

Jets from Accreting White Dwarfs

Jeno Sokoloski

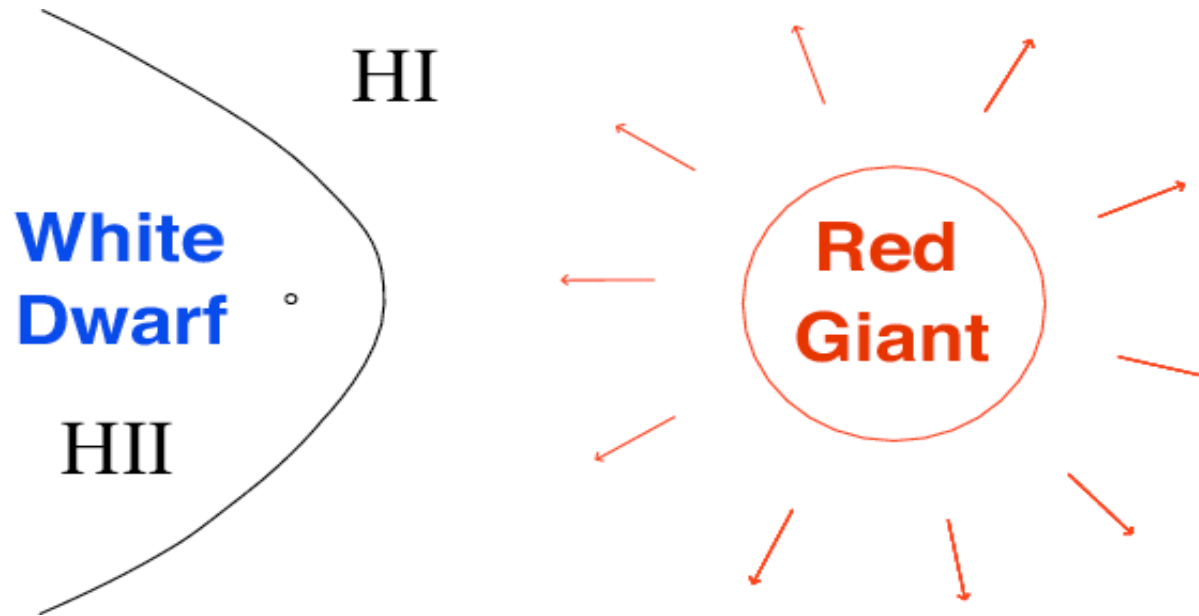
Harvard-Smithsonian CfA

Collaborators include: S. Kenyon, E. Kellogg (CfA),
C. Brocksopp (MSSL), C. Kaiser (U. Southampton)

Main Points

- 1) White Dwarfs can produce jets.
- 2) White-dwarf jets have a potentially important role to play in the general quest to understand the collimation and acceleration of astrophysical jets.
- 3) Amateurs, including students, can participate in research on white-dwarf jets.

