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TWO NEW X-RAY TRANSIENTS NEAR THE GALACTIC CENTRE

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ABSTRACT

Analysis of data obtained in 1989 with the X-ray widefield camera *TTM* of the *ROENTGEN–KVANT–MIR* observatory revealed the existence of two new X-ray transients: KS1732-273 and KS1741-293, the latter of which is situated in the error boxes of MXB1742-29 as well as MXB1743-29. Significant detections of KS1741-293 were made on 3 consecutive days during which it exhibited 2 bursts.

INTRODUCTION

A sky field of 6 x 6 degrees centered on the Galactic centre (GC) contains at least 17 X-ray point sources in the 3-10 keV energy band. In Table I these sources are listed. Most of these sources are strongly variable and till now only three of them have been classified as persistent sources. Possibly the three *EINSTEIN* sources are persistent also since they have been confirmed from *Spacelab 2 XRT* data (/8/). The same is true for SLX1744-299/300 and SLX1735-269: they have been confirmed from *TTM* data (see eg. /13/).

Most of the remaining sources in Table I are transients and burst sources. Due to the large error boxes of the burst sources these could possibly be identified with other point sources listed in Table I.

In this paper we present the discovery of two transient sources near the GC (KS1732-273 and KS1741-293) and discuss some of their characteristics.

OBSERVATIONS

The observations were carried out with the X-ray widefield camera *TTM* (/11/). This coded mask camera has a passband of 2-30 keV and a field of view of 16 x 16 square degrees full width to zero response (FWZR) at an angular resolution of 2 arcminutes at 6 keV. The instrument is located in the *KVANT* module of the Soviet manned space station *MIR* as part of the *ROENTGEN* X-ray observatory. Since its turn on in October 1988 the GC has been one of the prime targets.

The GC was observed on 12 days, most of them (9) in August 1989. The centre of the field of view was pointed either at the GC, GX1+4 or KS1731-260. This basically implies 3 different sensitivities for the GC region. The observation time is typically 20 minutes per orbit. Table II lists for each day the total observation time and the time span between the start of the first and the end of the last orbit when measurements were being carried out. In total, the GC was observed for about 15 hours.

RESULTS AND DISCUSSION

The data were combined into one image per day of observation in the energy passband 3-10 keV. Significant peaks were found in the images of 5 days at 2 positions where previously no point source was known. Table II lists for each observation day the detected fluxes for these two sources, in case of no detection a 3σ upper limit is given. As can be derived from Table II the two sources vary at least with about a factor 5, given the peak flux and the lowest upper limit found.

KS1732-273

As Table II shows KS1732-273 was detected on two days, March 20th and Sep. 4th 1989. The flux at both dates was comparable at 22 mCrabs (3-10 keV). A contour map of the immediate vicinity of the source is shown in Figure 1. KS1732-273 is situated near GX1+4 and the X-ray transient burst source KS1731-260, which was recently discovered by *TTM* (/12/). Using the known positions of GX354-0, GX5-1 and GX3+1, KS1732-273 was localized at:

$R.A. = 17^h\ 32^m\ 54^s$, $Dec. = -27°\ 23'\ 42''$ (1950.0 Equinox) or
$l_{II} = 0.°163$, $b_{II} = 2.°591$

with an error circle radius of 1' (90% confidence level).

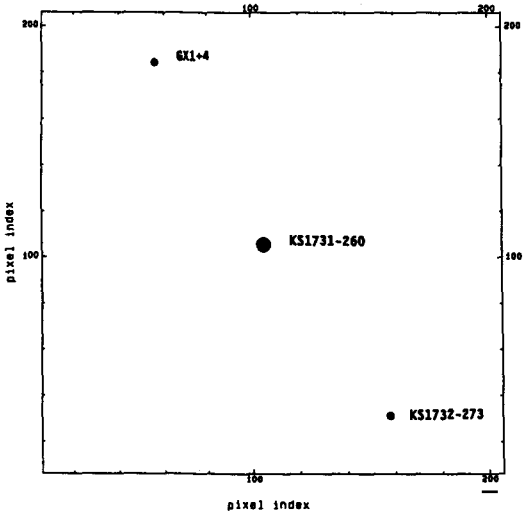

Fig. 1. Sources observed in the immediate neighbourhood of KS1732-273. Contours are given at significance levels of 5, 6, 7, 8, 10, 20, 30 σ. The sky coverage of this map is 3.1 x 3.1 square degrees.

