X-RAY BURSTS OBSERVED WITH JEM-X

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ABSTRACT

We report on the search for X-ray bursts in the JEM-X X-ray monitor on INTEGRAL during the first two years of operations. More than 350 bursts from 25 different type-I X-ray burst sources were found.

1. INTRODUCTION

Statistical studies of the occurrence of X-ray bursts may be used to provide information about the physics of accretion and the mechanisms responsible for the bursts [1,2].

2. DATA ANALYSIS

We have searched the public data of the JEM-X X-ray monitor [3,4] from the INTEGRAL [5] revolutions 40 to 292 for bursts (Feb 10, 2003 – Mar 07, 2005). JEM-X covers the energy range of 3-30 keV and has an effective field of view of ~5° radius, however with somewhat reduced sensitivity at large off-axis angles due to vignetting.

The bursts are visually identified in the raw detector light curves, and data intervals are selected including the burst and a corresponding reference interval. The burst source is then identified by imaging analysis.

The burst search and data analysis is done outside the regular ISDC OSA system. For the burst search we use parts of the JEM-X instrument monitoring system developed at the Danish National Space Center. The input to this system is the raw JEM-X housekeeping and science telemetry packets recorded by the JEM-X Instrument Station located at ISDC. The advantage of this system in searching for bursts is the interactive display of count rates and various housekeeping parameters in order to recognize events of varying time scales and to distinguish real X-ray events from spurious increases in background and other events related to the performance of the instrument. The system offers an easy point-and-click selection of burst candidates for further analysis.

For the imaging we use the stand-alone development version of the JEM-X imaging software used in the OSA software. The method used for detection of bursts is illustrated by a specific example in section 4.

3. RESULTS

More than 350 type I X-ray bursts were found. Bursts from 25 different sources were found. The 25 different sources are listed in Table 1 together with the number of bursts detected. One source, IGR J17254-3257, previously not known to be an X-ray burster, was found [6].

Table 1. List of the 25 Type I X-ray burst sources for which bursts have been detected with JEM-X in public data in INTEGRAL revolutions 40-292. (*Note that 4U 1730-335, the Rapid Burster, also shows numerous type II X-ray bursts)

Source name	**Number of bursts**	**Source name**	**Number of bursts**
4U 0836-42	34	SLX 1744-299	2
4U 1323-62	6	SLX 1744-300	21
4U 1608-522	6	GRS 1747-312	5
4U 1636-536	14	GX 3+1	26
4U 1702-429	7	1A 1742-294	54
4U 1705-440	3	4U 1812-12	1
IGR J17254-3257	1	4U 1820-303	1
4U 1724-307	14	GS 1826-24	13
GX 354-0	83	1H 1832-33	1
4U 1730-335	25*	Ser X-1	2
SLX 1735-269	5	Aql X-1	4
KS 1741-293	13	4U 1915-05	5
SAX J1747.0-2853	5		

4. NEW TYPE-I X-RAY BURSTER DISCOVERED: IGR J17254-3257

A new X-ray burster was discovered in the public archival data. The burst occurred on February 17 2004 at 19:44:00 in revolution 164, science window 76. The burst was found to be consistent with an origin from IGR J17254-3257 [6].

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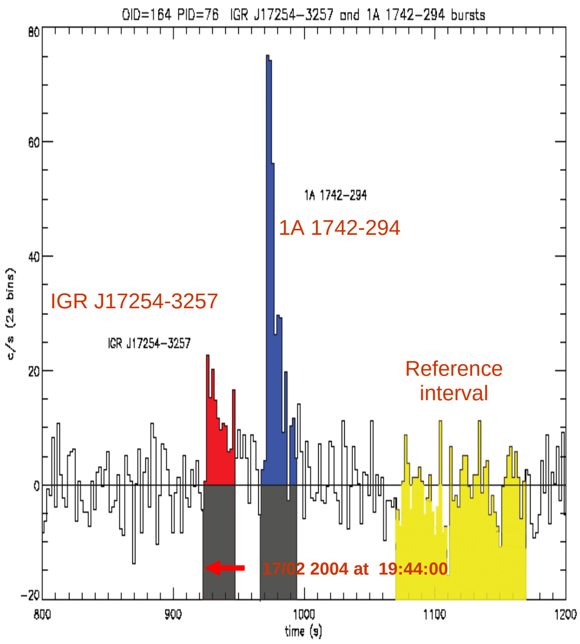

