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ABSTRACT

HESS J1507−622 is one of the bright unidentified TeV objects. HESS J1507−622 is unique, since the location of the object is off the Galactic disk. We observed the HESS J1507−622 region with the Suzaku XIS, and found no obvious counterpart although there is no severe interstellar extinction. However, there are two interesting X-ray objects; SRC1 is a bright extended source, and SRC2 is a faint diffuse object. If either of them is a counterpart, the flux ratio between TeV and X-ray is large, and HESS J1507−622 is a real dark particle accelerator.

KEY WORDS: acceleration of particles – X-rays: individual (HESS J1507−622)

1. Introduction

HESS J1507−622 (hereafter, HESSJ1507) is one of the bright (~8% of the Crab) unidentified TeV objects (H.E.S.S. Collaboration et al. 2011). HESSJ1507 is unique since it lies ~3.5 deg from the Galactic plane, while most of the unidentified objects are located within ±1 deg from the Galactic plane. The TeV spectrum can be described by a power-law model with $\Gamma = 2.24 \pm 0.16$ (stat) ± 0.20 (sys), and a flux of $F(1−10 \text{ TeV}) = 5.1 \times 10^{-12} \text{ erg cm}^{-2} \text{ s}^{-1}$ (H.E.S.S. Collaboration et al. 2011).

HESSJ1507 is also detected by Fermi-LAT (Domainko & Ohm 2012). The GeV spectrum can be described by a power-law model with $\Gamma = 1.7 \pm 0.1$ (stat) ± 0.2 (sys). The flux is $F(0.3−300 \text{ GeV}) = 3.5 \times 10^{-11} \text{ erg cm}^{-2} \text{ s}^{-1}$ (Domainko & Ohm 2012).

2. Suzaku Observation

Suzaku observed two regions around HESSJ1507; the center region and the off-center region ~ 15 arcmin northeast from the center. The exposure time is 79.9 ks for the center region and 40.9 ks for the off-center region.

3. Results

4. X-ray image

The XIS3 images are shown in Fig. 1. The position of HESSJ1507 is shown as a cross mark. There is no X-ray source which coincides with the peak of the TeV emission. The same regions were observed by Chandra, and many objects were found (H.E.S.S. Collaboration et al. 2011); most of them were identified as stars. These Chandra sources are shown as plus marks. Many of them are also detected by Suzaku.

There is a conspicuous source at $(\alpha, \delta)_{\text{J2000}} = (15:08:51, 62:10:18)$. We call this source SRC1. SRC1 was also detected with Chandra and ROSAT (H.E.S.S. Collaboration et al. 2011). Though SRC1 is outside of the 3 significance contour of the TeV emission (H.E.S.S. Collaboration et al. 2011), we will study the X-ray characteristics of this object in the following.

Chandra discovered a faint diffuse object, which is also detected by Suzaku; this source is shown by the small broken circle in Fig. 1, and we call this source SRC2.

4.1. SRC1

Fig. 2 shows a radial profile of SRC1 in the 3–10 keV band obtained from the XIS FI data (XIS0+3). The profile cannot be described by a point spread function, and SRC1 is a spatially extended object.

Time variability of SRC1 was examined. The light curve of SRC1 in the 2–10 keV band extracted from XIS3 is shown in Fig. 3. There is no significant time variability. No variability can be seen also in the 0.4−10 keV and 0.4–2 keV bands.

The X-ray spectrum is shown in the left panel of Fig. 4. The spectrum can be described by an absorbed power-law model. The best-fit parameters are
4.2. SRC2

The X-ray spectrum of SRC2 is shown in Fig. 5. The spectrum can be described by a power-law model. The best-fit parameters are $N_H = (0.8 \pm 0.5) \times 10^{22} \text{ cm}^{-2}$, $\Gamma = 2.4 \pm 0.5$. The flux in the 2–10 keV band is $F(2–10 \text{ keV}) = 0.8 \times 10^{-13} \text{ erg s}^{-1} \text{ cm}^{-2}$.

5. Discussion

Although the location of HESSJ1507 is away from the Galactic disk and the X-ray observation does not suffer from a heavy interstellar absorption, there is no obvious X-ray counterpart to HESSJ1507. If SRC1 is an X-ray counterpart to HESSJ1507, the flux ratio $F(1–10 \text{ TeV})/F(2–10 \text{ keV})$ would be $\sim 5.3$. If SRC2 is a counterpart, the ratio would be $\sim 64$. H.E.S.S. Collaboration et al. (2011) suggest that SRC2 could be a bright part of a larger and fainter source. We can see no hint in the Suzaku data suggesting that possibility. Since the total Galactic HI column density is $N_H = 5.1 \times 10^{21} \text{ cm}^{-2}$, both SRC1 and SRC2 can be thought as a Galactic object. If the density of interstellar matter is assumed to be $1 \text{ cm}^{-3}$, the distance to SRC1 is $\sim (1.7 \pm 0.2) \text{ kpc}$, and that to SRC2 is $\sim (2.6 \pm 1.7) \text{ kpc}$.

References

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