

Fermi-LAT observations of young Supernova remnants

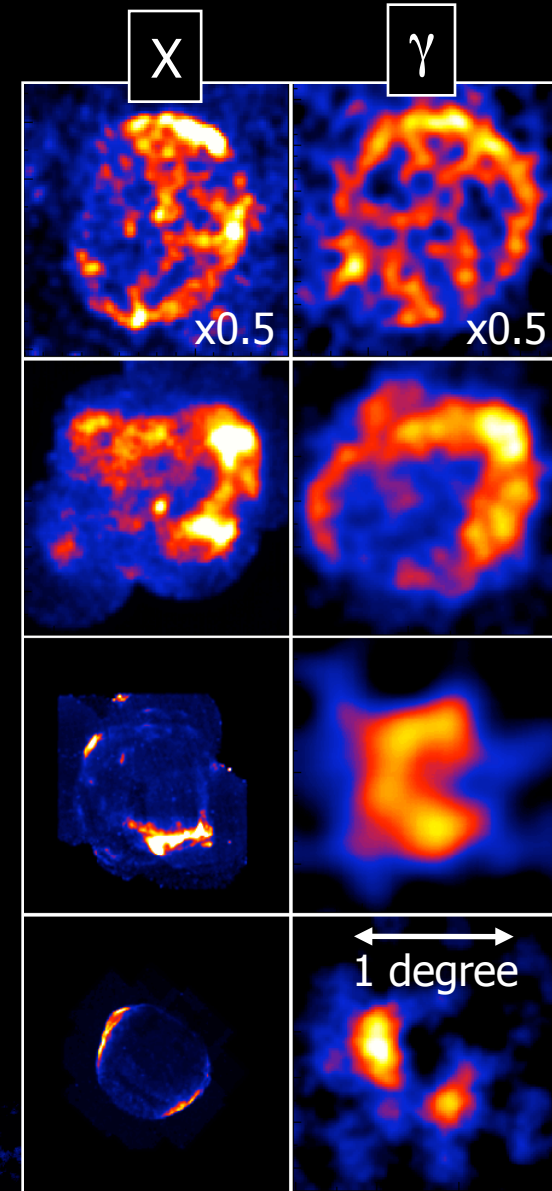
S. Funk, Kavli Institute for
Astroparticle Physics & Cosmology,
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on behalf of the LAT
collaboration

