Outskirts of Galaxy Clusters: Intense Life in the Suburbs
Proceedings IAU Colloquium No. 195, 2004
A. Diaferio, ed.
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DOI: 10.1017/S1743921304000328

Soft X-ray excess in the cluster of galaxies Sérsic 159-03

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Abstract. We present the results from a new 120 ks XMM-Newton observation of Sérsic 159-03. A previous XMM-Newton observation of this cluster shows the presence of a soft X-ray excess in the outer parts of the cluster, which is possibly connected to the interaction between the cluster and the gas from the surrounding filaments. We exploit the long exposure time to constrain the excess emission and discuss the relation to the warm-hot intergalactic medium. Furthermore, we show a high-resolution RGS spectrum of the core of the cluster and radial profiles from EPIC, which allow us to constrain the internal temperature structure and elemental abundances.

1. Introduction

The Sérsic 159-03 cluster of galaxies, also known as ACO S 1101, was discovered by Sérsic (1974). Since then it was studied in X-rays as part of several cluster samples: e.g. EXOSAT (Edge & Steward 1991) and ROSAT (Allen & Fabian 1980). Kaastra et al. (2001) reported results from an XMM-Newton observation with a useful exposure time of about 35 ks showing a radial temperature profile which peaks at a temperature of $kT \sim$2.7 keV at a radius of about 2′ from the core. The temperature drop in the core is relatively modest, while the temperature outside the 2′ radius drops rapidly to values around 0.5 keV. Sérsic 159-03 shows a large soft X-ray excess in a re-analysis of this observation by Kaastra et al. (2003), as well as from archival ROSAT PSPC observations (Bonamente, Lieu & Mittaz 2001).

In this paper we show the results from a much longer 120 ks XMM-Newton observation of Sérsic 159-03. We exploit the very high statistics to obtain accurate temperature and abundance profiles with the EPIC instrument. We also make two-temperature model fits to account for the contribution of the Warm Hot Intergalactic Medium (WHIM). Together with high-resolution spectra from the RGS instrument we can constrain the temperature structure and abundances in the core.

2. Summary

We confirm the presence of a significant soft X-ray excess in the cluster of galaxies Sérsic 159-03. The excess can be reasonably fitted with a warm (0.2 keV) temperature

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https://doi.org/10.1017/S1743921304000328 Published online by Cambridge University Press

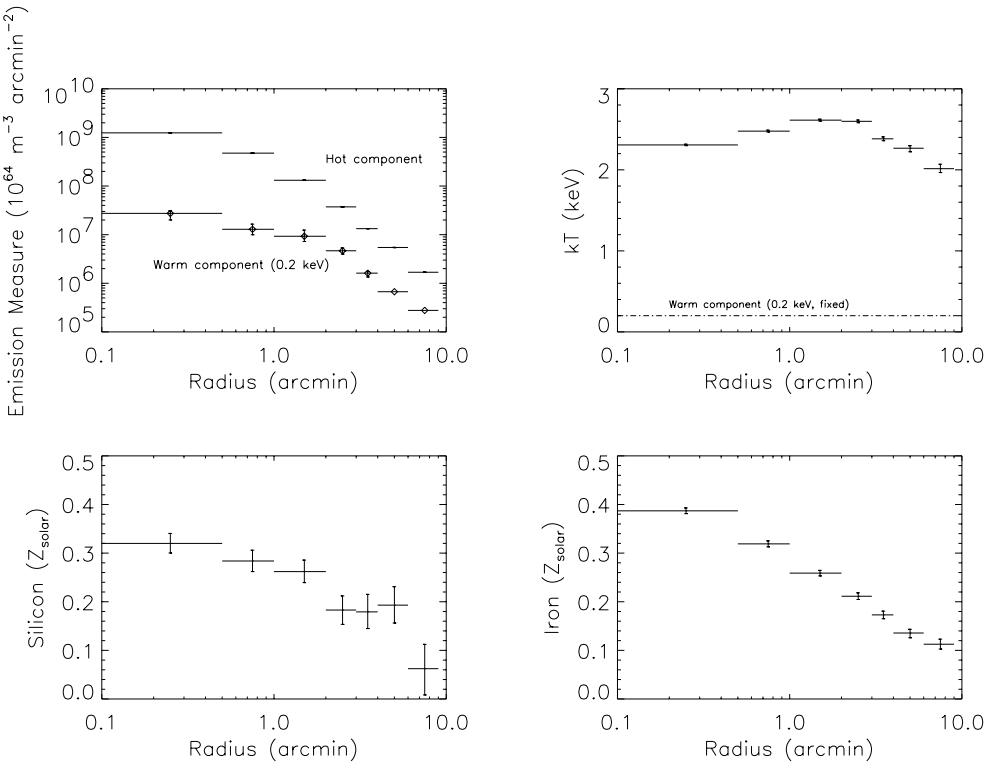

Figure 1. Radial profiles for a model with two-temperature components. *Top left:* Emission measure profiles for the hot and warm components. *Top right:* Temperature profile of the hot component. The warm component was fixed to 0.2 keV. *Lower left:* Silicon abundance profile. *Lower right:* Iron abundance profile. Both with respect to solar abundances.

