Contribution ID: **389** Type: **Talk**

Rapid variations of polarisation in X-ray binaries

Monday, 7 December 2015 17:38 (21 minutes)

Recently, evidence for synchrotron emission in both black hole and neutron star X-ray binaries has been mounting, from optical/infrared spectral, polarimetric, and (possibly) fast timing signatures. Time-resolved optical and infrared polarimetric observations of X-ray binaries are presented. It is found that the infrared emission of GX 339-4 in the hard state contains variable polarization on timescales of < 60 seconds. In the first study of its kind, we present strictly simultaneous time-series X-ray, UV, optical, infrared polarimetry and radio observations of Cygnus X-2. Variability in the flux is tested for cross-correlations with all other wavelengths, and polarisation strength and angle is cross-correlated with flux variability. Correlated variability could be caused by a disc-jet coupling mechanism on short timescales. The results are compared to other neutron star XRBs such as Sco X-1, which also has a variable polarisation signature at optical/infrared wavelengths. The synchrotron emission of jets can be highly linearly polarised, depending on the configuration of the magnetic field, and the magnetic fields near the jet base in these systems appear to be turbulent, variable and aligned with the jet axis. This probes the physical conditions in the accretion (out)flow and demonstrates a new way of connecting inflow and outflow, using both rapid timing and polarisation. The implications for future measurements of X-ray polarisation are discussed. We also present a detection of polarisation in the quiescent black hole system Swift J1357.2-0933 which originates from its highly variable infrared emission. These results likely constrain the magnetic structure in the inner regions of the jets launched from accreting X-ray binaries.

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Session Classification: 14 - Disks and jets