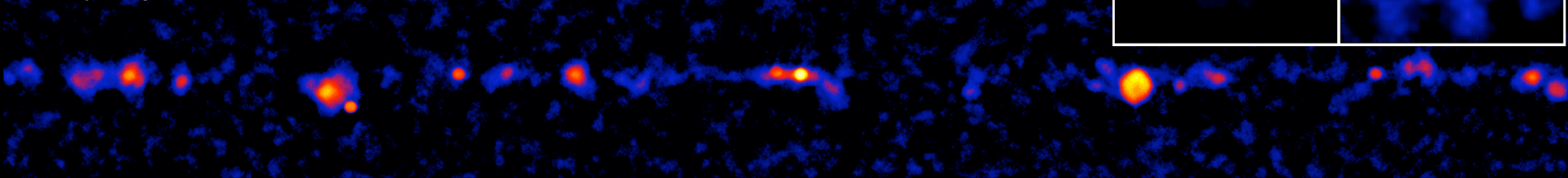


TeV gamma-ray observations

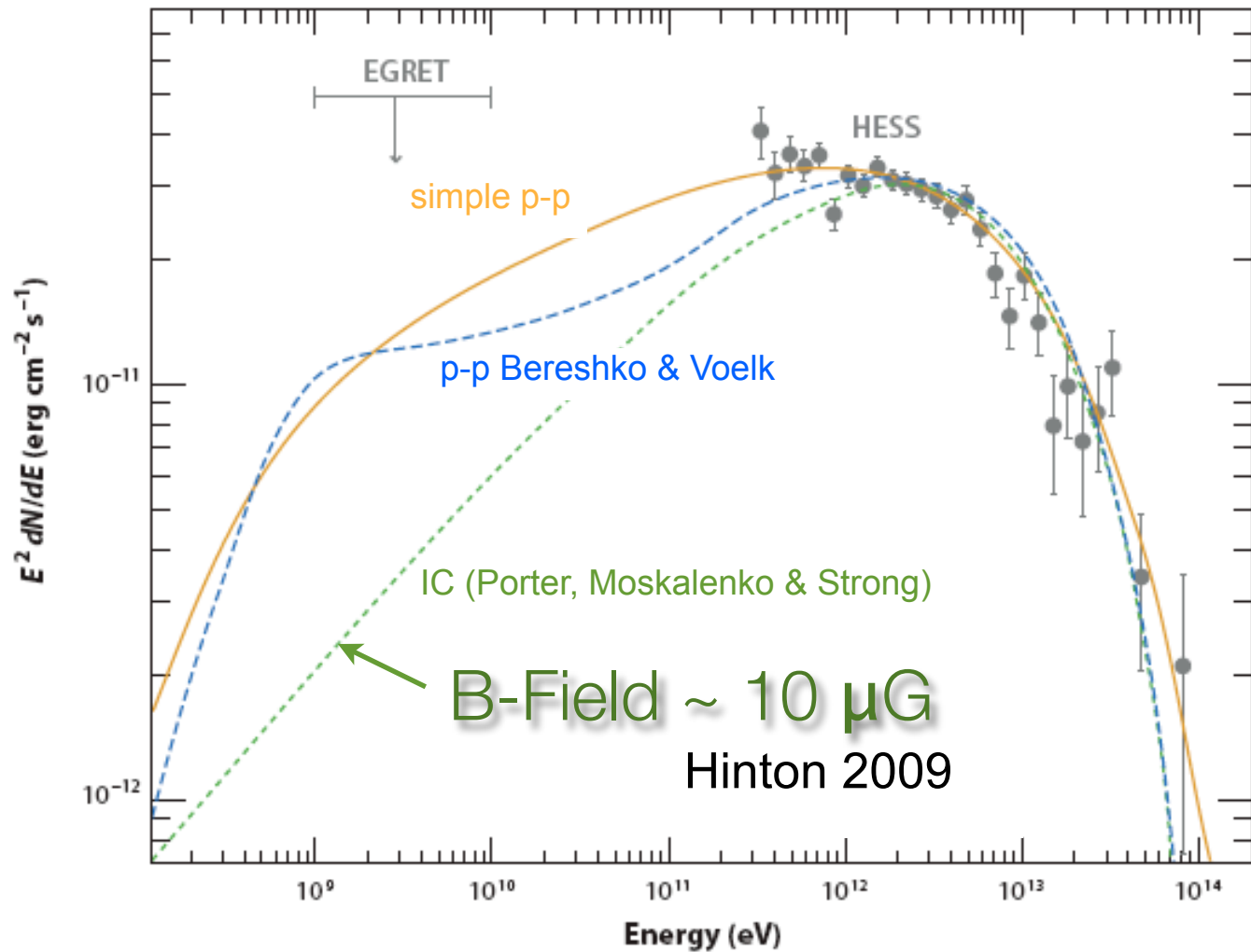
- ✦ 4 shell-like objects, detected in TeV gamma-rays
- ✦ Young historical SNRs
 - ✦ RX J1713.7-3946
 - ✦ Vela Junior
 - ✦ RCW 86
 - ✦ SN 1006
- ✦ All show rather clear correlation with non-thermal X-ray emission
- ✦ Also detection of Cas A, upper limits for Tycho, Kepler, ...



