Master's/Bachelor's Thesis

Compact objects and hot gas in nearby galaxies

Figure 1: Left: eROSITA X-ray image of the LMC, with different colors indicating different photon energies. Right: X-ray (blue) + infrared (orange) composite image of M31.
Credit: Mayer, M. G. F., et al. 2025, A&A, in press (arXiv:2506.23698); ESA/Herschel/PACS/SPIRE/J. Fritz, U. Gent & ESA/XMM-Newton/EPIC/W. Pietsch, MPE

Galaxies are not only massive agglomerations of optically shining stars and cold gas, but are filled with hot and energetic sources emitting bright X-rays. Among these, the brightest sources are so-called X-ray binary systems, in which a neutron star or black hole accretes matter from a companion star, giving rise to a bright accretion disk of hot gas. In addition, the shock waves resulting from stellar explosions give rise to supernova remnants (SNRs), heating the surrounding gas to temperatures around 10^7 K, and producing X-ray emitting shells. The energy released by SNRs also gives rise to a diffuse component of hot gas in the interstellar medium (ISM), which in turn drives outflows and impacts star formation.

Multiple projects are available regarding source populations in nearby galaxies. On one hand, existing deep observations of nearby galaxies (e.g. M31/Andromeda) with the XMM-Newton telescope allow for sensitive studies of X-ray bright point sources. Thereby, the candidate will be able to study for instance the luminosity function or typical spectral properties of populations of X-ray binaries or SNRs. Alternatively, using recent data by the eROSITA all-sky survey, it is possible to study the truly diffuse emission in the nearby Large/Small Magellanic Clouds (LMC/SMC), and thereby constrain the energy content or metal enrichment of the hot ISM phase.

Skills acquired during this work:

- X-ray data analysis (XMM-Newton SAS/eROSITA eSASS)
- Spectral modelling
- Modelling of source populations

Interested? Please get in touch:

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