Fig. 1. Two X-ray bursts from IGR J17254-3257 and 1A 1742-294 are superposed in the JEM-X raw detector light curve (persistent emission and background subtracted) showing a total of 400 s of data from revolution 164, science window 76. Two 25 s intervals (shown in red for IGR J17254-3257 and in blue for 1A 1742-294), as well as a 80 s reference interval (shown in yellow) and the full 2500 s science window were selected for imaging. Parts of the resulting images are shown in fig. 2 and fig. 3.

In fig. 1 is shown the detector light curve during a 400 s interval. During this interval a well known Type-I X-ray burster, 1A 1742-294 [7], was also showing a burst.

In order to identify the origin of the two bursts in fig. 1, 25 s of data were selected around the bursts and for an 80 s reference interval with no burst activity, as well as 2500 s of data for the full science window.

The resulting images, which for the JEM-X field of view have a radius of 5º, were then used to identify IGR J17254-3257 as the source of the first burst and 1A 1742-294 as the source of the second burst.

In fig. 2 we show 30 by 30 arc minutes sections of the 4 images centered on the position of 1A 1742-294. The persistent emission of 1A 1742-294 is clearly detected in 2500 s, but not in the shorter intervals of 25 or 80 s.

In fig. 3 we show the 30 by 30 arc minutes image sections centered on IGR J17254-325, which clearly identify IGR J17254-325 as the source of the first burst in fig. 1. We also see that the persistent emission is too weak to be detected by JEM-X in one science window.

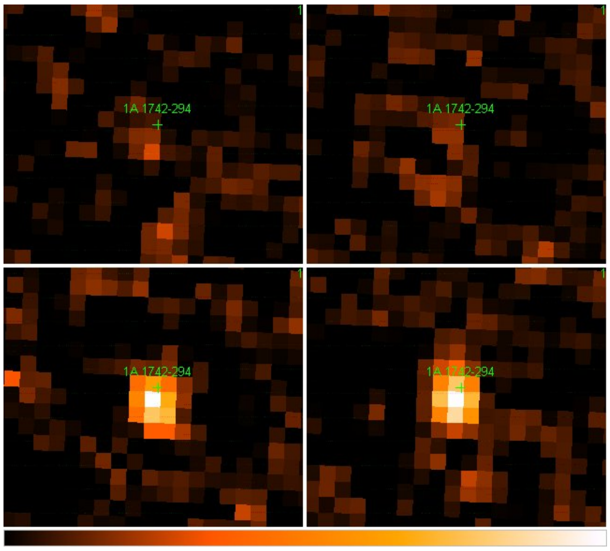

Fig. 2. Above are shown zooms centered around 1A 1742-294 of the 4 images from sampling 80 s of background (upper left), 25 s interval during the burst from IGR J17254-3257 (upper right), 25 s interval during the burst from 1A 1742-294 (lower left), and 2500 s of the full science window (lower right). The data are selected as indicated in fig. 1 of the raw light curve. The persistent emission from 1A 1742-294 is clearly seen in the 2500 s image, but not with an integration time of 25 or 80 s. The images each show an area of 30x30 arc minutes with a pixel size of 1.5 arc minutes. 1A 1742-294 is 2.1º off-axis.

