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An X-ray view of Sagittarius C

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Abstract. Over the past 15 years, the molecular complex Sgr C has been repeatedly observed with both *XMM-Newton* and *Chandra*. These observations reveal new features indicating that the region might be more complex than previously thought. We find that its strong iron line emission at 6.4 keV varies significantly over time, which supports the X-ray reflection scenario.

Keywords. Galaxy: center, ISM: reflection nebulae, X-rays: ISM

1. The molecular complex Sagittarius C

The molecular complex Sagittarius C (Sgr C) is located approximately 0.5 degree away from the centre of the Milky Way. This is a key position to investigate the high-energy processes ongoing in the central molecular zone and their link with the past activity of the supermassive black hole Sgr $A^\star$ (Ponti *et al.* 2013). Sgr C has therefore been repeatedly observed with various X-ray observatories. *Suzaku* notably revealed that it hosts a supernova remnant (SNR) candidate associated with a chimney-like outflow structure bright in the S XV Kα line (Tsuru *et al.* 2009). Observations performed with *Chandra* and *XMM-Newton* between 2000 and 2014 are now unveiling a more complex morphology for its thermal diffuse emission. In particular, using *Herschel* far-infrared data to trace the dense gas (Molinari *et al.* 2011), we find that the spatial correlation between molecular material and the edge of the SNR candidate G359.41–0.12 reported by Tsuru *et al.* (2009) is actually limited to the Galactic-northeastern portion of the SNR (Fig. 1, left). This indicates that its sharp, boomerang-like shape cannot be fully explained neither by absorption nor by dense gas preventing the plasma to expand further out. Besides, we discover a non-thermal comet-like X-ray feature within 30 arcsec of G359.40–0.08, another cometary X-ray filament already identified by Johnson *et al.* (2009). Their morphology and spectrum indicate that they are likely pulsar wind nebulae. Their proximity to each other and to the SNR candidate is puzzling and suggests that the origin of the Chimney is more complex than a simple outflow associated with the SNR. It also indicates that G359.41–0.12 itself may be more than a single SNR, as has already been suggested by Ponti *et al.* (2015).

2. Variability of the iron Kα line

The non-thermal diffuse emission from Sgr C consists of a Compton reflection continuum and a strong Fe Kα line at 6.4 keV. *Chandra* and *XMM-Newton* observations show that its morphology is similar to previous descriptions based on *Suzaku* data (Nakajima *et al.* 2009, Ryu *et al.* 2013). They also reveal a short-term variability together with an apparent motion of the Fe Kα emitting features towards the Galactic west (Fig. 1, right).

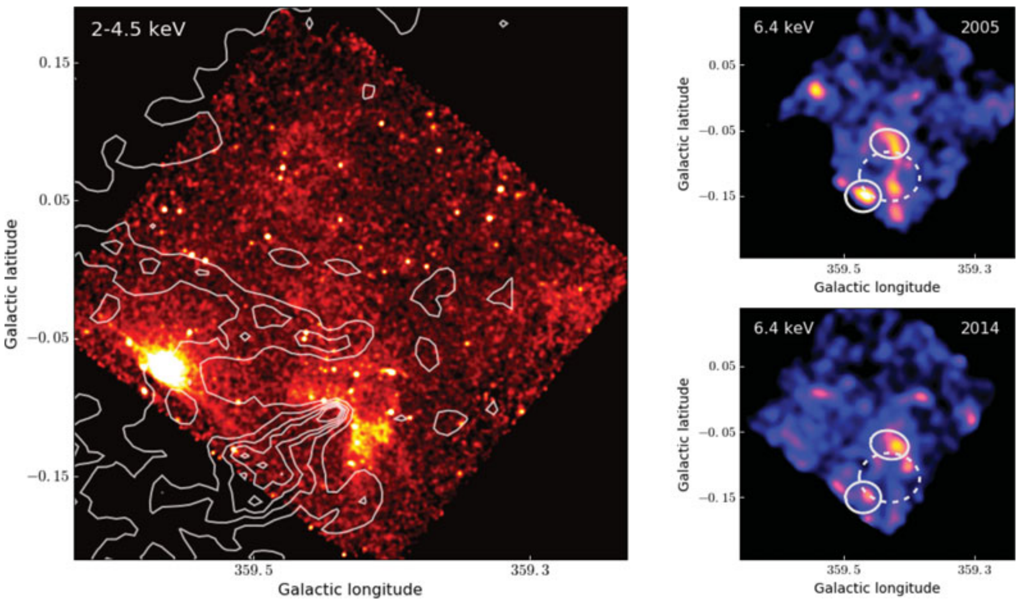

Figure 1. *Chandra* view of Sgr C in the 2-4.5 keV and 6.4 keV bands. The bright clumps M359.43–0.07 and M359.47–0.15 are marked by the solid ellipses. The dotted ellipse indicates the region G359.41–0.12 used to estimate the local diffuse emission. HI column density contours inferred from *Herschel* data are overlaid on the 2-4.5 keV image.

This short-term variability is comparable to what has been observed in Sgr B2 and in the Sgr A complex (Terrier *et al.* 2010, Ponti *et al.* 2010, Clavel *et al.* 2013). In order to study it more quantitatively, we determine the flux in the Fe Kα line by fitting spectra extracted in the main regions identified by Nakajima *et al.* (2009): two bright clumps spatially associated with molecular clouds (M359.43–0.07 and M359.47–0.15) and G359.41–0.12 that is used as a control region. After blank-sky spectra subtraction, spectral fits are carried out using a model composed of two thermal plasmas with $kT \sim$ 1 keV and $kT \sim 7$ keV, an absorbed power-law and an unabsorbed gaussian line at 6.4 keV. The results reveal a statistically significant time variability in all three regions (at a 99% confidence level). This strongly suggests that the 6.4 keV emission from Sgr C is due to X-ray reflection, probably due to past flares from Sgr A*, rather than to cosmic-ray irradiation, even if we cannot rule out that low-energy cosmic rays might contribute to the much fainter local diffuse emission.

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