The INTEGRAL Legacy on Magnetars

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Abstract

Magnetars are isolated neutron stars powered by magnetic energy that are at the center of current research due to their relevance in several fields of physics and astronomy. They are characterised by remarkable variability at high energies, with a variety of phenomena spanning a broad range in luminosity and duration, from short millisecond bursts to outbursts lasting several months or even years. The unpredictable occurrence of these variable phenomena complicates their observation, but, thanks to the large sky coverage and good imaging, timing and spectroscopic capabilities of its instruments, INTEGRAL has given significant contributions in several aspects of the study of magnetars. I will review the most important of these contributions, which include: - the first detections of hard X-ray tails in the persistent emission, showing the relevance of resonant up-scatter by magnetospheric currents; - the observation in 2004 of the brightest giant flare from a Galactic magnetar, leading to the discovery of a previously unknown long lasting component of emission likely associated to the production of heavy elements through the r-process in material ejected from the neutron star crust; - the observation of a hard X-ray burst from SGR 1935+2154 simultaneous with a bright radio burst, that provided the first observational confirmation for the long-suspected connection between magnetars and the still unexplained class of fast radio bursts; - the discovery and rapid localisation of a magnetar giant flare in the nearby starburst galaxy M82 Most of these results were made possible by the implementation of the INTEGRAL Burst Alert System (IBAS) that, starting in 2002, was the first facility able to distribute in real time the positions of GRBs and other transients with arcminute accuracy, thanks to the continuous telemetry stream from the satellite immediately fed into a sophisticated ground-based analysis system.

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