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Three years progress of the XMM-Newton Galactic Centre/Plane Survey

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Abstract. *XMM-Newton* EPIC has conducted surveys of both the Galactic Centre Regions ($-1^\circ < l_{\rm II} < 1^\circ$) and the Galactic Plane ($-0\overset{\circ}{.}25 < b_{\rm II} < 0\overset{\circ}{.}25$ and $19^\circ < l_{\rm II} < 22^\circ$). We report the progress of these survey projects over the last three years. Using the Plane survey, we have derived the Log$N$-Log$S$ relation for the X-ray point sources and modelled the results in terms of distinct Galactic source population. In the case of the Centre survey, here we concentrate on several topics including a peculiar transient source XMM J174544−2913.0, the supernova remnant Sgr A East, a non-thermal X-ray/radio filament XMM J174540−2904.5, and the unusual radio source Sgr C.

Key words. Galactic Centre – X-rays: stars – X-rays: supernova remnants

1. The Galactic Plane Survey

The first *XMM-Newton* Galactic Plane Survey was carried out in the Scutum Arm region ($19^\circ < l_{\rm II} < 22^\circ$) to study mainly the X-ray source population and the Galactic Ridge X-ray Emission (GRXE). We have developed source detection and flux evaluation algorithms and derived the Log$N$-Log$S$ relation of the X-ray sources. The *XMM-Newton* measurements fill a gap in flux terms between the high and low flux-end of source distribution measured in earlier surveys (Sugizaki et al. 2001; Ebisawa et al. 2001) We have succeeded in modelling the composite Log$N$-Log$S$ relation with the three components, i.e., the high and low luminosity Galactic populations and extragalactic sources. The contribution of the extragalactic sources becomes significant below 10^{-13} erg s^{-1} cm^{-2} (2–10 keV). Another most remarkable discovery is the detection of diffuse X-rays from four $H_{\rm II}$ regions in this region. A group of high-mass stars and/or pre-mainsequence stars may contribute to this emission. The details are presented in Hands (2003) and Hands et al. (2004).

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2. The Galactic Centre Survey

The Galactic Centre (GC) Survey was carried out during the period between 2000 and 2001 encompassing the region $-1^\circ < l_{\rm II} < 1^\circ$ and $-0\overset{\circ}{.}25 < b_{\rm II} < 0\overset{\circ}{.}25$. After the screening the exposure varies from field to field from 5 ks to 20 ks due to variable background in each observation. The full mosaic images of the survey in various energy bands and the detailed results on Sgr A* are presented by Decourchelle (2004) and Goldoni (2004), respectively, in this volume. Here we present some of the high-

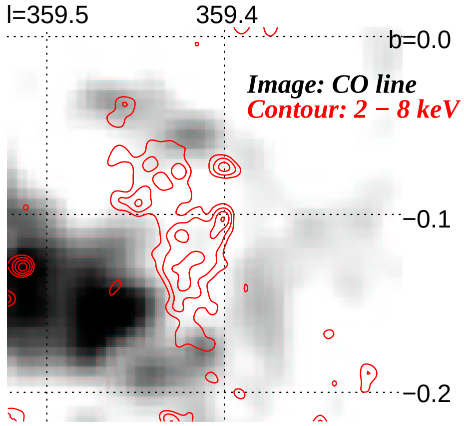

Fig. 1. The CO line emission ($-70 < V < -60$ km s^{-1}) (Tsuboi et al. 1999) overlaid with the *XMM* 2–8 keV contour.

lights from the results of the discrete source survey.

We have detected a number of point and diffuse X-ray sources, including Sgr A East, 1E 1740.7−2942, G0.9+0.1, the Arches cluster, Sgr B2 and C. In particular, we have found a number of transient sources, comparing the different field of views and/or *Chandra* GC survey image. Among these we have discovered an extremely strong K-line from helium-like iron at 6.7 keV from one of the transient sources, XMM J174544−2913.0. The equivalent width is ~2.4 keV. A cataclysmic variable with a peculiar geometry may be the most probable explanation (Sakano et al. 2004), although other possibilities are not totally excluded. This probably represents a new faint X-ray source population, which may contribute significantly to the GRXE.

From Sgr A East, which is a radio supernova remnant surrounding Sgr A*, thermal X-ray emission with an unusually high temperature of ~4 keV is detected. We also found the iron abundance in the core region to be ~4 solar, compared to <1 solar in the surrounding region. For contrast the spatial distribution of the other metals is nearly uniform. The special environment in the GC region may have given rise to these peculiar characteristics.

We have discovered an extended X-ray source, XMM J174540−2904.5, coincident with a non-thermal filament seen as a radio 'wisp'. The X-ray emission also appears to be non-thermal, implying that this source is the first X-ray/radio non-thermal X-ray filament seen in the GC region with an unequivocally non-thermal X-ray spectrum. The shape of the broad-band spectrum suggests its synchrotron emission process (Sakano et al. 2003).

From the Sgr C region we have detected an extended thermal X-ray emission, which apparently fills the "cavity" of the radio molecular cloud (Fig.1). Interestingly the radio continuum emission is weak in this region. Nevertheless this morphology suggests that an explosion (presumably a supernova) has occurred in the dense molecular cloud, and created a high-temperature cavity.

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