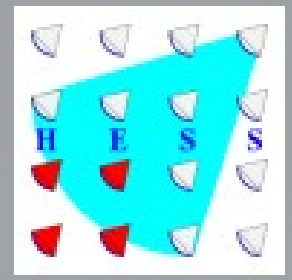


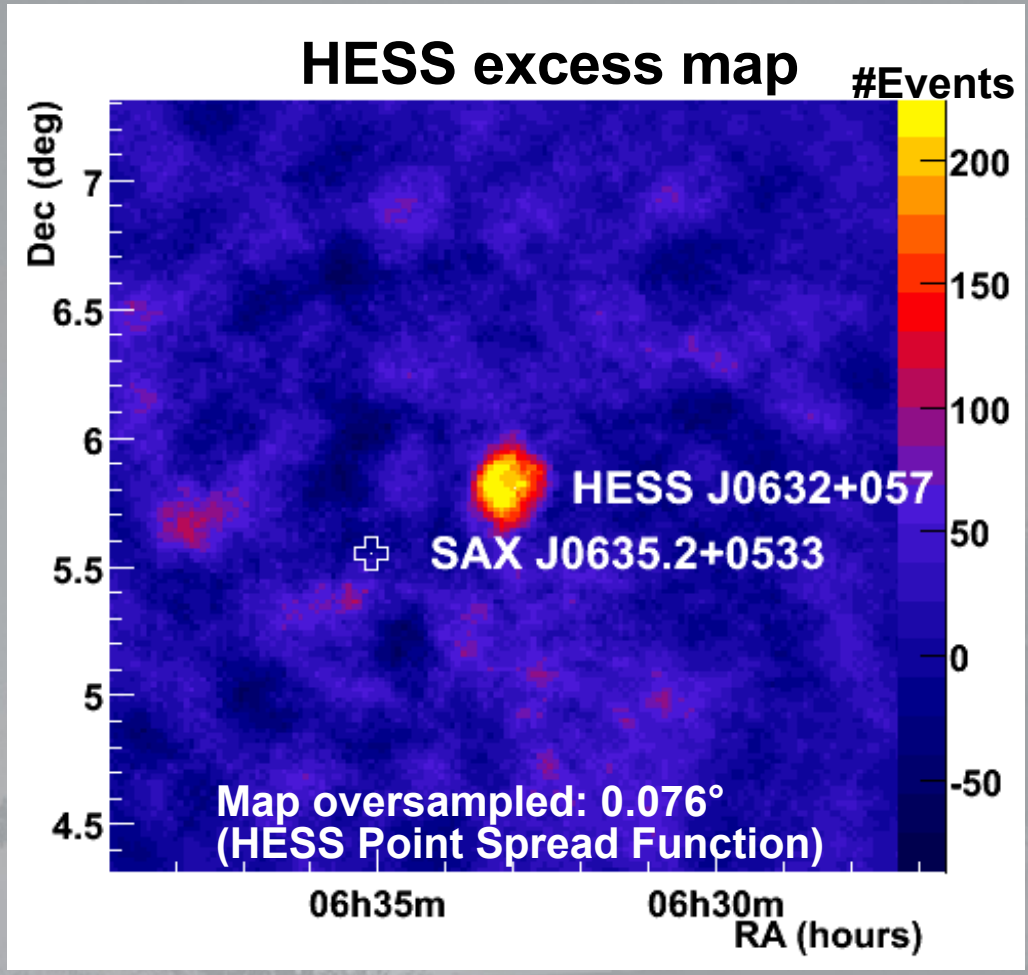
Discovery of point-like VHE gamma-ray source in Monoceros

A. Fiasson[1], J. A. Hinton[2], Y. Gallant[1], A. Marcowith[1], O. Reimer[3], G. Rowell[4] for the HESS Collaboration

[1] LPTA, Université Montpellier 2, CNRS/IN2P3, Montpellier, France
[2] School of Physics & Astronomy, University of Leeds, Leeds, UK
[3] Stanford University, HEPL & KIPAC, Stanford, CA 94305-4085, USA.
[4] School of Chemistery & Physics, University of Adelaide, Adelaide 5005, Australia.

