Finding Common Ground: Comparative Spectropolarimetry of WN+O Binaries

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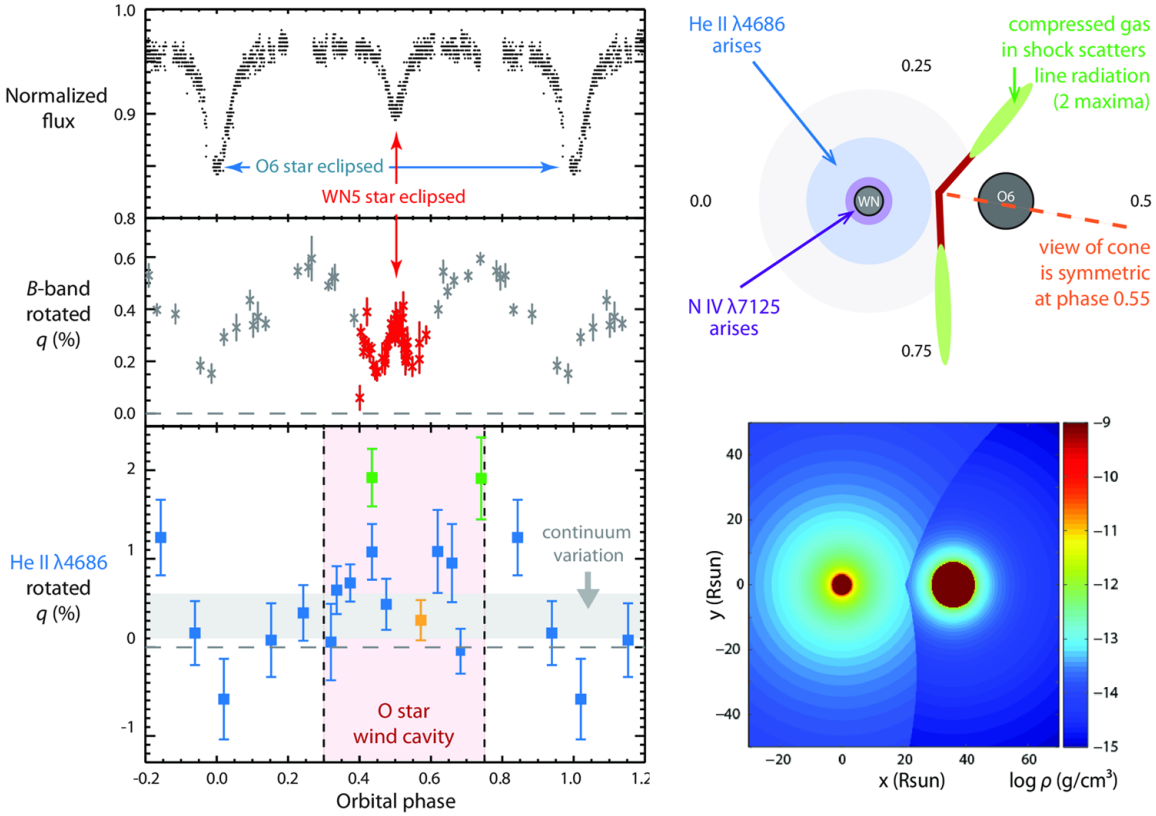
PRESENTED AT:

V444 CYGNI: THE CANONICAL CASE



Left:

- B-Band light curve (top), B-band continuum polarization curve (middle), and rotated He II λ4686 line (bottom).
- Pink shading indicates the shock cone regions formed by colliding winds within the binary system.