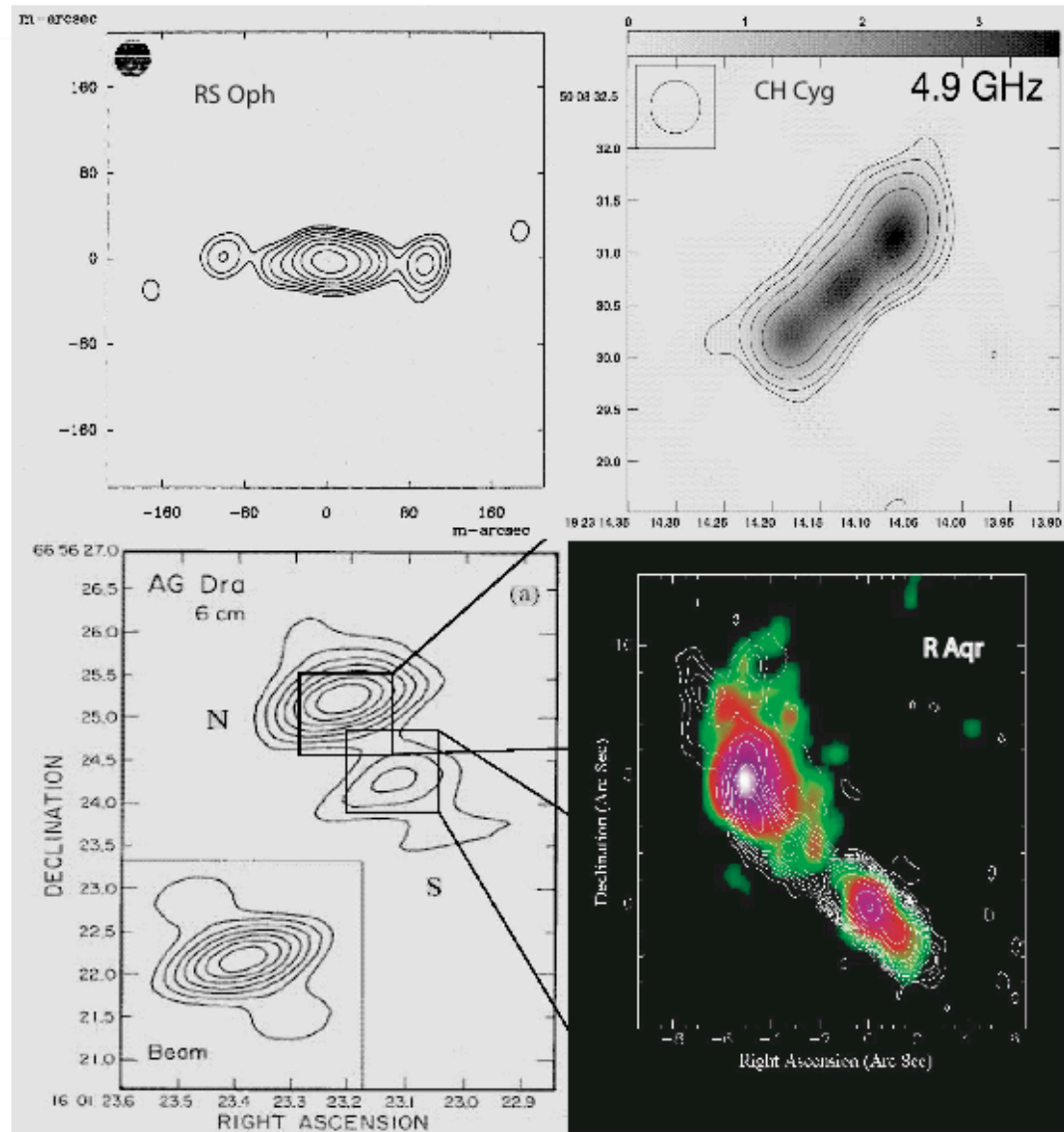
One Type of Accreting WD: Symbiotic Stars



