

Post Common Envelope Binary Stars

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Summer 2017

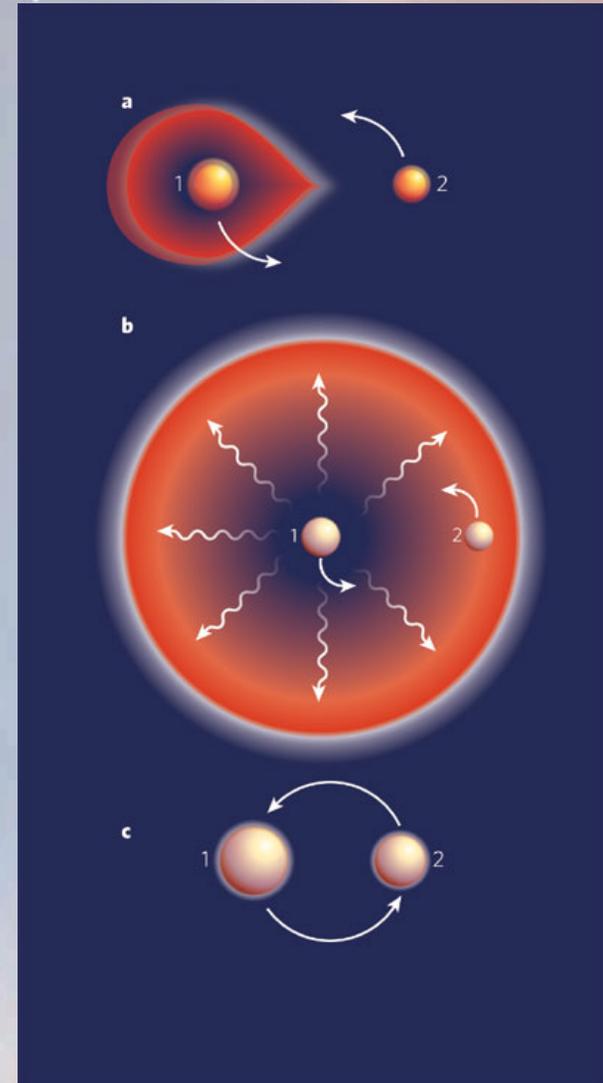


Valparaiso
University



1. The Common Envelope Phase

- A. When a star on the Red Giant Branch (RGB) or Asymptotic Giant Branch (AGB) “swallows” a nearby companion star
- B. The envelope is expelled after the two cores spiral together into a tighter orbit
- C. Produces all close binary stars involving a compact object (white dwarf, neutron star, black hole)



2. Central Stars of Planetary Nebulae

- A. The close binary *immediately* after the CE phase
- a) No time for further evolution or changes to the binary
 - b) The surrounding PN is the ejected envelope, so we can study both

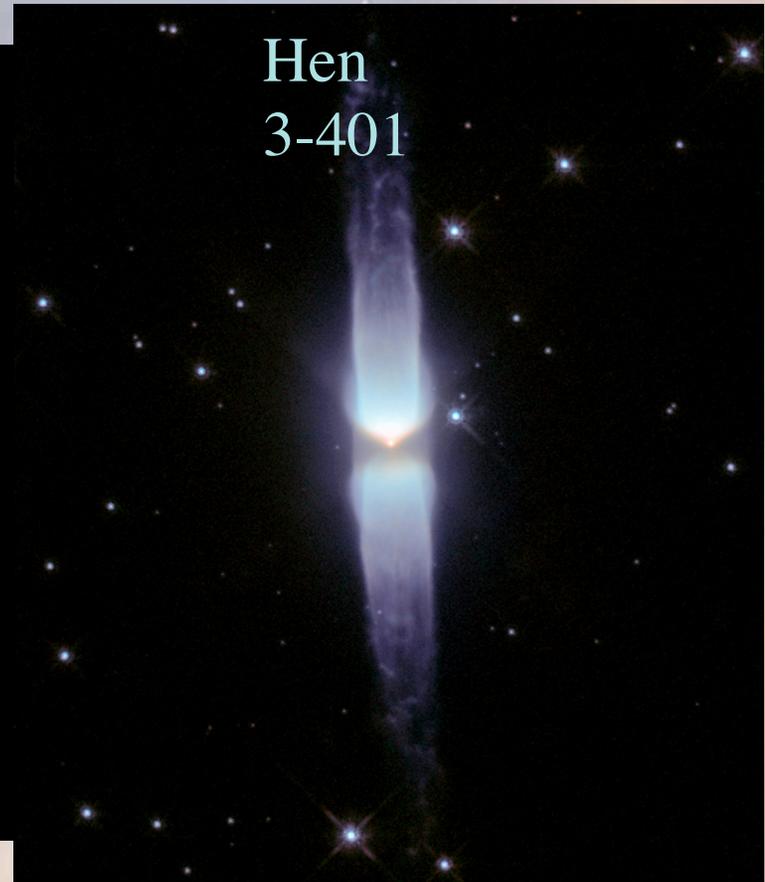
Planetary Nebula Mz3



Hubble
Heritage

NASA, ESA, and The Hubble Heritage Team (STScI/AURA) • Hubble Space Telescope WFPC2 • STScI-PRC01-05