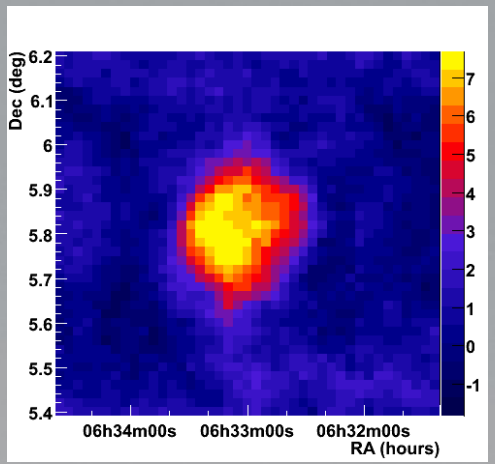
HESS J0632+057

- Monoceros loop SNR region:
  - Observed between March 2004 and March 2006
  - 13.8 hours live time
- VHE candidate in this region
  - SAX J0635.2+0533
  - 34 ms binary pulsar
- Point-like excess in the field of view
  - Stat. significance : 7.2 σ
  - Accounting for blind search: 5.6 σ

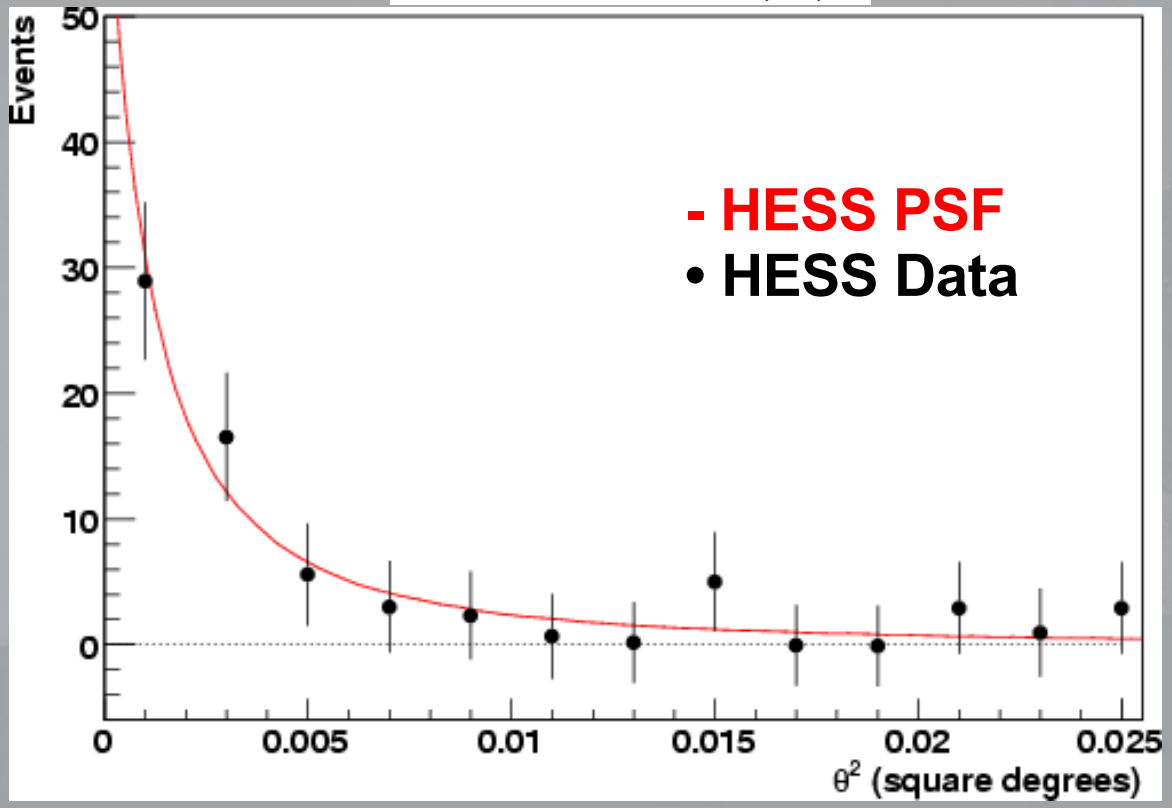


Source Morphology

- **Best fit position**
  - **RA: 6h 32' 58.3"**
  - **Dec: + 5° 48' 20"**
  - **Uncertainty: ± 28"**



