures, radio plays, readings, music and children’s programs under a 20-meter dome. At the neighboring Wilhelm Foerster Observatory, celestial observations have been conducted since 1963. The observatory will remain open. Both facilities, along with the Archenhold Observatory and the Zeiss-Großplanetarium, are part of the Planetarium Berlin Foundation.

For the peak of the Perseids meteor shower on 12 August, the Stiftung Planetarium Berlin, along with the astronomical clubs of Berlin planetariums and observatories, hosted the 10<sup>th</sup> annual Long Night of Astronomy at Tempelhofer Feld and welcomed more than 6,500 visitors. They were offered a free program that included telescope observations, planetarium programming in the INTENSE mobile science theater, star and astro-talk sessions, a special *Cosmorama* radio broadcast with FluxFM host, Katia Berg, and the foundation’s president, Tim F. Horn, numerous hands-on activities for children, a science slam, live music, and other exciting program items.

The radio program, *Cosmorama* by Tim F. Horn, President of the Stiftung Planetarium Berlin, in



**GDP:** Long Night of Astronomy. Courtesy of Steffen Junghanß.

cooperation with 100.6 FluxFM, was nominated as one of three outstanding informational formats for Germany’s Radio Award. The Deutsche Radiopreis is Germany’s most prestigious and important radio award. Whether the topic be black holes, the future of space travel, or aliens, every last Monday of the month, Tim F. Horn alternates with presenters Katia Berg and Sascha Schlegel from 7 to 9 p.m. on the radio show *Cosmorama* on 100.6 FluxFM to guide viewers through the Universe. Launched in September 2022, the show was one of three nominations of the renowned Grimme Institute. In addition to music that fits the theme, the popular radio program deals with celestial bodies, galaxies, astronomical phenomena, and the current state of research. Renowned experts have their say, and listeners are invited to submit their questions about the show’s topics in advance.

The nationwide roadshow, *Universe on Tour*, ended successfully with a final stop in Bielefeld. From Rostock to Munich, from Hoyerswerda to Heidelberg, around 60,000 people visited the *Universe on Tour* by the Federal Ministry of Education and Research (BMBF), in collaboration with the Stiftung Planetarium Berlin, the Astronomical Society, the Association of Star Friends, the Society of German-Speaking



**GDP:** *Cosmorama* with Tim Florian Horn, Katia Berg and Sascha Schlegel. Courtesy of FluxFM.

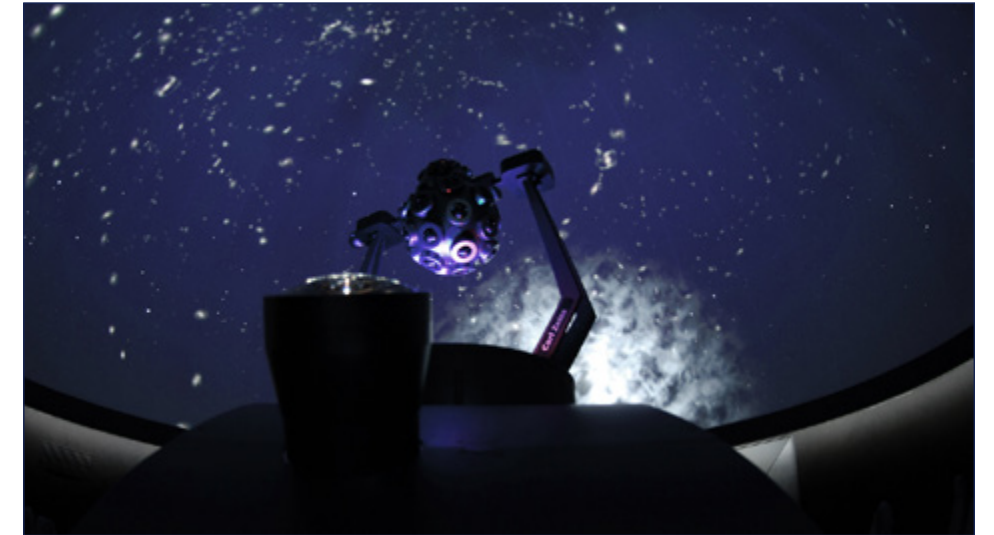
Planetariums, and the House of Astronomy. *Universe on Tour* toured from 10 May to 10 September across Germany, visiting 15 different cities to bring the cosmos to people who otherwise don’t have a planetarium near them. A fascinating 360° program in the dome of the mobile planetarium took visitors on a journey into space alongside an interactive accompanying exhibition. The Stiftung Planetarium Berlin was the initiator and organizer of *Universe on Tour*. It created the planetarium program, which incorporates local research institutions at each location and showcases their current research results as part of an ever-changing program in the mobile dome.

### Baden-Württemberg

Planetarium Laupheim is a medium-sized planetarium with an adjacent public observatory, located just outside the city of Ulm. The 10 m planetarium dome is equipped with state-of-the-art media systems, most notably a Zeiss Powerdome full-dome projection system and a synchronized Zeiss ZKP4 opto-mechanical star projector. The audio system features 11 speakers mounted behind the dome, two of which are subwoofers. Seven of the speakers



**GDP:** Exterior view of Planetarium Laupheim. Courtesy of Planetarium Laupheim.

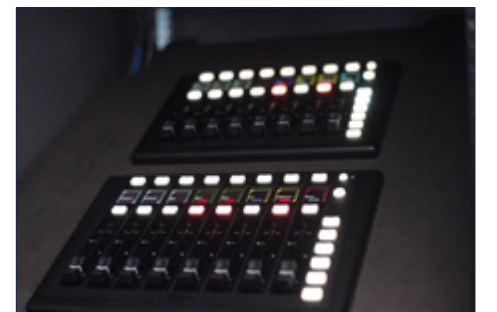


are arranged in a typical surround configuration just above the horizon of the dome, and two speakers are further up towards the zenith to complement the visually immersive nature of a planetarium projection.

As an upgrade to the existing installation, the planetarium was in need of a mixing solution that can accommodate this unconventional speaker setup and that can also interface to a large variety of existing audio sources (microphones, DVD, general-purpose HDMI, etc.).

Furthermore, the complicated controls were replaced by a common audio mixer, much to the relief of the planetarium operators, while maintaining mixer-style audio faders that can be conveniently and intuitively used in darkness. The theatrical lighting in the planetarium can be controlled through the very same control panel as the audio channels, in order to avoid a separate system.

Engineers Max Rößner and Alex Gölkel developed and commissioned a system to accommodate these needs. In the installed system, the primary audio source is a PC running the Reaper software package. This is in line with the planetarium’s established production workflow that had already been in place. Reaper is synchronized to the full-dome video system using SMPTE time code, and Reaper’s sound output is fed to a sound processor through a Dante audio link. At the



**GDP:** (Top to bottom) PC rack with upgraded hardware. Control panel impression. Synchronized projection with ZEISS ZKP 4 and VELVET LED. All courtesy of Planetarium Laupheim.

control console, two control panels featuring mixer-style audio faders serve as the control interface for the operator, remotely controlling the sound processor. For the theatrical lighting control, the fader positions of the lighting channels are sent to the lighting control PC for further processing in a purpose-built piece of software. When the lighting is under control of the show automation system, the motorized faders at the console follow, so that the operator can always reclaim manual control. The audio and lighting faders now coexist happily



on the console next to each other, resulting in a slick, integrated, and intuitive user interface.

ITALIAN ASSOCIATION OF PLANETARIA

The next edition of the initiative Two Weeks in Italy (any American planetarian can win this prize with a submission deadline of the end of July) will be held from 14-28 April 2024 in Padova, where the city planetarium will host the 2024 National Meeting of Italian Planetariums. The winner, Kenneth Brandt of Robeson Planetarium and Science Center (Lumberton, North Carolina, USA), will be involved in a long tour of lessons and astronomical visits organized by the Association of Italian Planetariums and the IPS Mobile Committee managed by Susan Reynolds Button. The tour begins in the city of Perugia, where the host is Simonetta Ercoli (Starlight – Un Planetario tra le Dita) and will continue to include the astronomical planetariums of Assisi and other astronomical facilities like Amelia, Florence, Ravenna, and Lumezzane Planetarium with the Serafino Zani Observatory (the organizer of the program, together with Susan Reynolds Button, since 1995). The initiative is open each year to other Italian planetariums.

A similar initiative to the Italian “Week” is also organized by IPS in the United States as a competition open to planetarians from around the world (deadline of the applications is the end of December). Among the past winners of the Week in the US are two Italian planetarians, the science communicator Elena Lazzaretto that works at the Planetarium of Padova (hosted by Orono Planetarium, Maine) and David Gruber, Bolzano Planetarium, operator when he won a week in Casper (Wyoming) and now director of the Natural Science Museum of Bolzano.

The 2024 calendar of the next Italian planetarium community initiatives includes the PLANit 2024 Award (XII edition), a fulldome contest open to anyone. Another contest is the Lara Albanese 2024 Award (IV edition) conceived during the corona pandemic

to promote activities online. For both, the deadline for submissions is the end of March.

Instead of the second Sunday of March, which has been the International Day of Planetariums in the past (an initiative born in Italy in 1991) it will take place on May 7, the date that marks the opening of the world’s first planetarium. Now, the month of February hosts the National Day Against Light Pollution connected with the event, M’illumino di Meno, that promotes the reduction of energy consumption.

Planetarian Francesca Limirolì celebrated the anniversary of the lighting of the first artificial star (September 1923) by visiting the famous Deutsches Museum in Munich that hosted, together with the city of Jena, Germany, the most important events dedicated to the centennial. The first projection of the sky with a planetarium projector took place in Jena, while the first projection for the public took place in 1925 in the Bavarian museum. During her visit to Germany, Francesca was lucky enough to meet a German colleague, operator of the Zeiss planetarium in Munich, who opened not one, but two “star rooms” especially for her. In fact, first she attended an exclusive projection under the dome of the planetarium and then, under the rotating one of the observatories attached to the museum, observed the solar photosphere with a powerful long focal length refractor. Her trip to Germany will forever be one of her unforgettable memories. Who knows how many times she will share it, telling it to the public and to very young people during the educational activities she organizes in the Observatory, that includes the planetarium of Val di Fiemme. Just recently, the tool that simulates the starry sky was implemented with the software made available by Lionel Ruiz. Francesca was able to deepen her knowledge of the program by following online lessons provided by French colleague. Lionel Ruiz is the second French planetarian



IAP: (Top) Francesca Limirolì’s on her visit to the Marseille Observatory where she met the colleague, Lionel Ruiz. Courtesy of Francesca Limirolì; (Above) Construction of the Ulrico Hoepli Planetarium in 1929. Piero Portaluppi was the architect of the Milan Planetarium. This image was taken by photographer Antonio Paoletti. Courtesy of Fondazione Piero Portaluppi, Milan.

that participated in the online initiative *Voices from the Dome* (see [www.planetari.org/2023/10/03/voci-dalle-cupole-intervista-a-lionel-ruiz/](http://www.planetari.org/2023/10/03/voci-dalle-cupole-intervista-a-lionel-ruiz/)).

The photograph of the construction of the Ulrico Hoepli Planetarium in Milan (19 September 1929), designed by the famous Italian architect, Piero Portaluppi, was chosen for one of the posters of the photo exhibition on the Centennial of the Planetariums. The project was carried out by professor Guilherme Frederico Marranghello for the International Planetarium Society. The Italian version can be downloaded from the PLANit website: [www.planetari.org/centenario-dei-planetari/](http://www.planetari.org/centenario-dei-planetari/)

EUROPEAN/MEDITERRANEAN PLANETARIUM ASSOCIATION

Croatia

In September, the Rijeka Astronomy Centre restarted its Matinee Saturdays for children while continuing its program for tourist visitors on



EMPA: From the presentation of the Croatian FD short film Null Cone for the Glowing Globe 2023 exhibition. From right to left: Ingeborg Fülepp (head of the Rijeka Centre for Innovative Media and Glowing Globe), Andrea Cvitan (Manager of the Rijeka Astronomy Centre), Boris Gareta (Film animation), Vladislav Knežević (film producer), Elio Janko (RAC planetarian technician) and Mirko Soldano (actor of Rijeka National Theatre, Italian Dram). Courtesy of Boris Gareta.

Wednesdays with a planetarium show combined with guided telescope stargazing.

In the beginning of October, the RAC celebrated Children’s Week and the World Space Week (4–10 October), for the 14<sup>th</sup> consecutive year. The World Space Week 2023, in particular, was dedicated to ‘Space and Entrepreneurship,’ and RAC participated with a live planetarium show focusing on the commercial space industry, the technologies and products that we use daily that have borrowed ideas and techniques developed solely for the exploration of Space, and on some future space exploration missions. During the World Space Week, the RAC presented more than 15 planetarium shows and films, hosted various workshops and public presentations, and offered night sky observation with its telescope.

Between 11-25 October, the RAC participated in the *Glowing Globe: Changes and Challenges* exhibition, focusing on how the different contemporary problems, or even crises, are reflected in innovative artistic practices, and which current artistic narratives are possible responses to these problems and crises. The RAC

Planetarium participated in the event by screening 360° short films by artists Alex Brajković, Vladislav Knežević, and Diane Reichenbach, and also by hosting a sound performance by Benjamin Heidersberger.

On October 21, RAC joined planetariums worldwide to celebrate the Launch Event for the *Centennial of the Planetarium*, a worldwide celebration from 2023 to 2025 to commemorate the unveiling of the first planetarium projector in Jena, Germany (October 1923) and the opening of the first planetarium in the Deutsches Museum, Munich (7 May 1925). Specifically, the RAC presented, for the first time in Croatia, the full dome celebration trailer followed by its own new live production titled *Amazing Planetariums – History and Wonders*. During the same event, RAC presented the fulldome film *Incredible Universe*, produced by the Brno Observatory and Planetarium, as well the first Croatian productions of a short fulldome film called *Null Cone* by Vladislav Knežević, and fulldome multimedia work *Axion Cartograms* by Alex Brajković. Both were produced for the Rijeka Planetarium and the Glowing Globe exhibition. The celebration concluded with visitors observing the Moon through RAC’s telescope.

Future plans include the hosting and preparation of various events related to the 50<sup>th</sup> anniversary of the Academic Astronomical Society of Rijeka, the Italian National Space Day, Carl Sagan Day, the Leonids meteor shower, and Christmas.

Greece

The New Digital Planetarium in Athens just turned twenty! Construction work for the New Digital Planetarium began in the Spring of 2000. After three years of extensive reconstruction and additions to the original building complex, and 37 years since the creation of the first Eugenides Planetarium, its state-of-the-art successor opened its doors to the public on 3 November 2003.

Having so far attracted an estimated 4,500,000 visitors, the New Digital Planetarium of the Eugenides Foundation continues to honour the last will and testament of national benefactor Eugene Eugenides (1882-1954), namely, “to contribute to the education of the Greek youth in the fields of science and technology.” Having already completed its latest major technical upgrade with Sky-Skan, which will drive it for many years into the future at a top performance level, the Eugenides Planetarium celebrated its 20th anniversary on 23 October, presenting the new system with the premiere of its latest digital production, *We are Stardust*, that was envisaged by its late director, Dennis Simopoulos, to honour legendary composer, Vangelis. The show is narrated by Dennis Simopoulos (using parts of some of his numerous past recordings), with original and unpublished music by Vangelis himself. It is a tribute to science and art by two creators whose friendship and mutual appreciation is more than evident in this work.