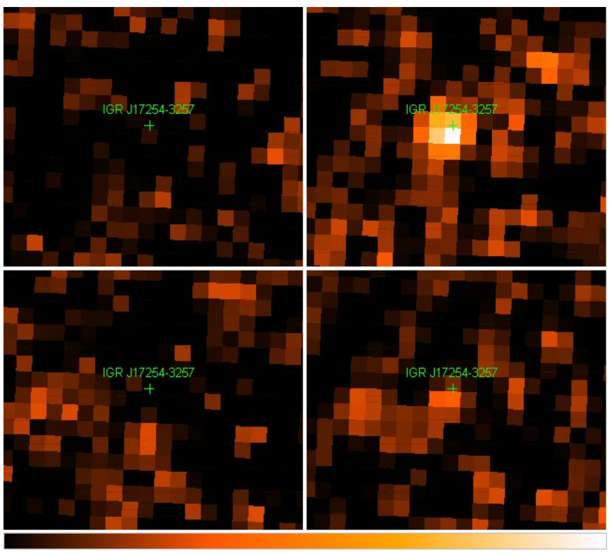

Fig. 3. Zooms around the source IGR J17254-3257 of the 4 images also forming the base of fig. 2. The images each show an area of 30x30 arc minutes with a pixel size of 1.5 arc minute. IGR J17254-3257 clearly shows up in the second image, and is thus confirmed as the source of the second burst seen in fig. 1. IGR J17254-3257 is 3.3º off-axis.

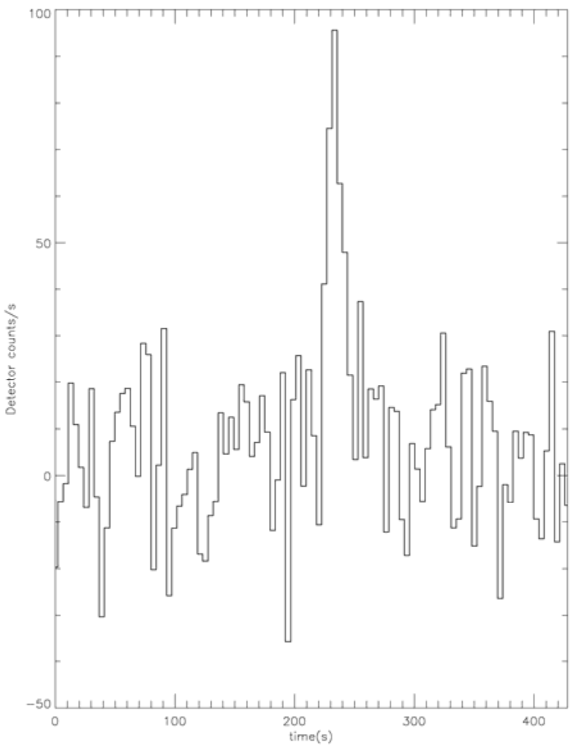

Fig. 4. The light curve of IGR J17254-3257 derived from the detector light curve shown in fig. 1 (note that the time axis has a slightly different offset). The burst reaches an intensity of ~0.8 Crab in the 3-30 keV band.

The derived light curve from IGR J17254-3257 is shown in fig. 4. The burst from IGR J17254-3257 had a rise time <5s and an e-folding decay time of ~15 seconds. The burst reached a peak flux of 0.8 Crab in the JEM-X 3-30 keV energy band. The persistent flux from IGR J17254-3257 is not detectable with JEM-X.

IGR J17254-3257 was discovered by INTEGRAL [8] and has been suggested identified with the ROSAT source 1RXS J172525.5-325717 [9]. The position of the burst detected by JEM-X is consistent with the ROSAT source within the JEM-X position accuracy, which is better than 1 arc minute.

5. CONCLUSIONS

A list of X-ray bursters identified in the INTEGRAL public data by the JEM-X X-ray monitor has been presented. The procedure of detection has been demonstrated by example of the newly discovered burst source IGR J17254-3257. More bursts are likely to be found with more sophisticated and complete analysis.

Details regarding the detection of individual events from the sources listed in Table 1 may be obtained by contacting the author.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

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