RXTE timing observations of SGR 0418+5729
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Data from (publicly available) monitoring observations with RXTE of SGR 0418+5729 covering a time span of about 2 months since its discovery on June 5, 2009 (ATEL #2077, GCN #9499) have been used to construct an accurate phase-coherent timing solution. Such an analysis requires the pulse profile to be stable during the monitoring period in order to obtain reliable pulse time-of-arrivals, TOAs.

In our study we noticed that the pulse-shape, using PCA PHA channels 5-27 (~2-11 keV), of SGR 0418+5729 changed since the first RXTE observation on MJD 54992.160 (June 10, 2009) till MJD 54996.021 (June 14, 2009).

As of MJD 54997.093 (June 15, 2009) the 5-27 PCA pulse profile is stable showing at least three emission peaks, two of them are narrow having a phase separation of only ~0.12. As template in the TOA correlation analysis we used the (5-27) PCA pulse-profile with the highest statistical quality as obtained on June 21, 2009 (MJD 55003.894-55004.103; 11.2 ks observation).

Surprisingly, we could NOT measure a significant value for the frequency time derivative over the ~50 days data period covering MJD 54997 - 55046! The pulse frequency we determine at epoch 54997.0 (TDB time scale; Swift XRT position of SGR 0418+5729 (ATEL #2127) used in barycentering process) and valid for the full MJD 54997 - 55046 interval is \( \nu = 0.1101517070(8) \) Hz. Our value is consistent with, but much more accurate than the value obtained by Gogus (ATEL #2076) who used only the first RXTE observation. Fitting two frequency parameters to the TOA set we obtained a 2 sigma lower limit on \( d\nu/dt \) of \(-3.32 \times 10^{-15}\) Hz/s. Adopting the canonical magnetic-dipole braking model the estimated two sigma upper-limit to the surface polar magnetic field is \( 5.04 \times 10^{13}\) Gauss, just above the quantum critical value of \( 4.413 \times 10^{13}\) Gauss and rather deviant from the established SGR group members. This value is also well below the magnetic field strength of AXP 1E2259+586, the magnetar with the currently known lowest field.

Note that the derived \( \nu, \nu_{\text{dot}} \) values place SGR 0418+5729 in a region of the period/period derivative diagram where XDINS and RRATS are located. Its X-ray spectrum as derived by Cummings et al. (ATEL #3127), a black body with a K of 0.92(2) keV, is also typical for XDINS. Finally, no pulsed emission has been detected above \( \sim 11\) keV.

Further deep X-ray monitoring observations are necessary to put tighter constraints on the timing parameters.