- **Point-like source**
  - **Compatible with the point spread function of the instrument**
  - **Size < 2' (95% confidence) assuming a gaussian profile**



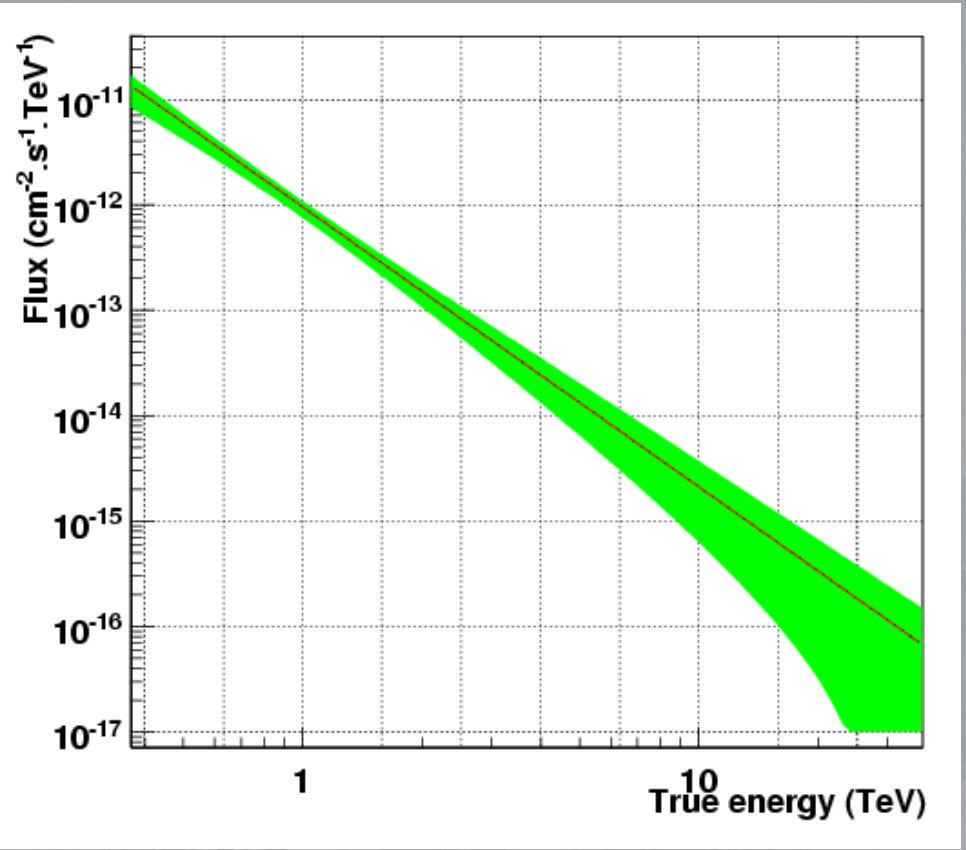
Reconstructed spectrum

- Compatible with a power-law
  - Index : 2.53 ± 0.26 ± 0.20
  - Normalisation at 1 TeV

