

Recent Observations and Results of the CANGAROO (*Galactic objects*)



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for the CANGAROO team

TeV Gamma-ray sources/candidates

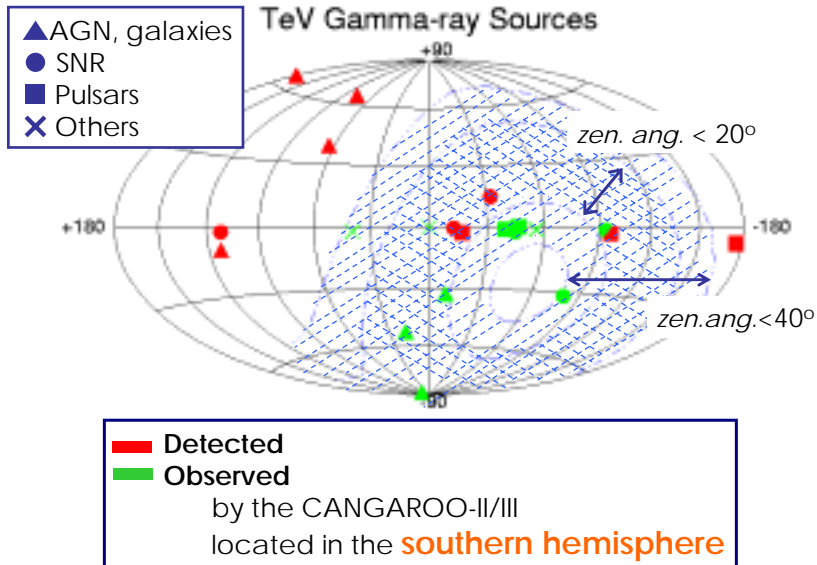
	Extra Galactic	Galactic
Objects	AGNs <i>galaxies</i> AGNs @ $z > 0.0008$ galaxies @ $z > 0.8$	SNRs, Pulsars, <i>Binaries,</i> <i>Galactic center ..</i>

Search for the Injectors & the accelerators
of high energy particles in the Galaxy
(cosmic-ray).

CANGAROO:

a trial observation ... ~20 hours of ON-source data
more hours for promising sources.

Latest TeV Gamma-ray sky



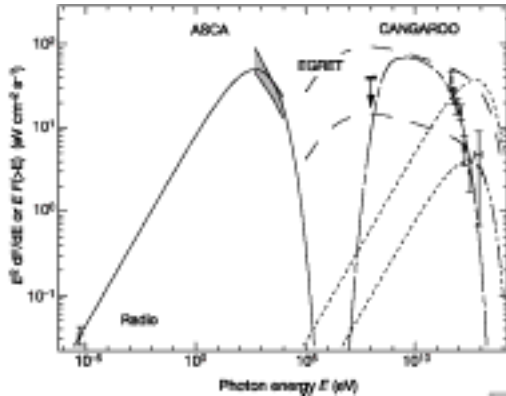
The SNRs observed by the CANGAROO-II/III

young, shell-type,
characterized by the **non-thermal** (synchrotron) X-rays

	<i>distance</i>	<i>age</i>	<i>X-ray</i>
★ SN1006 (NE rim)	2 kpc	1E3 yr	Non-thermal dominant
★ RXJ1713.7-3946 (NW rim)	1[6]kpc	0.2[1]E4yr	Non-thermal dominant dense molecular cloud
★ RXJ0852.0-4622 <i>New!</i> → see <i>Katagiri's poster [S19]</i>	0.5kpc	1E3yr	Non-thermal dominant along the line of sight to Vela
★ RCW86(SW rim) <i>New!</i> → see <i>Watanabe's poster</i>	1[3]kpc	0.2[1]E4 yr	thermal + Non-thermal
★ S321 SN1987A <i>New...</i>	50kpc	15yr	High energy component: Intensity increasing

★ *Repeated detection*
★ *analysis is on-going*

RX J1713.7-3946: the multi-wavelength spectrum



the details already mentioned
in Tanimori's review

Hard to explain the spectrum
with synchrotron/IC emission mechanism
↔ SN 1006

Enomoto et al., (2002) Nature, vol 416, pp.823—826.

