Variable spectrum of the X-Ray pulsar RX J0720.4-3125

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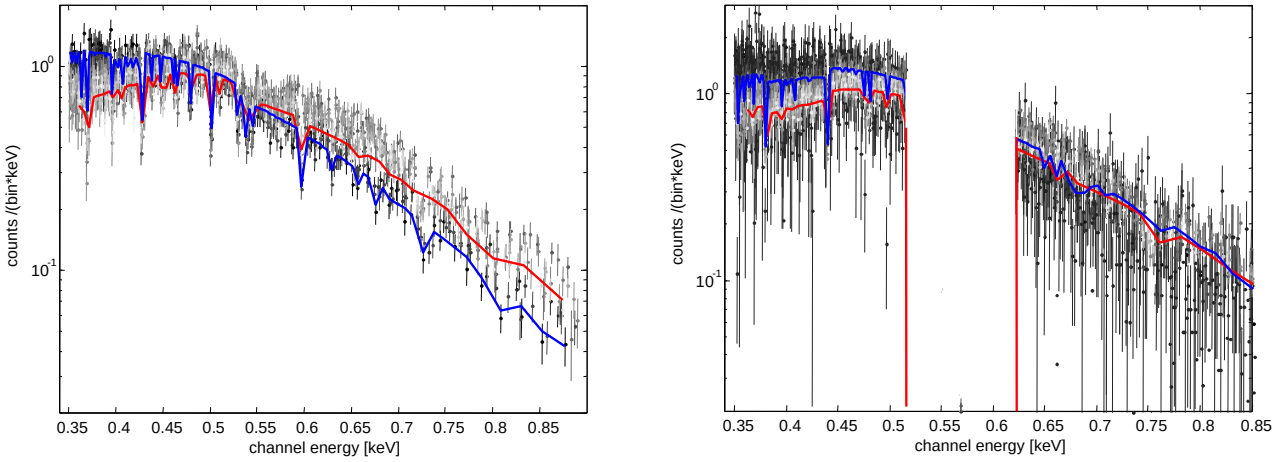
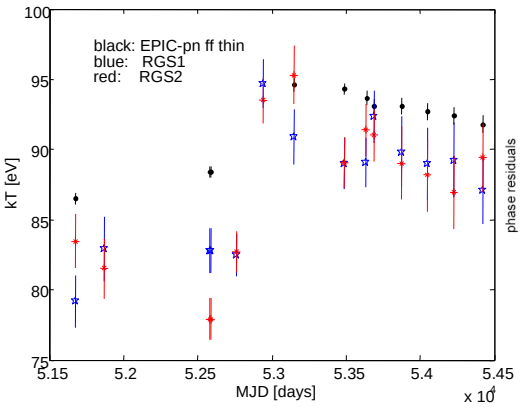
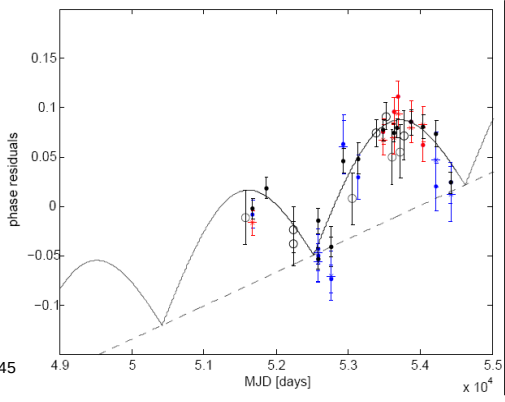
Abstract: RX J0720.4-31.25 is one of seven radio quiet, isolated neutron stars (often called the magnificent seven) with similar properties discovered during the ROSAT all-sky survey. The X-ray spectrum can be modelled with a blackbody and an gaussian absorption feature. This neutron star does not only show a short periodic variability – its spin period (P=8.3911153s), but also a long term variability in its spectral parameters (see de Vries et al., 2004; Vink et al., 2004; Haberl et al., 2006 and Hohle et al., 2009), i.e. its temperature, size of the emitting area and equivalent width of the absorption feature and a long term variability of its Period. The reason of this behaviour is still unknown, but might be evidence for precession or a glitch event around MJD=52800 days (Haberl et al., 2006 & Kerkwijk et al., 2007). Furthermore, there is an indication for an absorption line from highly ionised oxygen in the RGS spectra (Hambaryan et al.).



Top: The fourteen RGS (XMM-Newton) spectra from RX J0720 from RGS1 **(left)** and RGS2 **(right)**. Data points from the first observation are in black, the most recent spectra in light grey. The change of the spectra can clearly be seen for both cases: the blue line represents the model fit of the first observation, while the red line presents the fit of the last one.
Bottom left: Monitored variability of the temperature derived from XMM-Newton measured from EPIC-pn (eleven data sets in full frame mode with thin filter) together with the fourteen RGS1 and RGS2 data points (error bars denote 90% confidence level).
Bottom right: Applying the timing solution from Kaplan & Kerkwijk (2005) for the Period and its derivative leads to phase residuals, which likely follow a periodic variation. Black dots: EPIC-pn, red dots: EPIC-MOS1 small window and thin filter, red stars: EPIC-MOS2 small window and thin filter, blue dots: EPIC-MOS1 full frame and thin filter, blue stars: EPIC-MOS2 full frame and thin filter (all in hard band, i.e. 0.4-1.0keV); open circles show phase residuals from Chandra HRC (no energy selection) and ACIS (hard band).





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