Exploring subluminous X-ray binaries

Degenaar, N.D.

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Halfway the twentieth century, technological developments made it possible to carry detection instruments outside the absorbing layers of the Earth's atmosphere onboard rockets and satellites. This opened up the opportunity to detect the emission from celestial objects at X-ray wavelengths, thereby providing a window to study high energy phenomena in the Universe. The first X-ray source to be discovered outside the Solar system was Sco X-1, now known to be a member of a class of objects referred to as X-ray binaries. These are stellar binary systems in which a gravitationally collapsed object, either a neutron star or a black hole, consumes matter from its companion star. X-ray binaries provide a unique probe to test the laws of physics under extreme conditions, a basic quest of science. Neutron stars are a pure marvel representing matter at supra-nuclear densities in the presence of vigourous magnetic fields, conditions that are unattainable in laboratory experiments on Earth. Equally exciting, black holes form the ultimate testbeds for Einstein's theory of General Relativity.

Although constituting the brightest X-ray point sources observed in our Galaxy, X-ray binaries can actually be observed over a wide range of luminosities. Early X-ray missions allowed only the study of the most luminous X-ray sources, but instruments have increased in sensitivity by orders of magnitude over the past decades. Owing to their high spatial resolution and sensitivity, the current generation of X-ray imaging instruments carried onboard the satellites Chandra, XMM-Newton and Swift provide an unprecedented deep view of X-ray binaries. This thesis is devoted to exposing the properties of X-ray binaries at low luminosities, which have long been inaccessible due to limitations of X-ray instruments. This study covers three different phenomena: accretion outbursts and thermonuclear events occurring at low mass-accretion rates, and crust cooling of neutron stars once the accretion has ceased.

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