The variable spectrum of RX J0720

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From roughly 2000 known neutron stars only seven show a thermal emitting spectrum. They are radio quite young isolated neutron stars (so called magnificent seven, M7), which are, unlike radio pulsars and other neutron stars, suitable to constrain the equation of state. Moreover neutron stars are sources of detectable gravitational waves.

RX J0720 is one of these close by M7 stars. It has a distance of 360^{+170}_{-90} parsec. This neutron star shows an absorption feature in the soft x-ray spectra around 300eV which is supposed to be caused by a proton cyclotron line. Since RX J0720 was observed, it shows a long term spectral variation in surfaces temperature around 85eV (see Fig. 1), equivalent width of the mentioned line and radius of the emitting area. Furthermore short term variability, a pulsation with a period of 8.4911s and its derivative pdot was measured.

If one folds the x-ray pulsation into phase applying given p and pdot, phase residuals are left with a period of (5.5±0.3) yr (see Fig. 2). This behaviour in the spectrum can be explained with precession of RX J0720. If one assumes, that, due to the magnetic field on the surface of the neutron star, are two hot spots on the poles, one can explain the changes shown in Fig. 1. Our investigations have the aim to derive a self consistent model, which can explain the behaviour of RX J0720 and do some predictions. This includes finding out, whether and why RX J0720 is precessing. We use data from the epic pn instrument on the XMM Newton x-ray telescope.

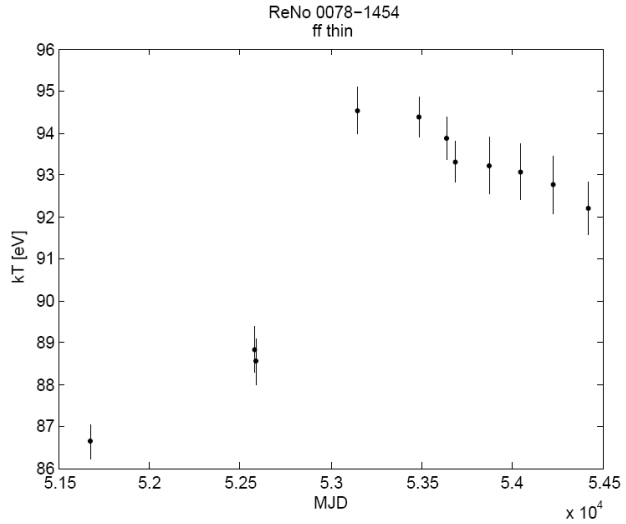

Figure 1. Variation of surface temperature if one applies a black body spectrum fit. The different temperatures of the two hot spots can not be resolved with the epic pn instrument.

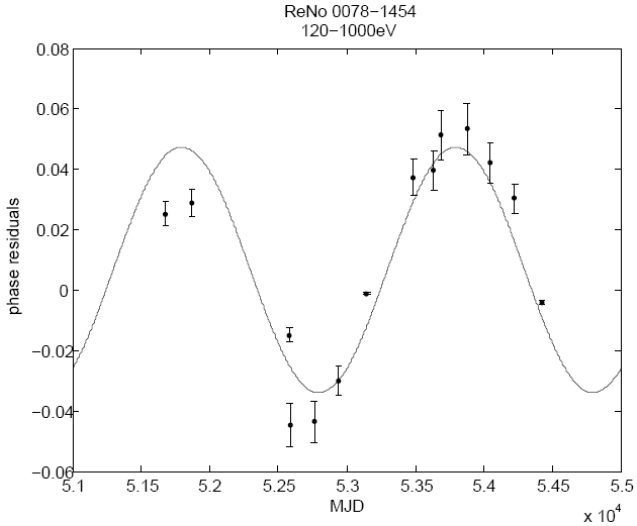

Figure 2. These phase residuals were obtained from the period solution from Kaplan & Kerkwijk (2005) and show a sinusoidal shape.