Search for TeV gamma-rays from the remnant of SN 1987A in 2001

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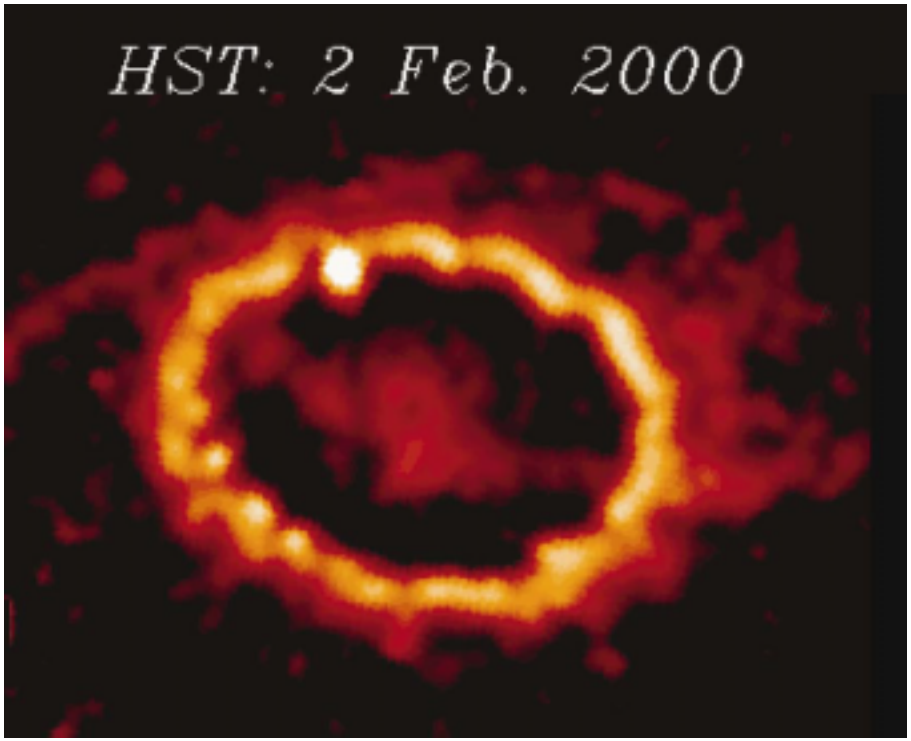
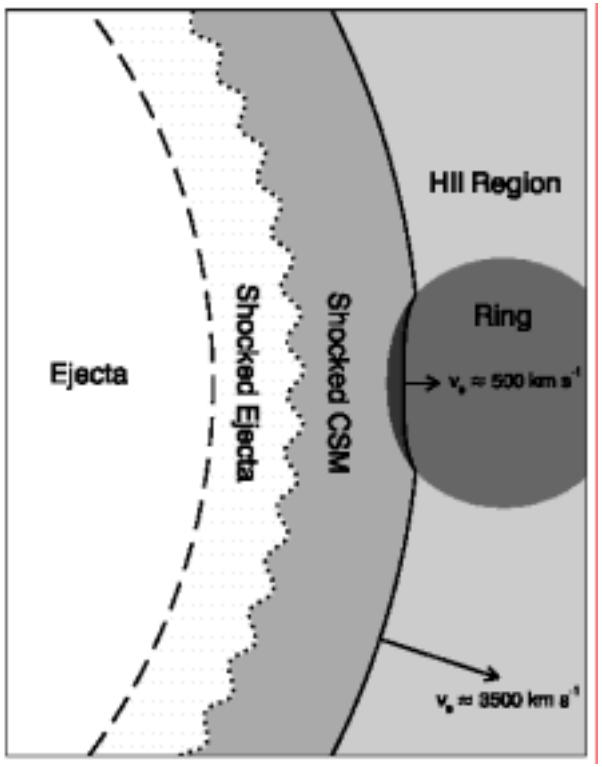
SN 1987A

Feb. 23, 1987 in the Large Magellanic Cloud
(distance ~50 kpc)