# TALES FROM DOME UNDER

## “TICKET TO VEN”

As show makers, we often find ourselves in some really interesting locations to acquire visuals needed as part of a production in progress. Such was the case in 1993 while working on a show covering the electromagnetic spectrum, what the eye can see, and how technology helped us with the parts it can't.

In the spring of 1993, Cosmonova installed some special, allsky projectors, the Kakspi system, invented by Antti Jännes (later starting the company ProDome Oy to manufacture them) at the Heureka Science Center in Vantaa just outside of Helsinki. One of these 5,000W projectors could throw a single fisheye image onto the dome, even domes tilted by 30° like Cosmonova's. This tilt was because our theater was also equipped with Omnimax (now known as IMAX Dome). When you had a pair of these allsky projectors as we did, you could make crossfades too.

The first custom-made camera for this system took pictures on 4"X5" transparency sheet film. One of my tasks as Cosmonova's astronomer/producer was to learn how to use it, and there were allsky scenes in the show I was then making. Included among these were some allskies to be shot at the site of Danish astronomer Tycho Brahe's (1546 - 1601) Uraniborg observatory on the island of Ven (pronounced "Vain" in Swedish).

Beside a large statue of the last of the great pre-telescope naked eye measurers of the heavens, some 25% of the gardens once on the property had been restored at that time to show how they might have been when he still lived there. Current photos show that more has been restored since our visit 30-years ago.

Unfortunately, Brahe was not a good choice to be the person in charge of this island as he treated those who lived on it like they were his personal servants, and worse. He was not well liked, but more about this later. Not only that, but Tycho was alleged to have kept a person

with dwarfism named Jepp (or Jeppe, or Jep – spelling varies) like a pet. Perhaps apocryphal, Jepp, who also acted as a jester, was even supposed to have psychic powers, and could "see" things.

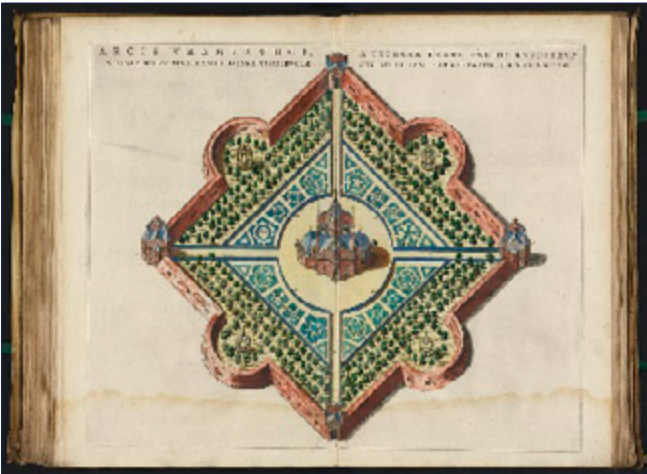
The Kakspi camera's builder, a young guy named Matti, and I traveled by night train from Stockholm to Sweden's southwestern Landskrona in the early summer. There we were to catch a scheduled ferry over to Ven. The train ride was pleasant enough, and we made the ferry at Landskrona's Skeppsbron in plenty of time. The half-hour cruise over to Ven's Bäckviken was scenic, with impressive views of the Skåne province's coast as well as Ven itself towering over the water as we pulled up.

Arriving immediately presented us with a problem we had not anticipated. There was a long hillside path up to the rest of the island, and we had a lot of photographic gear with us, not to mention what we needed for the train ride. Fortunately, there were several small flatbed carts at the ferry landing, so we borrowed one of them, loaded it up, and off we went to get to Uraniborg at the top. It was a beautiful, sunny day, with white clouds scudding across the sky, just the right conditions for making allskies with the Kakspi camera and 100 ISO 4"X5" Fujichrome analogue sheet film.

We had to be really careful with our time as there were only so many return ferries to Landskrona. It was a 2km return trip down to Bäckviken where we would need to catch the ferrie back to dry land and then our return night train to Stockholm.

Upon arriving at the top of the hill, we pulled the cart over alongside the

little cottage that, in 1993, served as a museum. Looking around the area, there was no one else in sight who could potentially photobomb out pictures. Uraniborg, which served as both Brahe's house and observatory, was long gone. All that remained to show where it had once stood was marked on the ground by a thick white outline.



Picture 1: A view of Tycho Brahe's Uraniborg as seen from above. Oriented to the cardinal points, the extensive gardens surrounding the central house/observatory can be seen as well as several outbuildings, which included servant's quarters and a printing shop. Source: Public domain.

After seeing contemporary woodcuts of the place in any number of astronomy books, I couldn't help but to be struck by how small it must have been. Clearly the pictures had greatly exaggerated it.

It turned out that there wasn't as much of the grounds to photograph as I had hoped, so we made some shots of the Tycho Brahe statue, and found a way to shoot the 25% of restored gardens so that they looked like more than what they really were.

Afterwards, Matti and I stepped inside the museum for a little look around. Once we had reached the top upon arrival, we had noticed there was another nearby structure on the other side of the road, which had some domes flush to the ground and large windows to look inside. This looked like it could be interesting.

After explaining what we were doing



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Picture 2: Uraniborg from the ground. Note all the various observing platforms, with their pointy "domes" scattered around the exterior. It was while observing from them that Brahe realized the wind interfered too much with his observations, leading to his decision to move operations underground. Source: Public domain.

there, we asked the woman behind the museum's sales counter if there was any way we could see the underground observatory, Stjerneborg, across from Uraniborg. She disappeared for a few minutes, coming back to tell us that the groundskeeper would meet us out front of the museum and we could ask him directly.

Having been out watering around the museum building's far side, he came to hear us out and agreed that we could see it. Pulling our cart behind as we went, the groundskeeper took us over there. Producing a huge clump of keys from somewhere, he inserted a large one into the padlock on the door and led us inside. It took a couple of seconds for our eyes to adjust to the semi-darkness, and, leaving our gear on the cart beside the door, down we went on a short flight of stone stairs. Here and there were squares of light on the floor in front of us cast by the overhead observation windows in some of the domes.

Since arriving on Ven, one thing we couldn't help but notice was the continuous strong winds sweeping past. This, we were told, was why Brahe had abandoned using Uraniborg as an observatory. Pictures of the building show various observing platforms on its exterior, sometimes complete with naked-eye measuring instruments. The wind, however, frustrated such observations, so he struck on the idea of avoiding them altogether by

observing from the protection of being underground, which led to Stjerneborg.

Once our eyes were really adjusted, it looked rather chaotic. There were a variety of short walls made of large bricks here and there, and some pillars, also of brick, stuck straight up from the floor. The ground underfoot was quite rough and strewn with rubble here and there. One had to really watch where they were walking.

The groundskeeper took us on a little tour, pointing out what the different walled off areas once were. One of them, for example, was where Brahe had a bed where he could rest, which indicated that the astronomer must have been quite short. He also showed us where there had been a secret water well, which Brahe never publicized for fear the people on the island would poison it in order to get rid of their landlord repressor. The story may also be apocryphal, but on the other hand, the well isn't marked on contemporary drawings showing the floor plan of Stjerneborg.

One of the brick pillars the groundskeeper pointed out was where a large astronomical instrument was once mounted. As I stepped up to it to look more closely, I saw that there were still large old screws stuck vertically in its top surface. And yes, they were one-in-the-same, which must have been used to hold the device in place. How so?

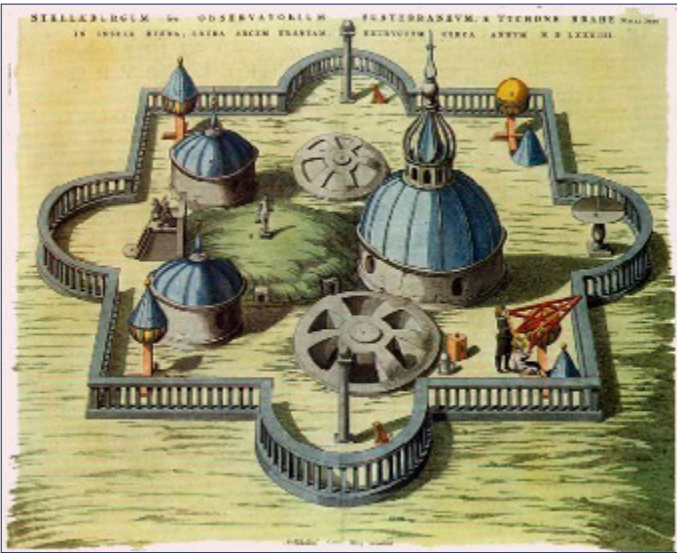
Everything was left as it was when

Tycho Brahe left abruptly, observing equipment and all, for Prague in 1597 after falling out of favor with Danish king Christian IV. And when he did, the locals showed their long-held feelings for him by razing Uraniborg to the ground, hauling off the demolished building's materials for their personal use. So, in the end, some good had come of their association with one another.

Tour finished, the groundskeeper turned to Matti and me, tossed the clump of keys over to us, and said, "Lock up when you're through," leaving we two standing there in both shock and surprise. He headed back up the stairs, leaving the door a crack open behind him as he walked away.

I don't know what my Finnish colleague was thinking, but to me this would be like being handed the keys to something as historical as the White House in Washington, D.C., and then being told to lock up after we were finished. Never in a thousand years could we have guessed we would have been left like this on our own. At best we figured it would be some quick shots with him present, then back up the stairs, and out the door again. Now we had all the time to get what we wanted, pending the time for the ferry back to Landskrona, and more.

(Continued on pg. 68)



Picture 3: A contemporary view of Tycho Brahe's Stjerneborg. The location of the current entrance that we used to enter is on the left side, and Uraniborg itself is located off about 105m in the same direction. In the text I mention taking a photo of the interior of a large dome from across the underground space; it sits to the right side of the observatory. Source: Public domain.



# MOBILE NEWS NETWORK

## OUTREACH WITH A MOBILE DOME

### Happy 100th Birthday!

The first planetarium projector was built 100 years ago in Germany. The next year, the first planetarium opened in Germany. The first planetarium in the United States, The Adler Planetarium, was built in Chicago and is still operating today.

Learning Technologies Inc. in Massachusetts offered the first easily portable planetarium in 1977. Philip Sadler designed this patented system which projected stars, constellation figures from many mythologies, celestial coordinate systems, and much else, from removable cylinders (Viewlex and others followed with their own portable versions). The STARLAB portable planetarium is an inflatable dome! It is made from a nylon-reinforced, flame retardant, industrial grade fabric. The outer surface of this durable fabric ensures opacity even in fully lighted rooms. The inside surface has an aluminized reflective coating designed to clearly display bright images. A powerful fan inflates and circulates air throughout the dome. Air is exchanged every five minutes through a carefully designed ventilation system that maintains a comfortable temperature and prevents excessive air loss during entry and exit. The dome can be set up almost anywhere: an empty classroom, gymnasium, cafeteria, etc. The best place would be a room at least 12 feet high and 20 – 22 feet wide. The dome is handicapped accessible and allows for rapid evacuation if necessary.

The STARLAB is a very simple and robust planetarium and, with care, can last a lifetime! I am currently using one of the original STARLAB systems to teach a basic astronomy class to seniors who are part of the La Roche University Adventures in Lifelong Learning program. My students are thrilled to be able to learn about the patterns and cycles of the universe in this unique environment. They are awed by the stars that we never get to see in the

light polluted and frequently cloudy Pittsburgh skies. Newer, portable planetariums are digital, but the mechanical projectors are still very useful in covering basic information and inspiring people to look at and enjoy their sky neighborhood!

### September Zoom Meeting

Another successful, well attended (48 planetarians from 20+ countries) meeting was enjoyed by our worldwide community! The next exciting meeting will be 13 January 2024 at the same time. We recorded this meeting so that those who could not be here will be able to watch it at a time more convenient for them. You can find it on IPS YouTube and on the Portable Planetarium Resources webpage <https://www.ips-planetarium.org/page/portableresources>.

We had 7 wonderful presenters who are listed below.

#### Presenters:

- Bryant González Vásquez Astronomical Backpacker and Mochileros Astronómicos, Paraguay [mochilerosastronomicos@gmail.com](mailto:mochilerosastronomicos@gmail.com) Bryant presented "Planetarium Experience: the growth of immersive shows in Paraguay."
- Marco Avalos Dittel Planetario Aventura, Cost Rica [info@planetarioaventura.com](mailto:info@planetarioaventura.com) Marco shared "Planetarium Centennial Initiatives"
- Dace Balode Riga Planetarium, Latvia [dace@pagrabi.lv](mailto:dace@pagrabi.lv) Dace demonstrated some very creative and simple hands-on teaching activities.
- Anna Fárová KRUTART animation studio and film production company, Prague- Czech Republic [anna.farova@krutart.cz](mailto:anna.farova@krutart.cz); [321liftoff](https://321liftoff.com).



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Thank you Marwan Shwaiki, Chairman of the Arab Planetarium Society, for the lovely poster!

[info](#) Anna played the trailer for "321 Liftoff" and talked briefly about the show.

- Humberto Guzmán Planetario Móvil Colombia, Universo Lúdico
- Bogotá D.C, Columbia [humberto.guzman@sequoia-space.com](mailto:humberto.guzman@sequoia-space.com); [www.universoludico.com](http://www.universoludico.com) Humberto presented their experience in the design of domes for inflatable planetariums by discussing characteristics, materials, design considerations, safety and comfort for attendees.
- Dr. Ayman Al-Nairat from Jordan - Arab Planetarium Society

(APS) and Dr. Sabra Mahmoud from Iraq - Arab Planetarium Society (APS) gave us an update about the many portables in Arab countries.

- Susan Button IPS Portable Planetarium Committee Pittsburgh, Pennsylvania.

Susan reminded everyone about:

- Portable Planetarium Resources <https://www.ips-planetarium.org/page/portableresources>,
- IPS new request for Centennial Local Projects submissions will be announced this Fall <https://planetarium100.org/>,
- IPS Conference scholarships <https://www.planetarium.berlin/ips2024>
- Contests: Week in US, Week with the GDP, Pages of Stars <https://www.ips-planetarium.org/page/share-Decl.Deadline> 5.
- Consortium for buying fulldome videos - Contact me: [sbuttonq2c@gmail.com](mailto:sbuttonq2c@gmail.com),
- IPS Membership- join now for 2 years for the price of one: <https://www.ips-planetarium.org/page/howtojoin>, and
- Associate Memberships: No Dues. For those in emerging communities. If you are from such a community or have financial challenges and are not able to pay for a full membership, please contact [operations@ips-planetarium.org](mailto:operations@ips-planetarium.org) about becoming an Associate member. Business Associate Membership: Dues are US \$25/year. For small 1-2 employee businesses performing outreach.

Our next meeting will be January 13, 2024.

