X-ray Observation of the X-ray Burster 1A 1742-294 in the Galactic Center Region with *Suzaku*

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Abstract

The object 1A 1742-294 is a type I (thermonuclear) X-ray burster having the brightest persistent X-ray emission in the Galactic center region. After the first X-ray observation with *SAS-3* (MXB 1742-29), 1A 1742-294 has been observed with various X-ray satellites including *Granat*/ART-P (Lutovinov et al. 2001). On 12th March 2007, *Suzaku* observed 1A 1742-294 during the Galactic center survey with 27 ksec exposure. Both the XIS and HXD PIN detected five bursts. Thanks to high sensitivities of *Suzaku* instruments, *Suzaku* successfully detected 1/4th dimmer bursts than those by *Granat* at the flux of up to 10 mCrab level in the same bandpass. The persistent spectrum can be reproduced by a bremsstrahlung model with a temperature of > 27 keV, which is over 3 times larger than 7.8 keV reported by Lutovinov et al. (2001). The average color temperature of bursts lies in 2-3 keV, which are canonical values of type I X-ray bursts. The time profiles of the bursts are well characterized by a fast rise (7 sec) followed by a smooth exponential decay. The decay time depends on the X-ray energy; 29.7, 18.4 and 12.0 sec in the 0.2-4 keV, the 4-8 keV and the 8-12 keV band, respectively.

Key words: stars: individual (1A 1742-294, 2E 1742.9-2929) — X-rays: bursts

1. Introduction

Low Mass X-ray Binaries (LMXB) are binary systems consisting of neutron stars. Many of them show the X-ray burst phenomena. A H and/or He gas stream from a companion star accretes onto the surface of the neutron star, making a compressed and hot plasma. When the temperature of the plasma exceeds a thermonuclear threshold, the type-I X-ray burst occurs (Galloway et al. 2008).

LMXB 1A 1742-294 is one of the type-I X-ray burster, having the brightest persistent X-ray emission in the Galactic center region. The detailed reports of this object are the observations by *Granat* (Lutovinov et al., 2001; Churazov et al. 1995).

2. Observation

1A 1742-294 is observed with *Suzaku* during the Galactic center survey in AO-1 phase (PI: K.Koyama) on 12th March 2007 (MJD 54172) with its effective exposure time of 27 ksec. The object is detected on 6 arcmins away from the XIS nominal position.

Another X-ray burster named KS 1741-293 is contaminated in the field of view of the HXD PIN which has no imaging capability. In addition to Cosmic X-ray background and non X-ray backgrounds, the Galactic ridge emission is also included in the PIN data.

3. Analysis and Results

In addition to a persistent X-ray emission, XIS and HXD PIN detected 5 bursts during the observation as shown in Figure 1.

First, we analyze the spectrum of each burst averaged over its duration. Spectra of all the detected bursts can be reproduced by the black body model with a temperature of 1 - 2 keV as summarized in Table 1. The corresponding radius of the emission is smaller than the size of the neutron star.

Next, we checked the time profile of each burst. An example of light curve is shown in Fig.2. As shown in Table 1, all the light curves decay faster in higher energy band. This fact is well known phenomena by Lutovinov et.al (2001), and can be explained by a spectral changes by cooling plasmas.

Finally, we performed the time resolved spectral analyses by summing up whole bursts. The lower panels show the evolutions of temperature (kT), black body radius

Table 1. Spectral and timing profiles of all the bursts detected with *Suzaku*.

Burst # [1]		1	2	3	4	5
Temperature (keV) [2]		$1.53^{+0.04}_{-0.04}$	$1.58^{+0.06}_{-0.05}$	$1.55^{+0.12}_{-0.10}$	$1.95^{+0.10}_{-0.09}$	$1.57^{+0.09}_{-0.10}$
R (km) [3]		$3.6^{+1.6}_{-1.4}$	$2.8^{+1.2}_{-1.0}$	$1.9^{+1.2}_{-0.8}$	$2.3^{+1.0}_{-0.8}$	$3.4^{+2.2}_{-2.5}$
flux [4]		$7.08^{+0.13}_{-0.20}$	$4.70^{+0.19}_{-0.18}$	$1.89^{+0.10}_{-0.19}$	$6.56^{+0.27}_{-0.39}$	$5.41^{+0.42}_{-0.33}$
τ (sec) [5]	0.2 - 4 keV	33.16	38.29	41.68	22.18	13.22
	4- 8 keV	28.69	27.49	12.66	12.61	10.63
	8 - 12 keV	20.31	14.08	10.57	2.99	12.25