Observations

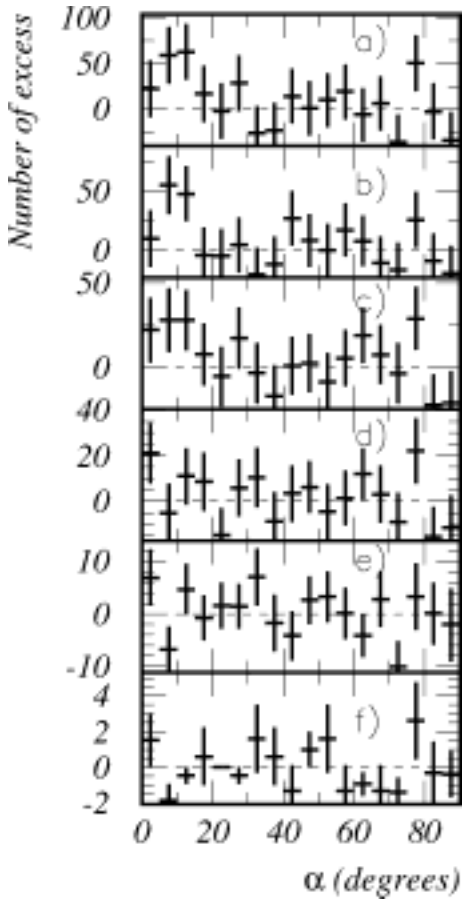
- Observations were carried out in 2001 over 10 moonless nights between Nov. 16 and Dec. 11 (~5400 days after the supernova) with the 10m CANGAROO-II IACT.

- In total, 708 min. ON- and 1019 min. OFF-source data were obtained.

- Due to mean zenith angle of 39^{o}, the detection threshold estimated to be 1 TeV
(~450 GeV at zenith)

Analysis

Background subtracted
α spectra



For differential flux power law index = 2.0

Threshold energy (TeV)	2σ-Upper Limit ($cm^{-2}s^{-1}$)
1.2	7.5×10^{-12}
1.5	5.3×10^{-12}
1.9	3.5×10^{-12}
2.7	1.5×10^{-12}
5.0	4.3×10^{-13}
7.7	1.7×10^{-13}

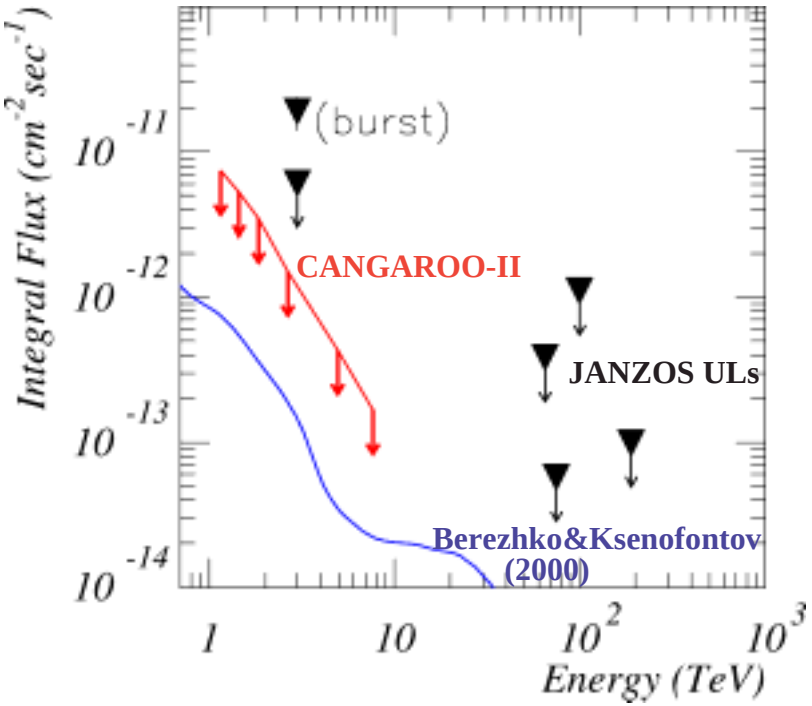
Procedures and further details of analysis in *Itoh et al. (2003, A&A, 402, 443)*

Model (by *Berezhko&Ksenofontov, 2000, Astron Lett., 26, 639*)

- Nonlinear diffusive shock acceleration of CRs model was applied for the case of SN1987A

- Gamma-ray flux from π^0 decay, which are generated in collisions of accelerated protons with SN environ matter, was calculated for different times since supernova

Results



- Current ULs are tightened by a factor > 3 than those of previous JANZOS observations
- About factor 3 above the theoretical prediction by *Berezhko&Ksenofontov (2000)*
- TeV gamma-ray luminosity is lower than 10^{37} erg s^{-1} at ~10 TeV

Results (II)