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2. Central Stars of Planetary Nebulae

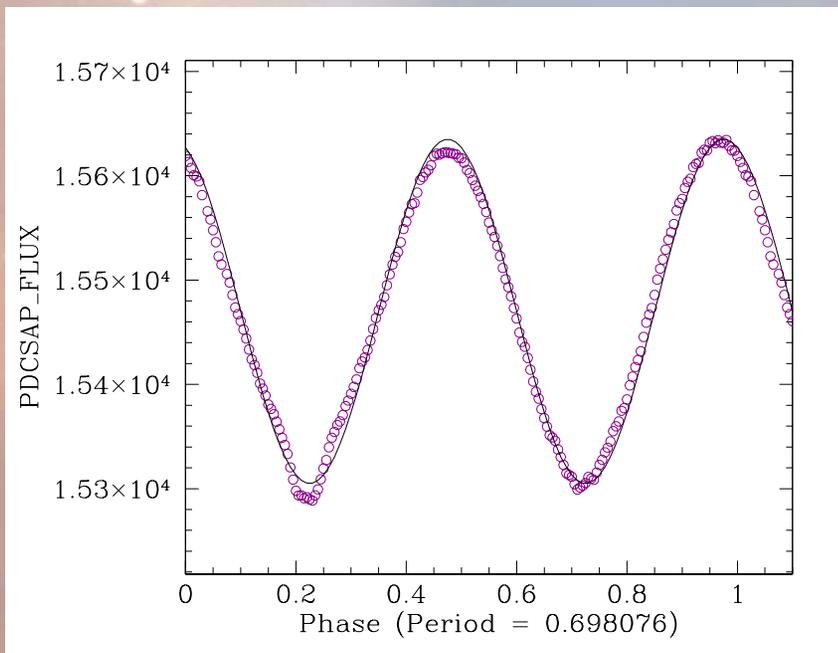
- B. Studying the properties of these binary stars can tell us
 - i. about the common envelope phase
 - ii. how it effects the stars individually (masses, radii, etc.)
 - iii. the resulting distribution of orbital periods

3. Finding Binary Central Stars

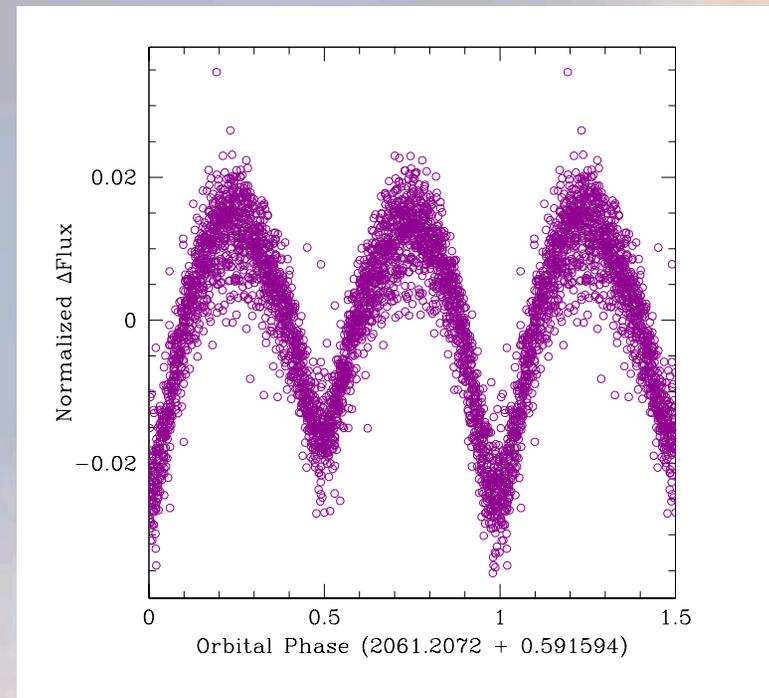
A. Brightness Variations

- a) Generally we find new *close* binaries through photometric variability – periodic, consistent changes in their brightness
- b) But it appears many of these systems *may* have very low amplitudes (< 0.01 mag) – from Kepler spacecraft data

