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A Spatial Study of X-ray Properties in Superbubble 30 Dor C with XMM-Newton

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Abstract. The superbubble (SB) 30 Dor C with the strong non-thermal X-ray emission is one of the best targets for study of the cosmic-ray (CR) acceleration. We investigated X-ray spectral properties of the SB with a high spatial resolution of ∼10 pc. Consequently, the spectra in the east regions can be described with a combination of absorbed thermal and non-thermal models while the spectra in the west regions can be fitted with an absorbed non-thermal model. We found that the observed photon index and intensity in 2-10 keV show variations of 2.0-3.5 and (0.6-8.0) × 10^{-7} erg s^{-1} cm^{-2} str^{-1}, respectively. The results are possibly caused by the spatial variation of the CR acceleration efficiency and/or the circumstellar environment.

Keywords. cosmic rays - ISM: supernova remnants - ISM: bubbles - X-rays: ISM

Sano *et al.* (2015) detected the sub-parsec spatial variations of the non-thermal X-ray properties in SNR RX J1713.7-3946 and a correlation between the X-ray intensity and the molecular mass interacting with the SNR. To explain the observational results, they suggested the shock-cloud interaction scenario (see the details [1]). Thus, in this work, we investigate X-ray properties of a superbubble (SB) which possesses a larger spatial extent created by successive supernova explosions and aim at constructing a CR acceleration mechanism also for SBs. 30 Dor C, located in Large Magellanic Cloud, is a young SB showing a shell structure with a diameter of ∼80 pc (∼6′) in X-ray and bright non-thermal X-ray luminosity of ∼5 × 10^{35} erg s^{-1} [2]. Recently, TeV γ-ray emission associated with the SB was detected for the first time [3], meaning that CR protons/electrons are efficiently accelerated up to at least 10 TeV.

We used XMM-newton EPIC-pn datasets and divided the X-ray shell into 33 regions with 0.7′× 0.7′ grids corresponding to a physical scale of ∼10 pc in order to examine the detailed X-ray properties in the SB. Consequently, the spectra in the east regions of 30 Dor C can be described with absorbed thermal and non-thermal models, while the spectra in the west regions can be fitted with an absorbed non-thermal model. The observed photon index and intensity in 2-10 keV show spatial variations of 2.0-3.5 and (0.6-8.0) × 10^{-7} erg/s/cm^2/str, respectively.

When comparing the X-ray properties with the total integrated intensity in ^{12}CO (J=1-0) observed by NANTENCO, we found a positive correlation between the X-ray intensity and ^{12}CO intensity and the fact that the photon index tends to be less steep when the ^{12}CO intensity increases. These trends suggest that an interaction between the ISM and shocks affects the process of the particle acceleration.

References

Sano, H. *et al.* 2015, *ApJ*, 799, 175S
Bamba, A., *et al.* 2004, *ApJ*, 602, 257
The H. E. S. S. Collaboration 2015, *Science*, 347, 406