RXTE timing observations of SGR 0418+5729

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Publication date
2009
Document Version
Final published version
Published in
The astronomer's telegram

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*on **6 Aug 2009; 14:37 UT***
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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 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 dNu/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 Nu, Nudot 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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