PNG 012.1-11.2



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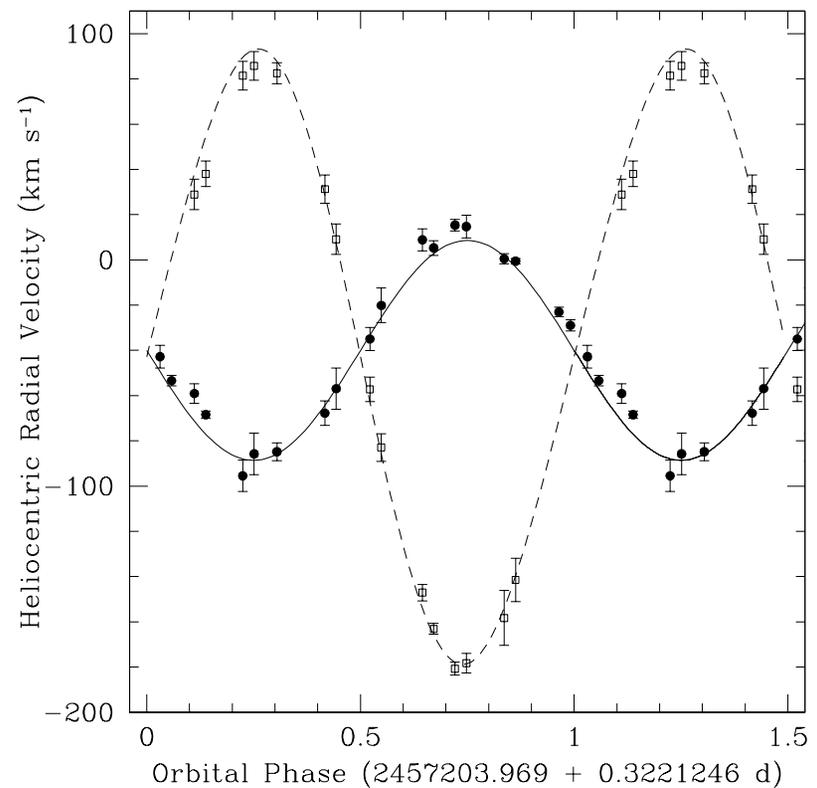
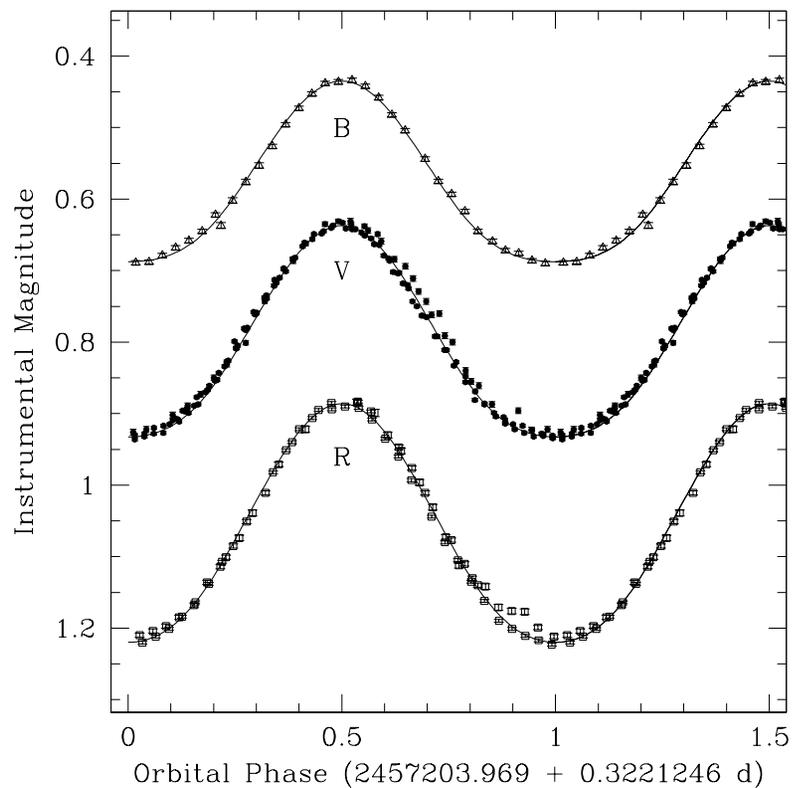


3. Finding Binary Central Stars

B. Understanding Binarity

- a) We can work out physical parameters of the system (like masses, radii, and temperatures of the stars) if we also have a *radial velocity* curve.