The rotation-powered pulsars observed by the CANGAROO-II/III

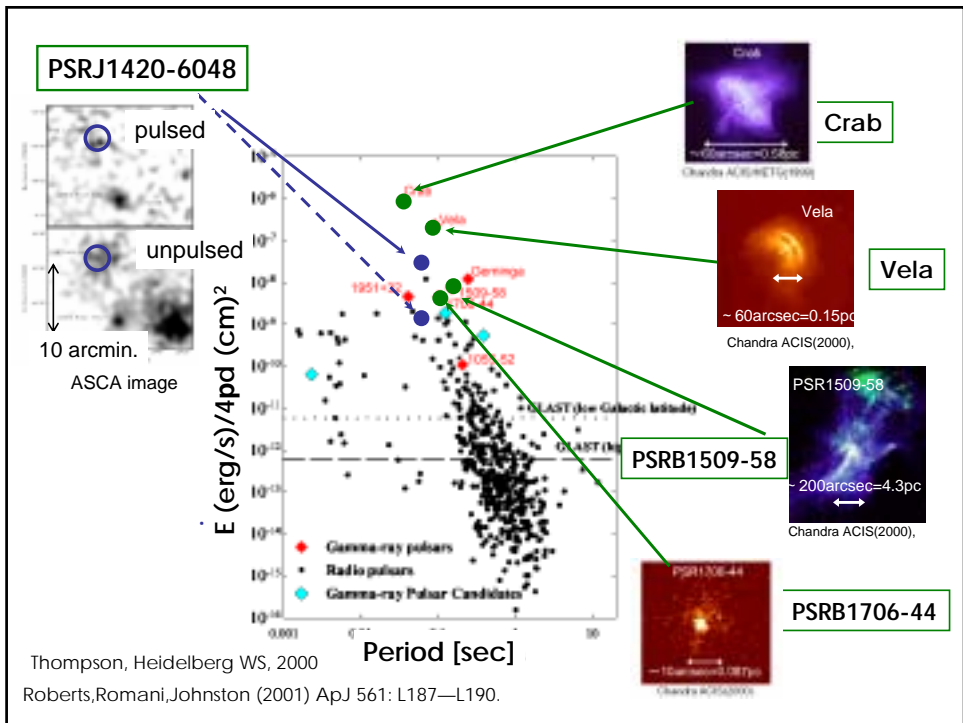
Large {spin-down power \dot{E} } / {distance d }²

	<i>period</i>	\dot{E} (erg/s)/ d (kpc) ²	
★	Crab	33.5ms	4.5E38/(2) ² EGRET / VHE unpulsed
★	Vela	89.3ms	7.0E36/(0.25[0.5]) ² EGRET /VHE unpulsed
★	PSR B1706-44	102.5ms	3.4E36/(1.8) ² EGRET pulsed /VHE unpulsed
→ see <i>Kushida's poster</i> [S28]			
★	PSR B1509-58	150.7ms	1.8E37/(4.2) ² BATSE/OSSE/COMPTEL
★	PSR J1420-6048	68.2ms	1.0E37/(2[7.7]) ² coincidence w/ 3EG1420-6048

New!

- ★ *Repeated detection*
- ★ *analysis is on-going*

D'Amico et al., (2001) ApJ 552: L45—L48.
Possenti et al., (2002) A&A 387, 993—1002.

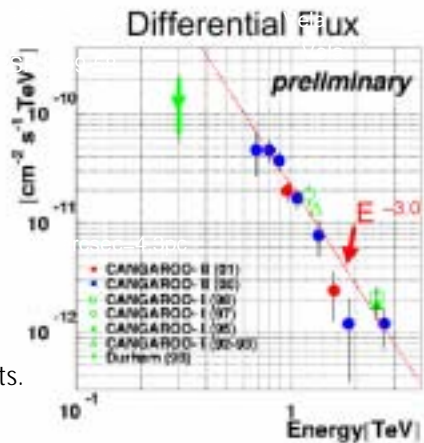


PSR1706-44: C-II results

Observations:

(2000) ON: 33.5 hr OFF: 28.7 hr
(2001) ON: 36.6 hr OFF: 30.1 hr
(selected)

Positive detection of the TeV gamma-rays from the pulsar.
The obtained differential flux is **consistent with** the previous results.



