eROSITA: ULX case (M. Middleton & T. Roberts)

i) The spectral evolution of individual ULXs indicates a continuum of 'states' (see Middleton et al. 2015a) which are best explained by the super-critical model of Shakura & Sunyaev (1973) with the addition of radiative transfer and geometrical beaming/collimation in an optically thick wind-cone (e.g. Poutanen et al. 2007; King 2009). The distribution of ULXs as a function of spectral hardness (hard flux/soft flux) should be uniform for a random (evenly distributed) likelihood of inclinations, with any deviations from this reflecting the geometry of the accretion flow/outflow *en-masse*. Such deviations result from beaming and the nature of the material (i.e. for Compton down-scattering) and can be compared to a theoretical, semi-analytical picture of radiatively driven winds which are dependent on the mass accretion rate from the secondary star.

- Naturally, testing the above is a strong function of how many ULXs we can detect, and how well we will detect them. Based on the distribution of spectral hardness in currently known and studied ULXs in the local Universe, we will determine how well sampled the distribution will be by *eROSITA* (which includes sources from a few × 10^{38} erg/s up to 10^{41} erg/s) through the sensitivity maps and XLFs/ULX spatial density.
- We will compare the predictions to (bespoke) simulations of radiative winds to determine the accuracy with which the nature of the accretion flow can be determined.

ii) Soft X-ray residuals in CCD quality spectra to best-fitting, physically motivated models have been identified with relativistically outflowing plasma (Middleton et al. 2014, 2015; Pinto et al. 2016; Walton et al. 216). These winds are a corollary of super-critical accretion and confirmed the long held belief that ULXs contained stellar mass compact objects. The strength of the residuals as a function of spectral hardness indicate that the geometry of the wind is equatorial (Middleton et al. 2015). Given the large response to soft X-rays, *eROSITA* is well-placed to study these features in more detail and once again, *en-masse*.

- Based on the observed features in well-studied ULXs we will simulate and determine the plausible constraints on the wind-speed, ionisation state etc. based on the distribution of sources in spectral hardness and luminosity (see above) with a natural focus on the softer sources (where the features are stronger).
- We will determine how the average structure of the wind can be determined from the *entire* distribution of ULXs and the strength of the features (i.e. telling us how the optical depth/speed etc. varies as a function of inclination). This will likely involve stacking procedures to ensure we can access high signal-to-noise without loss in spectral dynamic range.

iii) Three ULXs to-date have been identified as accreting pulsars with rotation periods of ~1s (Bachetti et al. 2014; Israel et al. 2016a, b; Fuerst et al. 2016). Such systems provide powerful new insights into the nature of neutron stars and finding more systems is of utmost importance. Given the transient nature of the pulsations (e.g. Bachetti et al. 2014), *eROSITA*'s all-sky survey is the *best* opportunity to find more of these systems in an unbiased way. Whilst the survey will indicate the likely lower limit of the ULX population composed of pulsars, the study of new, individual sources will help constrain surface field strengths (distinguishing between magnetar and lower field strength neutron stars) and test the standard sub-Eddington model of Ghosh & Lamb (1979).

- Based on the periods identified from existing ULX pulsars and a rough duty cycle we will simulate the likelihood of identifying new pulsars within the survey.
- As such systems are likely to be highly geometrically beamed (as they are at a higher super-Eddington ratio than a black hole for the same mass transfer rate) they may be the brightest objects in the survey (they are amongst the brightest of the known ULXs) providing high signal-to-noise spectra. Such spectra will indicate the presence or lack of residuals indicating an outflowing wind (see above) with modelling providing important clues to the energy budget of the system (and nature of the accretion disc). Based on existing models, we will simulate spectra for ULX pulsars within the *eROSITA* survey and determine the possible constraints on the nature of the winds in ULX pulsars.