### Portable Dome in Honduras

I found Nelson Iban Canales Cortes on Facebook. He is from Sonaguera, Colon, Honduras. In answer to some questions that I posed to him, after being intrigued by a picture his colorful dome, he wrote:

"I bought my Dome from ASE, a company in Ukraine. It is 7 meters in



diameter and 4.2 meters high. I have an Epson EBL 510U projector and spherical mirror and a basic Dell computer. I'm just trying to bring my educational project and entertainment to students and to the general public. I have only been able to be in 2 schools. For now I am using a video called from the earth to the Universe and also at the time I did some tests with videos of Lochness. But because, in my country, most of the schools have low ceilings, I can't even work there. That's why I'm building a structure around the Dome to protect from the wind and the sun. My desire is to get a fisheye system to present astronomy programs without the need to distort the fisheye image."

### "Ad Astra Planetarium:

Ron Mallory attended LIPS in Detroit this year and revealed that he had put together his mobile dome planetarium



at the relatively low cost of under \$4,000. Below is his explanation of how he did it and started his own company.

Ron wrote, "I'm primarily a musician by trade, but have always maintained an active side career in astronomy education. In early 2023, after several years of volunteering in fixed-dome and portable planetariums, I decided to purchase my own portable dome and start a side business presenting shows for schools, libraries, churches, and the like. There are a number of companies that offer complete portable systems, but costs are typically in the tens of thousands of dollars (USD) and largely out of reach of an individual freelancer like me. Fortunately, I discovered the resources on the IPS portable planetarium website, which demonstrated that a lower-cost DIY-type system was a possibility. I also reached out to some portable planetarians I found online and am particularly thankful to John Meader in Maine and Lauren Ard in Arizona for their information and encouragement.

I started out by looking for a dome. The IPS website includes plans for constructing a fabric dome on your own, but I decided this was beyond my skill level. I had some experience using Digitalis domes, but while I liked their quality and ease of use, the cost was beyond my budget. Through Lauren

(Continued on pg. 69)



# LIP SERVICE

## LIPS 2023—WHAT A BLAST!

=As I type this, it's been about six weeks since LIPS 2023. What a wonderful three days full of laughter, camaraderie, and learning... We had several undergraduate students attend this year, and they brought with them new ways of looking at situations and a willingness to ask and answer questions. About half of the attendees were at their very first LIPS, which was wonderful. I love seeing veteran LIPsters, of course, but I love knowing that more and more people are being exposed to the LIPS philosophy.

LIPS 2023 was hosted by the Michigan Science Center (MiSci) in Detroit, and it ran from Tuesday, September 12 through Thursday, September 14, with an opening

reception the evening of Monday, September 11.

MiSci was closed for maintenance during LIPS, so we had the run of the place. We held sessions in five different areas over the course of LIPS, including the intimate Classroom (classroom style space surrounded by windows), the Imax Dome Theater, and of course the planetarium dome. A huge thank you to Paulette Epstein and all of the MiSci staff for making us feel so welcome!

What happened at LIPS 2023? You can find the schedule and session descriptions here: <https://sites.google.com/view/lipsymposium/sessions>



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A highlight for me was the improv comedy workshop, which took place right after lunch on the first day. This was a fun and engaging way to get to know the other participants early on. I learned that several LIPS attendees do excellent Elvis Presley impersonations and elephant bugling impressions.

We also had several thought-provoking, atypical planetarium presentations. For example, Shira Moskowitz of the Maryland Science Center walked us through her activities for Havdalah, a Jewish religious ceremony or formal prayer marking the end of the Sabbath. (see image).

With Ryan Marciniak, owner and operator of the Toronto-based Astronomy in Action outreach

business, we explored a big question: Is it better to dramatically simplify some explanations and vocabulary with audiences in order to minimize the risk of confusion and misunderstanding? Or should scientific accuracy and completeness trump everything?

We had hands on activities led by the Fiske Planetarium team, who hosted LIPS 2022. These were designed for the PUNCH mission, and they featured activities such as plotting our birthdays at sunrise along the rim of Chaco Canyon, various dances to represent solar activity, learning about the crew behind the PUNCH mission, and more.

We had eight fantastic sponsoring companies, and I want to thank all of them as well as give an extra dose of appreciation to Mark Webb of GOTO, Inc., for continuing to act as sponsor liaison. In alphabetical order, LIPS 2023 sponsors were:

- Audio-Visual Imagineering (AVI)

- Cosm, Inc.
- Digitalis Education Solutions, Inc.
- ePlanetarium
- GOTO, Inc.
- Konica Minolta/RSA Cosmos/Solotech
- Laser Fantasy, Inc.
- SSIA Technologies/Sky-Skan

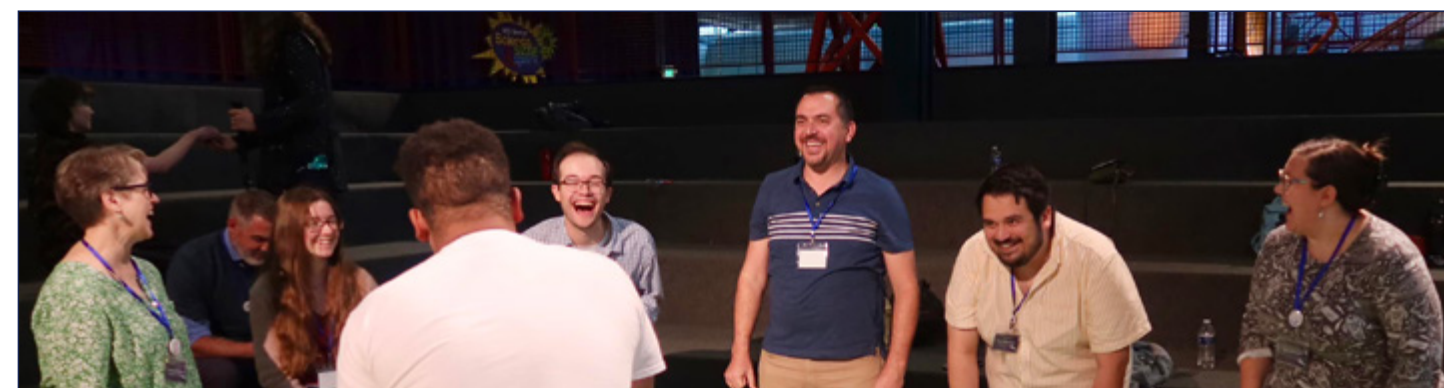
But don't just take my word for it that LIPS 2023 was awesome! Here are some comments from the LIPS 2023 follow up survey:

- Everything I learned at LIPS is so directly applicable to my professional development and the improvement of my planetarium programming. I had an amazing time at the conference, made fantastic connections with like-minded planetarians, and am looking forward to attending many more LIPS conferences in the future!

- I learned quite a bit about topics that I wasn't even aware of. In other words, I didn't know what I didn't know. To all of the organizers and presenters, Well Done!
- It is a tribute to the culture of LIPS that so many people were vulnerable enough to talk honestly about themselves and their personality traits, and misgivings, starting from Day 1, even before the improv workshop.
- Kudos to Paulette and her staff (and Michael McConville) on being gracious, helpful, attentive hosts. Also, to Karrie, for continuing to grow and shape her vision of LIPS. Group size is nearly perfect, so everyone stays together and is more able to interconnect.
- It was great to share and hear ideas from colleagues.

And continuing the trend from 2022 of problems arising on the last

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Clockwise from left: Our host Paulette Epstein kicking off the Laser Fantasy sponsor demonstration in the IMAX Dome Theater; The exterior of the Michigan Science Center; Kicking off the improv workshop. Images: Andy Kreyche

Clockwise from top: There was almost non-stop laughter during the improv workshop.; Working in teams of three to make an elephant; MiSci CEO Christian Greer welcomed us to the science center during the opening reception. Images: Andy Kreyche



## A DIFFERENT POINT OF VIEW A LITTLE BIT OF EVERYTHING

So, something interesting happened to me recently (this probably happens all the time for you big guys) but for the second time a visitor wanted to spend their birthday under my dome. I'm not at all sure about the first time but I do know the second birthday request person had never been here before. He had heard about it by word of mouth and wanted it as the highlight of his special day.

Back to what to do for the centennial and an expansion of what to do. What popped into my head was, "why not a planetarium crawl," kind of like a bar crawl? Now to participate one would need to be retired and independently wealthy as planetariums are actually fairly far apart, so perhaps it could be a state thing. That would still probably take more than one day, so the idea requires refinement. (Some time goes by...) "Erika, I have an idea!" The planetarium crawl could all take place at my single dome. People would enjoy a projection starting with the Spitz Jr. on the dome and then exit the south door, pick up a pint of planetarium ale and come back in the north door. Since my entire project is based in the seventies, I might have trouble adopting the slogan, "The Stars Are Only the Beginning" and perhaps rephrase to, "The Stars Are All There Is," but then I could add a bunch of seventies era special effects projectors, as many of them do as good or better of a job than the computer-generated kind.

I am using a bunch of slide projectors, but slides are getting harder and harder to get and some of my plans will probably go belly up without a fresh supply. My connection with the present is a video projector with Blu Ray technology and computer operation to run laser shows, but I always have problems with trying to get material for use in my mirror dome video projection system. Perhaps I need to add a 16mm film projector, but I have a limited amount of software for that as well.

There would also be good nibbles, perhaps Brats and soft drinks as well, but imagine doing the full-scale trips. The problem is that, after a few rounds, all of the projector's star images would all start looking like big blobs. Perhaps the full-bore planetarium crawl would need to be limited to a select few or a limited number of refills...

So now I'm thinking that it might be worth documenting all of this (I think I still have a digital motion and still camera that work). Not many people have seen a close-up view, properly exposed, of the operation of a planet projector - most fascinating. But the things that I find interesting, most others find boring. It could be just a big waste of time.

I just realized once again that even though I'm rambling on and on in the final days of September, you are reading in the final days of December and all of October is over.



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Things like the "International Observe the Moon Night" falls on October 21st... I wonder who picked that day - a lot to cram in.

I'm really glad the centennial is spread out over a year and a half, so maybe I can actually accomplish something. But then, I am getting older and might not accomplish anything, so I will leave it like this.: no special days set aside (not yet anyway), but if you're in the neighborhood and want to see this offering, "From The Spitz Jr. to the Minolta IIB: A study in light" just give me a couple days' notice and I'll set up a mini planetarium crawl just for you (at least as long as the keg holds out).

What more could you ask for?

### Keith's Captured Quips ~ Chapter Twenty- Five

"It takes Jupiter like 1,000,000,000 years to revolve. You did a great job with the planetarium." (Evidently not as great a job as I should have!)

"My favorite part was the whole thing."

"I learned that the bear with the long tail had a long tail."

"You rock more than any meteor in the universe!!!!!"

"I didn't know that much about the soloar system only that planets and stars are in it."

### 10 years ago (December 2013):

As we all continue in the one-hundred-year celebration of the planetarium projector, you might want to review Peter Volz history of the Zeiss Company, "Tracing Paths of History: Rudolf Straubel, Walter Bauersfeld, and the Projection Planetarium." It is an interesting history of the forming of the Zeiss Company and the history of how the projector came about. Well worth the read.

As if the story of the Zeiss planetarium wasn't enough, this issue also contains the early life with Armand Spitz by Verne Spitz Rice, "Who Was Armand Spitz? Father, Husband, Educator, Innovator. This transcript of interviews with Armand Spitz's daughter, Verne, might be properly called, "Growing Up with Armand Spitz."

And if projecting stars isn't enough, take on Ivan Dryer, the father of laser light shows, as he reviews his high-voltage career in, "Forty Years of Light." If it was on que, it got applause.

### 25 years ago (December 1998):

"The Monty Python, Barnum and Bailey, Super Deluxe Planetarium of the Future," penned by James G. Manning, is perhaps the most copied and re-printed article I have ever seen concerning planetariums. Who could forget this introduction to a show of the future, "There is no planetarium projector or control console, only a brightly

garbed, fresh-faced theater attendant carrying a small box with a single large green button that says "Go?" The button-pusher says, "Hi" - and pushes the button. The house lights dim, as we don our 3-D holographic goggles, and deep in the bowels of the facility, the latest advance in AV computerized theater technology rouses.

What makes this so good is that, even back twenty-five years when it was written, we all knew, deep inside, that the writing was indeed on the wall.

Jim Manning's column, "What's New" makes mention of the seventy fifth anniversary of the planetarium projector.

If you still have a dinosaur (I love my dinosaur) optical mechanical projector, Richard McColman's article on "Servicing Slip-Rings" is worth downloading and keeping with your maintenance folder.

### 45 years ago (December 1978):

Paul T. Davis does "A Study of Kindergarten Students In The Planetarium." I find this interesting as these are visitors that haven't been introduced to Dick, Jane, Sallie, Spot, and Puff yet. Why the Sun moves across the sky might be a bit much for five-year-olds, but then, what do I know.

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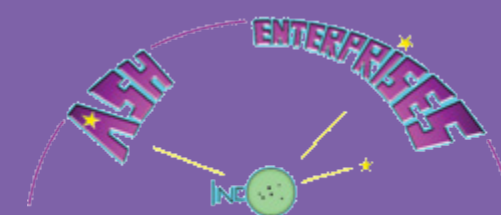
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Dome Cleaning & Painting

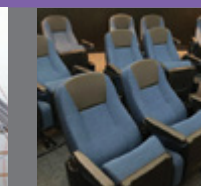
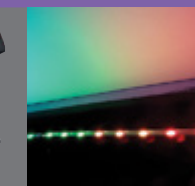
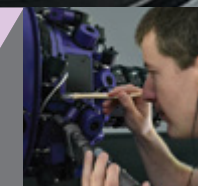
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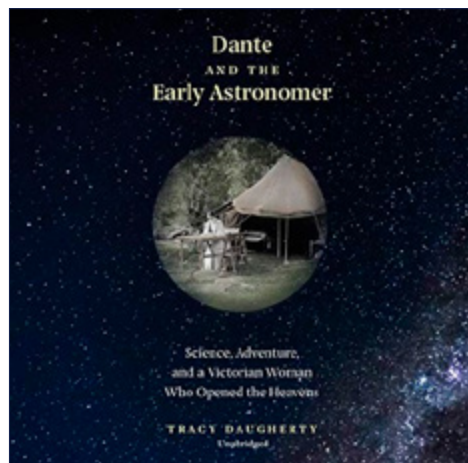


PROJECTORS / COVE LIGHTING / DOMES / SEATING



## BOOK REVIEWS

### NEW IN THE WORLD OF LIT



#### **Dante and an Early Astronomer: Science, Adventure, and a Victorian Woman Who Opened the Universe**

By Tracy Daugherty, New Haven: Yale University Press, 2019, ISBN 978-0-23989-8, hardbound, US\$29.00

Reviewed by Francine Jackson, Ladd Observatory, Providence, Rhode Island, USA.

Many of us read a lot, not only for our jobs, but just to enjoy, perhaps as an escape. However, there are some readers who might begin a book, then find themselves analyzing certain points in what to many might just be a book read for enjoyment.

As a young girl, while reading Dante's Divine Comedy, Mary Acworth Evershed concluded that many of the notations in the book could be compared to the cosmos. She saw in him a poet with the ability of a scientific researcher. In fact, Evershed knew that Galileo Galilei avidly read Dante, and tried to sketch much of Dante's locations, based on his incredible descriptions, geometrical theorems, and numerical proofs.