  $9.1 \pm 0.7 \pm 3.0\ 10^{-13} cm^{-2} s^{-1} TeV^{-1}$

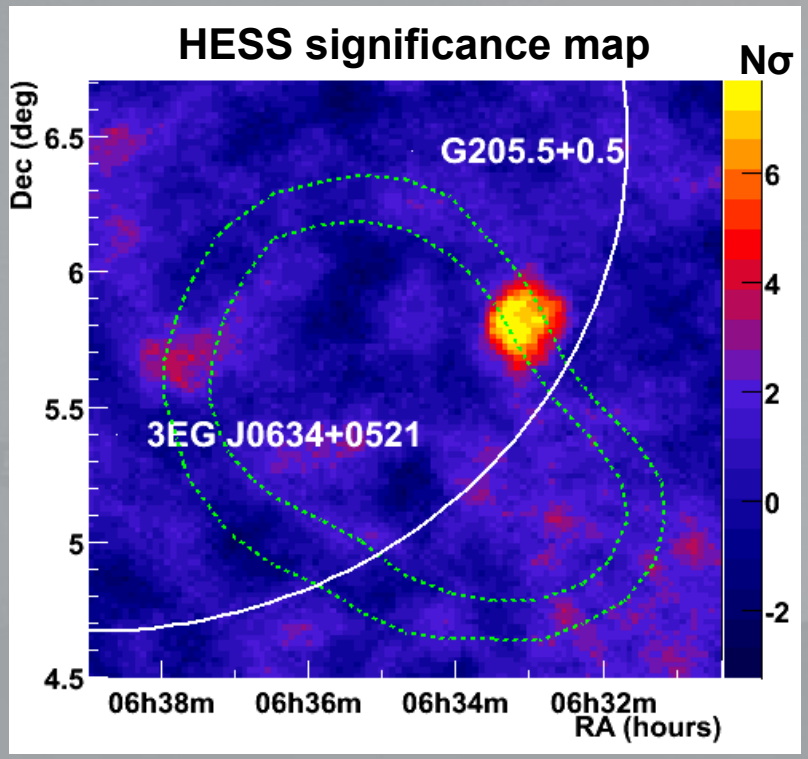
  <=> 3% Crab Nebula flux
  - Chi2 : 16.3/21 ndf => P=0.75

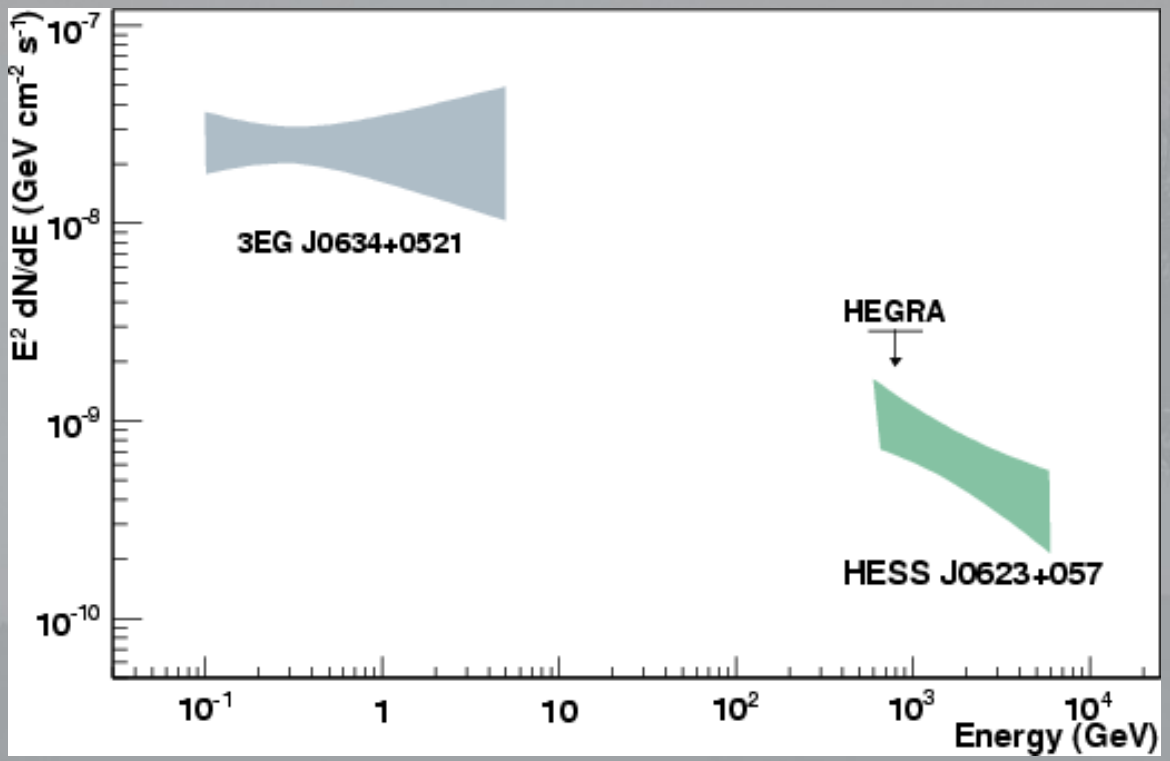
- No evidence of variability but not efficiently constrained
  - Sparse sampling
  - Close to sensitivity threshold



Association with 3EG 0634+0521?