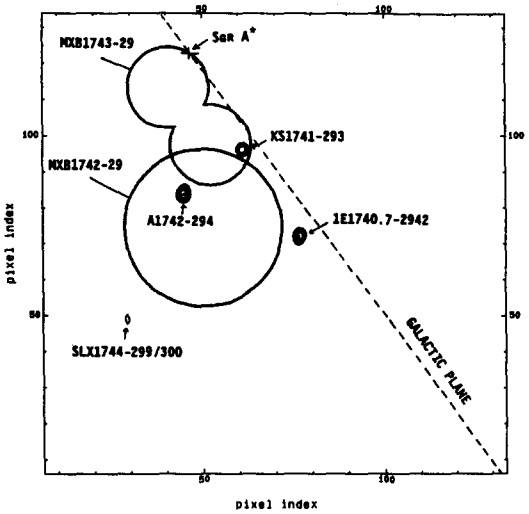

Fig. 2. Contour map of the region observed near the GC, where Sgr A West (not detected) is situated. Contours are given in significance steps of 0.5 in 5-8σ. Furthermore the error boxes of two SAS-3 burst sources are given. The new transient burst source KS1741-293 is inside the error box of MXB1743-29 and just outside that of MXB1742-29. The sky coverage of this map is 2.0 x 2.0 square degrees.*

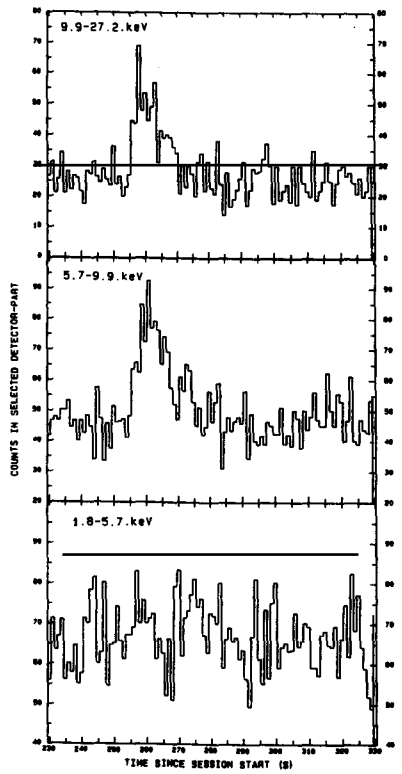

Fig. 3. Time profile of the second and most significant burst detection of KS1741-293 on August 22nd 1989. The intensity is given in raw counts per second, neither corrected for background radiation nor for dead time effects. A double peak structure, as observed by SAS-3 for MXB1743-29, is absent at a 99.7% confidence level.

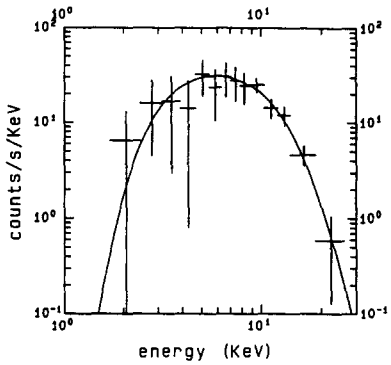

Fig. 4. Blackbody fit (solid curve) to the spectrum of the second burst of KS1741-293 during peak intensity. The best fit temperature is $kT = 2.8 \pm 0.5$ keV.

Table I: Known X-ray point sources (3-10 keV) in a 6 x 6 square degrees region centered on the Galactic centre

Source	Characteristic[1]	Ref.	Remark
4U1735-28	T (1971)	/1/	
GX3+1	P	[2]	
A1742-293	P	[2]	
A1742-289	T (1975)	/2/	
GX+0.2,-0.2	T (1976)	/2/, /3/	
GX+1.1,-1.0	T? (1976)	/3/	
MXB1742-29	B (1976)	/10/	Identification possible with A1742-294 and KS1741-293
MXB1743-29	B (1976)	/10/	Identification possible with 1E1742.5-2859 and KS1741-293
MXB1743-28	B (1976)	/10/	Identification possible with 1E1743.1-2843
H1743-32	T (1977)	/4/	
1E1740.7-2942	P?	/6/	Hardest source in region
1E1742.5-2859	P?	/7/	Coincident with Sgr A* West
1E1743.1-2843	P?	/7/	
SLX1732-304	P+B	/8/	Situated in Terzan 1
SLX1735-269	P?	/8/	
SLX1737-282	?	/8/	
SLX1744-299/300	P?	/9/	Double source
GS1741-282	T (1987)	/5/	
KS1732-273	T (1989)	This paper	
KS1741-293	T+B (1989)	This paper	

[1] P = Persistent source, T = Transient (between parentheses the year of detected appearance), B = burst source (between parentheses the year when the bursts were detected). If a question mark is given the characteristic is unclear.

[2] This source is referred to in many X-ray studies of the galactic centre region, see for a list in eg. /14/.

