The X-ray R Aquarii: a Two-sided Jet and Central Source

E. Kellogg(*Harvard/Smithsonian Center for Astrophysics*), J. Pedelty, R. Lyon (*NASA Goddard Space Flight Center*),

Abstract

The sub-arcsec spatial resolution and simultaneous energy resolution of Chandra with the ACIS detector allows us to resolve for the first time the structure of the nearby symbiotic star R Aquarii, an M giant and WD. We see a spectacular jet in an observation done on 2000 Sep 10. We compare with VLA observations taken ten months earlier. The jets in this system are likely to be governed by a different regime of physics than those seen from more compact objects - neutron stars or black holes, such as Sco X-1 and SS433.

The WD in R Aquarii appears to be in a highly eccentric orbit, with outbursts believed to be associated with periastron every 44 y. These outbursts, likely are fueled by accretion onto the compact object, and result in the jets.

Such symbiotic stars provide one evolutionary path to being progenitors of type Ia supernovae, currently of great interest as standard candles for Λ cosmology. We need to better understand the process by which these systems accrete and eventually transfer enough mass to the WD so that it undergoes a SN transition to a neutron star. Systems like R Aquarii, in which the mass transfer rate is thought to be $10^{-8} M_{\odot} y^{-1}$, will approach the Chandrasekhar limit gradually. If they are understood well enough, they may display unique characteristics that identify their luminosity, making the argument for them as standard candles more persuasive.

The significance of the R Aquarii X-ray jet morphology and spectrum are discussed. Comparisons with the VLA data raise interesting questions.

At the position of the central binary, we also detect apparent continuum X-ray emission consistent with several emission mechanisms, with current analysis indicating temperatures of order two to eight million degrees. We plan to present results of further analysis with the improved Chandra ACIS low energy calibration to be available shortly.

The central source also has an intriguing prominent 6.4 keV feature, a possible fluorescence or collisionally excited Fe line. This may come from an accretion disk or from excitation of the wind of the giant star by some unseen hard source. Such a source in close proximity to the hot star would be hidden from view by an edge-on accretion disk. Further observations of this and similar objects should lead to a better understanding of the accretion mechanism, and events leading up to a SN explosion.

CATEGORY: WHITE DWARF BINARIES AND CATACLYSMIC VARIABLES