2022 PhD Project

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The Galactic low mass X-ray binary population

Low-mass X-ray binaries (LMXBs) are compact binary systems in which a neutron star or stellar-mass black hole accretes material from a close, low-mass stellar companion. Interest in LMXBs has revolved mainly around accretion and relativistic jets, the neutron star equation of state, and strong-field gravity. Most studies of these systems have focused on individual sources. However, the overall population properties, and formation and evolution of these systems, also have wide-ranging consequences in many areas of astrophysics, including studies of transient at all wavelengths and gravitational wave sources.

Data such as the orbital period distribution, observationally inferred mass transfer rates, and duty cycles of their transient X-ray behaviour, provide constraints on the theory of how LMXBs form and evolve. Ideally, one wants a complete, uniformly-selected sample of systems, for which the observational selection effects can be quantified, in order to compare it to population synthesis models. A suitably well-defined sample can be constructed using wide-field hard X-ray data from *Swift*. The astrometric *Gaia* mission is also already providing distances and proper motions, leading to powerful new constraints on the properties of the Galactic LMXB population (the *Gaia* Early Data Release 3 is now available).

Project goals This project will focus on the observed properties of the Galactic LMXB population, and the constraints that they place on the evolution of these systems. The details of the research to be undertaken will be defined by the successful applicant, with guidance from the supervisor. The project will use mainly existing data, from e.g. *Gaia*, *Swift*/BAT, *Chandra*, and MeerKAT, but there is scope to propose for additional observations, especially with MeerKAT, the SAAO telescopes, and SALT.

Skills Basic programming skills and demonstrated research ability are required. Experience in observational or computational astrophysics will be an advantage.

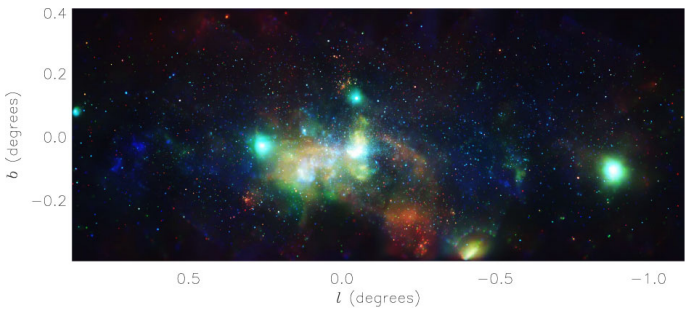

Figure 1. A *Chandra* X-ray image of the Galactic Center. Although this image covers less than 2 square degrees, it contains more than 9,000 point sources, the majority of which are accreting white dwarfs, while likely several hundred are LMXBs.