Bulletin of the AAS • Vol. 57, Issue 2 (AAS245 Abstracts)

Analyzing the Impact of Ground Stations for the Black Hole Explorer Mission

Marvin Martinez[1] Kazunori Akiyama[2] Daniel Palumbo[3] Vincent Fish[4]

[1]Massachusetts Institute of Technology, [2]MIT Haystack Observatory,
[3]Black Hole Initiative at Harvard University, [4]Haystack Observatory

Published on: Feb 28, 2025

URL: https://baas.aas.org/pub/2025n2i256p02

The Black Hole Explorer (BHEX) mission aims to increase the resolution of the Event Horizon Telescope (EHT) in the 2030s by sending an antenna to space. As a very long baseline interferometry (VLBI) array involving only a single telescope in space, the choice of ground stations is an important consideration for BHEX. We identify the minimum and optimum ground array for the mission-defining scientific goals to discover and measure photon rings around the black holes in M87* and Sgr A*. We use the python package ‘ngehtim’ to simulate BHEX observations with different arrays, including ground stations expected to be available in 2030. We measure relative performance by considering the u-v coverage obtained for each array under average weather conditions. We find that four large ground antennas provide sufficient sensitivity to obtain good detections at both 81GHz and 244GHz. These “anchor stations” further improve the array by serving to phase-calibrate smaller ground antennas, effectively allowing nearly all EHT antennas to produce detections on baselines to the satellite. We suggest that four antennas (Haystack, LMT, NOEMA and IRAM 30m) would be the most significant after ALMA for observing the photon ring of M87*’s supermassive black hole during the proposed BHEX mission. This work was made possible by the National Science Foundation (NSF; AST-1935980, AST-2034306), funding from Vanderbilt University and initial seed funding from Fred Ehrsam.