Evershed grew up to be an astronomer, not an easy profession for a woman born in the 1860s. Fortunately, she was homeschooled by a father who didn't believe that girls should be treated differently from boys educationally. As a young girl, she became very interested in science, and, upon her marriage to astronomer John

Evershed, she followed him to what was then a wilderness section of India where, for years, husband and wife earned acclaim for their scientific activities. But, through it all, Mary kept Dante close to her, to the point that she wrote articles on the various inferences to the sciences; for example, her An Easy Guide to Southern Stars seemed equivalent to Dante seeing the new stars upon entering Paradise. She believed Dante understood astronomy because of his interest in Greek writings, especially that of Aristotle. If only, believed Evershed, telescopes had been available in Dante's time!

Despite being a "Victorian woman," Evershed proved that she was an accomplished scientist, writer, and, of course, aficionado of Dante. To her, he was a consummate scientist. The Divine Comedy, she believed, was proof that he was more than just a fascinating storyteller. Read this book yourself and decide.



#### **The Universe**

By Andrew Cohen, London: William Collins, 2023, ISBN 978-0-00-838935-2, paperback, \$19.99, US

Reviewed by Francine Jackson, Ladd Observatory, Providence, Rhode Island, USA.

It often happens that a book on the universe is written by someone who is so immersed in the subject

that the average person has great difficulty understanding it. In this case, though, The Universe was the work of the executive producer of the BBC series The Universe. As such, he has apparently coordinated the topic with the program, writing this for anyone who would like to know about our universe, yet in a tone that's not patronizing.

Each chapter contains the history of a topic. The chapter, Alien Worlds, for example, not only discusses what normally comes to mind – exoplanets – but looks at our own planetary neighborhood (although the author mentions that such scientists as Camille Flammarion and William Herschel spent time considering other stars with plural worlds). And, although there were 20th century observations of planets from ground-based telescopes, the numbers exploded with discoveries from the Kepler spacecraft. Of course, we know that so far there has only been what we believe to be an important indicator of the possibility for life – water. As of yet, according to the author, we have no knowledge of other civilizations.

Stars and Galaxies, although two separate chapters, weave the history of the stars, both singly and as the giant conglomerations. Each one begins at the beginning, from the first stars to the first time a nebula was realized to be a galaxy, courtesy Edwin Hubble, utilizing the distance measurements of Henrietta Leavitt.

Of course, no book on the universe would be complete without a segment on black holes. All sizes are described, from the "minis" to the monstrous centers of our galaxies. The book introduces the reader to the first one discovered, Cygnus X1, courtesy of suborbital rockets launched from the White Sands Missile Range in New Mexico. We also learn about gravitational waves in this book, actually predicted by Einstein early in the last century and confirmed by the work of the LIGO (Laser Interferometer



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Gravitational Wave Observatory) by determining how they are created.

Particularly enjoyable are the quotations from many different scientists, both to supplement the topic being discussed and to add to the interest of the subject. Each vignette is well worth reading, as many persons quoted were part of the research involved.

This is a great book for someone who isn't very familiar with the workings of the universe, but a professional should also pick this up. The author has written The Universe for everyone to enjoy.



#### **Tales From Dome Under**

By Tom Callen, Askman, 2022, ISBN 9798366155489, US\$30.20, available on Amazon.com

Review by Dave Hostetter, New Iberia, Louisiana, USA

Tales From Dome Under is a series of autobiographical stories from the author's life in planetarium-land, ranging from personal experiences to musings about soundtracks, pre-digital program preparation, special programs, famous visitors, the unique smell of red opaque, and more. It's a trip down memory lane for older experience-enriched planetarians!

I was unsure at first about the book's intended audience. I decided on three basic groups: planetarium groupies (surely there are some!), old-guard planetarians who started their careers before fulldome, and newer planetarians who are curious about planetarium history (and/or want to know what the boss is talking about).

The book is mostly based on articles from The Planetarian, and I figured I'd be familiar with much of it. I was wrong. The first section of the book is a good description of the nature of planetariums (both traditional and fulldome), the kinds of equipment found there, and how it all comes together for different kinds of programs. Since the other chapters came from The Planetarian over a period of 10 years (modified for a general audience), I found them much more enjoyable than expected.

It was fun to recognize many of the people mentioned, even when names were not used. I knew and have worked with some of them, and my own memories of them often brought a chuckle.

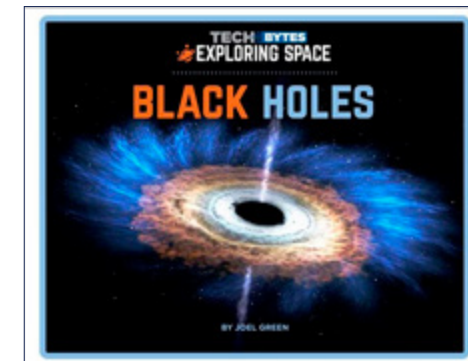
The author worked in some major planetariums, and it was interesting to see behind the scenes at those places in comparison to my own experiences in 30- and 40-foot domes. One chapter reminded me of my trip to the planetarium at the National Air and Space Museum back in the 1980s. A panorama in the presentation showed an observatory, with a rotating dome obviously produced by a movie—but there was no gray rectangle. I had a nice talk afterward with the console operator (who knows, it might have been the author) who amazed me with the technique for masking the film. The book explained in some detail how they did that, and now I'm more impressed than ever!

Overall, I found Tales From Dome Under to be an enjoyable read, and I recommend it. In fact, I'm considering donating my copy to the planetarium for our part-time console operators to read.

Now, where did I put that old bottle of red opaque?

## CHILDREN'S BOOK REVIEWS

By Francine Jackson



#### **Exploring Space: Black Holes**

by Joel Green, 2023, Norwood House Press, Juvenile, \$26.60, Ages 8-12

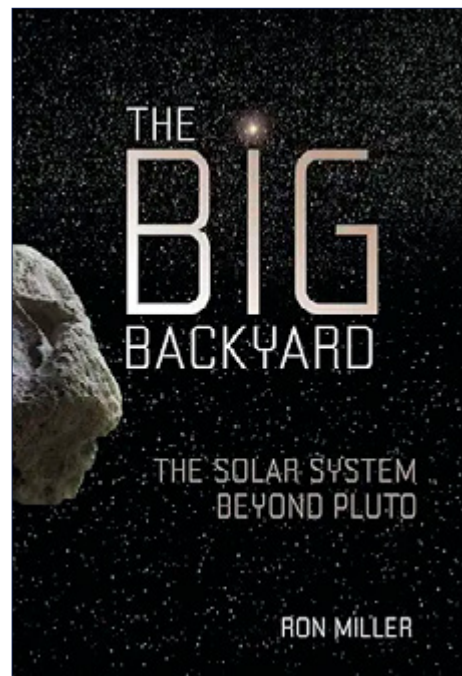
Ask anyone what subject they want to learn about in astronomy, and chances are the answer will be black holes. This book, in only 48 pages, tells the reader almost anything they would want to learn about them: Places in the sky where some can be found, why they form, and how they were discovered. Even the 'why' of their existence is covered.

A problem, though, has to do with the layout of this book. The concept of gravity, necessary to discuss black holes, is the first topic of the book but it isn't explained why until several pages later. The idea behind black holes and how they were first thought of is a bit muddled. Plus, every paragraph is filled with so much information, it is hard to keep all the concepts in mind.

The writing is good, and the author is an astrophysicist who works with the Hubble Space Telescope. However, he apparently wanted to put everything about the topic in a small, child-sized book. If a child picked up this book, it could prove to be too difficult to read, and the child would want to ask an adult to help understand. The information is correct, up to date, and thorough, but there doesn't appear to be a smooth transition as to the subject matter for the audience level this book apparently is directed to serve. An adult would definitely find this book an interesting,



informative read. Perhaps, after reading it, the adult will find the topic worthwhile to impart the information to a young audience.



### The Big Backyard: The Solar System Beyond Pluto

by Ron Miller, 2023, Twenty-First Century Books, Young Adult, \$37.32, Ages 12-17

For many people, one of the hardest changes in science occurred in 2006 when the planet Pluto was demoted, becoming the largest of a new class of solar system objects, dwarf planets. Today, there are still some who believe Pluto got short shrift on this decision, but, regardless, Pluto, and its neighbors, are objects that are worthy of study.

The author introduces the solar system with its rough beginning, apparently as a result of the collapse of a giant cloud about 4.8 billion years ago. About 4.5 billion years, our Sun was formed, followed by the other bodies that began circling around it. Early observers could only resolve five wandering objects: the naked-eye planets, the Sun, and the Moon. The invention of the telescope expanded discoveries, including the outer planets Uranus, Neptune, and Pluto. From there, we are introduced to the vast selection of objects within the Kuiper

belt, a region similar to our asteroid belt but containing objects much more diverse, including varied dwarf planets and comets of all shapes and sizes. We then travel even further to the Oort cloud, a region containing possibly billions of proto comets so far away from our Sun that some at the outskirts are also affected by the gravitation of some close stars.

The author even mentions one of the most puzzling objects ever to be observed: Oumuamua. Today, astronomers are still stumped as to what it was.

This author is very well-known in astronomical circles. As he has written over 70 books, many of which he has illustrated. The reader can be assured that this book is not only informative, but interesting and beautiful. For anyone wanting to learn about our solar system, this is definitely the book to read.



### Light Speaks

by Christine Layton, illustrated by Luciana Navarro Powell, 2022, Tilbury House Publishers, Juvenile, \$18.95

This short, beautifully illustrated book should be in every library and home. Not only is each picture described in detail, but this book also makes the reader think about the reason each image was chosen.

The study of light is necessary to understand the concepts of what we see in the sky, and how the universe began. It can act as a comfort in the dark of night. It can also be a source of entertainment.

But the author also speaks of “bad” light: the fury of a lightning storm;

the “lies” sea turtles are given when attempting to take their first steps into the sea.

An unusual part of this book is that, at its end, the author goes into an explanation of every page. She compares light with sound, and their differences in speed. She explains the need for light to research celestial mysteries and she states the sadness of losing many sea turtles because of misguided lighting.

In addition, there is a section on light pollution and its effects on our appreciation of the sky, with a note on an organization working to decrease over-lighting in today’s world.

As light is all around us, this book should be with you all as an eye-opening look at how light does, indeed, speak to all of us.

### The Big Dance (con’t.)

October 14, 2023. However, we plan to add more opportunities. Our goal is that maybe food truck and coffee truck vendors will participate. A variety of crafts, like making solar bead necklaces and bracelets, eclipse coloring sheets, corona chalk art, etc. are planned for inside the lobby area along with outside observing stations. The eclipse will once again be streamed in the dome and on lobby TVs. Specific planetarium show times will be planned. Three different planetarium shows will be used throughout the day- Totality!, Totality- Explore the Wonders of Eclipses, and Light’s Out! Eclipses- Whys, Wonders, and Wows. Overall, visitors on this day will be offered a variety of opportunities to experience the eclipse outside totality’s path. We truly hope the April 8 eclipse is a memorable experience for all, no matter where (or how!) it is viewed.

# SCS

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## SEEKING WHAT WORKS: WORKING WITH YOUNG AUDIENCES: 3-7-YEAR-OLD CHILDREN

Planetariums are usually seen as places of higher learning, where one goes to unlock the mysteries of the universe. One does not typically think that a planetarium would be the favorite spot of a 3-year-old. However, it is possible! Many planetariums are situated on college campuses or alongside museums. The Schuele Planetarium at Lake Erie Nature & Science Center in Bay Village, Ohio is attached to preschool classrooms. Our facility has five different preschool classes, three of which are in session on any given day, and our main audience in the planetarium is young children and their families. We do not show pre-recorded children's films very often, and we do not do story time in our dome either. We pride ourselves on live, interactive programming for all ages, and our most popular show with the most repeat visitors is for 3-7-year-old children and their families.

Our public show, called Stellar Stars, started many years ago and has gone through several iterations. The current format, and the one that has been working for us for the last 9 years, is a 25-minute show. We find that any longer than that and our young audience members tend to get wiggly and lose focus. The first ten minutes of the show are always the same. We get them used to the planetarium dome and the fact that interesting things are going to happen up instead of in front of us, and we get used to following the laser pointer around with some silly 'follow the dot' movements. The show always starts out with the same view on the dome, a moving model of the solar system. The presenter then identifies the parts of the solar system with the children's help: sun, planet orbits, and Earth's location. Then it is time for the blast off. Since it is a pretend blast off, we must first buckle our pretend seat belts and put on our pretend space helmets to get the children actively

involved. We really emphasize the fact that this is pretend, as some children who are new to the planetarium experience actually think that we will be blasting off to space and they get very overwhelmed and start to panic. After an enthusiastic countdown from 10, we set the digital system to fly us to the planet of the day.

The key to this show, and why we have so many repeat visitors, is that we only talk about a single planet in each show. We repeat the same show 4 times a week and move through the solar system over a 12-week, rotating schedule (Sun, 8 planets, asteroids, dwarf planets, and comets). Our planet fact statements are very simple and usually compare things to what the children already know. Common talking points are, 'is it bigger or smaller than Earth?' 'Is it made out of rock like the Earth or is it different?' 'Is it colder, or hotter than the Earth?' 'Could we live there?' 'What would we need to take with us to explore the planet?' 'Can we send robots there instead?'

Along with digital models of the planets, we show current images from active and past space missions and keep up to date with the newest discoveries. We have found that by showing many images in a variety of different locations around the dome keeps kids engaged and looking around themselves instead of just staring straight ahead. In the past, when we had presentations where all the images were located in the front of the dome and we showed them one at a time, similar to a slide presentation, children got very fidgety and were getting out of their seats. Now, we will put a spread of images across the dome with a similar theme (craters on Mercury, for example). Or we will put up two totally different images. For example, in the Mars show we put up a photo of Olympus Mons and Mariner Valley and ask the children to point to the picture that looks like a mountain or volcano. By giving them two images

to decide from, and asking them to turn and look around, the kids are actively thinking and moving.

Sometimes there can be too much extra talking during the show. At those points, asking children to point and follow a last pointer, or to say the name of an object or feature, tends to get everyone back on track. During these moments of 'repeat after me' or 'point to an object,' we find it is not just the kids participating, usually all the adults are doing it, too. When we notice that there is extra movement, or other nonverbal cues from the kids, we simply switch topics. If kids were wiggling because we were talking about the rocks on Venus, usually they stop when we show images of real robots that landed there. By changing topics, we keep the conversation moving, and if kids don't like one topic, we won't linger there too long. Staff are never discouraged if they don't get to share all their Saturn atmospheric information when there is so much more to explore. We usually spend only about 10 minutes talking about the planet/object of the day before moving on.


After we learn all about the planet of the day, we head home and learn about the constellation of the day. We always tell age-appropriate constellation stories. Most of the stories shared in our dome are rooted in their original mythology but edited for content and made appropriate for all ages. For Stellar Stars, the goal of the constellation of the day is to introduce them to as many different constellations as possible. We have other shows for older age ranges, and the constellation of the day for them is something that they actually have a chance of seeing in their night sky.

Something that we noticed really helps families be prepared for our shows is to have clear communication as to what our show actually is. Frequently,

our ticket sales staff will hear parents ask their children if they want to see "the space movie." Our staff will politely inform them that the show is not a movie, and instead a teacher is going to show all sorts of cool stuff about one planet today, and then they get to hear a story. We noticed that listening in to conversations and politely correcting families as to what the show will be like helps them decide if they want to buy tickets or not. The last thing we want is for kids or parents to be disappointed with what they are seeing. Our online ticket sales section has a little more explanation of the show, however, families that buy tickets online are often the ones that are disappointed with what they are seeing, so there

is some benefit to having that live person at the ticket counter explain what the show is.