PSRB 1706-44: **X-ray nebula** is relatively small.
Different emission mechanism from nebula SSC ?

→ See Kushida's poster [S28] for detail

The other targets observed by the CANGAROO-II/III

Energetic regions and dense matter environment

	<i>distance</i>	
★ Galactic Center <i>New!</i> → see <i>Tsuchiya's poster</i> [S17]	8 kpc	Massive BH, 2EGJ1746-2852? SNR (Sgr A EAST)
★ SS433/W50 <i>New!</i> → see <i>Hayashi's poster</i> [S24]	5 kpc	Micro quasar (Western lobe) c.f. Eastern lobe .. U.L. by HEGRA
★ PSR B1259-63 <i>New!</i> → see <i>Kawachi's poster</i> [S27]	2kpc	pulsar/Be star binary Synchrotron X-rays, EGRET U.L.

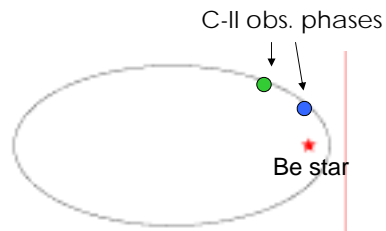
★ *analysis is on-going*

★ *Upper limit*

Rowell et al., in Proceedings, astro-p/ 0104288

PSR1259-63/SS2883 : C-II observations

Be star: 10th Mag
Pulsar: P=47.8 ms,
 \dot{E} (erg/s)/d (kpc)² = 9E35/(1.5)²
Orbital ecc. = 0.87
Orbital period = 1236.7 Days
Periastron epoch t: MJD48124.4
....1994 Jan., 1997 May, 2000 Oct.

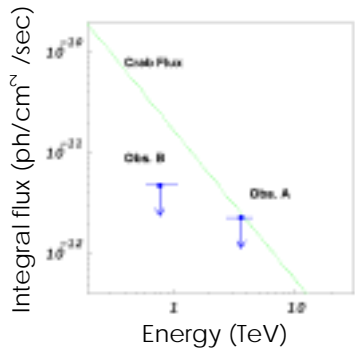


ASCA; non-thermal index/ intensity varies
OSSEE; detected, COMPTEL, EGRET; U.L.

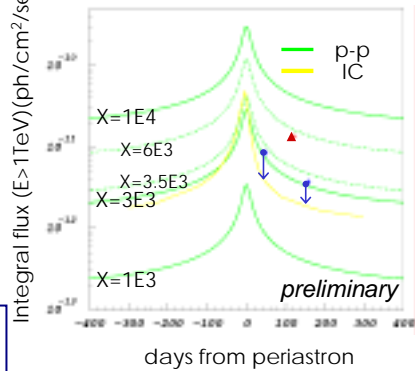
C-II Observations

	selected
(2000-Dec. : t + 47.3 days) ON: 196 min. OFF: 160 min. @zenith angle =58 deg.	
(2001-Mar. : t + 156.8 days) ON: 623 min. OFF: 645 min. @zenith angle =31 deg.	

PSR1259-63/SS2883: C-II results



→ see my poster [S27] for detail



No significant gamma-ray signals.

2000-Dec.:

$$E(>3.6\text{TeV}) < 2.3 \text{ E-12 ph/cm}^2/\text{sec}$$

2001-Mar.:

$$E(>0.8\text{TeV}) < 4.8 \text{ E-12 ph/cm}^2/\text{sec} \quad \textit{preliminary}$$

Comparison with light curves by model calculations constrains the **mass outflow parameters**.

