Deep Searches for Pulsations in SGR 1627-41 and 0526-66

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Abstract.
Deep searches for X-ray pulsations from SGR 1627-41 and SGR 0526-66 were performed with ASCA. SGR 1806-20 and 1900+14 were previously established as X-ray pulsars. SGR 0526-66 is suspected to be a strong candidate for a magnetar but X-ray pulsation have not confirmed yet. Detection of X-ray pulsations from SGR 1627-41 and SGR 526-66, is the key issue to the unified magnetar model of the SGRs. Although ASCA has done the deepest observations of $\sim$ 80 ks for both of them, we could not detect pulsations. The long-term period history of SGR 1900+14 is compared with a very similar change of AXP pulsar 1E1048.1-5937 in discussion.

INTRODUCTION

SGR 1900+14 and SGR 1806-20 are well established as X-ray pulsars. The rapid spin-downs of the order of 10^{-10} ss^{-1} with RXTE and ASCA suggest a magnetar origin of energy with magnetic field of $\sim 10^{15}$ Gauss [1,3,5]. Although SGR 0526-66 showed pulsations of 8.0 $\pm$ 0.05 s during the decay of the March 5th event [6], stable pulsations were not detected from the point-like X-ray source, which was discovered by ROSAT [7], in the supernova remnant (SNR) N49. SGR 1627-41 was discovered independently by the three instruments, BATSE, RXTE and Konus and was localized to a small error region [1,9]. The IPN3 error coincided with the SNR G337.0-0.1 [11] and the BeppoSAX observation of this region discovered an

X-ray source located inside the SNR [9,10]. The BeppoSAX observation suggested a probable pulsation of 6.41 s [9]. As two of the SGRs show stable pulsations and rapid spin-downs, if same physics is at work in all the SGRs, we expect to detect pulsations from others also.

OBSERVATIONAL RESULTS

SGR 1627-41

The observation of SGR 1627-41 was done from 1999 Feb. 26 to 28 in total of 73 ks using ASCA. ASCA observation found at least three X-ray sources in the FOV as shown in figure 1 and the brightest one coincided with the reported BeppoSAX position which is also within the IPN3-RXTE error box. We have searched for pulsations by FFT and pulse folding method at around 6.41 s but no pulsations were detected. The upper limit to the signal power at this period is 1.8% (rms) in 1 -10 keV [4]. However the spectrum is best represented by a power-law of photon-index -2.2 and this is similar to the plerionic X-ray pulsar SGR 1806-20. So still there is a possibility of detection of pulsation with a deeper observation.

SGR 0526-66

SGR 0526-66 was once observed in 1993 with ASCA. We made a new long observation in 1999 with 80 ks. The GIS-mode was set to a pulsar search mode in this observation. The PSF of the ASCA X-ray mirrors is poor, so we could not separate the SNR emission from the X-ray point source. Thus, we focused our pulsar

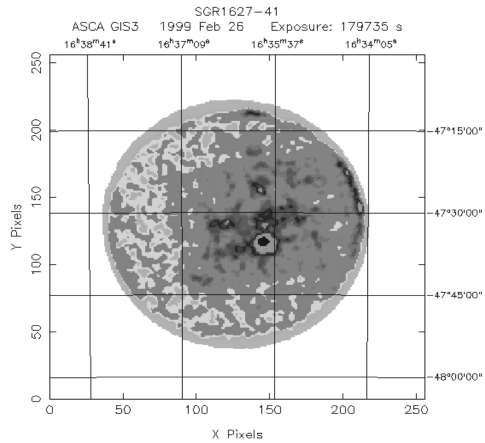

FIGURE 1. A raw image of the SGR 1627-41 region. At least three X-ray sources are seen. The brightest one is consistent with the IPN3-RXTE error.

search to higher energy band which is less contaminated from the SNR. Since 8.0 $\pm$ 0.05 s pulsation was reported before during the decay of the March 5th burst, we extensively searched for pulsations at around this period. However we could not find any pulsation. Moreover, the SIS X-ray spectrum of N49 can be explained without any harder component and therefore the presence of a plerionic pulsar like SGR 1806-20 is doubtful [12].