For our audiences, having weekly different topics, having kids move their head and arms, and changing subjects frequently during the show seems to captivate the 3-7-year-olds. We have, on average, 10,000 people come through our doors each year, and last year we had 30 families attend all 12 Stellar Stars shows. Kids love the planets, and they love stories, so putting both together in a show makes sense for a planetarium that serves many young kids.



# PLANETARIUM EDUCATION


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# PLANETARIUM EDUCATION

## 100 TIPS FOR TEACHING IN A PLANETARIUM

*Second installment of a six-part series*

**Compiled and created by Ken Brandt,  
Co-Chair, IPS Education Committee**

“Reach me down my Tycho Brahe...” begins Sarah Williams’ poem, *The Old Astronomer to His Pupil*. The astronomer imparts some deathbed advice to his pupil, as time is short, and “Venus looks like ruddy Mars.” We will all probably find ourselves in the old astronomer’s boots someday, though perhaps less dramatically. Do you have wisdom that you want your students, staff, or mentees to have, even if they remember nothing else?

My colleagues and I are presenting in this series some ideas for a list of 100 of the best practices for teaching in the dome, in concert with and supporting the centennial of the planetarium. This edition features the second seventeen tips that concern gaining audience knowledge and checking for understanding.

How much you care about this segment is directly related to how interactive you are with your audience. For those of us who do interact a great deal with your audiences, read on! For us, it is useful to understand the functionality of our audience and what cognitive level are they expected to operate at? Are they capable of upper-level reasoning? To an extent, I have an unfair advantage in this endeavor with my school-aged audiences, since I know beforehand what grade level is visiting when, so I have a rough idea of where they “ought to be.” How I answer the question, “What is a black hole?” for example, definitely involves their level of cognition.

One of the ideas from *Setup and First Pitch*, a piece published in September, carries over to this segment, since it represents a significant hurdle to gaining knowledge about your audience. Ridky’s *The Mystique of the Planetarium* suggests that we should familiarize the audience with the layout and function of the special equipment

in the room, as fascination with it can impede learning under the dome. This especially applies to a big, beautiful, and complicated optomechanical projector (the elephant) in the middle of the room. It can also apply to the awesome sound system, or be as simple as the comfortable seat they’re in. If they are in awe over where they are at, they are not going to communicate as effectively with you.

One technique I have begun to use is that I have students write down questions prior to their arrival on 3x5 cards, or something similar. This accomplishes several things, which will be laid out more formally in a future article for *The Planetarian*. I’m finding that this technique seems to open the floor for increased question-asking during the Q&A sessions sprinkled throughout the presentation. By allowing students to remain anonymous as I read a few of their handwritten questions as I’m opening the program, their subsequent interaction increases markedly. I’ve noticed a significant difference in the level and depth of interaction with audiences who have done as I asked, versus those audiences who didn’t.

In terms of our current discussion herein, however, these written questions also let me know what they’re curious about, which is a side door into gaining understanding of where they are at as an audience. It also informs the content and depth of my questions for them as we go through the program.

Since I know the theme of a given program, such as Mars exploration, I sometimes open my program with the open-ended question; “So, what do you already know about Mars?” I can gauge the general level of interactivity I can expect, and I can see if the teacher has prepared them for the planetarium lesson ahead.

Once I’ve gotten a general idea, I always aim high. Ask questions and offer content that is slightly beyond what they came in the door understanding.

And now, the suggestions brought by fellow Education committee members, and those who responded with feedback to my posting on dome-L, and at various recent conferences where the “100 Tips” idea was presented, to include Stars for All in June.

- “Start with the familiar.” Of course, knowing where your audience is helps guide this idea.
- “It’s possible for one child to put their hand up and give a perfect answer while none of their classmates understand anything at all.” Your impression of where the audience in general is at may be skewed by this one brilliant student.

One way I gauge the level at this point is to ask if other students can tell me why the answer given was correct. If that’s repeatedly the case, I am probably dealing with the academically gifted cluster within that school’s grade band that is visiting on a given day and adjust my questioning style accordingly.

- “Give people an overview before specific concepts are addressed.” Sometimes, there are particular concepts that you want to make sure you’ve gotten across, such as “most motion of objects in the sky is caused by the rotation of Earth.” In a case like this, “a general rule of thumb is that people need to encounter (and understand) new concepts about three times in different contexts before they will move them into their long-term memory. Repetition is good!”
- “The more people practice recalling something, the better they will remember it in the long term. Especially if there are good gaps between learning and recall.”
- “Think about the prior knowledge someone will need to understand a new concept. Check that everyone has that knowledge!”

*(Continued on pg. 72)*

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# INTERNATIONAL PLANETARIUM'S CALENDAR

COMPILED BY: LORIS RAMPONI

## 2024

- **13th January.** 4th Worldwide Meeting online dedicated to traveling planetariums and in particular to operators, producers and sellers. Begin at 02:00 PM Universal Time UTC  
Contact: Susan Button, sbuttonq2c@gmail.com, Marco Avalos Dittel, info@planetarioaventura.com <http://www.ips-planetarium.org/>
- **19-21 February.** Japan Planetarium Association (JPA), Annual Workshop, Cosmo Planetarium Shibuya, Tokyo, Japan.  
Contact: Misa Ichikawa, ichimisa0518@yahoo.co.jp <https://planetarium.jp>
- **21st February.** Deadline of the Stipends Application for IPS 2024 conference registration. The stipends cover full conference registration for IPS members whose circumstances make it otherwise difficult or impossible to attend. Applications will be initially reviewed by the International Development Committee, and this will be followed by a final decision from the IPS Officers. Stipend information will be updated at page <https://www.ips-planetarium.org/page/stipends>  
<https://www.ips-planetarium.org/page/StipendApplication>  
Contact: martingearge3@hotmail.com.
- **31 March.** Deadline of PLANit Prize for an original video production, organized each year by Italian Association of Planetaria (PLANit), Italy. The prize is open to everyone. First prize 500 euro.  
Contact: [segreteria@planetari.org](mailto:segreteria@planetari.org) [www.planetari.org](http://www.planetari.org)

- **8 April.** Total Solar Eclipse (Mexico, USA and Canada). <https://eclipse.aas.org/eclipse-america-2024>
- **26-27 April.** WIMPS Spring 2024 Meeting, Paulucci Planetarium, Hibbing, Minnesota (USA) that involve planetariums from Wisconsin, Iowa, Minnesota Planetarium Society.  
Contact: Kevin Milani, kevin.milani@outlook.com
- **26-28 April.** Italian Association of Planetaria (PLANit), Padova Planetarium, National Conference of Associazione dei Planetari Italiani.  
Contact: [segreteria@planetari.org](mailto:segreteria@planetari.org); Dario Tiveron, [dario@fdbb.org](mailto:dario@fdbb.org) [www.planetari.org](http://www.planetari.org)
- **7 May.** International Day of Planetariums, 99th birthday of Centennial of the Planetarium <https://planetarium100.org> [ips-planetarium.site-ym.com/?page=IDP](https://ips-planetarium.site-ym.com/?page=IDP)
- **7 May.** Astronomy Day. Astronomy Day is a world-wide event designed to celebrate all facets of astronomy. <https://www.astroleague.org/astronomyday/news>
- **18 May.** International Museums Day, <http://icom.museum>
- **4-6 June.** 9th Fulldome Festival Brno. It will again offer its visitors with the newest content on the fulldome market from all around the world, Brno Observatory and Planetarium, Brno, Czech Republic  
[fulldomefestivalbrno.com](http://fulldomefestivalbrno.com)  
Contact: [director@fulldomefestivalbrno.com](mailto:director@fulldomefestivalbrno.com)
- **5-8 June.** European Network

Science Centres & Museums (ECSITE), Annual Conference, Kersnikova Institute, Ljubljana, Slovenia.  
<https://www.ecsite.eu/conference>

- **30 June.** Asteroid Day. <https://asteroidday.org/>
- **21st July.** Gesellschaft Deutschsprachiger Planetarien e.V., (GDP), Annual Conference of the Society of German-Speaking Planetaria, Berlin.  
Contact: [bjoern.voss@lwl.org](mailto:bjoern.voss@lwl.org) [www.gdp-planetarium.org](http://www.gdp-planetarium.org)

### 27th International Planetarium Society Conference, Berlin-Jena, Germany.

- **17-21 July.** Pre-Conference Activities (Fulldome Festival, IMERSA Day, and LIPS Day).
- **21-25 July.** IPS Conference.
- **26-28 July.** Post-Conference Tours.  
Contact: [ips2024@planetarium.berlin](mailto:ips2024@planetarium.berlin) <https://www.planetarium.berlin/ips2024>
- **31 July.** Deadline for applications for "Two weeks in Italy" organized, with the support of International Planetarium Society, by PLANit in collaboration with IPS Portable Planetarium Committee and Serafino Zani Astronomical Observatory.  
Contact: Susan Reynolds Button, [sbuttonq2c@gmail.com](mailto:sbuttonq2c@gmail.com) <http://www.ips-planetarium.org/>
- **31 December.** Deadline for the contest "A week in United States" For information and application requirements go to: [www.ips-planetarium.org/?page=WeekinUS](http://www.ips-planetarium.org/?page=WeekinUS)
- **31 December.** Deadline of the prize "Page of stars" organized

(Continued on pg. 68)

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# IPS 2023 BOARD MEETING NOTES

## Board Meeting Official Minutes

17-18 June 2023 | Kingsport, Tennessee, USA

Derek Demeter, Executive Secretary

**Officers in Attendance**

Michael McConville (President), Mike Smail (Treasurer), Shannon Schmoll (President-Elect), Kaoru Kimura (Past-President), Derek Demeter (Executive-Secretary), P. Hicks (Director of Operations)

## Board Members in Attendance

Jin Zhu (Asia), Sumito Hirota (Asia), Björn Voss (Europe), Anna Green (Europe), Michele Wistisen (North America), Patty Seaton (North America), Susan Murabana Owens (Africa), Oana Jones (Oceania).

## Standing Committees in Attendance:

Eric Edleman (Equity, Diversity, Inclusion)

## Standing Committees via ZOOM:

Manos Kitsonas (Awards), Martin George (Election)

## Task Force in Attendance:

Björn Voss (Centennial)

## Guests:

Bid delegates from U.S. Space and Rocket Center (Huntsville, USA), National Astronomical Research Institute [NARIT] of Thailand (Chiang Mai, Thailand), and Fukuoka City Science Museum (Fukuoka, Japan).

## Day One: 17 June 2023

- 1. Call to Order:** Meeting called to order at 13:13 UTC
- Welcome and Introductions: M. McConville welcomed everyone to the first day of a two day board meeting and thanked officers, board members, and conference bidders for traveling far and wide to the meeting.
- 2. IPS 2026 Conference Host Final Bids**
- a. U.S. Space & Rocket Center (Huntsville, USA): Total capacity for the conference is 750 people. Proposed dates for conference are Wednesday September 30 thru October 4, 2026. Justification for the dates selected is that it is an optimal time due to limited activities going on at the center. Conference spaces include the Space Camp Operations Center, which can seat 850 people. Vendor hall would be held in the Davidson Center for Space Exploration during the first two days. Intuitive Planetarium can seat 250 people. Mid-week trips to various locations have been proposed. Conference

hosts want to minimize delegate breakout sessions and try to get everyone together as much as possible. Suggestion to have an Artemis astronaut as one of the keynote speakers. Conference would be hosted on the entire campus with all buildings within a short walking distance. Transportation shuttle loop provides wheelchair accessibility. The U.S. Space and Rocket Center is a 15-minute drive from the airport. Hotel options are within 3 miles of Rocket Center. They will offer budget lodging at their Space Camp habitat on campus. Childcare is offered and children are allowed to participate in Space Camp during the conference. Cost to host the conference is estimated at \$789,475 and based on 750 attendees. Delegate registration is estimated at a range of \$375 to \$475 for IPS members and \$475 to \$650 for IPS non-members. Rocket Center is a state entity and is tax exempted.

- b. National Astronomical Research Institute [NARIT] of Thailand (Chiang Mai): Conference dates proposed from July 27-31, 2026. Registration Fee is estimated around \$300-600. Coffee breaks 2 per day for 5 days. Conference venues are within 12 km from the airport. NARIT has a 160 seat Planetarium. Planetarium operates on an in-house fulldome digital system designed by NARIT staff. There will be two conference venues: The Empress Convention Center and Princess Sirindhor AstroPark. Over 57 countries exempt visas to travel to Thailand making it a safe and easy destination. Hotels are available within 5 km from the conference and range from \$20 to \$300. Lots of pre and post conference trips can be arranged. Conference hosts want to also be very sustainable as well and as carbon neutral as possible. Chiang Mai is a very LGBTQIA+ friendly and safe city. A DIY Make Your Own Cardboard Planetarium workshop was proposed during the conference as well.
- c. Fukuoka City Science Museum (Japan): Science Museum boasts a 25 m dome theater with 220 seats, Konica Minolta Projector and Mediaglobe system. There are several science classrooms and activity spaces available. Science center also has a 300-seat auditorium with a 300-inch screen. Full conference dates are proposed to be June 11- 20, 2026. Fulldome Film Festival will proceed from June 11-12, 2026, with the main portion of the conference from June 15-19, 2026. Post conference tours held June 20, 2026. Fukuoka City Science Museum and Hakata International Exhibition Hall and Conference Hall are two primary venues. Conference hall includes 16 meeting rooms of various sizes, Double 3,000 m halls will be used for the vendor hall space. Airport accessible within a 5-minute subway ride to Science Center and a 10-minute walk to Conference Center. Public transportation fully available to all locations. Accommodations range from \$60 to \$200. No visa needed for 69 countries. Childcare is available during

the conference. LGBTQIA+ friendly. Virtual programs will be available during the conference.

**3. Question Session from Board to Bidders:** Below are the questions board members presented to each conference bidder. Questions are not site specific but addressed to all bidders.

**Question 1:** Can you provide a more detailed breakdown of travel time and accessibility (shuttles, transport options, etc.) for delegates to attend all the conference activities?

**Question 2:** How will conference hosts provide a safe environment for delegates and visitors who are LGBTQIA+ and other marginalized groups?

**Question 3:** What funding opportunities are there for emerging communities?

**Question 4:** What will the conference provide for the future of IPS and its members?

**Question 5:** How will you support attendees who are hearing and visually impaired, or have language barriers?

**Question 6:** Will there be any sensory rooms (quiet spaces) available?

**Question 7:** Will Vendors be able to set up equipment and what space will be available for vendors?

**Question 8:** Will you provide space for exterior domes?

**Question 9:** What level of accommodations for dietary restrictions will be available during the conference and how will it be addressed?

**Question 10:** What will the conference host do to make the conference sustainable and to what level will the host provide for attendees to attend virtually?

**Question 11:** Would hosts need IPS external funding for streaming conference activities?

**Question 12:** What networking opportunities will be available both in-person and virtually?

**Question 13:** Who will you be approaching to be a part of your Local Organizing Committee, and will you make the decisions to ensure a diverse committee?

