eROSITA narrowband maps at the energies of soft X-ray emission lines

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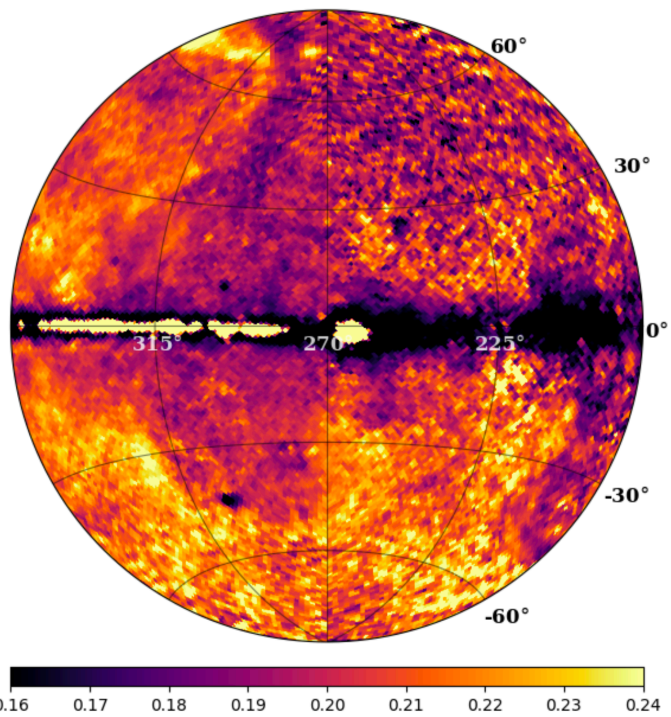
01.Abstract

This work presents the SRG/eROSITA eRASS1 half sky maps, for first time, in narrow energy bands corresponding to soft X-ray lines, O VII and O VIII.

We used the line ratio as a proxy to constrain the temperature of the warm-hot CGM, and we defined a pseudo-temperature $\mathcal{T}$ map based on the CIE assumption. The map highlights how different regions are dominated by different thermal components;

By examining the pseudo-temperature distribution, we find the constrain of temperature distribution of the CGM and on inner eROSITA bubble region.



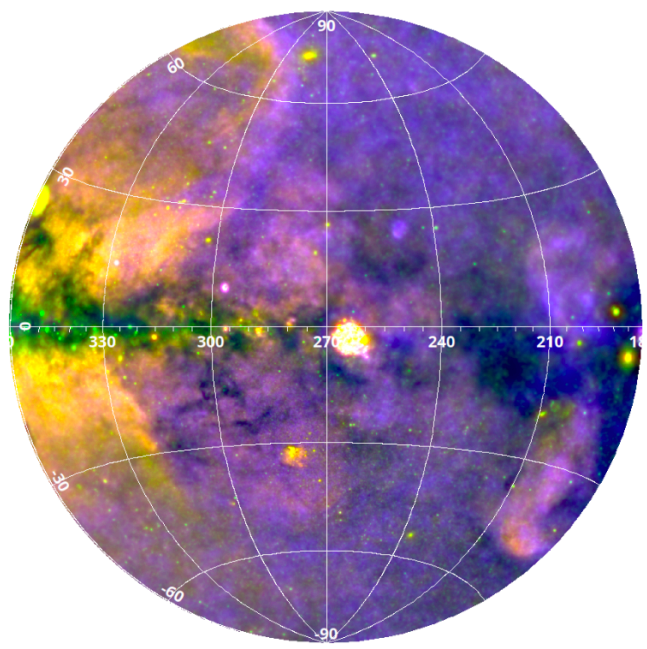


Fig.1. (Left) Pseudo-temperature derived from the O lines ratio; (Right) The RGB map: O vii (red), broadband emission in the 0.2–2.3 keV energy range (green), and the O vii / O viii line ratio (blue).

02.Data reduction

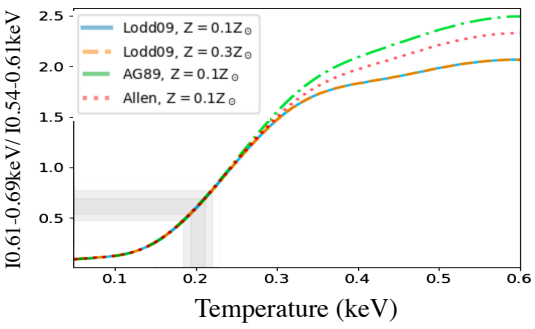


Fig.3: Narrowband intensity ratio as a function of temperature, and absolute and relative metal abundances.

Utilising the data from SRG/eROSITA eRASS1, we corrected the maps by removing the expected contribution associated with the cosmic X-ray background, the time-variable solar wind charge exchange, and the local hot bubble. We applied corrections to mitigate the effect of absorption.

Assuming that the line ratio map is produced by only one warm-hot plasma component, by using the relation of Fig. 3, we create the first pseudo-temperature map of the warm-hot CGM of the Milky Way (see Fig.1).