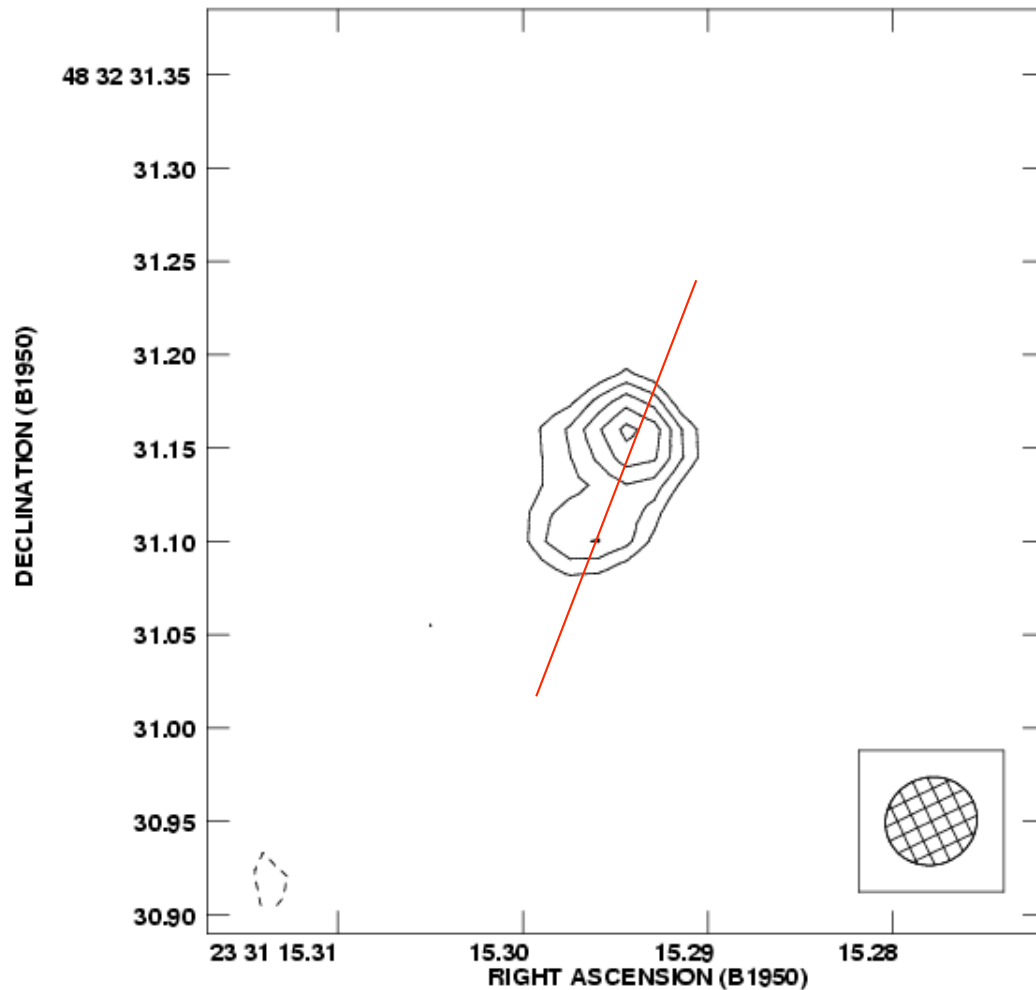
- **Wide, Wind-Fed Binaries**
- **Partially Ionized Emission Nebula**
- **Quasi-Steady Shell Burning on the White Dwarf**
- **Outbursts every few years to decades.**

Gallery of Symbiotic-Star Jets

- Angular sizes: tens of mas to tens of arcsec.
- Physical sizes: tens to thousands of AU.
- Inferred velocities: hundreds to thousands of km/s.
- Often transient.
- Wide variety of symbiotics represented.