**Question 14:** What do you hope having the IPS conference will benefit for your region?

**4. Closed Board Discussion:** No minutes reported during this closed session.

## 5. Lunch with Conference Bidders

## 6. Officer Reports

a. Secretary’s Report (Derek Demeter): Minutes from the last two annual board meetings were not submitted and need to be and approved. D. Demeter will work with past executive secretary, P. Seaton, on getting these minutes completed and submitted. Secretarial documents, including IPS Standing Rules, will also be transferred to D. Demeter.

- b. Treasurer’s Report (Mike Smail): Full Treasurer’s Report
1. End-of-the-Year 2023 Highlights:

1. Total Member Dues Income: \$32,692.00
2. Total Donations: \$135.00
3. Total Income: \$86,445.01
4. Total Cost of Member Services: \$40,629.4
5. Income – Sales = Gross Gain/Loss: \$45,815.60
6. Total Administrative Expenses: \$68,396.56
7. Gross Gain – Admin Expenses = Net Gain/ Loss: -\$22,580.96
8. Total Assets: \$202,369.37
9. Total Equity: \$202,369.37

## III. Mid-Year 2023 Highlights:

1. Total Member Dues Income: \$18,805.00
2. Total Donations: \$250.00
3. Total Income: \$79,352.71
4. Total Planetarian Expenses: \$7,955.53
5. Total Cost of Member Services: \$10,609.05
6. Income – Sales = Gross Gain/Loss: \$68,743.66
7. Total Administrative Expenses: \$45,125.40
8. Gross Gain – Admin Expenses = Net Gain/ Loss: \$23,618.26
9. Total Assets: \$225,987.98
10. Total Equity: \$225,987.98

## III. Proposed Budget for 2024:

1. Total Estimated Income: \$138,400
2. Total Cost Of Sales: \$43,000
3. Total Admin Expenses: \$59,600
4. Total Income - Total Expenses = Net Profit: \$35,800

c. Past President’s Report (Kaoru Kimura): International Festival of Science Visualization was held on 18-20 February 2023. The Asia-Pacific Regional IAU Meeting will be held on 7-11 August 2023. JPA will have a booth and IPS brochures will be distributed. The planetarium of Tokyo University of Marine Science and Technology has been registered as an important science and technology history material of the Industrial Technology History Information Center. It was the first planetarium built in Japan. Several posters and exhibitions will be created for the centennial celebration which will also include a pre-event before the official opening ceremony in Germany. Collaboration exist with historical observatories, including Lowell Observatory in Flagstaff Arizona, USA and Yerkes Observatory in Williams Bay, Wisconsin, USA. Full report.

- d. President’s Report (Michael McConville):
- 7. IPS 2024 Conference Update (A. Green):** New conference dates have been selected and the conference will be held from 17-21 July 2024. Preconference tours will be available plus



a fulldome festival, IMERSA, IPS Board Meeting, LIPS, and GDP. Conference will take place on 21-25 July, 2024. Arena Berlin conference center has been booked. Over 700 people can fit in the main stage area. Several large portable domes are available in the conference center. Mid conference tours are still being determined. Haus Zena will be where the Gala takes place. Nearby observatory will be the site for the afterparty. Post conference tours are still being determined as well. Registration costs estimated from 250 euro to 600 euro. Hotel costs range from 105 euro to 300 euro. Current budget for the conference is 875,359.15 euro which includes VAT. Concerns have been brought up about traveling around the city. Shuttles will be provided with limited mobility and setup will work well with public transportation.

8. Special Project Reports

- a. EDI Financial Equity Survey: Eric Edelman provided a report of the survey results. Data and presentation will be available soon and be shared to general IPS membership. Survey will be available throughout the Stars for All Planetarium conference. Full Report.
- b. Centennial of the Planetarium (Björn Voss): The centennial will be celebrated from October 2023 thru 2025. The Centennial show trailer has been translated to many languages. Premier will be 21 October 2023 and will be free for all planetariums. An accompanying package, which includes teaching materials and an additional history show, will be offered with a small fee. Anniversary book, “100 Years in 100 Objects,” planned to be released on 21 October 2023. Opening ceremony will occur on 21 October 2023 in both Munich and Jena. Keynote speaker by ESA astronaut and/or Artemis astronaut. Other participants are being considered. A traveling exhibition is being developed and will be unveiled around the time of the opening ceremonies. A poster exhibition has been created by Guilherme Marranghello and can be printed by downloading it from the Centennial website (<https://planetarium100.org>). Poster is available in EN, ES, FR, DE, PT. Centennial committee is looking for participants for the Art and Design contest. Winners will be selected by an IPS-nominated jury. Winners will be presenting in the opening ceremony. 31 submissions were collected for the Local Project grants contest. 16 winners were selected by an IPS jury in spring. Winners will publish their projects on the website. A planetarium emoji is being created and is expected to be completed in 2024. An official postage stamp was created in Germany and will be published on 18 October 2023. Dr. Jim Tarter has accepted to serve as ambassador of the Centennial. A UNESCO heritage status was accepted at the German state level in 2022. Domecast programs will be presented throughout the two-year celebration as well as other projects. Grand finale program slated for 7 May 2025. Full Report.
- c. Pink Floyd’s The Dark Side of the Moon Fulldome Show (Mike Smail): First public screening was on 24 March 2023. Pink Floyd approved license and fee structure

through 31 December 2024. There are 16 worldwide distributors and currently showing in 42 planetariums around the world. Q1 Revenue was \$20,500 with forecasted revenue in Q2 at \$139,600. Forecasted expenses is \$118,660 which will go to Pink Floyd and forecasted profit for IPS is expected to be \$23,727. Quarterly tracking will continue through Q1 2025. Full Report.

- d. Education Fellowship Grants (Shannon Schmoll): Application timeline was presented. Round one application due on 15 March 2024 and winners will be notified on 29 March 2024 for advancement to round two. 26 April 2024 is the round two application and 10 May 2024 is when funds are awarded. \$5,000 awarded directly to the Principal Investigator with no overhead. Grant Period is one year with the earliest date of 1 July 2024. Primary focus for the fellowship on research on planetariums as an educational value. Expectation is that the fellowship holder must be an IPS member for the duration of the project. In one year of the project that the recipient submits to The Planetarian. Fellowship Documents.

**9. Board Highlights from Affiliates:** Due to time limit, M. McConville proposed to move the highlights to Sunday to give more time for reports. Anna Green motioned, Patty Seaton seconded, all in favor to move this to Sunday afternoon.

**10. Day Wrap & Adjournment:** M. Smail motions to adjourn the meeting. K. Kimura seconded. All in favor. Meeting adjourned at 21:28 pm UTC.

Day Two: 18 June 2023

Officers in Attendance: Michael McConville (President), Mike Smail (Treasurer), Shannon Schmoll (President-Elect), Kaoru Kimura (Past-President), Derek Demeter (Executive-Secretary), P. Hicks (Director of Operations)

Board Members in Attendance: Jin Zhu (Asia), Sumito Hirota (Asia), Björn Voss (Europe), Anna Green (Europe), Michele Wistisen (North America), Patty Seaton (North America), Susan Murabana Owens (Africa), Oana Jones (Oceania).

Ad-Hoc Committees via ZOOM: Jenny Shipway (Education), Charles Morrow (Immersive Sound), Martin George (International Development), Ian McLennan (Planetarium Design and Operations), Susan Button (Portable Planetarium)

**11. Call to Order:** Meeting was called to order at 13:34 UTC

**12. Board Discussion of 2026 Conference Final Bids and Final Vote:** Closed discussion. Vote called at 14:32 UTC. Additional ballots were discarded at 14:35 UTC. All votes unanimous with one abstention. Vote carries to Fukuoka, Japan.

**13. Conference 2026 Selection Announcement to Bidders:** M. McConville addressed the bidders on the results of the vote. IPS officers and board thanked the bidders for all their work and noted how difficult it was to decide the vote.

14. Committee Reports (virtual and in-person)

- a. Elections (via Zoom): 23-30% membership voted in past elections. Committee will like to work on strategies to improve membership participation in elections. Committee will put together an article for the December planetarian on governance.
- b. International Development (via Zoom): Laos about to open their first planetarium. IPS funds have been added to the “A Week in a Country program.” Request to raise funds for “A Week in Italy” program to match the other two programs to \$1,000 for each awardee from \$500.
- c. Portable Planetarium (via Zoom): Patent for the original Starlab was released to the committee to help with the “DIY Build Your Own Portable Planetarium.” This patent is public domain. Suggestion to release the patent as a historical record and connect it with the Centennial celebration. Request was made to use the IPS ZOOM account for the committee meetings. A user account was suggested to be added. ACTION: Investigate adding a user account for the main IPS ZOOM account.
- d. Awards (via Zoom): Updated 2024 conference host on number of awards, which include awards for 2020 and 2022, including EDI award and gold and silver medal awards. Previous glass trophies used in the IPS conference will no longer be created by current vendors after the 2024 awards ceremony and new manufacture will need to be considered. It was suggested to manufacture the awards in the USA. O. Jones mentioned she could help in the production of the award trophies and medals. Discussion for nominations for award nomination be discussed by board only. Move to accept the nomination for IPS Fellow. M. McConville motioned. A. Green seconded. Motion carries all in favor. IPS service award moved to accept the nomination. M. Wistisen motions to approve nomination, S. Schmoll seconded. Motion carries all in favor.
- e. Equity, Diversity, and Inclusion: No meeting report but report submitted to IPS Google drive. An EDI panel will be presented at the Stars For All National Conference.
- f. Education: New email and google drive is now available for the committee. Recruit more diverse nationalities to the committee. Committee would like to start a new article called “100 Tips for 100 Years” in honor of the centennial. Update “Values of the Planetarium” in the education document. Publish a list of research projects that will be translated in multiple languages.
- g. Membership: There is currently no chair for this committee. M. McConville tasked the board to consider someone for this position.
- h. Publications: Suggestion for The Planetarian be delayed by one week for officers to review the publication for changes that have been requested but ignored.
- i. Immersive Audio: Meeting twice a month now. New email account has been created for the committee. It

was suggested that music performances be added to the Centennial celebration. Committee asked to provide suggestions from the membership.

j. History: Report submitted.

k. History of the Planetarium Working Group: Report submitted.

l. Planetarium Design and Operations: There has been a low level of activity in the committee. Suggestion was made to re-consider the committee to act as an informal group or task force when needed.

**15. Lunch:** We had lunch, it was good.

16. Board Highlights from Affiliates

- a. North American: Received reports from GPPA and MAPS.
- b. Latin America: No report.
- c. Europe: Eight report submissions received. ESA will not sign a MOU but will provide a letter of intent to plan activities with them. Event was held on May 7th for the JUICE mission. There are plans to host another ESA event for the EUCLID mission sometime in 2024.
- d. Asia: Two planetariums closed in March 2023. JPA is hosting several events for the planetarium Centennial. Annual JPA meeting was held in mid-June. The National Chinese conference will be held next year alongside the Centennial. New planetariums want to be built in China but do not have people who understand how to build and design planetariums and would like IPS to assist in this area.
- e. Africa: Regional associations are improving throughout the continent to help build the planetarium community. Ethiopia has a large new planetarium. Ghana planetarium is now closed, and a solution is being figured out. There are needs for free resources, training, and collaborations needed to help grow the community. There is a desire to build sustainable domes that will reduce their carbon footprint. There is limited government support for planetariums in many African communities and they are looking for IPS to help find ways to solve this.
- f. Oceania: There has been a large turnover in management in many planetariums in the region. APRA/AMCOS (Australasian Performing Right Association and Australasian Mechanical Copyright Owners Society), is threatening planetariums for audio royalties. Integrating Hawaiian Planetarium Association into the Australoasian Planetarium Society was discussed.

17. Old Business

- a. President Report: I love you all.
- b. Past-President Report: Attended the International Festival of Science Viz from February 18-20 2023 and discussed the Centennial celebration. Will be attending



The Asia-Pacific Regional IAU meeting from August 7-11 2023. Will have an IPS booth and distribute IPS materials. M. McConville thanks Kaoru for all her work and he looks forward to sharing her award in Berlin in 2024.

18. New Business

- a. Distribution of IPS funding to sanctioned nations: Discussion was made on how funding can be provided to countries in need but since IPS is bound by USA laws, will follow sanctions and embargoes set forth by the US on countries regarding funding. IPS will also not support countries that do not follow IPS code of conduct policies.
- b. IPS Conflict-of-Interest Policy: Policy presented to the board. Board will review the policy and approval will be done at the next Board Meeting.
- c. IPS bylaws and standing rules matters: Be revised and submitted by September 1, 2023 for board approval. This will include an amendment to elevate the Education committee to a standing committee.

19. For the Good of the Order: None

20. Adjournment: 20:11 UTC

Calendar (con't.)

by IPS Portable Planetarium Committee in collaboration with Serafino Zani Astronomical Observatory.  
Contact: Susan Reynolds Button, [sbuttonq2c@gmail.com](mailto:sbuttonq2c@gmail.com)  
<http://www.ips-planetarium.org/?page=pagesofstars>

2025

7 May. International Day of Planetariums, 100th birthday of Centennial of the Planetarium <https://planetarium100.org>  
[ips-planetarium.site-ym.com/?page=IDP](https://ips-planetarium.site-ym.com/?page=IDP)

Tales from Dome Under (con't.)



Picture 4: Interior Kakspi allsky of the large dome inside Stjerneborg. The condition of the foreground gives an idea about how the rest of the underground observatory looked at the time. The hole visible in the front center is not Brahe's secret well, which was on the opposite side of the room, and behind this camera location. Source: the author



Picture 5: A modern view of Stjerneborg, which includes the door, open on this day, leading to the stairs going underground to where Tycho's observing instruments were located. The largest dome, whose interior is shown in Picture 4, is seen in the center. Source: Public domain.

One thing we immediately realized was that we had an extremely unique opportunity. No one had ever done anything like this before, and we were using an extremely unique camera and format to document it.

We set about shooting both the general underground scene as well as focusing on certain areas where the downcast light from the windows made for even better photos. One that particularly sticks out to me even today was taken looking toward the largest dome. It arches overhead, while below it is a large, walled structure that's about waist high. I later used this same shot in a live lightshow I produced in November 2009 with the Swedish ambient music group, Carbon Based Lifeforms.

After watching Matti take some shots, which included using a hand-held light meter to figure out the exposures with the camera, we switched places, and I operated it as part of my training experience.

Something we had to be really careful of was not accidentally getting in the photographs ourselves. The fisheye lens on the Kakspi camera was the same as the projectors in the theater and covered a field-of-view of 180°X360° (vertically X horizontally).

Since our dome was tilted by 30°, we had to be sure that the tripod was tilted the same amount so the real scene view and the one on the dome would match. I don't know if you've ever been in a dome trying to show something that has a horizon not matching the theater's, but it can be pretty strange looking.

This tilting of the tripod by 30° also afforded us the ability to hide behind the tripod, and as long as we crouched down while an actual photo was being taken, it was no problem. Had we had a conventional, non-tilted dome, we would have had to lay under the camera's FOV; given the condition of Stjerneborg's floor, that was probably something best avoided.

We had been shooting for a while, keeping an eye on the time, but had been so busy that we hadn't noticed that it had started to rain outside. Or at least, not until some people showed up at the door and thought they would be able to come inside with us.

