OBSERVATIONS OF THE GALACTIC CENTER REGION WITH BEPPO-SAX

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ABSTRACT

We are performing a survey of the Galactic Center region (Sidoli et al., 1998a) with the BeppoSAX satellite. Several known point sources are visible (including one at the position of SgrA*), as well as newly discovered sources and diffuse emission. Here we report the preliminary results of the on–going analysis of both the point sources and the diffuse X–ray emission.

KEYWORDS: X–ray; BeppoSAX; Galactic Center; compact sources; diffuse emission.

1. INTRODUCTION

The region ($|l| < 2^\circ$)×($|b| < 2^\circ$) around the Galactic Center was observed with the BeppoSAX satellite (Boella et al., 1997) during April 1997–1998 and August–September 1997 for a total of ∼120 hours of effective time exposure. An observation of the black hole candidate GRS1758–258 has also been obtained on April 10, 1997. Figure 1 shows a mosaic of the MECS images obtained during this project. In Table 1 we report the preliminary results of the spectral analysis of the point sources observed by the MECS instruments in the energy band 2–10 keV. Details on the analysis performed will be reported elsewhere (Sidoli et al., in preparation).

2. INDIVIDUAL SOURCES

X–ray emission from the core of the radio supernova remnant G0.9+0.1 was discovered in April 1997 (Mereghetti et al., 1998), confirming the composite morphology derived from the radio observations. A young, energetic pulsar in G0.9+0.1 could contribute to the unresolved gamma–ray excess observed by EGRET in the Galactic Center (Mayer-Hasselwander et al., 1998).

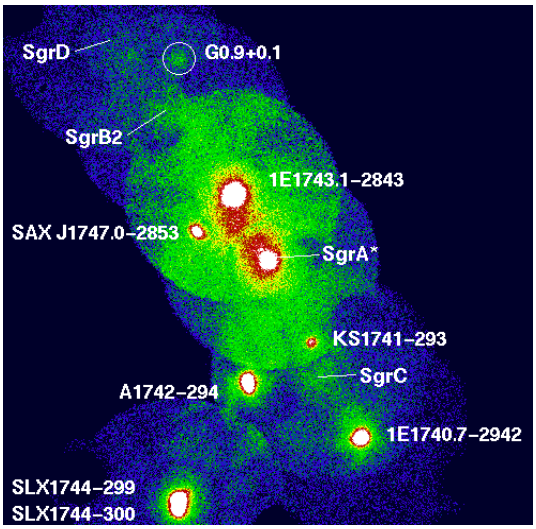

FIGURE 1. Image of the Galactic Center region ($|l| < 2^\circ$) in the 2–10 keV energy range, not corrected for the exposure. North is to the top and East to the left.

TABLE 1. INDIVIDUAL SOURCES: MECS Results of the Spectral Analysis (errors are 90% c.l.).

Source	Class[a]	Obs. date	N_H (10^{22} cm^{-2})	Parameter[b] of best fit	Flux[c]
G0.9+0.1	SNR	Apr/Sep 97	34^{+16}_{-9}	$\Gamma = 3.7^{+1.3}_{-1.0}$	$1.36^{+3.74}_{-0.72}$
Galactic Center[d]	UN	Aug 1997	7.0 ± 0.3	$kT_M = 4.1 \pm 0.3$	3.5 ± 0.2
1E1743.1–2843	UN	Apr 1998	13 ± 0.5	$kT_{bb} = 1.78 \pm 0.03$	16.5 ± 0.3
SAX J1747.0–2853	NS	Apr 1998	8.3 ± 0.6	$kT_{br} = 6.1 \pm 0.9$	4.0 ± 0.3
KS1741–293	NS	Mar 1998	20 ± 0.2	$kT_{br} = 11 \pm 3$	13 ± 1
1E1740.7–2942	BHC	Sep 1997	14.7 ± 0.4	$\Gamma = 1.52 \pm 0.04$	47.4 ± 0.04
SLX1744–299	NS	Sep 1997	5.1 ± 0.2	$\Gamma = 2.1 \pm 0.1$	20 ± 0.4
SLX1744–300	NS	Sep 1997	5.3 ± 0.2	$\Gamma = 2.2 \pm 0.1$	12 ± 0.3
GRS1758–258	BHC	Apr 1997	1.44 ± 0.1	$\Gamma = 1.55 \pm 0.03$	30 ± 0.2

[a]Class: BHC=black hole candidate; NS=neutron star; SNR=supernova remnant; UN=unknown;
[b] Power law photon index (Γ) or temperatures in keV for a black body (T_{bb}), bremsstrahlung (T_{br}) and emission from hot gas (T_M, MEKAL in XSPEC).
[c]Unabsorbed fluxes are in the energy band 2–10 keV in units of 10^{-11} ergs cm^{-2} s^{-1}.
[d]The total contribution of the sources within $\sim 2'$ from the Galactic Center (see text).

A type I X–ray burst from SAX J1747.0–2853, an X–ray transient recently rediscovered with the WFC on-board BeppoSAX (in't Zand et al. 1998b, Bazzano et al. 1998) and positionally coincident with the X–ray transient GX 0.2–0.2, has been detected with both MECS (Sidoli et al., 1998b) and PDS on April 15, 1998. The burst light curve is shown in Fig. 2 as well as the luminosity, temperature and neutron star radius variations during the burst.