Summary

Using the CANGAROO-II 10-m telescope, the CANGAROO has observed 5 *SNRs* and detected 2 of them;

SN1006 ... ★ RXJ1713.7-3946 ... ★

RXJ0852.0-4622 ... ★ [S19]

RCW86 .. ★ [S32] SN1987A .. ★

observed 5 *rotation powered pulsars* and detected 2 of them;

Crab ... ★ PSRB1706-44 ... ★ [S28]

Vela ... ★ PSRB1509-58 .. ★ PSRJ1420-6048 ... ★

observed 3 sources of other classes and obtained the upperlimit for 1 of them;

PSRB1259-63 ... ★ [S27]

Galactic center ... ★ [S17] SS433 ... ★ [S24]

★ *Repeated detection*

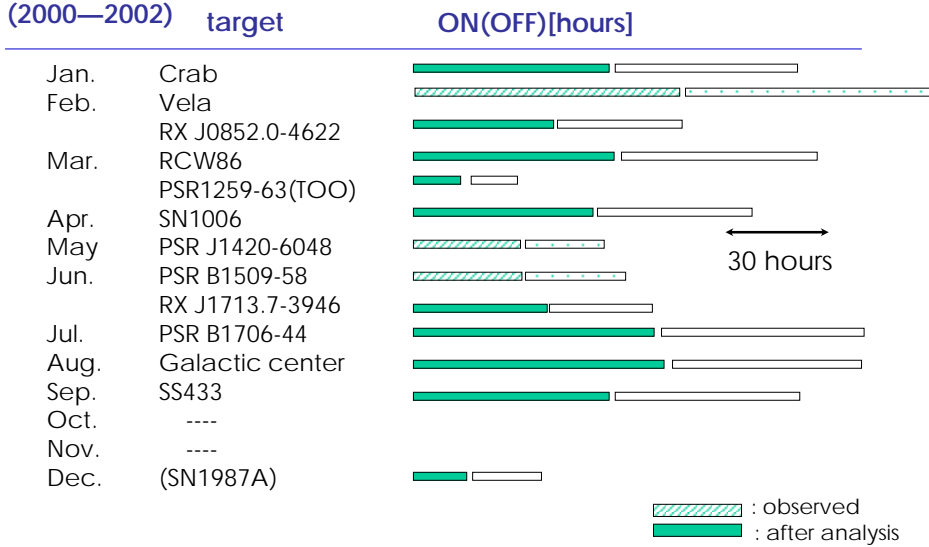
★ *Upper limit*

★ *Analyses are on-going for these sources.*

*Please wait for the results and **check** the present status of analyses in the poster presentations !*

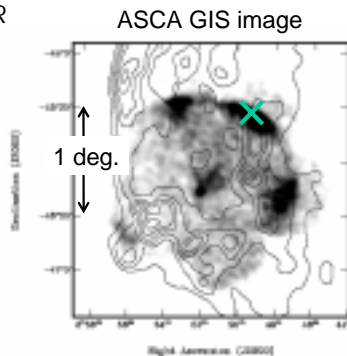
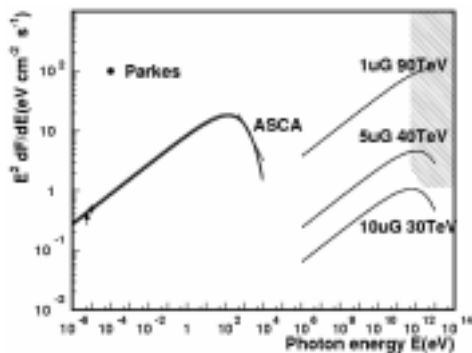
The observation history of our "Galactic" targets

Observing season
(2000—2002)



RXJ0852.0-4622

- along the line of sight to Vela SNR
- Non-thermal X-ray emission from the north section



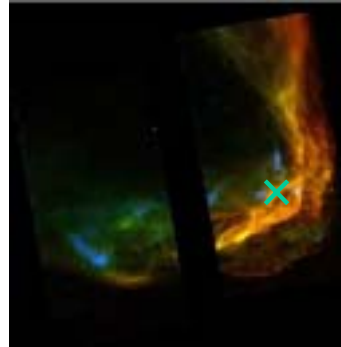
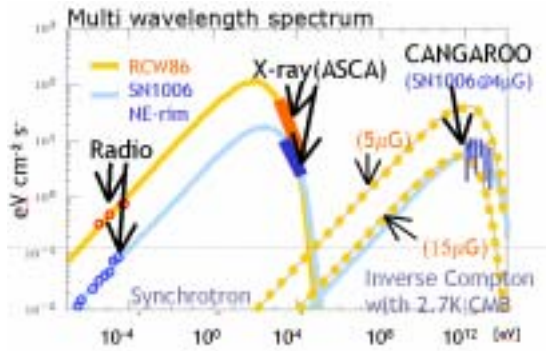
Slane et al., (2001) ApJ 548:814-819.

