TeV gamma-ray observation of the Supernova Remnant RCW86 with the CANGROO-II telescope

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, for CANGAROO collaboration


CANGAROO-II


KOALA-II

Abstract: RCW86(G315.4-2.3) is a shell-like supernova remnant(SNR). Following the ASCA discovery of non-thermal X-ray emission from RCW86, we have observed it in 2001 and 2002 with the CANGAROO-II telescope directed at the point in the south-west shell which has the highest intensity of X-ray emission.

1. Introduction

RCW86(G315.4-2.3), type II and shell-like SNR, has a non-thermal X-ray emission stronger than that of SN1006. Assuming the X-ray emission, shown in the multi-wavelength spectrum in Figure 5, is due to synchrotron emission, RCW86 is a good candidate for the emission of TeV gamma-rays by inverse Compton (I.C.) scattering.

RCW86 is...
- ✓ Type II SNR
- ✓ Diameter 42 '
- ✓ Distance 2.5 kpc
- ✓ Age ~3000 yr

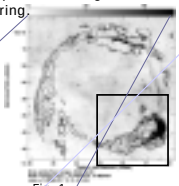


Fig. 1.
Dickel et al. 2000
Gray scale
– Hα (Smith 1997)
Contours
– 1.34GHz radio

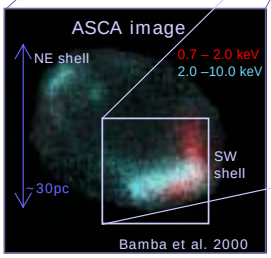


Fig. 2. ASCA image of RCW86
SW shell has stronger hard X-ray emission than NE shell.

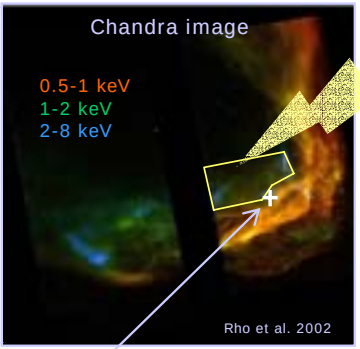


Fig. 3. Chandra image of RCW86 SW shell
White cross is the tracking center point of CANGAROO observation.

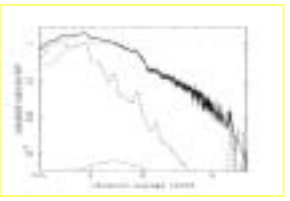


Fig. 4. Spectrum of the emission from the yellow region
Non-thermal component is dominant in the energy region above 2 keV (Rho et al. 2002).

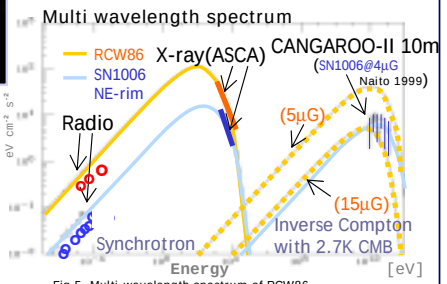


Fig.5. Multi-wavelength spectrum of RCW86
Solid lines are calculated based on the assumption of synchrotron model using the observation data.
Dashed lines are estimated based on I.C. model with magnetic fields of 5μG and 15μG.

Synchrotron emission from RCW86 is stronger than that of SN1006.

Therefore, if the magnetic field is weaker than 15μG, I.C. gamma-rays can be detected with CANGAROO-II telescope.

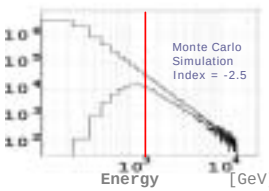
2. CANGAROO observation

- Observation term
  - ✓ 2001.. March, April, May
  - ✓ 2002.. March, April
- Observation tracking center point
  (R.A., Dec.)=(14h40m46.2s, -62d40m38.6)
  - ✓ Highest intensity of X-ray emission
- Maximum elevation angle = 58.43 degree
- Observation time

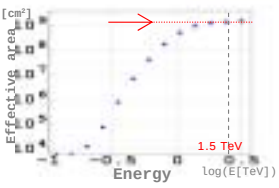
		observation	selected
2001 March, April, May	ON	38h 09m	28h 12m
	OFF	33h 59m	23h 05m
2002 March, April	ON	41h 11m	30h 08m
	OFF	38h 37m	33h 49m

3. Estimation of energy threshold and effective area

Because of its low zenith angle, the energy threshold is relatively high.



Energy threshold ~ 1.5 TeV
(Zenith angle ~ 35º)



Effective area ~1.5x10^{9}cm^2
(@1.5TeV)

4. Analysis

We treated the data of two years individually, and carried out following processes for each.

- ➢Data selection
  - ✓ Elevation > 50º
  - ✓ Cloud cut
- ➢Event selection
  (reduction of night sky background)
  - ✓ Scaler cut
  - ✓ Timing cut
    |TDC start| < ±35ns
  - ✓ ADC threshold = 500ch
  - ✓ Cluster cut T4a

calculate shower image parameters for each selected events

- ✓ Image parameter cut
  (energy dependence is taken into account)

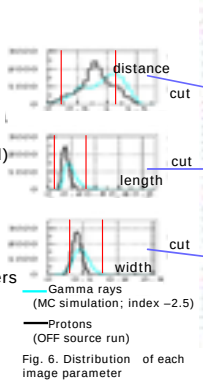


Fig. 6. Distribution of each image parameter
This shows the different distributions of parameters of gammas and protons.


Fig. 7
The distribution of background events (blue) eventually becomes flat.

Gamma-ray events can be distinguished from proton events by the differences of image parameter distributions as shown in Figure 6.

The events with the parameters between the two red bars are selected.

Check the change of the alpha plot by cut of each parameter in Figure 7.

5. Result

After summing up the results of each energy band, the alpha distributions are obtained as shown in Figure 8.

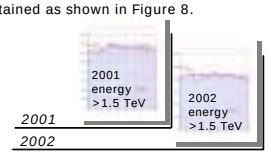


Fig.8. Preliminary result for each year.
(alpha distributions above 1.5 TeV)

Analysis is now in progress !

Further Study in detail is needed.

..and we are going to make stereoscopic observation of RCW86 next March !!

Reference
Dickel et al., 2000, ApJ 546, 447D
Bamba et al., 2000, PASJ 52, 1157B
Rho et al., 2002, ApJ in press
Naito, 1999, Astron. Nachr. 320, 205