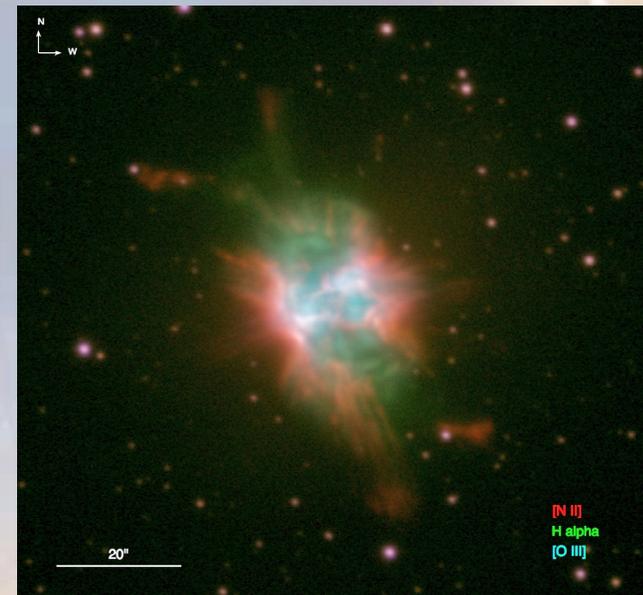
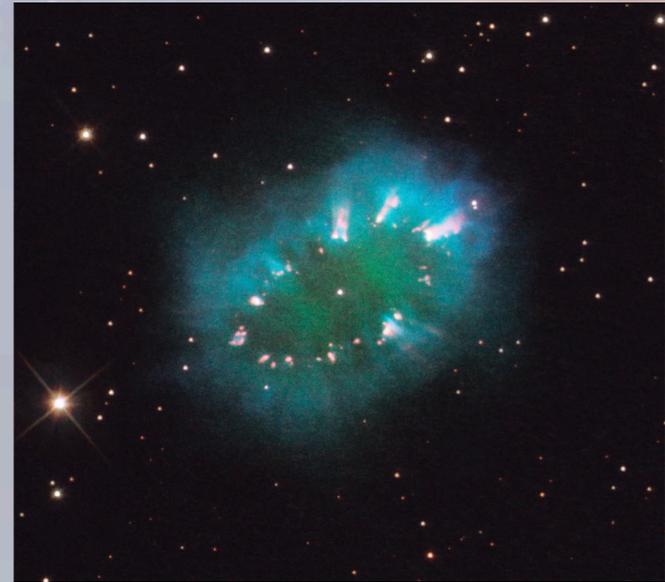
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3. Finding Binary Central Stars

Broader Goals

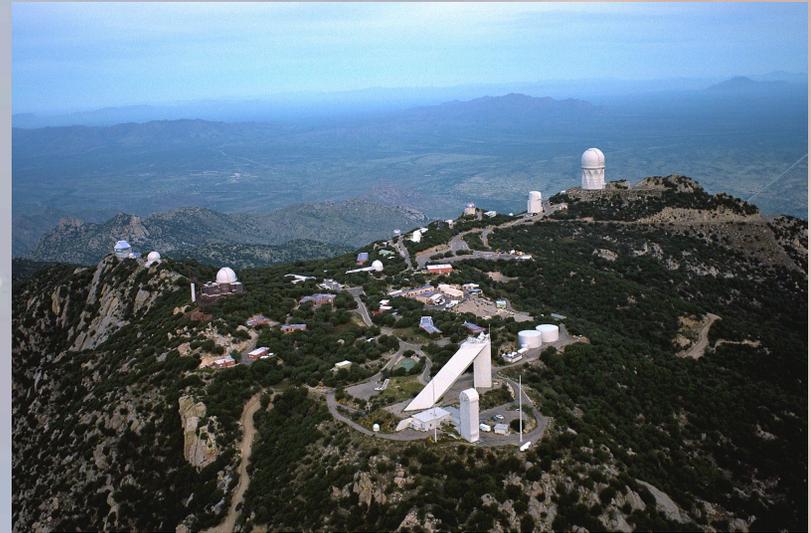
- Relationship between close binary central stars and other close binaries like Cataclysmic Variables, Type Ia supernova progenitors, symbiotic stars, et?
- What are the relative fractions of different binary types (main sequence companions, white dwarf companions)
- Mass distribution of central stars



4. Student Involvement

A. Ongoing variability survey to discover more binaries

- a) SARA North
- b) SARA South
- c) CTIO 1.3m (queue)
- d) Kitt Peak 2.1-m (June)
- e) Kepler spacecraft



4. Student Involvement

- B. Observations of new and known but poorly studied systems
- a) Only about 13 of the 37 catalogued systems are well studied.
 - b) We are collecting photometry of additional systems.
 - c) Spectra from Gemini South & North



4. Student Involvement

D. Student Research positions

- a) Plan ten weeks, starting and ending dates negotiable
- b) On-campus housing provided (pending approval)
- c) Data reduction & analysis –photometry & spectroscopy
- d) Potentially some binary star modeling
- e) Two positions
 - Applications through the department
 - Travel
 - Kitt Peak (early June)
 - Maybe: American Astronomical Society Meeting, Maryland (January)