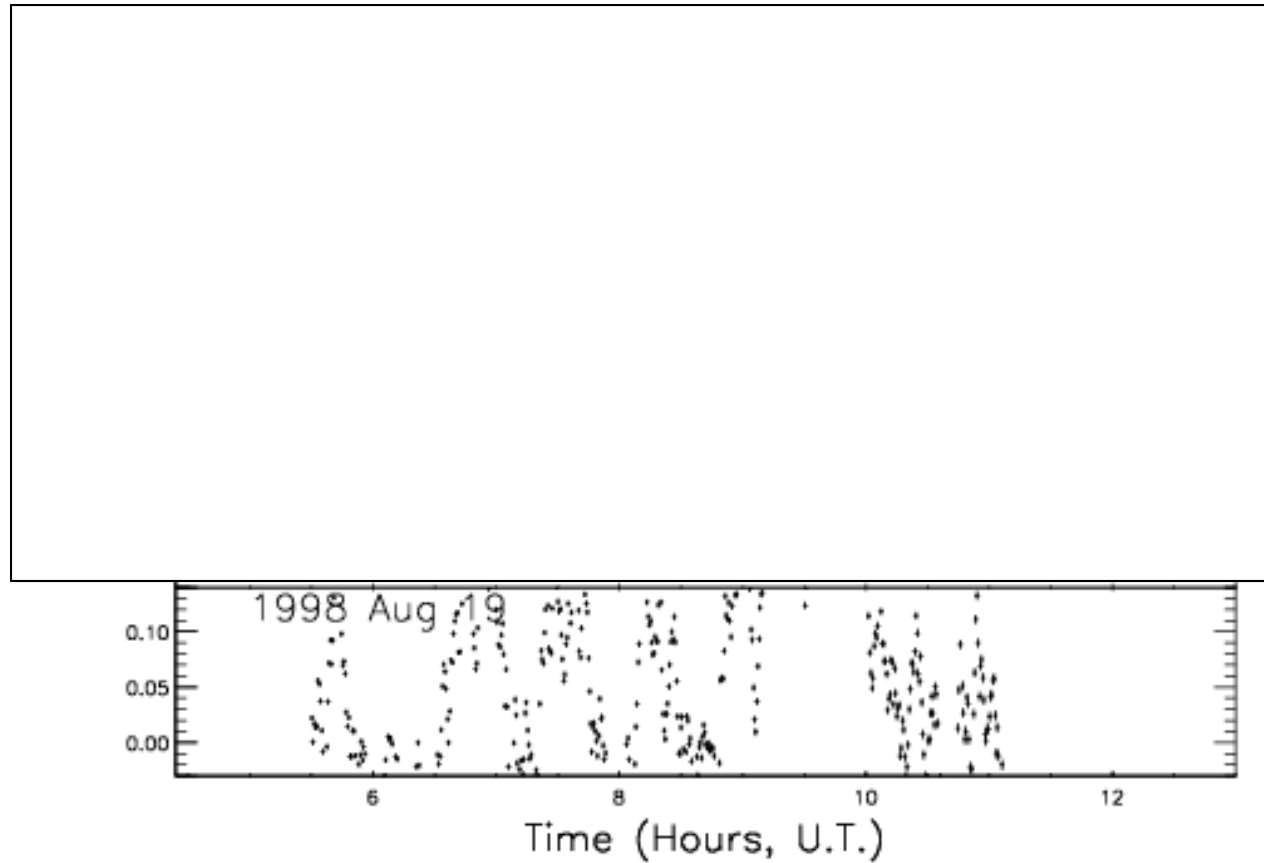
Z And Transient Radio Jet



- Z And: prototype, with strong B field
- Size: 60 mas
- Outflow perpendicular to orbital plane
- Duration: order of months
- Outflow velocity: 400 km/s

Brockopp et al. 2004

Disk-Jet Connection in CH Cyg



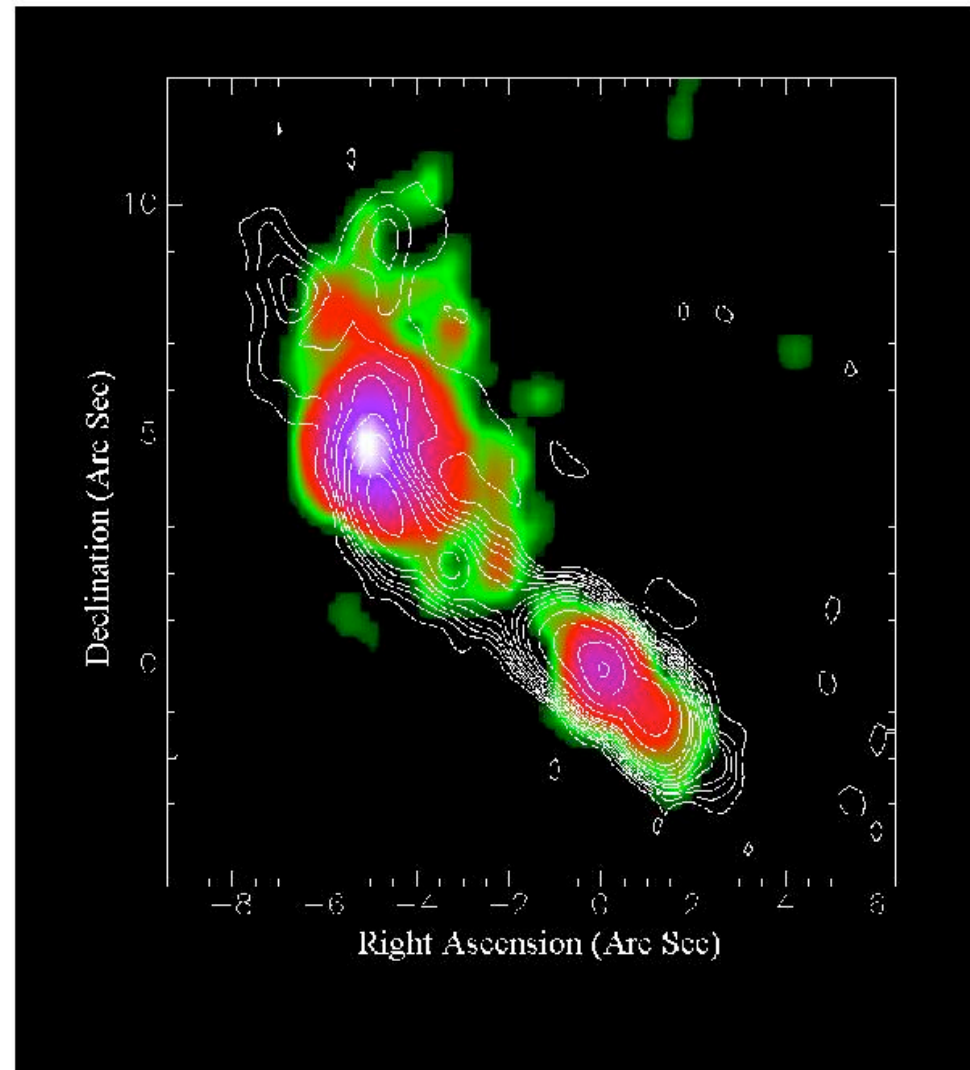
Smooth light curves → Inner disk disrupted when jet produced.