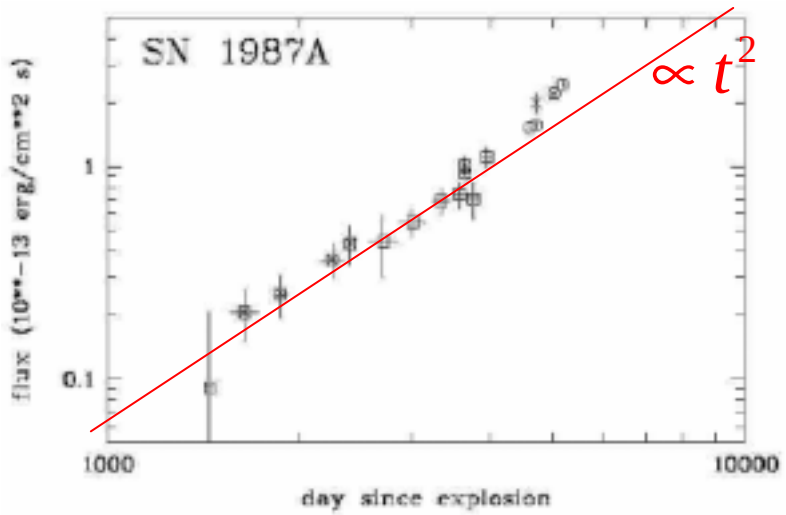
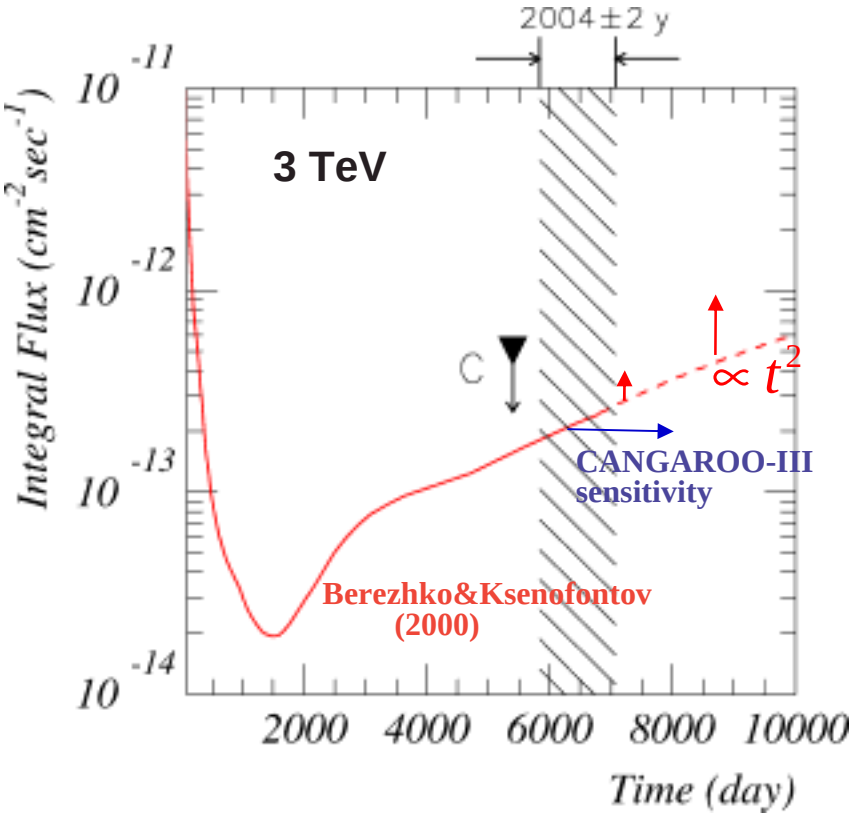


Fig. 17. 0.5 -2.0 keV lightcurve of SN 1987A compiled from ROSAT, Chandra (hexagons, from Park et al., 2002) and XMM-Newton (crosses) measurements.

From *B.Aschenbach (2002)*

The XMM-Newton and the Chandra data points tend to exceed t^2 best fit



In the year 2004±2 (*Manchester et al. 2002*) the shock will encounter the dense inner optical ring. Then one can expect a dramatic increase also of TeV gamma-rays.

Summary

- Upper Limits for the gamma-ray flux for the day ~5400 after the supernova are reported
- The next generation of southern hemisphere IACTs will have a good chance of detecting a signal
- Regular observations in TeV gamma rays of the SN1987A remnant over the next decade are highly desirable.