→ see Katagiri's poster [S19] for detail

RCW86

→ see Watanabe's poster [S32] for detail

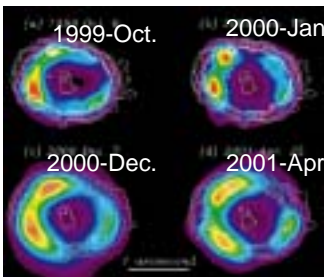
- Thermal+non-thermal (hard tail)
- Intense non-thermal X-ray emission from the SW shell



Chandra: mosaic image of 3 energy bands

Rho et al., (2002) astro-ph/0208013

SN1987A



Chandra ACIS + HST Ha

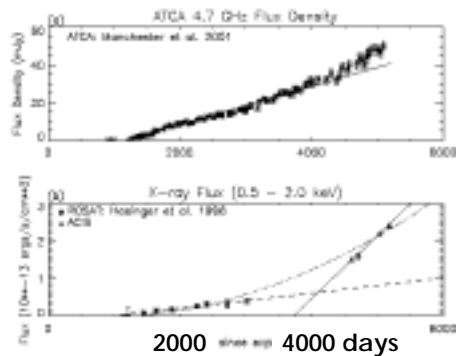
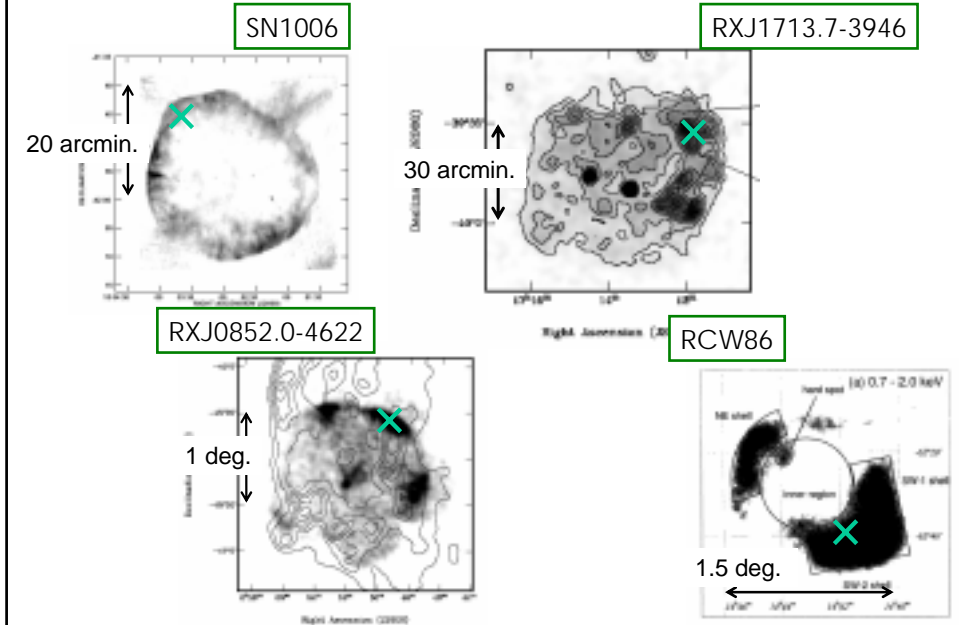


FIG. 5.—Top: Long-term light curve of SN 1987A in the 4.7 GHz (ATCA). Bottom: Long-term X-ray light curve of SN 1987A (ROSAT and Chandra ACIS).

Long-term light curves of radio/X-ray (ATCA/ROSAT)

Park et al., (2001) ApJ 567:314–322.

