“Neutron Stars' Mass / Radius spectral measurements in quiescent LMXBs with Athena”

Alessio Marino[1], Nathalie Degenaar[2], Tiziana Di Salvo[1] et al.

[1]: Università degli Studi di Palermo, Dipartimento di Fisica e Chimica, via Archirafi 36 - 90123 Palermo, Italy
[2]: Anton Pannekoek Institute for Astronomy, University of Amsterdam, Postbus 94249, 1090 GE Amsterdam The Netherlands

Spectral modeling of quiescent Low Mass X-Ray Binaries hosting Neutron Stars (NSs) has been, for over a decade, one of the main techniques for measuring Mass and/or Radius of Neutron Stars and, in turn, constrain the Equation of state of ultra-dense matter. However, the quality of the analysed spectrum has a key-role in determining how effective and precise these estimates might be. Furthermore, this method is affected by several biases; the outcomes of the fit is highly dependent on the precision the distance to the source is known with, which is typically affected by a 10% uncertainty, and also the energy range over which the spectrum is extracted might play a part in determining them, as shown in Cheng et al., (2017), Marino et al. (2018) (*submitted*). It is then interesting to explore if such limits can be overcome with new instrumentation and, in particular, with ESA's Athena mission, whose large collective area at soft X-ray energies is expected to be very useful for obtaining NS mass and radius constraints from studying their quiescent thermal X-ray emission. A comparison between a Chandra observation and the simulated Athena spectrum of the field LMXB 4U 1608-52 shows that, while in the former case, a fit with a composite thermal plus power-law model is uneffective in giving valuable constraints on mass and radius parameters, in the second case mass and radius might be know with surprising precision (relative erros of 0,01-0,001%). Furthermore, the energy range it is not influent at all in simulated Athena spectra, according to a comparison between the spectral analysis performed on a Chandra data set of the LMXB EXO 0748-676 in two different energy ranges (0.3-10 keV and 0.5-10 keV, i.e.) and a simulated single Athena spectrum of the same source: while the results of the real data set is affected by the change in the energy range, the simulated spectrum is unsensitive to it. These results show how the coming of Athena may give a considerable boost in the near future to the search for constraints on the equation of state of ultra-dense matter via NS radius and mass measurements.