Jets in XRB Low/Hard States: Models of XTE J1118+480 suggest a strong signature from radio through X-ray *

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Keywords: X-ray binaries –jets – black hole physics – radiation mechanisms:non-thermal

Summary

Observations reveal the presence of powerful jets in the Low/Hard states of several black hole candidate X-ray binaries, so it is important to consider what signatures these outflows will have in the broadband Low/Hard spectrum. Correlations between the radio and X-rays, as well as in at least one case the optical, suggest that emission from a jet, via either synchrotron or inverse Compton (IC) processes, may play a role. The recently discovered X-ray transient XTE J1118+480 (Remillard et al. 2000), a black hole candidate in the Low/Hard X-ray state, provides an excellent opportunity for multi-wavelength modeling, since it has been observed not only in the radio through X-rays (see Fender et al. 2000, and references therein), but is also at high enough Galactic latitude to allow the first ever EUV detections of an X-ray transient (Hynes at al. 2000, hereafter H00).

We consider a simplistic scenario of symmetric, magnetized relativistic plasma outflows. The jet plasma encounters a shock, which accelerates the particle distribution into a power-law, creating a jump in the spectrum where the shock-accelerated leptons produce an optically thin power-law extending to the X-ray regime. The details of this calculation, as well as a more evolved model which addresses the presence of an accretion disk component, can be found in Falcke & Markoff (2000), Markoff, Falcke & Fender (2000), respectively, and references therein. We include a representative figure, which includes only synchrotron emission from the jet. Surprisingly, we can account for the radio-IR and the X-ray data reasonably well without invoking an IC component or the presence of significant disk emission.

* We are grateful to the (late) Bob Hjellming for sharing his data with us.
† Supported by a Humboldt Research Fellowship

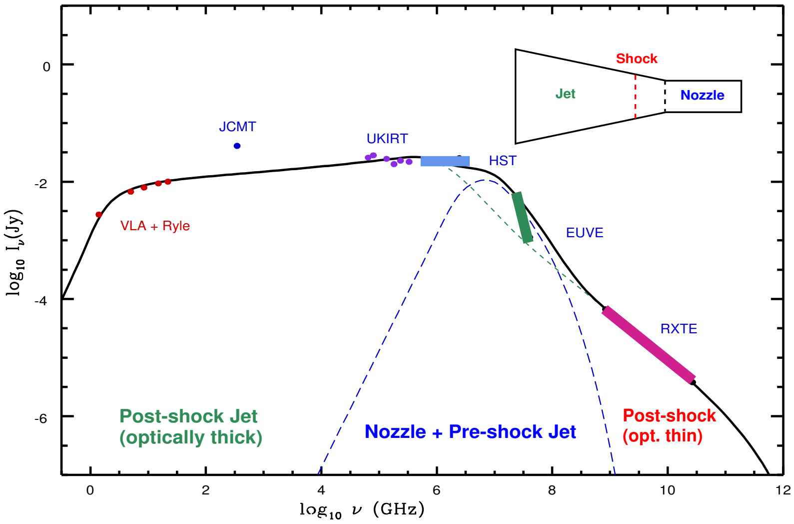

Figure 1. Fit for power-law spectral index 2.6, $M_{\rm bh} = 5M_\odot$, $L = 0.04L_{\rm Edd}$, $z_{\rm sh} = 16r_s$, and inclination angle 40°. Data points from H00 except radio (Hjellming et al., in prep.), and JCMT (Fender et al. 2000). We cannot account for the entire optical range from the jet alone, but the detection of strong H_α lines (Garcia et al. 2000) could be indicative of disk emission at these frequencies. We use the maximum absorption case presented in H00 for the EUVE data. Included is a schematic explaining the different emission regions. The JCMT point obviously is well outside the range of this model, which could be accounted for either by the addition of another shock further out, resulting in enhanced emission, or by thermal emission from a torus.

As an interesting note, the hard X-rays have been seen lagging the soft in several XRBs (e.g., Ford et al. 2000). A multi-component model such as that presented here, or including disk emission (see Markoff et al. 2000) is favorable.

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