Parameter	Value	Parameter	Value
$kT_{\rm hot}$ (keV)	2.89 ± 0.05	Mg	0.16 ± 0.05
O	0.216 ± 0.014	Fe	0.388 ± 0.010
Ne	0.43 ± 0.04		

Table 1. RGS fit results for a model with two temperature components.

component in combination with a hot component (see Fig. 1). In this figure we also see that the emission measure profile of the soft component shows a more gradual decrease toward the outer parts of the cluster than the emission measure of the hot component. In the outer parts the warm component grows to be relatively more important, while the hot component decreases in temperature. The iron and silicon abundances show an increase toward the core, consistent with the findings of Tamura et al. (2004) in a sample of clusters.

The high-resolution RGS spectrum (Fig. 2) shows line emission from Fe-L, Ne, Mg and O. In Table 1. the values for the hot temperature component are listed. Our RGS fits show that the ratio of the oxygen and iron abundance (O/Fe) in the core is 0.56 ± 0.04, which is consistent with other soft X-ray excess clusters measured by Tamura et al. (2004). This value is in between the theoretical values of < 0.05 and 1.5–4.0 for supernova types Ia and II, respectively.

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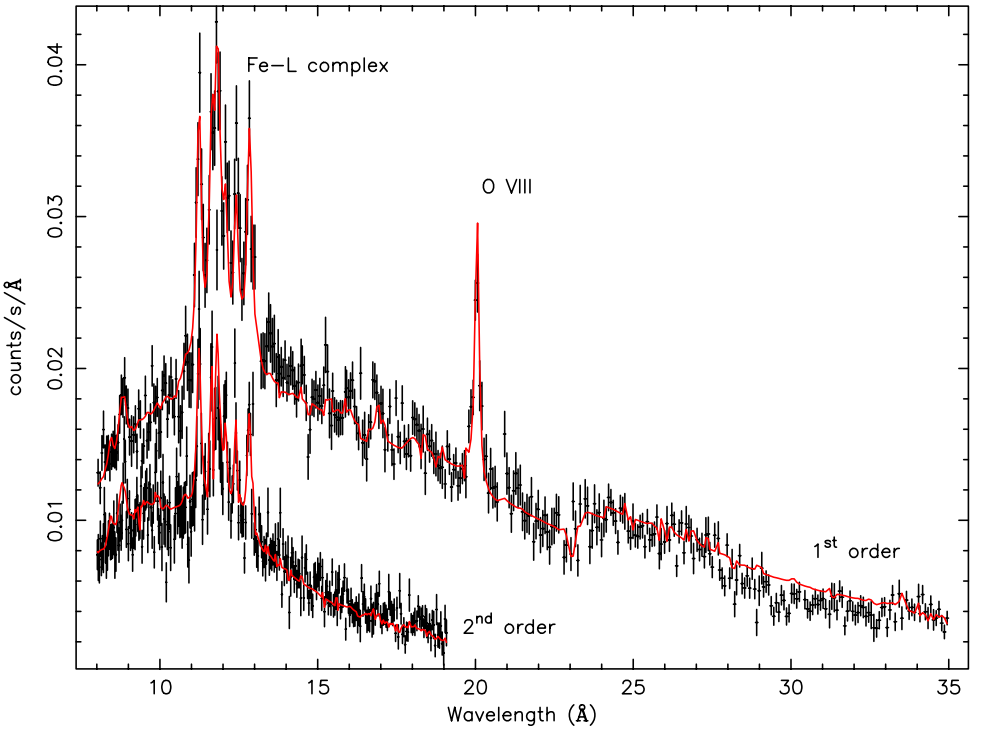

Figure 2. 1^{st} and 2^{nd} order RGS spectrum of Sérsic 159-03.

Acknowledgements

This work is based on observations obtained with XMM-Newton, an ESA science mission with instruments and contributions directly funded by ESA member states and the USA (NASA). The Space Research Organization of the Netherlands (SRON) is supported financially by NWO, the Netherlands Organization for Scientific Research.

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