The X-ray cavity system and radio mini-halo in the galaxy cluster RBS 797

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We present a study of the cavity system in the galaxy cluster RBS 797 based on Chandra and VLA data. The Chandra data confirm the presence of a cool core and indicate an higher metallicity along the cavity directions. This could be due to the AGN outburst, which lifts cool metal-rich gas from the center along the lobes orientations, as seen in other systems. We find indications of cool cavity rims surrounding the cavities. Likely, the 1.4 GHz radio emission, expanding, have displaced the gas compressing it into bright cool arms. Finally we show that the large scale radio emission detected with our VLA observations can be classified as a radio mini-halo powered by the cooling flow (cf), as it nicely follows the trend $P_{\text{radio}} \sim V_{\text{A}}^2$, predicted by the re-acceleration model.

INTRODUCTION

Imaging spectroscopy obtained with the new generation of X-ray telescopes shows that the spectra of galaxy clusters do not present the evidence of any cooler phase of the cooling flow gas below an intermediate temperature (1-2 keV). Many possible explanation to these observations have been proposed (e.g., Peterson and Fabian, 2006 for a review) but the most accredited scenario is the non gravitational heating by a central AGN in the galaxy cluster (McNamara and Nulsen, 2000). In these cases, the central AGNs of galaxy clusters drive strong jet outflows which interacts with the hot plasma of the ICM inflating bubble-like non-thermal lobes. These lobes displace the ICM, creating X-ray photon-deficient holes that for this reason are generally called cavities. Such peculiar features can heat the cluster gas to very high temperatures, thus the bubbles contain also relativistic particles and magnetic fields, hence making possible to be observed as X-ray cavities.

We present the analysis of new, deep Chandra X-ray data and new VLA radio observations of RBS 797 to investigate the ICM physical properties and study its interaction with the radio source. RBS 797, whose central galaxy cluster is located at RA (E2000): 10h 46m 5.5s, Dec (E2000): -76° 23′ 10′′, is a cool cluster ($z=0.35$). With $H_0=70$ km s$^{-1}$ Mpc$^{-1}$, and $\Omega_M=0.3$, the luminosity distance is 1858 Mpc and 1 arcsec corresponds to 4.8 kpc. The radio spectral index is defined such as $\beta=\alpha-1$.

ENERGETICS AND RIMS

The comparison between the X-ray luminosity of the ICM within the cooling radius and the cavity power provides an estimate of the balance between energy losses by X-ray emission and the cavity heating.

Comparison between the temperature of the cavities (white contours) and the temperature of the surrounding regions (green contours).

There is an indication of cool rims compared with the cavity system, supported also by the analysis of the hardness ratios:

$$H = \frac{N\text{erg s}^{-1} \text{ keV}}{N\text{erg s}^{-1} \text{ keV}}$$

The 1.4 GHz emission with its expansion could have spread and pushed away the gas that previously was in the X-ray lobes, finally compressing it into bright cool arms.

REFERENCES