Radio and mm-wave studies of Milky Way Black Holes
STSM Visit to Onsala (8-22nd May 2011) Summary Report

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Some of the most bizarre and dramatic objects are to be found among radio emitting X-ray binaries in our galaxy. The dramatic radio flaring outbursts in Cygnus X-3 – first discovered in 1972, have been found to be accompanied with complex changes in the structure of a radio jet. SS433 is famous for its precessing jets which emit in optical lines as well as in the radio – and uniquely has measurements of both jet gas velocity (0.26 c), radio expansion rate and hence distance (4.8 kpc). Many objects show superluminal jets, giving rise to the term microquasars. The jets are generated in the inner region of an accretion disk responsible for the X-ray emission. The object responsible for the accretion requires a deep gravitational potential and is therefore a neutron star or black hole; perhaps the best candidate for a stellar mass black hole is Cygnus X-1 which also has radio jet. Jet properties are closely related to the X-rays – with flares produced at state changes and jet quenching occurring during the X-ray soft state. Work on a paper showing these effects in Cyg X-1 was done during the visit, and has been submitted to Monthly Notices of the RAS (Rushton et al.)

A few Northern latitude microquasars have been found to have sub-mm wave excesses (e.g. figs 1 and 2). Proposals for Early Science with ALMA were worked on in the STSM visit in collaboration with Anthony Rushton. We aim to study the mm-and sub-mm spectra of a sample of 6 Southern microquasars and also variability measurements of GRS1915+105.

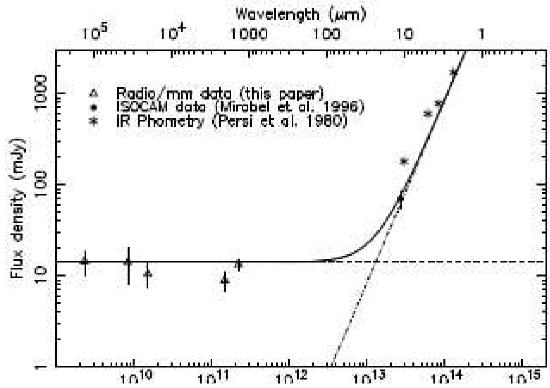

Figure 1 Radio – IR measurements of Cyg X-1 showing an IR excess from the OB supergiant companion. The non-thermal emission from the jet dominates even at sub-mm wavelengths (from Fender et al . 2000)

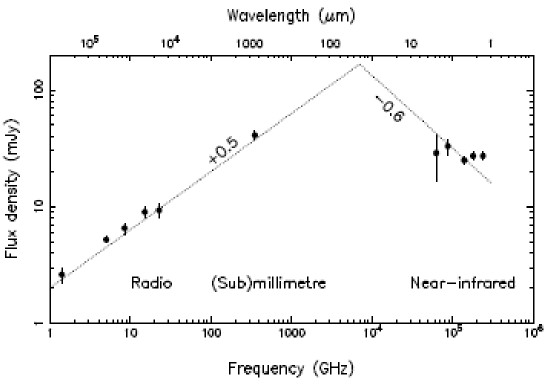

Figure 2 Radio-IR spectrum of XTE J118+480. Note the excess at sub-mm wavelengths which could be due to thermal emission from a stellar wind (from Fender et al 2001)

The sub-mm excess could be either via non-thermal emission from the jet itself (as seems to be the case in Cyg X-1) or from thermal emission from a wind. Optical depth effects in a jet mean that the higher frequency non-thermal emission comes from the more compact part of the jet – nearer the accretion disk and jet formation region. Our observations will hopefully tell us more on how jets are formed. The proposals were submitted on time by the deadline of June 30th.

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