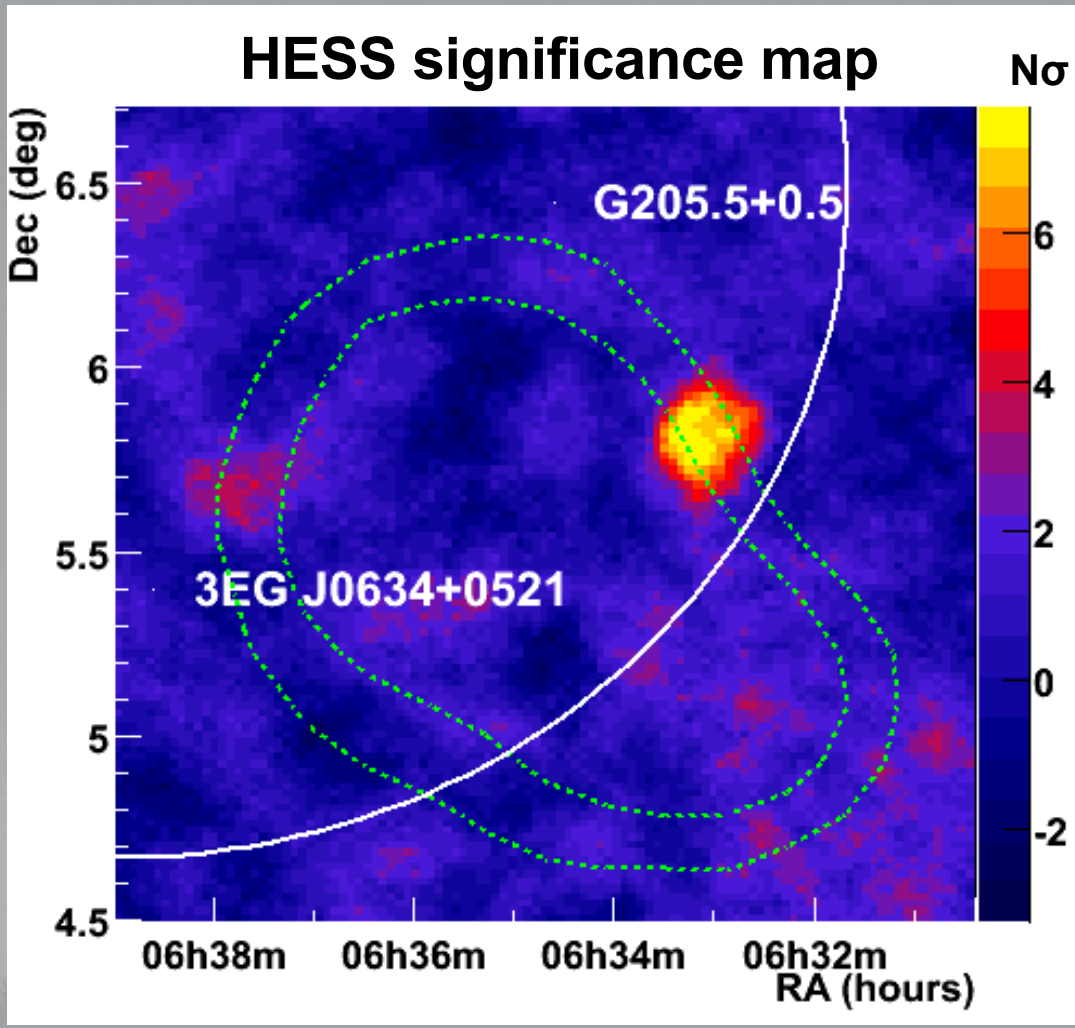
- The excess lies inside 99% conf. level of 3EG 0634+0521
  - Flagged as confused and possibly extended
- EGRET flux is consistent with an extrapolation of HESS flux
  - Fit of two spectra gives a photon index Γ = 2.41 ± 0.06





