New techniques for unveiling fundamental parameters in neutron star harboring low-mass X-ray binaries

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Low mass X-ray binaries (LMXBs) harbour a low-mass donor star which transfers matter on to a compact object (typically a neutron star) via an accretion disc. Among them, transient systems spend most part of their lives in a faint, quiescent state, but show occasional outbursts where their X-ray luminosity increases several orders of magnitude. On the other hand, the so-called persistent systems are always X-ray active.

The combination of X-ray observations with optical photometry provides the first hint about the nature of the compact object early after the discovery, but in order to determine the full set of fundamental parameters of a LMXB the spectroscopic study of the companion star is fundamental, as it reveals the dynamical solution of the system. However, this task has been hampered so far in many systems due to several reasons: (i) the high contribution in the optical range of the accretion disc during the outburst completely veils the donor star features, sometimes even in quiescence; (ii) as the vast majority of these systems are located in the Galactic disc, they are sometimes found in crowded fields where interloper stars prevent a proper study.

In the recent years, our team has led the development of novel techniques to overcome these situations. In particular, I will review: (i) the Bowen technique, which has been successfully applied to a dozen of both persistent and transient systems during the outburst, revealing dynamical information of the donor while it is still veiled and (ii) the exploitation of the better spatial resolution inherent to the NIR observations as well as adaptive optics techniques to obtain phase-resolved spectra of systems placed in crowded fields. These novel methods have been successfully applied to classical systems as Sco X-1 and Aql X-1, unveiling their (until now) hidden fundamental parameters.

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