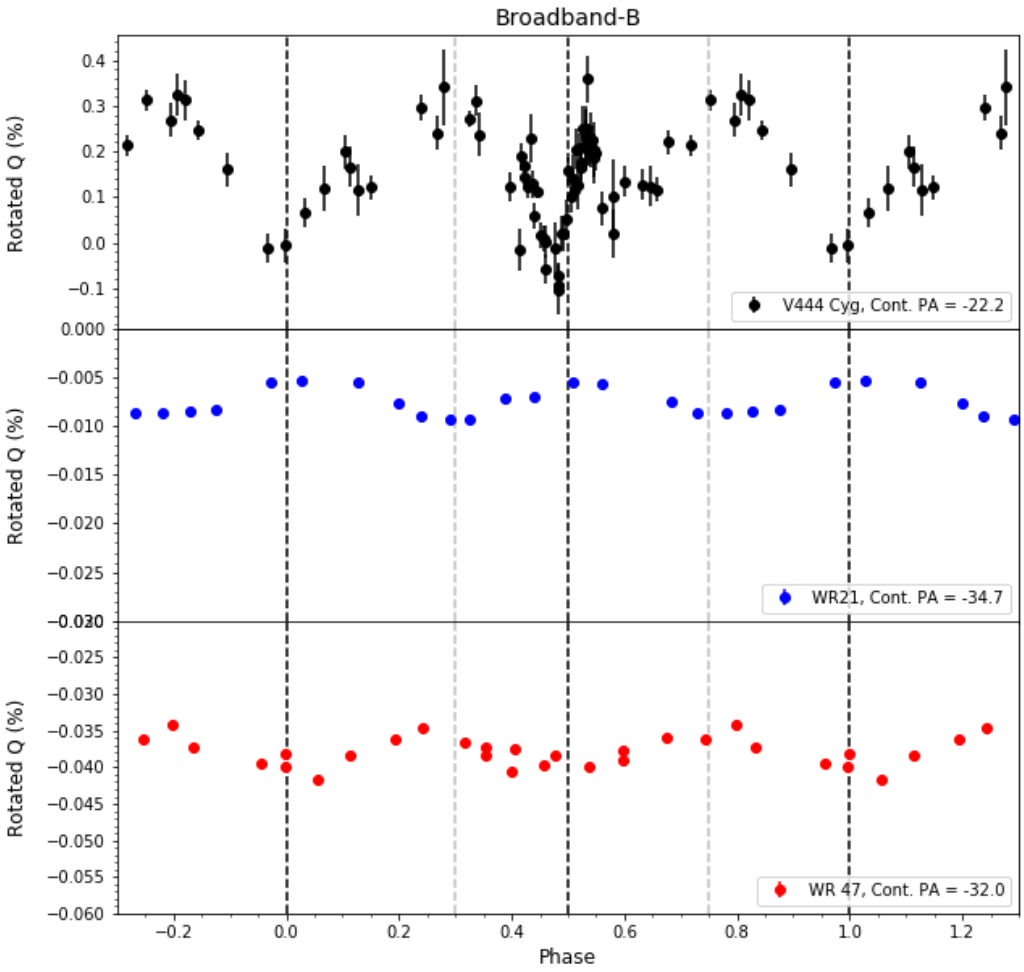
Right:

- Schematic of line emission and scattering in the winds (top) and X-ray model of the density of the system.