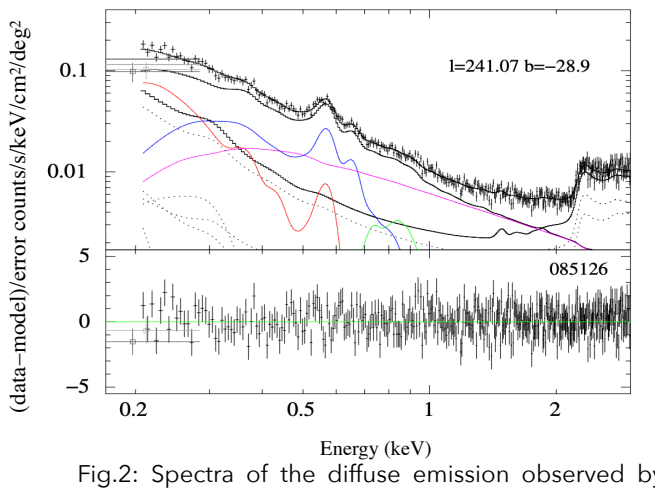


Fig.2: Spectra of the diffuse emission observed by eROSITA within sky patches of $3^{\circ}\times3^{\circ}$. The red, blue, green, and magenta lines show the contribution of the LHB, warm-hot CGM, hot corona, and CXB emission components.

03. Results: the distribution of pseudo-temperature

From the Probability distribution function (PDF) of the pseudo-temperature derived in the north and south CGM regions (Fig. 4):

(I) toward the outer halo, the temperature distribution of the CGM on angular scales of 2–20 deg is consistent with being constant $\Delta\mathcal{T}/\langle\mathcal{T}\rangle \leq 4\%$, with a marginal detection of $\Delta\mathcal{T}/\langle\mathcal{T}\rangle$=2.7% ± 0.2% (statistical) ±0.6% (systematic) in the southern hemisphere.

(II) significant variations of ~12% are observed when comparing the northern and southern CGM regions.

(III) the excess of dispersion in the eROSITA bubble region (σ_{rms} < std($\mathcal{T}$), indicating a significant pseudo-temperature variations observed.

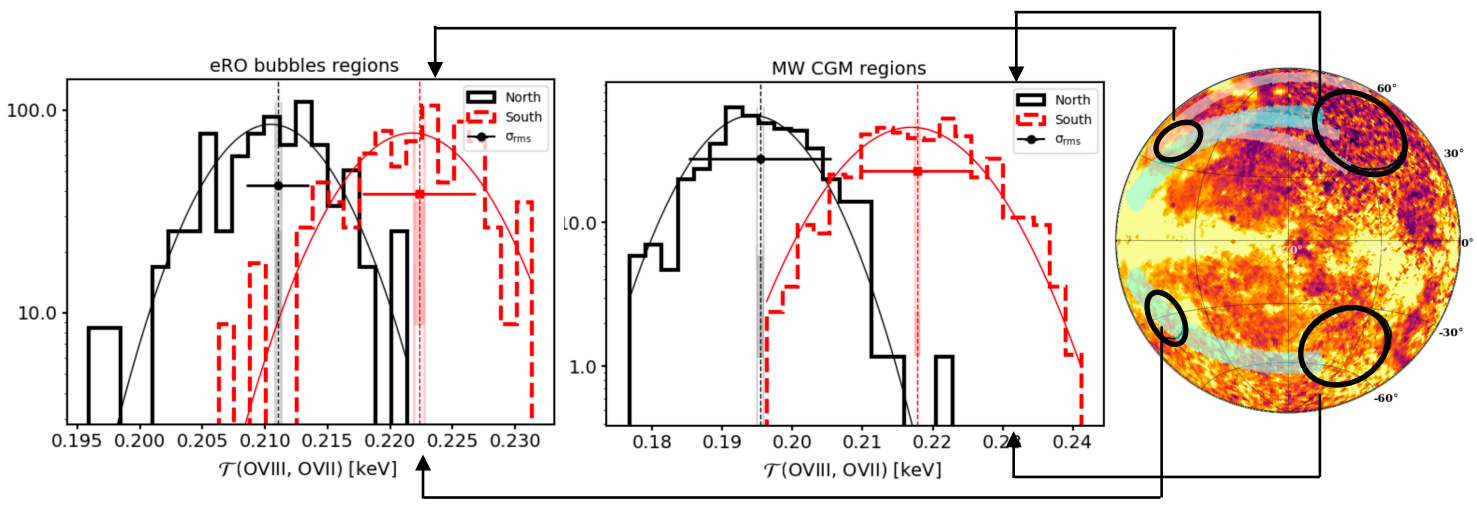


Fig.4: The PDF of the pseudo-temperature derived in the north/south CGM and eROSITABubble regions. The thin solid lines show Gaussian fits of the distributions. The horizontal error bars show the σ_{rms} of the pseudo-temperature uncertainty in the regions considered.

04. Results: the variation across the eROSITA bubbles

The pseudo-temperature map shows significant variations across the borders of the eROSITA bubbles, suggesting temperature variations, possibly linked to shocks, between the interior of the Galactic outflow and the unperturbed CGM.

In particular, **a shell characterized by a lower line ratio appears close to the edge of the eROSITA bubbles** (arrows in Fig.5).

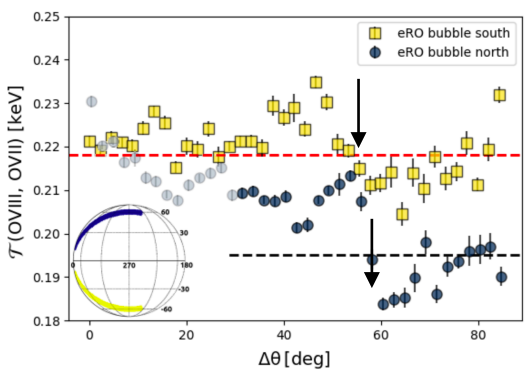


Fig. 5: Pseudo-temperature profiles across the eROSITA bubbles. The paths are also shown as semi-transparent regions in the right panel of Fig. 4

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