Observation of sub-TeV gamma-rays from RX J0852.0−4622 with the CANGAROO-II telescope

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Abstract

RX J0852.0−4622 (G266.2−1.2) is a Type-II Supernova Remnant (SNR) located along the line of sight to the Vela SNR. We observed RX J0852.0−4622 with the CANGAROO-II telescope from the middle of December, 2001, to the end of February, 2002, to search for sub-TeV gamma-rays. A preliminary analysis shows an apparent excess of gamma-ray-like events in alpha distribution from RX J0852.0−4622, which is to be examined in continued analyses and further observations.

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1. Introduction

Shell-type Supernova Remnants (SNRs) are believed to be a favored site for accelerating cosmic rays up to 10^{15} eV, and several examples have been found [9]. However, these are not yet sufficient to determine whether SNRs dominate cosmic ray production at these energies. RX J0852.0−4622 is a Type-II SNR [3] located along the line of sight to the Vela SNR. It was discovered at X-ray energies during the *ROSAT* all-sky survey [1]. Observed line spectra indicate the existence of ^{44}Ti produced during explosive nucleosynthesis inside the supernova and over-abundant ^{44}Ca converted from ^{44}Ti. From the short life time of ^{44}Ti, and the SNR radius of $\simeq 1^\circ$, the distance and age were estimated to be less than 500 pc and $\sim$1000 yr, respectively [2, 10]. Non-thermal hard X-ray emissions were detected by the *ASCA* satellite, with the spectra well described by power laws [8, 10]. These observations imply the existence of highly accelerated particles in this young SNR and high-energy gamma-rays may be produced by their interactions. The detection of TeV gamma-rays would provide further evidence for the acceleration of the Galactic cosmic rays in SNRs.

2. Observation

RX J0852.0−4622 was observed with the CANGAROO-II telescope [6] from the middle of December, 2001, to the end of February, 2002. The pointing direction was (α, δ)= ($8^h48^m59^s$, -45°39′00″) (J2000), where the maximum X-ray emission was observed. The maximum elevation angle was $\sim 75^\circ$. The SNR is about 2.5° from Vela pulsar so that there is no source confusion. Each night background observations (OFF-source runs) were carried out before or after ON-source runs for similar amounts of time. The total observation time were 40h45m (ON-source runs) and 36h12m (OFF-source runs).

3. Analysis

Photons emitted from atmospheric air showers generated by incident gamma-rays and cosmic rays are detected using the imaging air Cherenkov technique. Data selection was carried out in order to eliminate Night Sky Background photons, bad weather condition data, electrical noise, and the effects of bright stars. After these cuts, 'clean' shower images of gamma-rays and cosmic rays remained [5], with a total of 35h23m ON-source and 33h26m OFF-source data. The Hillas parameters [4] were then calculated to reduce the cosmic ray events. The characteristic image parameters are shown in Fig. 1. The hatched areas show those from Monte Carlo simulations of gamma-rays, the blank areas from the observed data (OFF-source runs) which were mainly protons. We selected the region indicated by the arrows for each parameters in Fig. 1. The energy threshold for

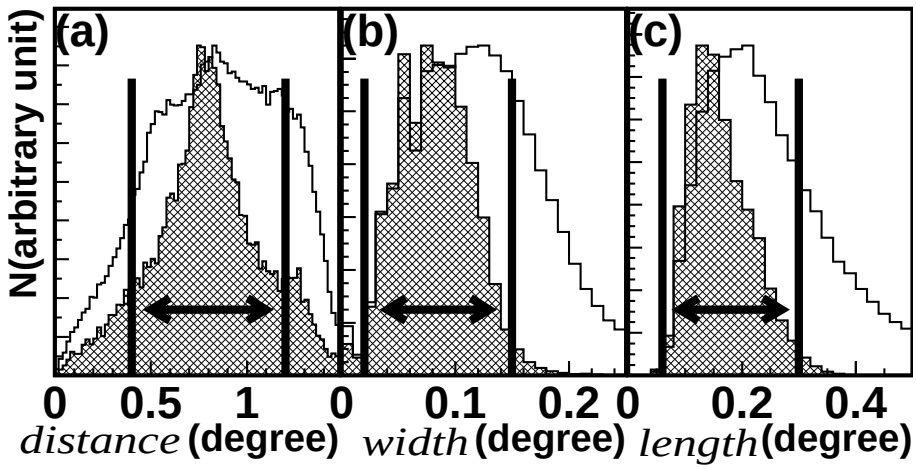

Fig. 1. Hillas image parameters. Monte Carlo simulations of gamma-rays are shown by the hatched area, and OFF-source data are the blank area: (a) *distance*, (b) *width*, and (c) *length*. The selected regions are indicated by the arrows.

detecting gamma-rays was estimated from the simulations to be $\sim 400\,\mathrm{GeV}$.

