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X-ray polarization from magnetar sources

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The launch of the IXPE telescope in late 2021 finally made polarization measurements in the 2-8 keV band a reality, more than 40 years after the pioneering observations of the OSO-8 satellite. In the first two years of operations, IXPE targeted more than 60 sources, including four magnetars, neutron stars with magnetic fields in the petaGauss range. In this presentation I will summarize the IXPE main findings and discuss their implications for the physics of ultra-magnetized neutron stars. Polarimetric observations confirmed theoretical predictions, according to which X-ray radiation from magnetar sources is highly polarized, up to ~80%, the highest value detected so far. This provides an independent confirmation that magnetars are indeed endowed with a super-strong magnetic field and that the twisted magnetosphere scenario is the most likely explanation for their soft X-ray emission. Polarization measurements allowed us to probe the physical conditions of the star's outermost layers, showing that the cooler surface regions are in a condensed state, with no atmosphere on top. Although no smoking-gun of vacuum QED effects was found, the phase-dependent behavior of the polarization angle strongly hints that vacuum birefringence is indeed at work in magnetar magnetospheres.

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