Unfortunately, they weren't allowed to do so as the groundskeeper specifically told us we shouldn't let anyone else in while we were down there. Which meant, in essence, we ended up being gatekeepers to the place, and they had to remain outside, taking shelter elsewhere as best they could. It didn't feel so good on our part, but

Mobile News Network (con't.)

And I learned that some manufacturers of children's "bouncy houses" also sell specialty items such as planetarium domes. After researching several, I selected a company called SayOK Inflatables. Their sales representative was easy to work with and explained their custom options. I went with a 6-meter black dome, which cost just under \$2,000 USD and arrived within a few weeks. So far it has been working quite well.

While I preferred the idea of a central fisheye projector, it quickly became clear that this would also be beyond my budget. Through the IPS website I discovered a document produced by the University of Washington in which they describe building a DIY projection box using a standard multimedia projector and a first-surface spherical mirror. Paul Bourke's excellent website, [paulbourke.net](http://paulbourke.net), helped me better understand the geometry of how this type of system works. Having had some woodworking experience, I decided

we had no choice in the matter. The museum was nice enough to let us do this, and we didn't want to go against their wishes for our having access.

By good fortune, the rain was stopping just as we were finishing. We brought all the gear up out of Stjerneborg, packed up the cart again, padlocked the door, brought the keys back over to the woman still behind the sales counter in the little museum, thanked them profusely, and went back 2km down the hill to catch the ferry back to Landskrona.

Arriving back at the train station, we settled in for the night trip back to Stockholm. After a quick stop in Cosmonova's location, the Swedish Museum of Natural History, for some breakfast, Matti headed off to the ferry terminal to catch one of the cruise ships going back and forth between the Swedish capital and Finland's: Helsinki.

After unloading all of the exposed 4"X5" sheet film from the dual-sided plate holders back into the light-tight

boxes they originally came in, I sent them off to the photo developers to have them processed. It seemed to take forever, but I received the finished 4"X5" transparencies a couple of days later.

Our expedition to Ven was a success. Everything came out fine, so there were some good shots to choose from for the show's section talking about Tycho Brahe and his naked-eye observations from his island-based observatory.

I continued to use the Kakspi plate camera, but I wouldn't be telling the truth if I didn't say that I appreciated when it's "baby brother" camera, which used 120-format roll film, came along. Far more portable and easier to deal with while traveling, I took it and 30 rolls of film on a 1999 photo expedition across the United States for a show I produced, which opened in 2001.

A unique camera, and a unique experience in a unique location - certainly one of the most unusual and special in my time spent under domes and artificial skies.

I could go this route. The spherical mirror (ordered from New Zealand) cost just under \$600 and is a flat first-surface mirror (to fold the light path for greater portability) that cost about \$100. The wood and hardware to build the projection box was about \$200. For a projector, I chose the 4K Optoma UHD38, which I found on sale for \$1,000. I already had a good laptop computer, and downloaded the free, open-source programs, Stellarium, and OpenSpace to use as presentation software. The image quality in the dome is quite good has elicited plenty of "oohs" and "aahs" from children and adults alike as they've learned about the wonders of the universe.

My company is called "Ad Astra Planetarium," after the Kansas state motto (Latin for "to the stars"). I did several shows for libraries and churches during summer 2023 and have already done a number of presentations for elementary schools this fall. At some point in the future, I hope to upgrade

to better quality equipment, but was pleased to discover that I could get underway as a portable planetarium for just under \$4,000 USD (not including the laptop computer). I hope my story might encourage others who are considering a portable planetarium but are intimidated by the initial costs. With a little research and creativity, it is indeed possible to become a portable planetarium on a budget! I'm happy to share further details with anyone who is interested; I can be contacted at [ron@aaplanetarium.com](mailto:ron@aaplanetarium.com). Ron's plans will be posted on the IPS Portable Planetarium Resource webpage.



## LIP Service (con't.)

afternoon of LIPS, the middle school held a fire drill during Michael McConville's presentation. Last year you may recall that we finished LIPS on an elementary school playground. This year we had sirens blaring during the last official session. I shudder to think what will happen during the last afternoon of LIPS 2024...

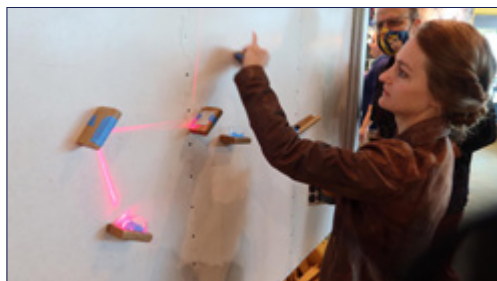
The other item I want to bring up in this column: LIPS is FINALLY becoming a registered non-profit with 501(c)3 status. We started exploring this possibility several years ago, but there was never time to go through the steps to make it official. As I type this, we're still waiting to get our tax identification number, but the process is well underway.

LIPS will have a five-person board. In the interest of efficiency, I reached out to people who had expressed interest in the past to see if they were interested in being on the board, and everyone said yes. The initial board members are:

- Myself as President
- Julie Tomé of the Royal Ontario Museum (Canada) as Secretary
- Mark Webb of GOTO, Inc. as Treasurer
- Brian Koehler of Mystic Seaport/Trewoy Planetarium as At Large Member 1. Brian's primary responsibility will be conference planning, and as a previous LIPS host, he knows what to do.
- Andy Kreyche, formerly of Hartnell College, as At Large Member 2. Andy's primary responsibility will be leading re-development of the LIPS website. If you've ever looked at the LIPS site, I'm sure you'll agree there's a lot of room for improvement!

One of our first orders of business will be to decide how long the board member terms should be and whether we have the appropriate number of positions and functions.

Why are these people so willing to serve? I asked them why they were



Clockwise from top: Plotting sunrise positions on our birthdays along the rim of Chaco Canyon; Trying to create a solar eclipse using a meter stick, a bright light, and Earth-moon representatives; Was Michael McConville speaking too loudly? No, it was a fire drill for the middle school attached to MiSci; AVI's Laser Camp sponsor demonstration gave us the opportunity to try bouncing a laser beam off several targets to hit a mirror, as shown by SSIA Technologies' Beth Moger. Images: Andy Kreyche

interested and what their hopes were for LIPS. Here are the responses I received.

### From Julie:

I agreed to become a LIPS board member because the planetarium community is one of the most generous I have ever encountered and I believe that live, interactive programming is the most powerful kind of planetarium programming. My hopes for the future of LIPS include broadening the community to welcome more international folks and continuing the work of making the dome a place where everyone feels welcome and can see themselves represented.

### From Mark:

I have been involved with LIPS from the very beginning, even before the first LIPS get together. My experience, and I think it matches

the experience of most planetarians, is that audience reaction to a good live show is more enthusiastic than to even the best entirely pre-recorded presentation. However, when the first LIPS happened in Bremerton, trends were moving in the other direction - more movies and fewer, if any, live presentations. I think the original group attending the first LIPS was completely aware of this situation and willing to address it. And I believe the effort of many likeminded planetarians since that time has indeed changed the situation.

LIPS removed the focus from the technology and placed it back on the audience experience where it belongs. I sincerely hope that by serving as a LIPS board member I can continue to help with realizing the full potential of live and

interactive experiences for planetarium visitors around the world.

### From Brian:

I believe in everything that LIPS stands for. Live and interactive elements will always be key elements of planetariums as institutions. The formation of LIPS as a non-profit organization opens up tremendous opportunities for everyone who cares about live presentations and interactivity in the dome, and I am eager to help advance this organization and its crucial missions.

I hope that LIPS is able to tap into new resources for its members, like grant funding, networking opportunities, maybe even a periodical newsletter. I hope that LIPS becoming a non-profit gives us even more visibility on the planetarium stage. But most of all, I hope that LIPS always stays true to the core values with which it was founded - meaningful discussions where voices from all over can weigh in on the impact and delivery of interactivity in planetariums.

### From Andy:

Before ever working in a planetarium, I cut my teeth in astronomy education by leading hands-on activities, in both classrooms and informal education settings. Much of my training was through the Astronomical Society of the Pacific (ASP) and their various workshops and

programs. ASP activities are designed so students make their own discoveries; that way they can better understand the process that scientists go through. As I carried this philosophy into my work in planetariums, audiences responded well, and I felt more engaged with them.

When I discovered LIPS and attended my first conference a decade ago, I found my true home within the planetarium community and have been enriched by the colleagues I've met. LIPS emphasizes the creative process required for audience connection, discovery, and deeper learning. So, when Karrie asked me to become a board member at this year's LIPS, I was happy to oblige. But one particular aspect of LIPS 2023 gave me a further push; prior LIPS conferences seemed to be mostly composed of repeat attendees, with a few first timers mixed in. This year in Detroit, it was pretty much a 50/50 mix. Seeing so many young educators, already giving live presentations and eager to up their game, was truly inspiring. Like me 10 years ago, they were delighted that a community such as LIPS exists. This discovery seemed to have many of them considering planetarium work more seriously as a long-term career. With my participation on the board of LIPS, I look forward to doing just a little to assure that this home that I've found continues to be a welcoming place to others who bring their own spirit and style into the dome.

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As for myself, LIPS has already gone so far beyond where I hoped it would go. It's hard to believe now, but back when Digitalis organized and hosted the first LIPS in 2011, there was no guarantee that there would ever be another, let alone become such a robust movement.

I know this step of being a formal organization is going to help LIPS do even greater things, such as:

- Collect grants and tax-deductible donations so that we can offer more symposium scholarships. Scholarships will help offset the cost for new planetarians or those whose institutions cannot fund LIPS attendance.
- Build and maintain a more robust website with resources for live, interactive programs to be shared freely across the planetarium community.
- Creation of a newsletter with teaching tips, news from the LIPS community, and more.
- Establish mentorships between experienced LIPS-style presenters and those new to interactive planetarium programs.
- Offer a “boot camp” before each full LIPS, for those who are interested in intensive training on presenting interactive programs. This could also target new supervisors, providing guidance on giving constructive feedback to their employees.

I am so incredibly proud of the LIPS community and everything we have accomplished together. Everyone shares ideas and knowledge, and we provide a safe place where people can try new things without fear of being shamed for making mistakes. Even if something doesn't go according to plan the first time something is attempted, LIPS attendees will give respectful and constructive feedback, focusing on the positives while brainstorming suggestions for improving outcomes the next time.

In the next column, I hope to be reporting that we have received our tax ID number and have made a plan of action. I should also know the location and dates for LIPS 2024 by that time as well.

As always, I end this column with reminders about the LIPS Google Group, Live Interactive Planetarium Symposium Facebook group, and the LIPS team chat. Contact me ([karrie@DigitalisEducation.com](mailto:karrie@DigitalisEducation.com)) if you need information about any of these, or if you'd like to share any ideas or feedback.



From top: Kicking things off the first morning in the glass room. That's your author in the green shirt, with my back to the camera. Photo credit: Mark Robinson; A scene from Shira Moskowitz's Havdalah session. Image: Andy Kreyche.

Planetarium Education (con't.)

- “It's better to explore one new idea really well than to rush through several. Learning takes time.”
- “People don't learn better in their preferred learning style. But some topics are easier to learn through particular styles.”
- “People are more likely to remember new information if it is linked in their mind to concepts they are already very familiar with. Offer them ways to do this.”
- And finally, “don't feel compelled to fit in all the facts or “cover” all the topics you planned. You're not there to cram knowledge into the audience's brains. It's way better to leave them wanting more, even if it means feeling like you left something out.”

Ghosts Among Stars (con't.)

Asklepios, mortal son of the god Apollo, was the first human to learn the practice of medicine, studying under the wise centaur, Chiron. With further help from the goddess of wisdom, Athena, he even discovered how to cure the ultimate human malady: death.

He was summoned to Athens by Theseus to resurrect his son, following the events we know most canonized by Euripides' excellent and emotional play, *Hippolytus*. Asklepios successfully brought Hippolytus back to life, but the gods feared this power, because they knew if humans did not need to fear death, there would be no limits to our imagination, no limits to our ambition, no limits to our achievements, and no limits to our power, and we would have no need to fear the gods themselves. And so, Zeus struck Asklepios down with a thunderbolt.

But it was too late to destroy the dream and hope that Asklepios had brought to the world. Asklepios was placed in the sky as Ophiuchus, a ghost among the stars, to remind humanity of the hope of what is possible in this world. The expression of the ultimate liberty that knowledge can bring.

For me, this story speaks of the essential quality of our oldest connection to the sky. The sky is our first library, it is where we have placed our stories of importance, our hopes, our ambitions, our dreams. What could humanity achieve if everyone could live a life without fear?

Each one of us is just one link in a long chain of storytellers, philosophers, artisans, engineers, scientists, astronomers, and mathematicians who have helped connect humanity to the sky. Our impact on any individual may seem small, but I would encourage each of you to think of the thousands, if not millions of lives you have touched in your work. However small it feels, we make a difference, and the planetarium is the tool we achieve that through.

Similarly, to our audiences, we as individual planetarians may not stand out in their memory. But if we have created the feeling of awe, their spirit will remember that feeling. We become the ghost inside the planetarium instrument, giving it life, amplifying its power. And when we do our job right, for our audience, we, planetarium and planetarian alike, fade away into their awe of experiencing the Cosmos. Just like our mentors were to us, just like the ancients with their orreries and temples, and just like the mythical figures of old, we too become just ghosts among the stars.

IPS ELECTIONS 2024: Officers and Board

IPS will conduct two separate elections in 2024 – one for Officers and one for Board Members in four of the continental zones. Everyone can have a say! IPS is governed by five Officers and, currently, nine Board Members (two in each of Asia, Europe, and North America, and one in each of Africa, Oceania, and Latin America).

IPS Officer Elections 2024

IPS members are asked to put forward their nominations for Officer positions of President-Elect, Executive Secretary, and Treasurer for 2025-26. These elections are held every two years. Current Executive Secretary, Derek Demeter, and Treasurer, Michael Smail, are both eligible for re-nomination, and IPS will also be electing a new President-Elect. The terms of office for the winning candidates will begin on 2025 January 1 and end on 2026 December 31. The President-Elect will be IPS President in 2027-28 and Past President in 2029-30.

Multiple nominations for all positions (especially President-Elect) are highly desirable, so we encourage nominations from the worldwide IPS membership.

Please first discuss your nomination with your nominee, then send nominations to Martin George, Chair of the IPS Elections Committee, at [martingeorge3@hotmail.com](mailto:martingeorge3@hotmail.com). Nominations close at the time of the IPS General Meeting at the upcoming 2024 IPS Conference in Germany in July.

Please contact Martin George if you have any queries about these positions, or the election process.

IPS Board Member Elections 2024

In addition to nominations for Officer positions, IPS is seeking nominations for Board Member positions in four of the six continental zones: Europe, Asia, Latin America, and North America. In Europe and Latin America, the Board Members whose current terms will finish at the end of 2024 (Anna Green and Milagros Varguez, respectively) are eligible for re-election.

In regions covered by an IPS Affiliate, Board Member nominations are to be made by the Affiliate, which, if approved, will make the nomination on your behalf. In regions not covered by an affiliate, IPS members may nominate Board Members directly.