Sokoloski & Kenyon 2003

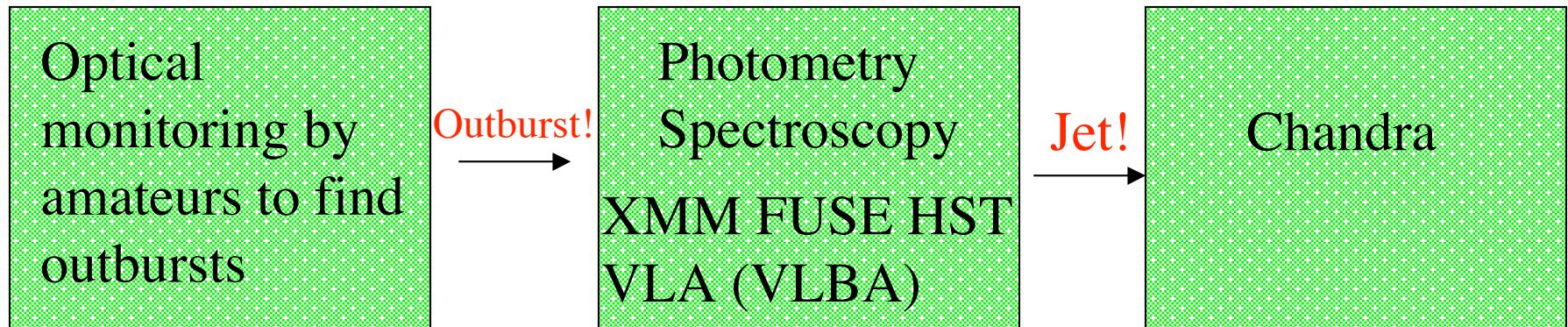
X-Ray Emission from a Symbiotic-Star Jet

from Kellogg, Pedelty, & Lyon 2001

- Northeastern lobe of persistent jet.
- X-ray contours from Chandra shown in color.
- $E < 1$ keV: central source + jets; $E > 1$ keV: point source.
- Jet plasma shock-heated and not in thermal equilib.



Observational Approach: Multi-Wavelength TOO



Women in Science

Programs for Middle-School Girls:

- Eyes to the Future - Online mentorship
- Science Club for Girls - Science and Leadership



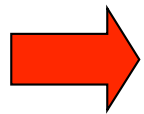
Acknowledgments

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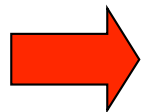
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Properties of Accreting WDs with Jets

- Some have shell burning on the WD, and others do not (possibly some preference for no shell burning).
- Many jets clearly associated with outbursts, some are not.
- Z And has a strong WD surface field. Other jet sources have no evidence for such a field.
- Some have high mass-loss Mira donor stars. Others do not.



One feature could be common to all is an accretion disk. The necessity of a disk should be testable with symbiotic stars (since some don't have disks)



Disk accretion with accretion rate above some threshold?