VHE γ -rays

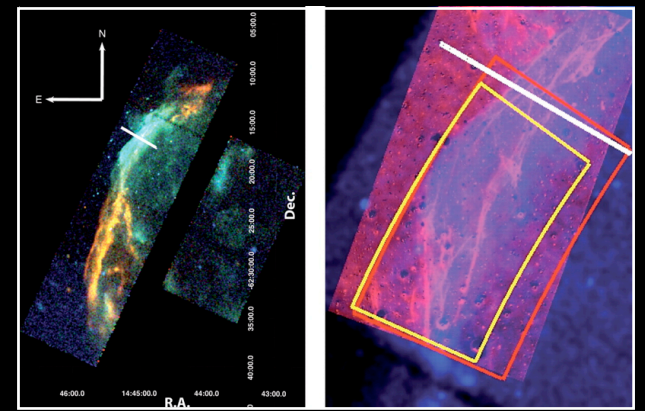
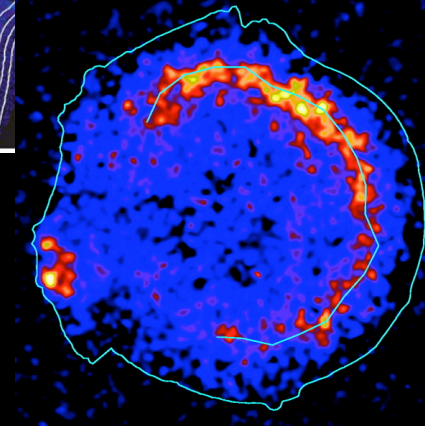
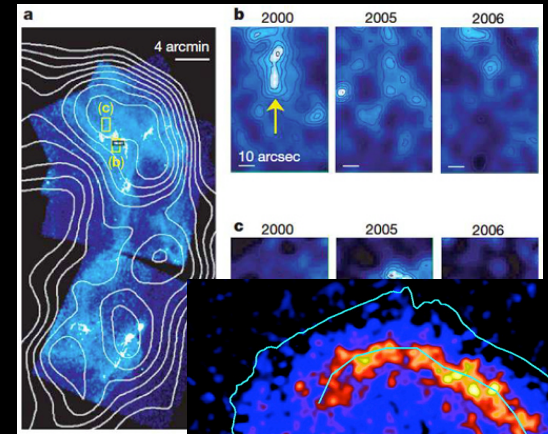


Protons or Electrons?



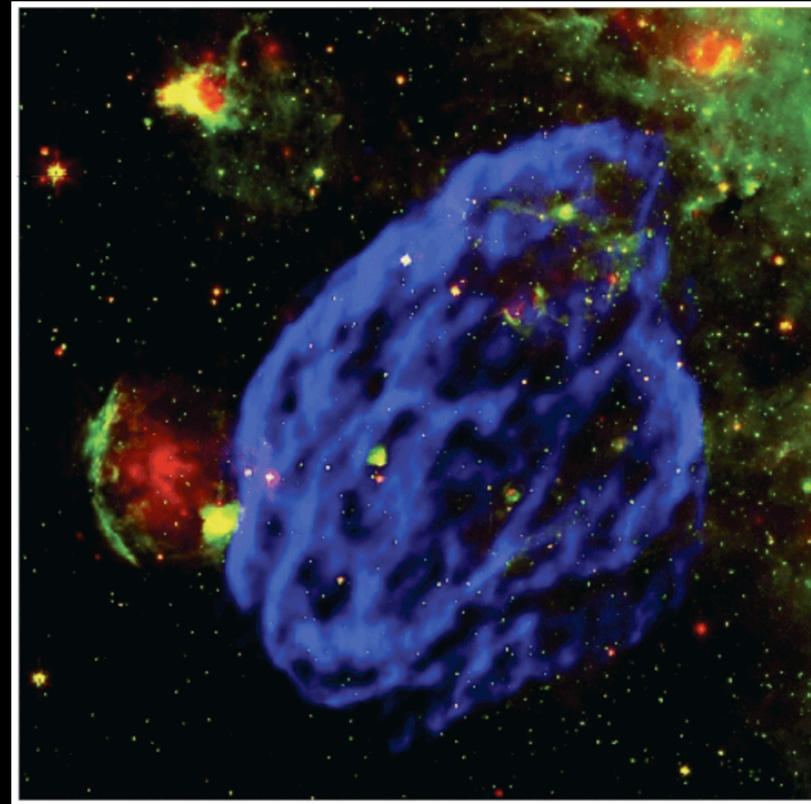
Magnetic fields in SNR shells

- Mounting evidence that
 - B-fields amplified in SNR shocks
 1. X-ray Filaments
 2. X-ray Variability
 - Cosmic ray pressure is significant
 1. position of CD
 2. post-shock temperature
 3. high B-fields