[1] Burst number as shown in Fig.1.
[2] Black body temperature to the averaged spectrum during the flare.
[3] Block body raduis assuming that the distance to the object is 8.5 kpc.
[4] Flux of total of each burst duration in unit of $\times 10^{-10}$ erg/cm^2/s (0.2 - 10 keV).
[5] Decay time scale of the light curve.

(R), and the flux, assuming that the distance to the object is 8.5 kpc. R calculated taking into account the fact that the color temperature appears to be higher than real one (effective temperature), because of scattering photons of black body by electrons (Ebisuzaki 1987). In Fig.3, we can see that the temperature is clearly getting lower as a function of time, and sat the same time, the plasma radius expands and slightly shrinks.

References

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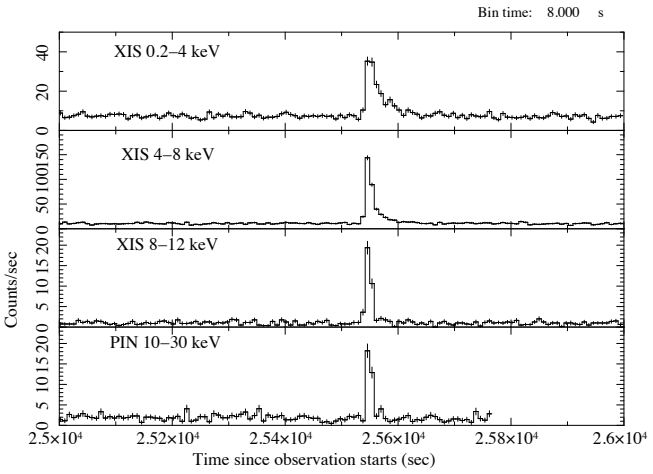

Fig. 2. Background-subtracted light curves of the No.4 burst. The x-axis shows the time since MJD 54172.0

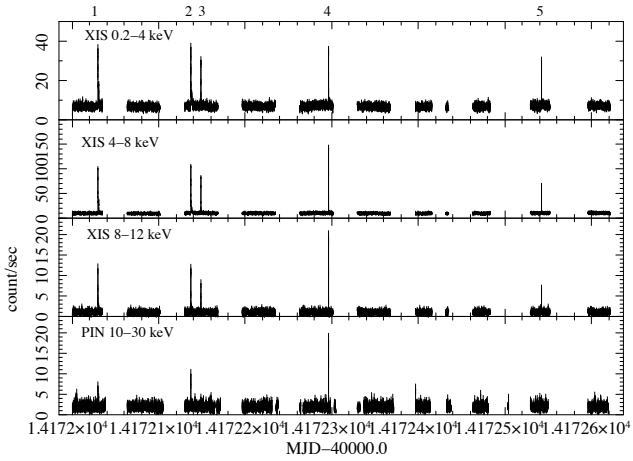

Fig. 1. Energy-resolved background-subtracted light curves of all the five bursts detected by the XIS and PIN. The burst numbers are putted on the plot.

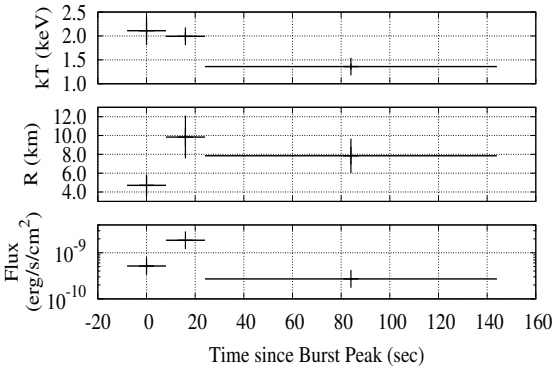

Fig. 3. The time evolutions of temperature (kT), radius (R), and the flux from fitting whole five bursts with black body model.