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X-ray Polarization in neutron stars and magnetars

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Over the recent years the scientific interest around Xray polarimetry has blossomed, thanks to the advent of the first instruments conceived to perform systematically these measurements in celestial sources.

The Imaging X-ray Polarimetry Explorer (IXPE, NASA), launched in December 2021, is opening a new window in Astronomy, adding for the first time polarimetry to the array of techniques to investigate systematically the X-ray sky. Looking beyond, we also expect to see in orbit the enhanced X-ray Timing and Polarimetry (eXTP) mission, which is a mission concept developed by an international Consortium led by the Institute of High Energy Physics of the Chinese Academy of Science, and expected to be launched in the next decade. The eXTP mission will also host on board an X-ray polarimetry, continuing and consolidating the path opened by IXPE, but this instrument will also be complemented to a powerful array of instruments capable to perform simultaneously high resolution X-ray timing and spectroscopic observations.

Highly magnetized sources, which are at the same time characterised by transient outburst and burst activity emission therefore represent key targets for these missions. In this talk I will show a few examples of the science potential of polarimetry data for studies of the physics and astrophysics of strongly magnetized objects, namely magnetars, accreting X-ray pulsars, and other classes of neutron stars, and for QED studies. I will present the very first X-ray spectro-polarimetry observation for a magnetar (4U 0142+61, as observed by IXPE), and possible interpretation(s).

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