The newly elected Board Members will have three-year terms beginning on 2025 January 1 and ending on 2027 December 31. Board Member nominations close on 2024 August 1 at 0h UT, and are to be sent to Martin George, Chair of the IPS Elections Committee, at [martingeorge3@hotmail.com](mailto:martingeorge3@hotmail.com).

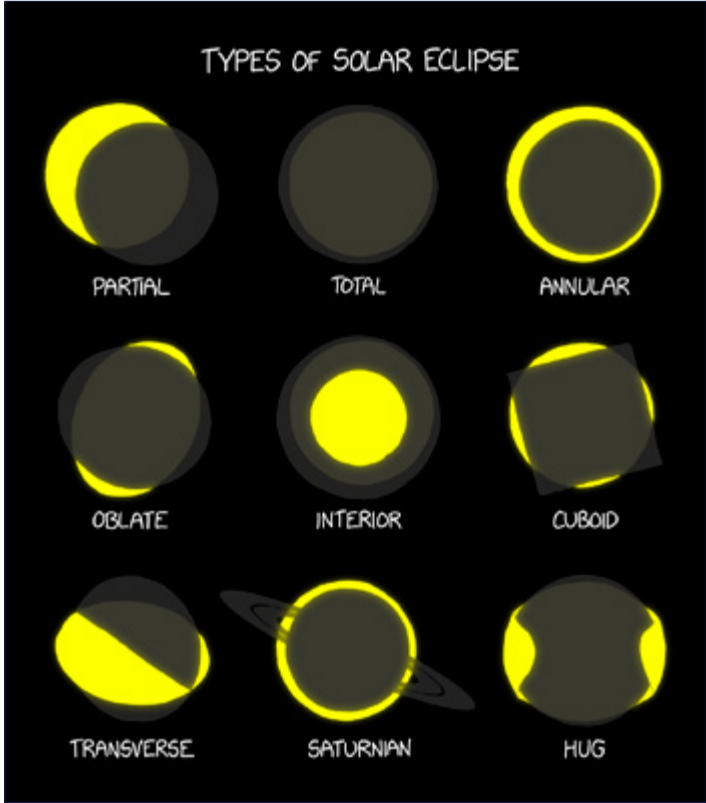


# LAST LIGHT

## CHATTING WITH FRIENDS

Many of us are preparing for the next total solar eclipse in April of 2024. Weather data has been consulted, solar filter glasses and cards are being ordered (although it's probably last-minute now), telescopes and the volunteers to run them have been organized, and many of us are presenting information to prepare the public.

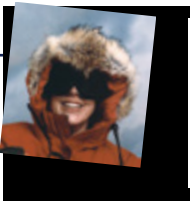
This xkcd cartoon may help in planning:



The best place to be for a big eclipse is a scenic natural area with good views and few clouds. The worst place to be is on the lunar surface. Courtesy of XKCD.

And without the Moon, eclipses wouldn't be the same. At all. October's annular eclipse was the perfect excuse to travel to New Mexico, to help out the New Mexico Museum of Natural History and Science's team with their programs. Kim Eaves and the NOAA folks joined the fun, along with Dr. Cherilynn Morrow and the PUNCH team. Both groups had lots of excellent handouts and activities to share, and Dave Hurd shared his "Getting a Feel for Eclipses" materials with great success. Many, many thanks to Jim Greenhouse (running around with his hair on fire) and Mike Toomey's generous hosting.

The best part of working with the public is meeting enthusiastic people excited about the whole experience. Two new friends stopped by the Sunspotter table, where I was showing the Sun's image and demonstrating Earth's rotation as the image "moved" every few minutes. We



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I mean, it's pretty, but it doesn't really affect us beyond that. Except that half the nights aren't really dark, and once or twice a day it makes the oceans flood the coasts. Courtesy of XKCD.

talked for a long time, sharing ideas and news about telescopes and equipment.

Myron mentioned the Dwarf 2 telescope he had with him, and how simple it was to use. He shared two images he'd taken of M101 earlier in the year. In his second image, he pointed out the supernova that appeared in May. (*See M101 images*).

The annular eclipse coincided with the Albuquerque International Balloon Fiesta, which meant hundreds of hot-air balloons ascended at sunrise and floated over our heads where we were set up for the eclipse.

Steve Fentress, long-serving astronomer at Strassenburgh Planetarium, retired in November. When I chatted with him about his experiences there, he shared a story about the early days of 870 film projection.

The film *To Be an Astronaut* had been developed for Science Center Houston and played in several planetarium theaters. For the Strassenburgh run, then-director Don Hall wanted to fatten up the show run-time and had a short segment about the Balloon Fiesta.

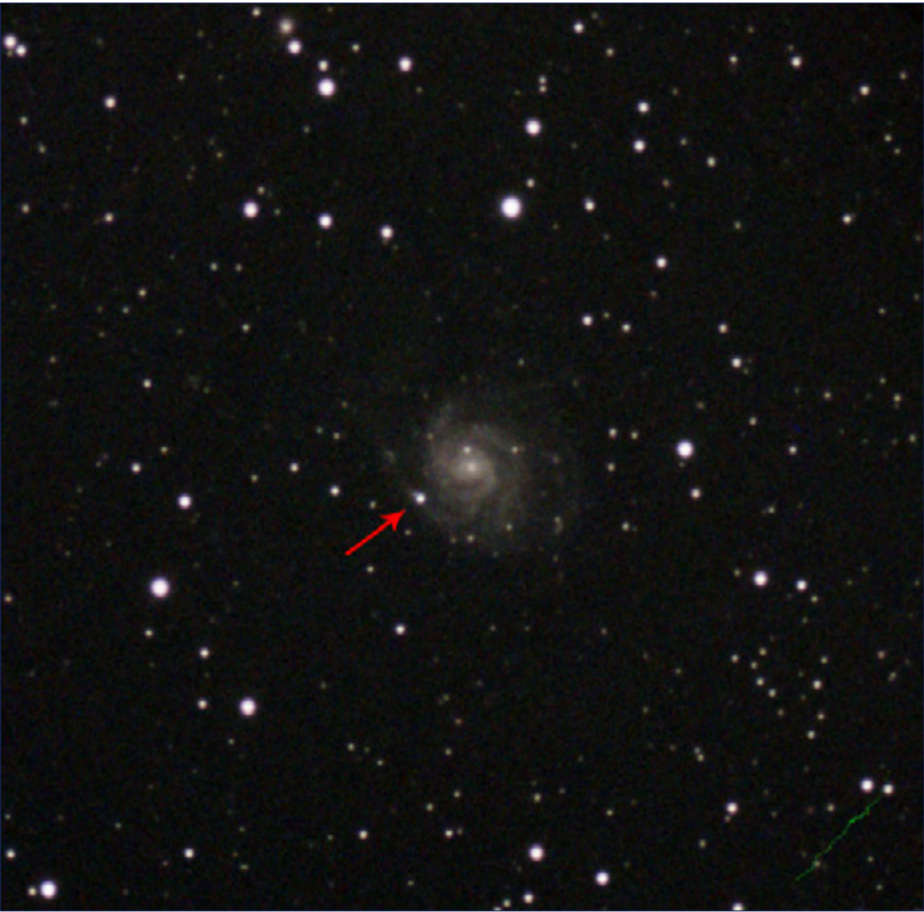


*To Be an Astronaut* was shot at 30 frames per second (fps). The Balloon Fiesta piece was shot at 24 fps. One of Steve's first jobs was to redo the soundtrack part of the film to match the images: the whoosh of the burner flames, the crowd noise, and to compose new music to fit.

The program didn't run for that many shows, but, Steve said, "That was my introduction to the Balloon Fiesta."

Clear skies and helpful volunteers to all,

M101 before (top left) and after (bottom left).



**More Accessible (con't.)**

International Conference on PErvasive Technologies Related to Assistive Environments (pp. 1-7).

Multilingual, M. (2023). Deaf Awareness Week: the importance of closed captions. *Matinée Multilingual*. <https://matinee.co.uk/blog/importance-of-closed-captions/>

Namatame, M., Kitamura, M., Wakatsuki, D., Kobayashi, M., Miyagi, M., & Kato, N. (2019). Can exhibit-explanations in sign language contribute to the accessibility of aquariums?. In *HCI International 2019-Posters: 21st International Conference, HCII 2019, Orlando, FL, USA, July 26-31, 2019, Proceedings, Part I 21* (pp. 289-294). Springer International Publishing.

National Association of the Deaf - NAD. (2023). What is Captioning? <https://www.nad.org/resources/technology/captioning-for-access/what-is-captioning/>

Phillips, K. W. (2014). How diversity works. *Scientific American*, 311(4), 42-47. <https://doi.org/10.1038/scientificamerican1014-42>

Ravelli, L. (2007). *Museum Texts*. In Routledge eBooks. <https://doi.org/10.4324/9780203964187>

Ruiz, B., Pajares, J. L., Utray, F., & Moreno, L. (2011). Design for All in multimedia guides for museums. *Computers in Human Behavior*, 27(4), 1408-1415.



## IN MEMORIAM: DALE W. SMITH



Dale W. Smith, 75, of Bowling Green, Ohio, passed away early on Sunday, September 10, 2023, as a result of complications from a stroke suffered in June. He was born May 9, 1948, and grew up in the small village of Ames, New York, son of George W. and Florence (Wessels) Smith, who predeceased him. He graduated from

Canajoharie High School in 1966 as valedictorian of his class and was inducted into the school's Alumni Hall of Fame in 2018. He graduated from Colgate University in 1970 and earned his Ph.D. in astronomy in 1978 at the University of Washington, Seattle, with a dissertation on dust in the atmosphere of the planet Jupiter.

After serving brief terms on the faculties of Bellevue Community College, Western Washington University, and Colgate University, he came to Bowling Green State University in 1983 where he served as Professor of Physics and Astronomy and Planetarium Director through the time of his death. At the Planetarium, he delivered educational multimedia programs to the general public and to area school groups, and created many of these programs himself. He oversaw an extensive renovation of the Planetarium in 2013 and 2014 with the installation of a state-of-the-art fulldome video system. In 2016, he was named Professor of Service Excellence at BGSU.

Dale was active in professional planetarium societies and served as President of both the Great Lakes Planetarium Association (1990-1994) and the International Planetarium Society (1999-2000). In these organizations, he served as editor of annual conference proceedings and editor of a worldwide directory of planetariums, among other roles. He was given the highest award of each society: GLPA's Galileo Award and IPS's Service Award.

Dale enjoyed traveling and visited more than 60 countries and all US states, Canadian provinces, and states of Australia. In 2000-2001, he set foot on all seven continents in the span of one year. On his travels, he took more than 200,000 photos, including both slides and digital images. Besides photography, his hobbies included collecting books and international and old US currency.

He was active in the First Presbyterian Church of Bowling Green where he ran the sanctuary sound system for over thirty years, and also served as church photographer.

At his request, there will be no services or public viewing. His ashes will be placed in the Ames, NY cemetery next to his

parents. He is survived by numerous cousins and by many friends around the world.

Kind, generous, supportive, gregarious... These are just some of the adjectives that can be attributed to Dale. I know others will add their list of positives to this special person. He always had that smile that made you feel that you belonged, and mattered, in the professional planetarium community. He was truly an ambassador to our quirky world. Thank you, Dale, for being you.

-- Adam Thanz, *Bays Mountain Planetarium, Kingsport, TN*

### About Dale...

In addition to his serving as IPS President 1999-2000 he received the prestigious IPS Service Award in 2006 "for an individual or institution whose presence and work in the planetarium field has been, through the years, an inspiration to the profession and its members." I knew him mostly from being part of the Publications Committee, which he chaired when I was IPS webmaster. His process for compiling the IPS Planetarium Directory periodically was nothing short of heroic given the technology available in the decades that he took on that function. In our digital age, that tradition and labor of love is carried on in new style by Lionel Ruiz and Daniel Audeon in the Worldwide Planetariums Database (<https://planetariums-database.org/>). Dale also took on the daunting task of digitizing all the IPS Proceedings (<https://www.ips-planetarium.org/page/proceedings>), Planetarians (<https://www.ips-planetarium.org/page/plntrnarchive>), and Special Reports (<https://www.ips-planetarium.org/page/special>) that we then posted on the IPS website. Granted, a lot of the digitizing grunt work he delegated to some of his students, but still, it was a monumental service to IPS. I already miss his calm demeanor and his subtle smile that somehow said, "I know a secret that you would really like."

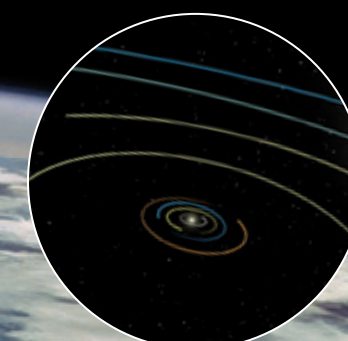
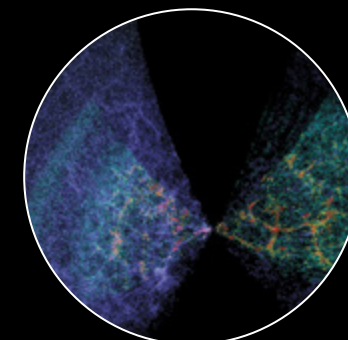
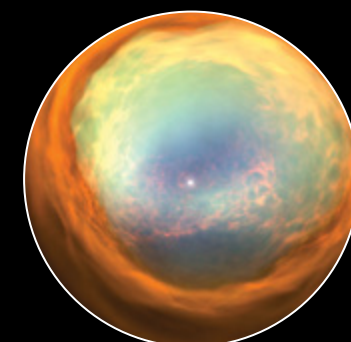
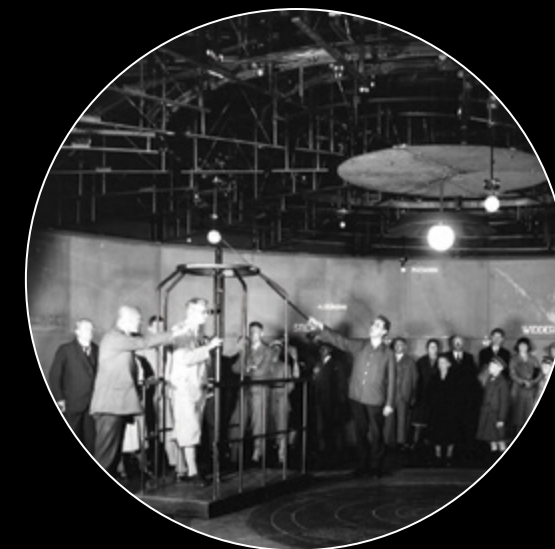
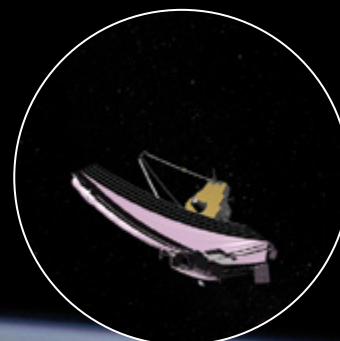
-- Alan Gould

### Condolences to Dale

Whether he was IPS President or not, he was always supportive of me and our work, and at times gave us valuable advice. He always looked after us with a kind smile. I was looking forward to seeing him again after greeting him in IPS Toulouse, and I am shocked that this won't happen. Please continue to watch over us from space.

-- Takayuki Ohira, *President of Ohira Tech*

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