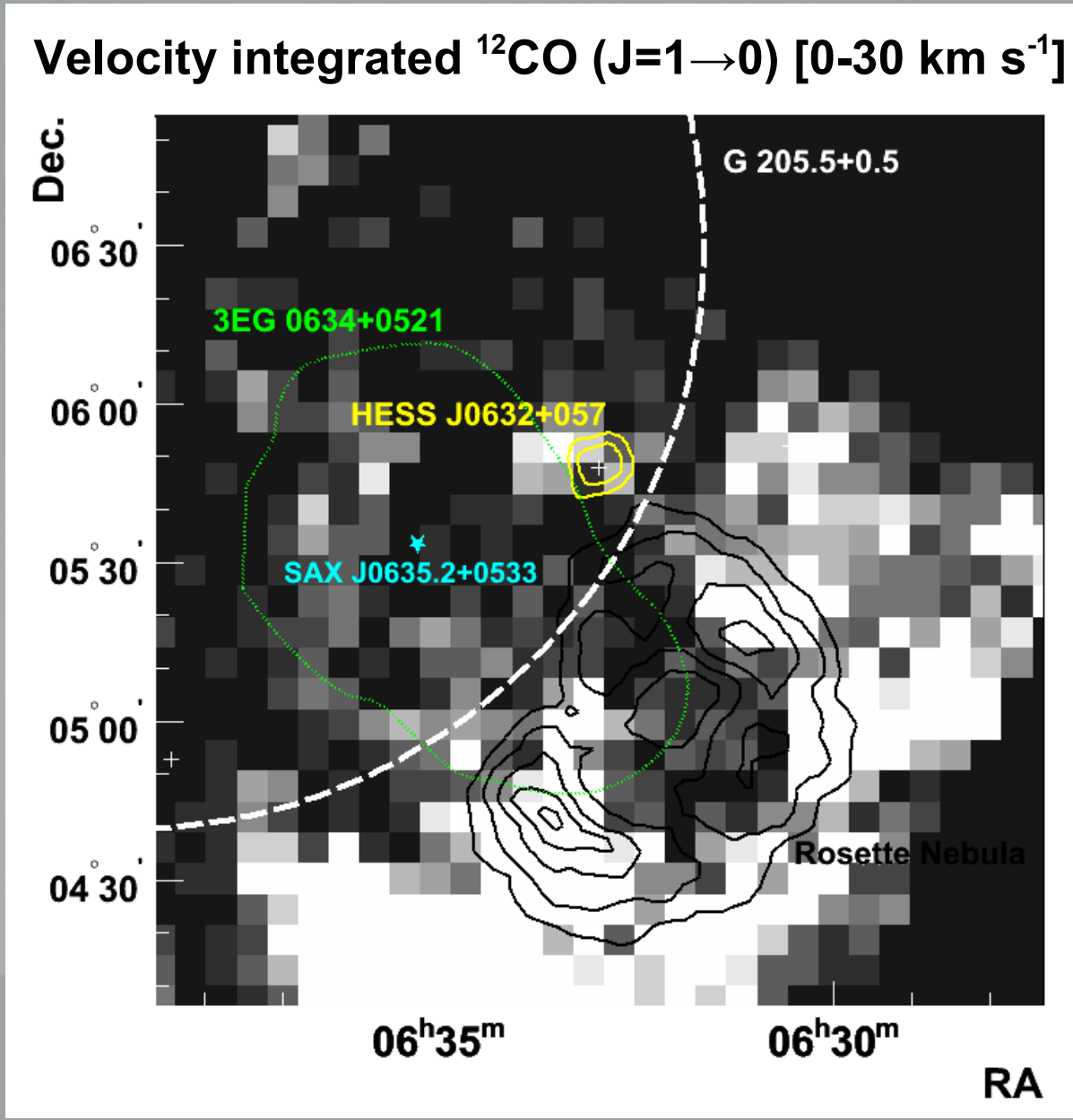
Association with G205.5+0.5 ?