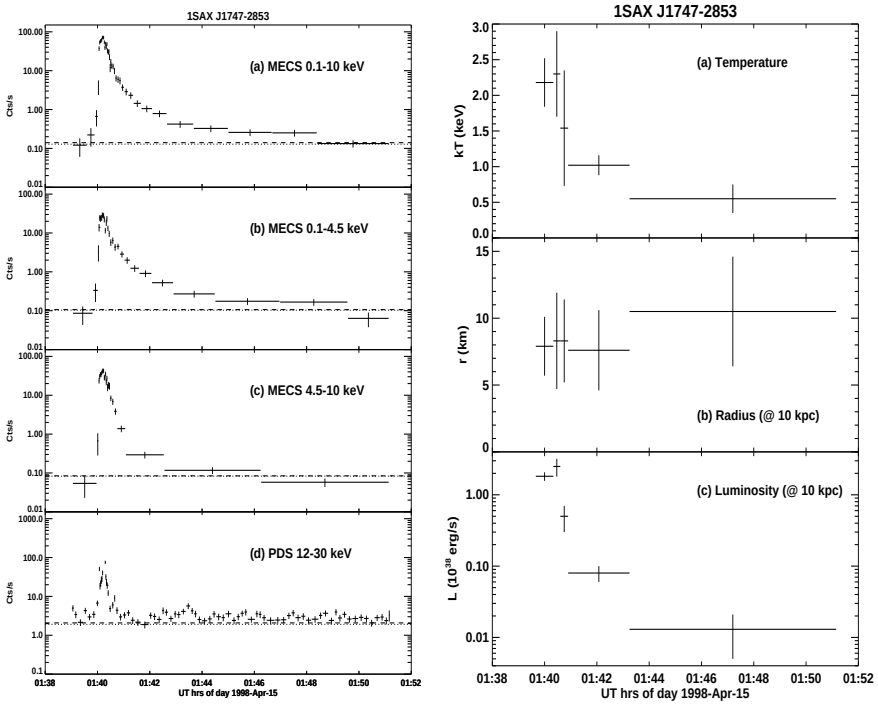

FIGURE 2. Left panel: Light curve of the burst detected with the MECS and PDS from SAX J1747.0–2853. The dotted and dashed lines indicate the level of the persistent emission in the contiguous interval respectively before and after the burst. Right panel: Results obtained by fitting the burst emission in different time intervals with a blackbody spectrum.

The transient activity of a source positionally coincident with the burster KS1741–293 (in't Zand et al., 1998a) has been detected during the observation pointed on the molecular cloud SgrC. In March 1998 it had an X-ray luminosity (2–10 keV) $L_X \sim 10^{36}$ erg s^{-1}, while in September 1997 it was under the threshold of detectability ($L_X < 10^{35}$ erg s^{-1}).The 0.1–200 keV spectra of the two black hole candidates 1E1740.7–2942 and GRS1758–258 have been fitted using LECS, MECS and PDS data. 1E1740.7–2942, observed in September 1996 and exactly one year later, did not show strong flux variability. For both sources a Sunyaev and Titarchuk comptonization model fitted the data better than a simple power law. For 1E1740.7–2942

the parameters are: $N_H = 1.46 \pm 0.02 \times 10^{23}$ cm^{-2}, $T = 24 \pm 1$ keV, $\tau = 5.5 \pm 0.1$ and unabsorbed flux $F_{2-10} \sim 5 \times 10^{-10}$ ergs cm^{-2} s^{-1} ($\chi^2 = 1.3$, 282 d.o.f.). The corresponding values for GRS1758–2588 are: $N_H = 0.18 \pm 0.01 \times 10^{23}$ cm^{-2}, $T = 32 \pm 4$ keV, $\tau = 4 \pm 0.3$ and $F_{2-10} \sim 3.5 \times 10^{-10}$ ergs cm^{-2} s^{-1} ($\chi^2 = 1.05$, 748 d.o.f.).

3. SgrA.

The possible existence of an X–ray counterpart of the radio source SgrA*, the dynamical center of the Galaxy, is still an open issue. The Einstein Observatory source 1E 1742.5–2859 (Watson et al., 1981) was later resolved into three sources by ROSAT PSPC (Predehl & Trumper, 1994). One of these sources, highly absorbed and located within $10''$ from Sgr A*, is very likely associated with it. About $1.5'$ SW of SgrA* ASCA revealed a harder source, possibly the quiescent state of the bright soft X-ray transient A1742-289 (Maeda et al. 1996, but see also Kennea & Skinner 1996). The flux reported in Table 1 refers to the total contribution of the sources within $\sim 2'$ from the Galactic Center. Indeed the BeppoSAX spatial resolution hampers a detailed analysis of the single sources present in this region.

4. DIFFUSE X–RAY EMISSION.

The MECS spectrum of the diffuse emission in a circular corona from $2'$ to $8'$ around the Galactic Center is thermal (kT$\sim$7 keV, $N_H \sim 4 \times 10^{22}$ cm^{-2}) and contains several emission lines, with the K-lines from iron and sulfur particularly bright. The corresponding luminosity is $\sim 10^{36}$ ergs s^{-1}, while the luminosity of the other three molecular clouds (SgrB2, SgrC and SgrD) within $8'$ from the center of their emission ranges from 0.1 to 0.3×10^{36} ergs s^{-1}. The X–ray diffuse emission detected from the direction of these molecular clouds is harder and the intensity of the emission lines weaker with respect to SgrA. A 6.4 keV fluorescent iron line is detected and is found to be particularly strong in the direction of the molecular cloud SgrB2.

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