SGR 1900+14 and 1E1048.1-5937

Deep ASCA observations to search for pulsations from both SGRs gave negative results. A hard and power-law type spectrum of SGR 1627-41 still suggests a pulsar origin. All reported pulse periods of SGR 1900+14 are shown in figure 2. Three epochs can be seen in this figure. A change in the spin-down rate was first detected with the RXTE observation in June 1998 [2], before the giant burst on August 27. Since the first change at June 1998 coincided with the start of SGR activity, it is clear that the change was not a sudden jump. The change might be a change in the spin-down rate. However this fluctuation in the pulse period raised a doubt about the magnetar origins, which fully rely on the dipole-magnetic radiation of a single neutron star [14]. They alternatively suggest a possibility of a pulsar-wind with normal magnetic fields for the spin-down. The fast spin-down can be explained by a strong pulsar-wind, but we think that it is very difficult to explain the large amount of internal energy required for the SGR activity of an order of 10^{40-44} ergs by the pulsar-wind mechanism. Moreover the recent report by the Parkes multibeam observations, which discovered three radio pulsars with B $\sim$ 10^{14} Gauss [15], supports an existence of super-strong magnetic fields in neutron

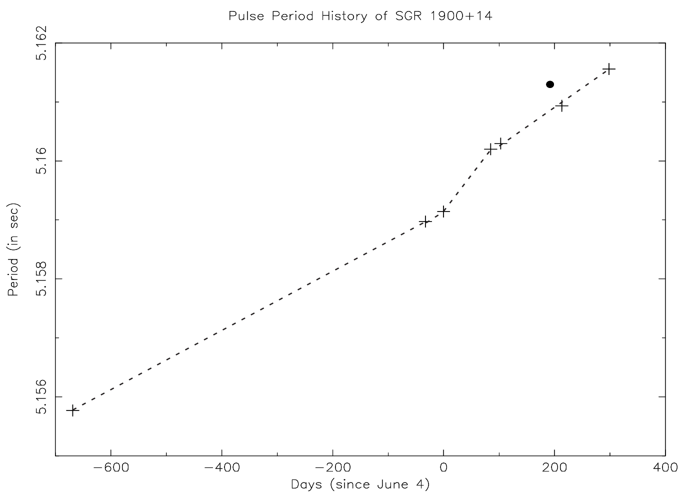

FIGURE 2. Pulse period history of SGR 1900+14. A filled circle is the radio observation by Shitov (IAUC7110). Three different epochs can be seen. One coincided with the start of SGR activity.

stars. A period history of 1E1048.1-5937 with ASCA is interesting. In the paper by B. Paul et al., [13] they claim that the rapid spin-down of 1E1048.1-5937 and lack of correlation between X-ray flux and the spin-down rate suggest absence of accretion and the changing in spin-down rate does not support the magnetar. We think that no correlation is also very hard to support the pulsar-wind models.
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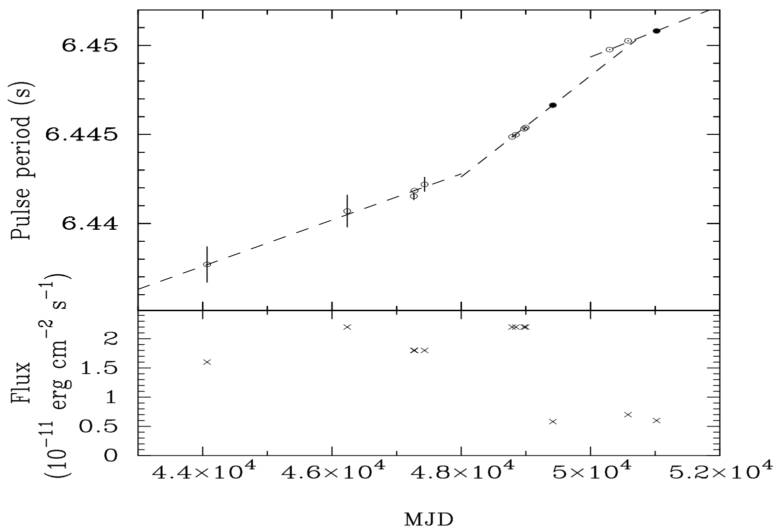

FIGURE 3. Pulse period and flux history of 1E1048.1-5937. The lines show three different epochs. Adopted from B. Paul et al., 1999.