- HESS J0632+057 lies close to the edge of the remnant
- Shell type SNR
- Apparent interaction with Rosette Nebula
  - Distance ~1.6 kpc
- Old SNR ~3.10^4 year
  - Acceleration of CR always possible
- Main problem: point-like nature
  - Existence of a dense molecular cloud in the shock vicinity?
- Cloud apparently coincident in CfA survey (Oliver et al. 1996)



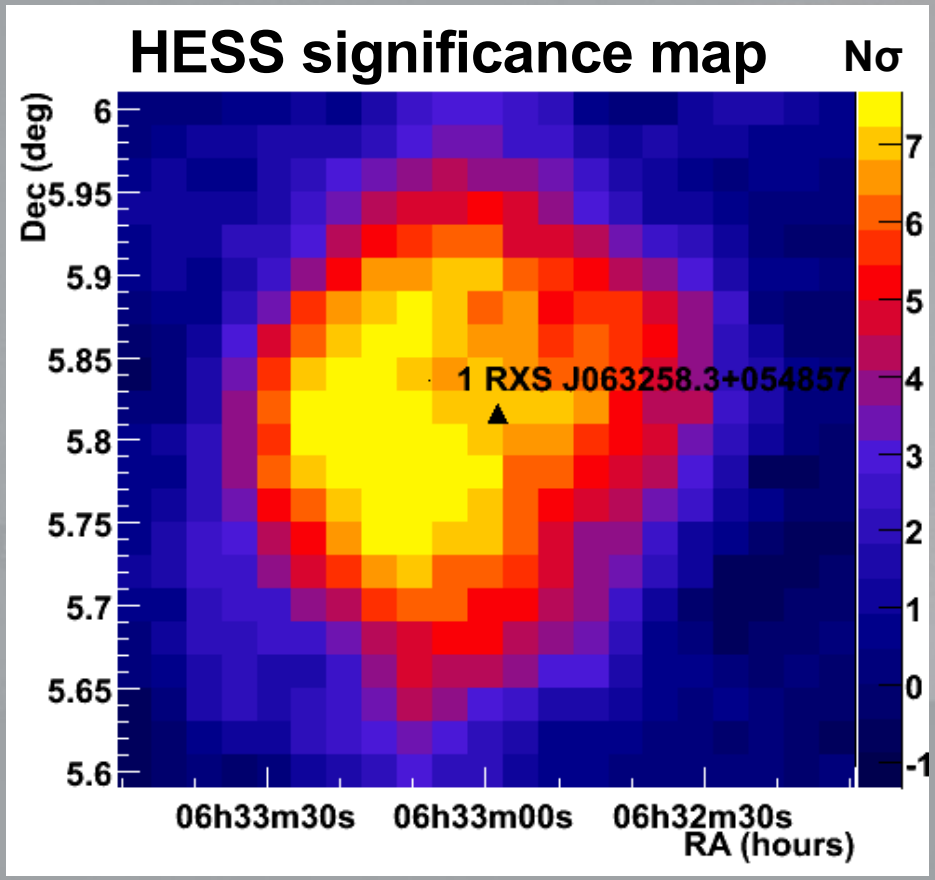
NANTEN CO Observations

- **NANTEN**
  - **4 m diameter sub-mm telescope**
  - **Galactic plane survey**
  - **Angular resolution better than CfA survey**
- **Cloud in the vicinity of the supernova remnant**
  - **Similar velocity**
- **Position significantly shifted from the position of HESS J0632+057**
- **No significant cloud along the line of sight**



Association with a ROSAT source?