Sizes of the observed SNRs



Galactic Center

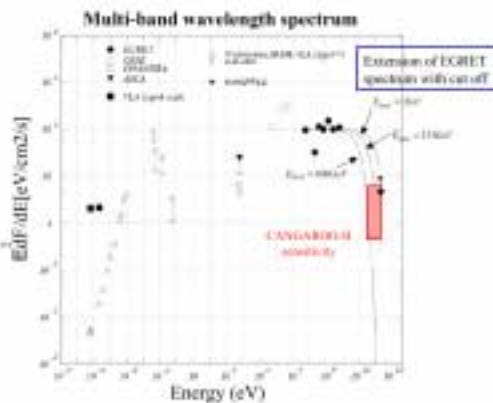
Maeda et al., (2002) ApJ 570:671—687.

→ see Tsuchiya's poster [S17] for detail

association with 2EG J1746-2852 ?



Chandra (1.5—7.0keV band)



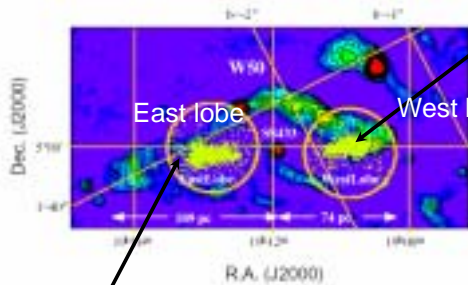
Mahadevan, Narayan, Krolik (1997) ApJ 486:268—275.

SS433/W50

Bipolar jet $\sim 0.26 c$

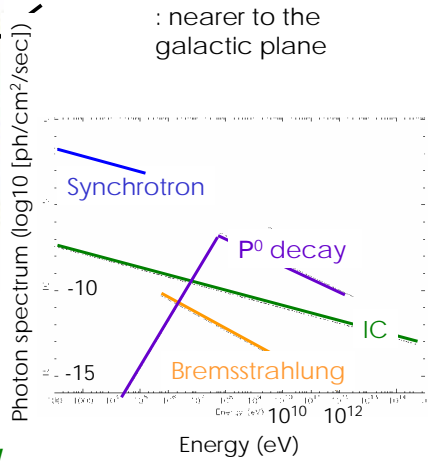
10^{39-41} erg/sec

→ Jet termination point: 10^{48} erg/year in the electron energy



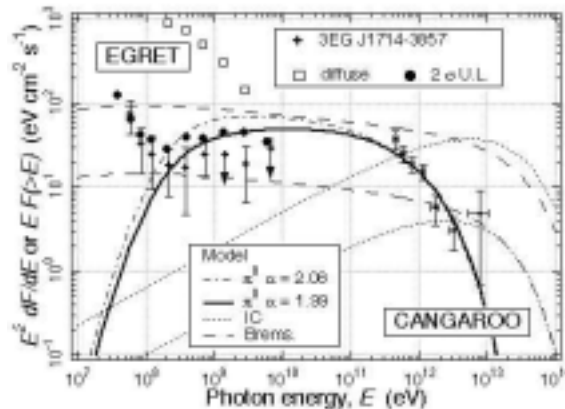
HEGRA observation
: bright spots

CANGAROO observation
: nearer to the galactic plane

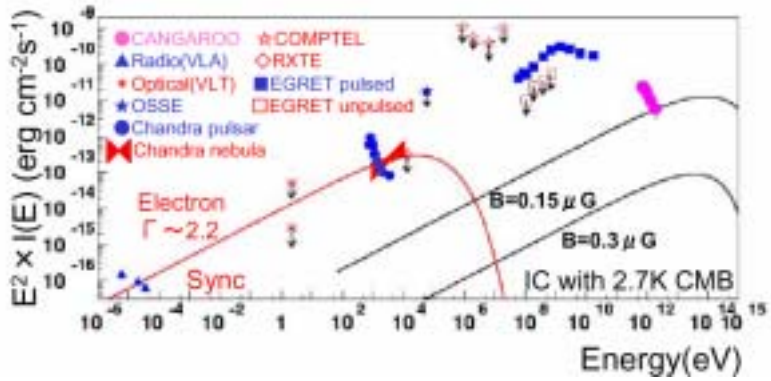


→ see Hayashi's poster [S24] for detail

RX J1713.7-3946: the multi-wavelength spectrum



PSR1706-44: C-II results



→ See Kushida's poster [S28] for detail