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XML	Transients
XML	SGRs
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RXTE timing observations of SGR 0418+5729

ATel #2151; [L. Kuiper \(SRON\) and W. Hermsen \(SRON/UvA\)](#)
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Subjects: X-ray, Neutron Stars, Soft Gamma-ray Repeaters, Transients
Referred to by ATel #: [2152](#), [2209](#)

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 $\dot{\nu} = 0.1101517070(8)$ 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 $-3.32E-15$ Hz/s. Adopting the canonical magnetic-dipole braking model the estimated two sigma upper-limit to the surface polar magnetic field is $5.04E13$ Gauss, just above the quantum critical value of $4.413E13$ 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 $\dot{\nu}$, $\dot{\nu}$ 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 #[2127](#)), a black body with a kT of 0.92(2) keV, is also typical for XDINS. Finally, no pulsed emission has been detected above ~11 keV.

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

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