Citations

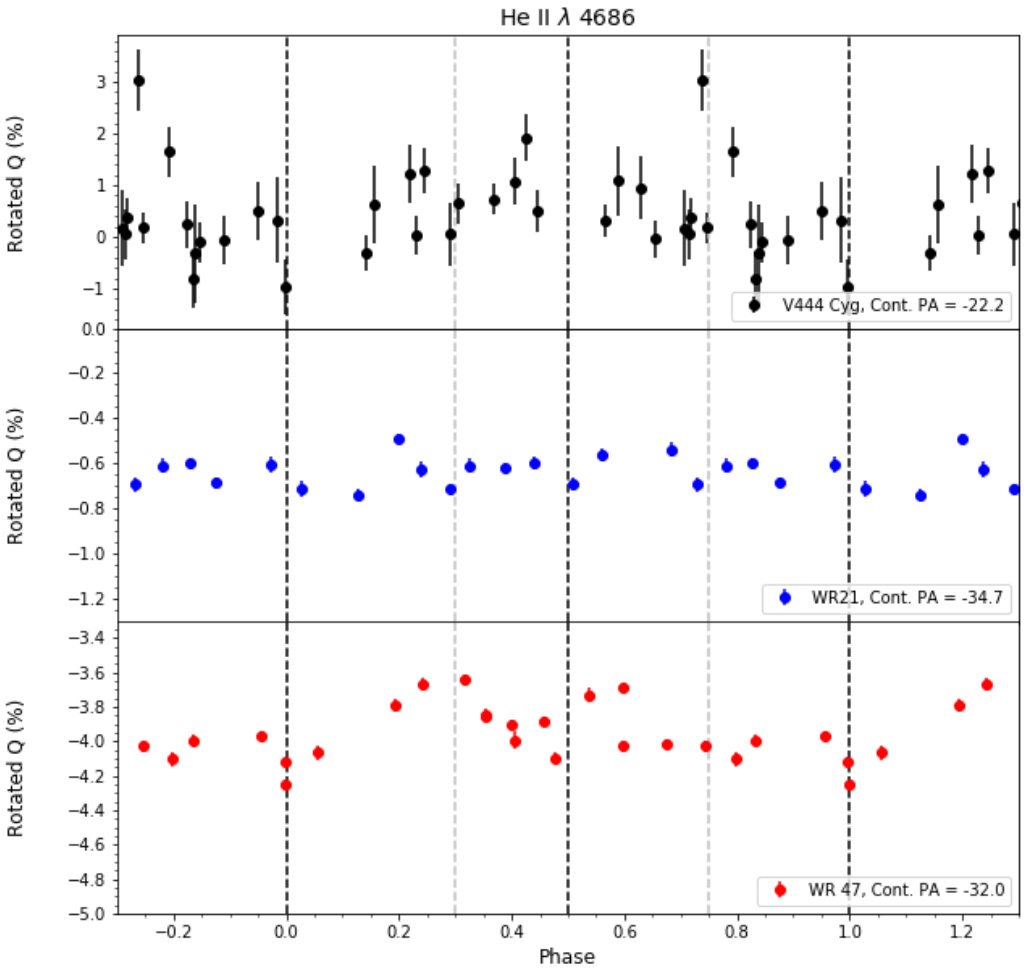
- Top left: Eris & Ekmekci 2011, Astonomische Nachrichten, 332, 616
- Middle Left: St.-Louis et al. 1993, ApJ, 410, 342
- Bottom Left: Hoffman et al. 2017, American Astronomical Society Meeting Abstracts, 229, 344.02
- Top Right: Lomax et al. 2015,A&A, 573, A43
- Bottom Right: Hoffman et al. 2017, American Astronomical Society Meeting Abstracts, 229, 344.02