Table II: Some characteristics of the data on the GC and fluxes for KS1732-273 and KS1741-293. Columns: (1) = date of observation, (2) = Total Observation-time in s., (3) = Time span in hours (see text), (4) = Intensity in mCrabs (in case of no detection a 3σ upper limit is given), (5) = Significance of detection

			KS1732-273		KS1741-293	
(1)	(2)	(3)	(4)	(5)	(4)	(5)
21-Oct-88	2520	5	<10		<20	
20-Mar-89	4300	8	22	11	< 6	
1-Apr-89	2310	2	<15		<10	
16-Aug-89	5900	5 $\frac{1}{2}$	< 5		< 8	
20-Aug-89	7870	9 $\frac{1}{2}$	< 5		27	12
21-Aug-89	7200	9 $\frac{1}{2}$	< 5		28	10
22-Aug-89	7100	8	<10		23	15
23-Aug-89	6400	8	<10		< 5	
31-Aug-89	3670	5	< 7		<10	
3-Sep-89	1230	2	<10		<17	
4-Sep-89	3720	22	23	13	<11	
5-Sep-89	1720	5	<10		<15	

Table III: Parameters of 2 bursts (1 and 2) of KS1741-293.

Burst No.	1	2
Start time (days since Aug 1st, 0^h UT.)	19.56378	21.15758
Duration (s)	28 +/- 4	28 +/- 4
Number of counts	300 +/- 32	900 +/- 70
Peak flux (mCrab, 2-30 keV)	425 +/- 53	302 +/- 28
Blackbody temperature (keV)	2.5 +/- 0.5	2.8 +/- 0.5
Energy in 10^{39} ergs at an assumed distance of 10 kpc	6	4

Because of poor statistics it is difficult to determine the shape of the spectrum of KS1732-273 with reasonable accuracy. However, the shape is compatible with a thermal bremstrahlung spectrum with a temperature of about kT=3 keV and a hydrogen column density N_H of less than 10^{23} cm^{-2}.

The source could not be identified with any other source in any wavelength regime (SIMBAD database, Strassbourg, June 1990).

KS1741-293

This source was detected on three consecutive days (August 20-22, 1989) at a comparable flux level of about 26 mCrabs. A contour map of the observed vicinity of KS1741-293 is shown in Figure 2. KS1741-293 is located less than 0.5 degree from the galactic nucleus, at

R.A. = 17^h 41^m 38^s, *Dec.* = -29° 19' 53" (1950.0 Equinox) or
l_{II} = -0.°441, b_{II} = -0.°065

with an error circle radius of 1' (90% confidence level). With *TTM* the following sources were detected in the vicinity of the GC: A1742-294, 1E1740.7-2942, SLX1744-299/300, KS1741-293; not shown in Figure 2: 1E1743.1-2843, GX3+1, Terzan 1, SLX1735-269.

Shown in Figure 2 are also the error boxes of the burst sources detected in 1976 with *SAS 3* (/10/). KS1741-293 is located near the edges of both the (95% confidence level) error boxes of MXB1743-29 and MXB1742-29. KS1741-293 could therefore possibly be identified with either one burst source.

A thermal bremstrahlung fit to the total spectral data of KS1741-293 yields that the hydrogen column density must be less than $N_H = 10^{23}$ cm^{-2} and the temperature more than kT = 9 keV.

Bursts From KS1741-293

Two bursts were detected from KS1741-293, on August 20th and 22nd 1989. Characteristics of the bursts are given in Table III. Figure 3 displays the time profile of the second burst in three energy bands and Figure 4 the blackbody spectral fit to this burst at peak intensity. Details about the extraction of burst data can be found in /12,13/.

Because KS1741-293 may be identified with either MXB1742-29 or MXB1743-29, it is interesting to compare the time profile of bursts from the latter source with that of KS1741-293. Lewin *et al.* (/10/) reported a double peaked profile structure for 7 out of 8 bursts which they could attribute to MXB1743-29, the two peaks separated 6-8 seconds (depending on the energy band considered). The two bursts reported here do not show a double peaked time profile (see Figure 3). To check the significance of *not* observing the double peaked time profile as was the case for MXB1743-29 the time profile of the burst of KS1741-293 was binned in 3 s intervals in the energy band 8-19 keV (in this energy band the double peaked nature of the bursts observed with *SAS 3* is most prominent). Taking into account the expected peak separation and checking for all possible phases of the binning, it was found that the observed intensity ratio excludes a double peak structure in the *TTM* data at a confidence level of 99.7%, when compared with the minimum to maximum intensity ratio seen in the double peaked bursts reported by Lewin *et al.* (/10/).

The burst emitting area radii of the two bursts from KS1741-293 are comparable at $R = (6.0 \pm 0.5) \times (D/10\ kpc)\ km$, where D is the distance of KS1741-293 to Earth.

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