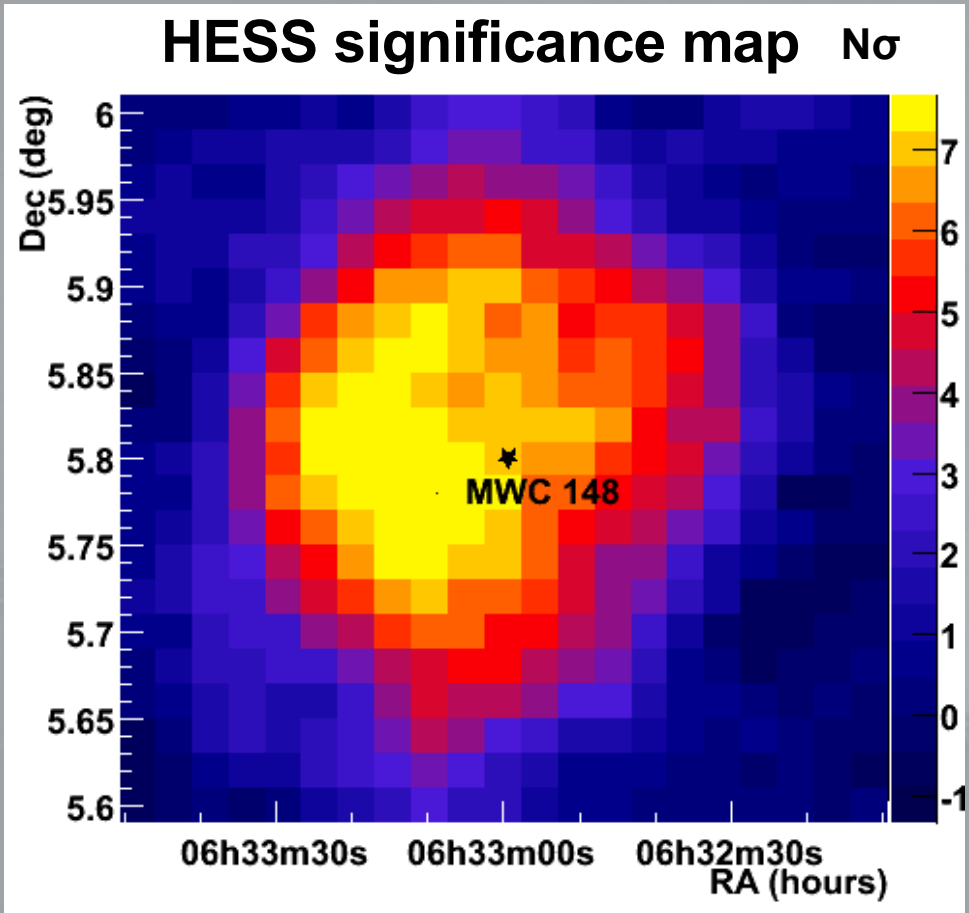
- ROSAT source
  - 1RXS J063258.3+054857
  - Faint X-rays source
  - Within HESS position errors



- Synchrotron emission from accelerated electrons?
  - Low level compared to VHE γ-rays
  - Required low magnetic field and strong source of electrons
  - X-rays absorbed?
- Secondary electrons from hadronic interactions?
  - Weaker X-ray emission expected
  - Probably compatible with VHE γ-rays

Association with a Be-star?

- Be-star MWC 148
  - Massive emission line
  - Within HESS errors



- Important winds from such stars
  - Acceleration sites in wind shocks?
- Binary system?
  - Pulsar companion not yet observed?
  - Same system as VHE γ-ray source

    PSR B1259-63 / SS 2883

Summary

- New point-like source close to the Monoceros loop SNR
- Reconstructed spectrum compatible with a power-law
  - Index : $2.53 \pm 0.26 \pm 0.20$
  - Normalisation 1 TeV : $9.1 \pm 0.7 \pm 3.0\ 10^{-13} \mathrm{cm}^{-2}\mathrm{s}^{-1}\mathrm{TeV}^{-1}$

    <=> 3% Crab nebula observed emission
- No clear counterpart
  - No significant molecular cloud along line of sight in NANTEN data
  - Possible associations with other wavelengths
    - EGRET source 3EG 0634+0521
    - ROSAT source 1RXS J063258.3+054857
    - Massive line emission star MWC 148

backup