BROADBAND POLARIZATION



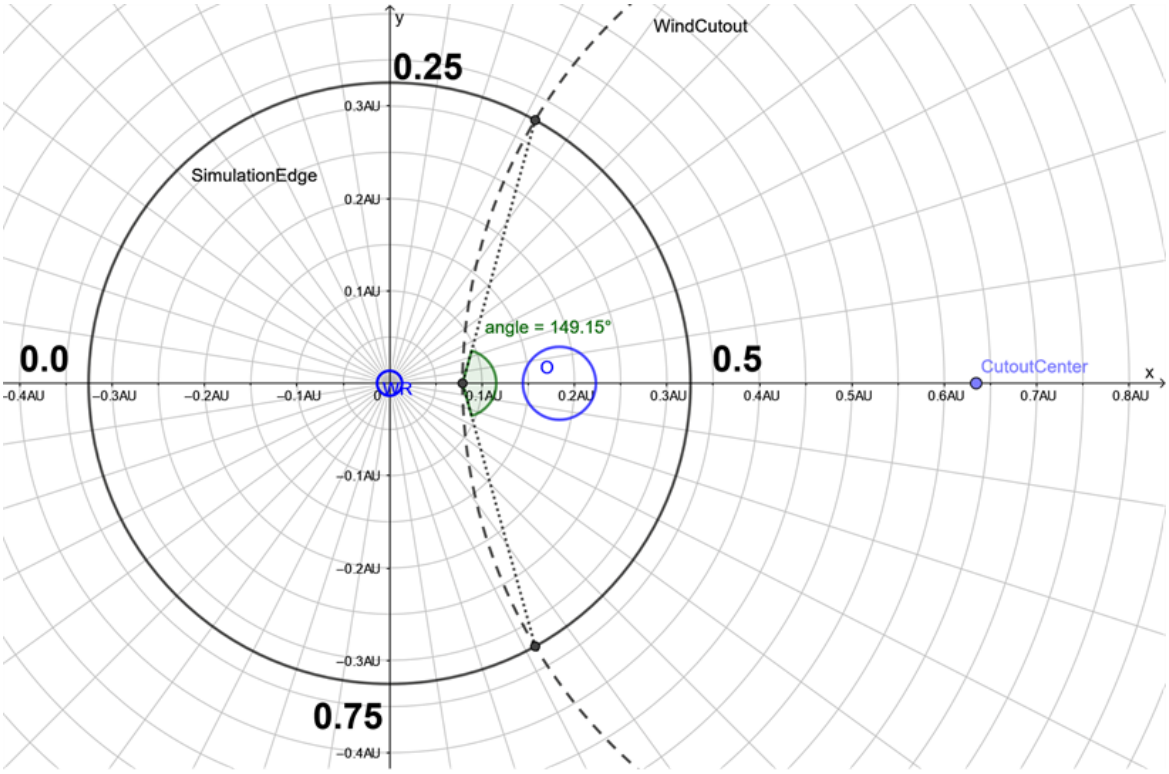
- This plot depicts the continuum polarization of each target.
- The black dashed lines indicate eclipses.
- The gray dashed lines indicate the extent of the shock cone found for V444 Cyg.
- The offset in %Q for WR21 and WR47 is likely due to ISP.