4. Result

The resulting *alpha* (orientation angle) [7] distribution after selecting the events by the preliminary shape analysis is shown in Fig. 2 (left). ON-source data are plotted by the blank histogram and OFF-source data are shown by the hatched area normalized to the ON-source data by the ratio of the number of the events in $alpha > 30^\circ$. A preliminary significance map of sub-TeV gamma-ray emission is plotted in Fig. 2 (right). The solid thick contours are our observation. The solid thin contours are the *ASCA* X-ray data.

5. Discussion

The observed *alpha* distribution appears to show a broad peak up to about 30°-40°. The fact, if attributed to gamma-rays, may suggest extended emission of TeV gamma-rays from the object, which is consistent with the significance map of Fig.2 as well as with the map of X-ray data [8, 10].

6. Conclusion

We observed RX J0852.0−4622 and carried out the analysis. The preliminary results suggest an excess of gamma-rays and a correlation between the X-ray emissions and the gamma-ray significance map. RX J0852.0−4622 was also observed in this year 2003, and further studies are now being carried out with

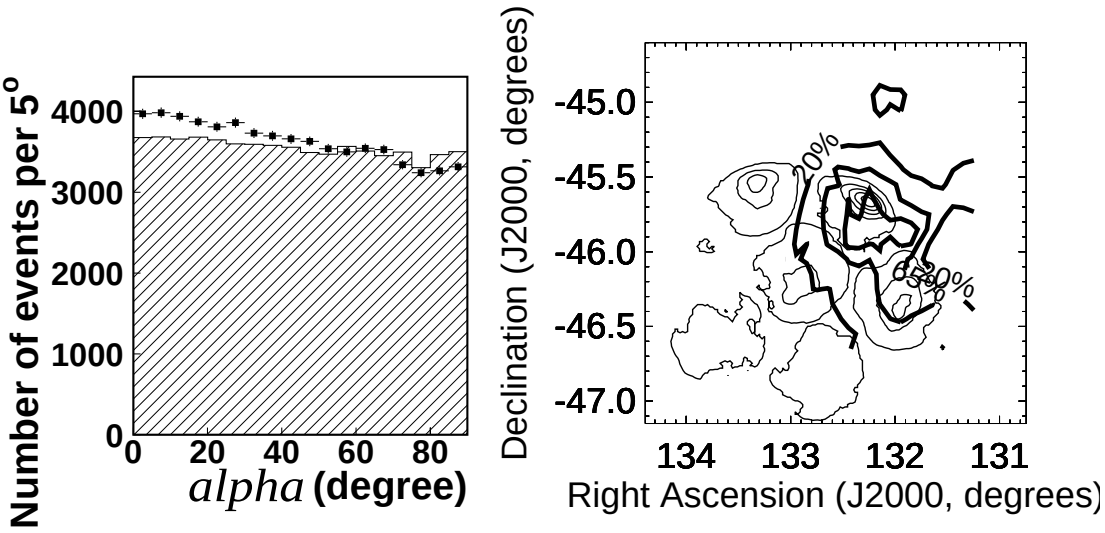

Fig. 2. Preliminary distribution of *alpha* (orientation angle) (*left*). ON-source data (filled with squares with statistical errors) are plotted. OFF-source data are shown by the hatched histogram. OFF-source data are normalized to the ON-source data by the ratio of the number of the events in $alpha > 30°$. Preliminary significance map (*right*). The solid thick contours are our observation (20%, 65%, 90% confidence level). The solid thin contours are the *ASCA* X-ray data.

better statistics. The total observation time were 58h30m (ON-source runs) and 51h0m (OFF-source runs). These data are now being analyzed.

7. References

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