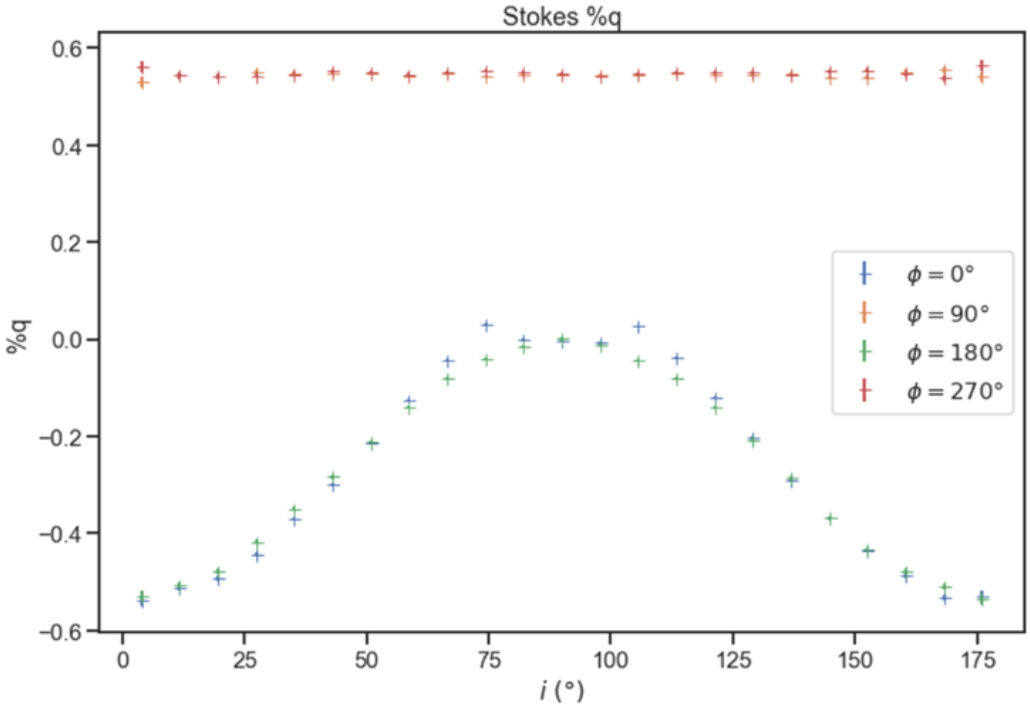
4686 LINE POLARIZATION



- This figure depicts the integrated He II line polarization .
- Each target's plot is rotated to its system axis.
- The black dashed lines indicate eclipse phases.
- The gray lines mark the shock cone boundaries found for V444 Cygni.
- The offset of WR21 and WR47 in %Q is likely due to ISP.

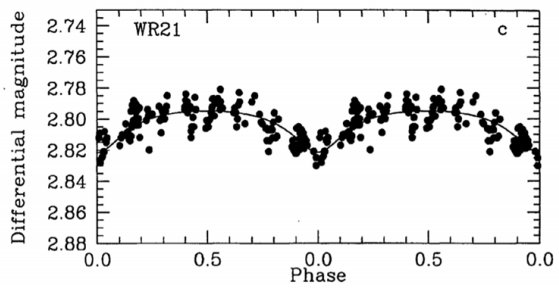
MCRT MODELLING

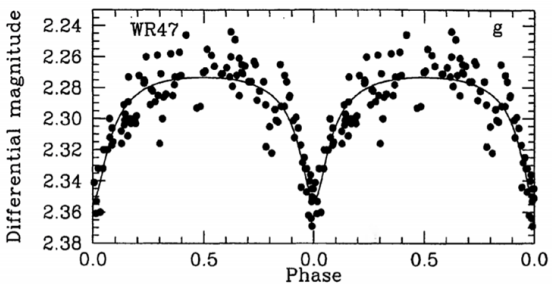




- The schematic (top) depicts the geometry code developed to replicate the geometry of V444 Cygni.
- The graph (bottom) displays preliminary continuum polarization results from the spherical cutout geometry code as viewed from different angles.

THE TARGETS





Object	Spectral Type	Observations	Instrument/ Observatory
V444 Cyg	WN5+O6II-V	30	HPOL/PBO, Ritter
WR 21	WN5+O4-6	16	RSS/SALT
WR 47	WN6+O5	21	RSS/SALT

START HERE:

The Goal

- Understand whether and how WR+O binary systems give rise to LGRB-producing supernovae (Type Ic)

The Tools

- Spectropolarimetric observations with RSS/SALT
- Monte Carlo Radiative Transfer (MCRT) modelling with SLIP code

Phase 1

- Create a code to simulate the well-constrained geometry of V444 Cygni
- Reproduce observed polarization (continuum and line)
- Calculate mass loss and transfer within the system

Phase 2

- Refine cavity geometry for SLIP MCRT model for V444 Cygni
- Apply code to WR+O targets of similar spectral type (WR21 and WR47)

ACKNOWLEDGEMENTS

- NSF Grant AST-1816944
- Dr. Kenneth Nordsieck (University of Wisconsin Madison)
- Dr. Jamie Lomax (United States Naval Academy)
- Southern African Large Telescope (SALT) staff
- University of Denver staff, especially Faun and Angelo
- University of Denver Undergraduate Research Center

ABSTRACT

Massive Wolf-Rayet (WR) stars in binary systems may produce supernovae capable of emitting long-duration gamma-ray bursts (LGRB). The canonical WR+O eclipsing binary is V444 Cygni, which is a WN5+O system that has X-ray emitting colliding winds and a well-constrained geometry. I will present new time-dependent spectropolarimetric data, collected using RSS at the Southern African Large Telescope, from several Southern WN+O binary systems that may be analogs to V444 Cygni. By analyzing their polarimetric variations with respect to V444 Cygni, I investigate their wind geometries and assess the similarities among the WN subclass. Characterizing the mass loss and transfer structures within these systems will help to constrain the future evolution of the WN stars and their role as LGRB progenitors.

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