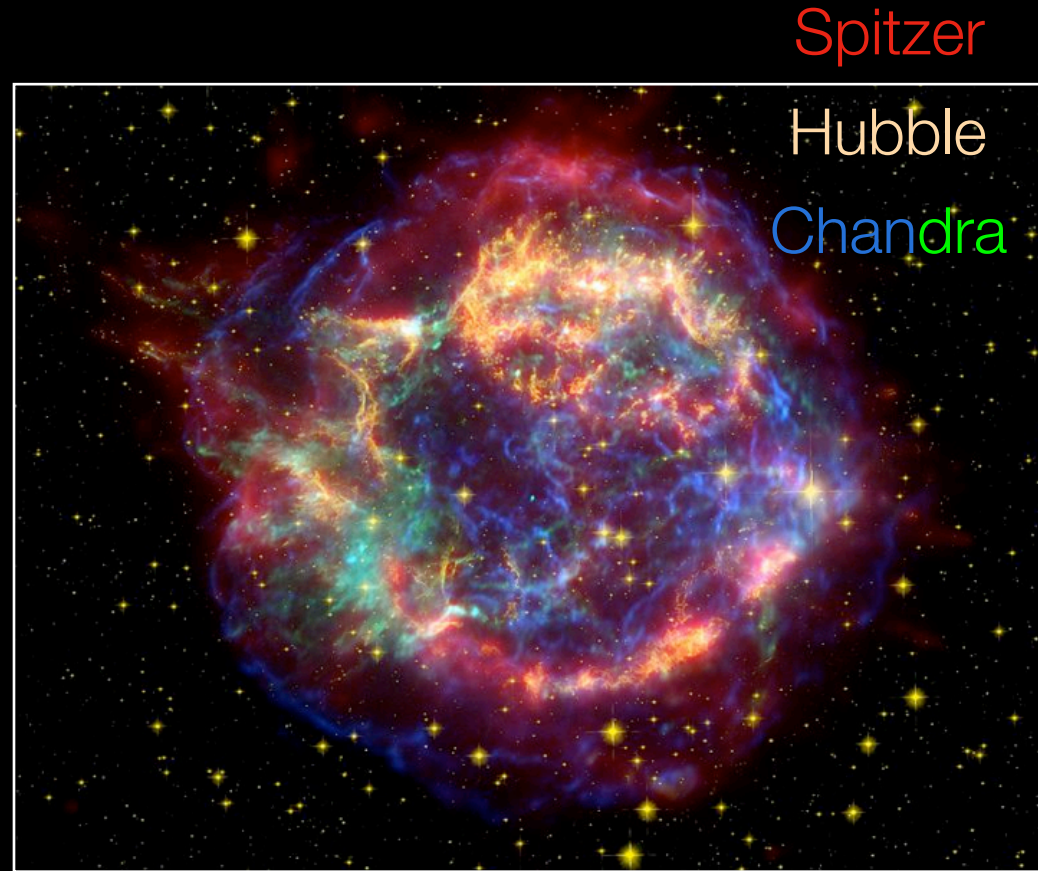
General comments

- Any positional coincidence with an SNR must be tested vs pulsars
- Clear detection of bright GeV gamma-ray sources coinciding with **mid-aged** SNRs interacting with molecular clouds
 - W51C, W44, W28
(see talk by T. Tanaka)
 - IC443 (poster by H. Lee)
- This talk: **young** SNRs



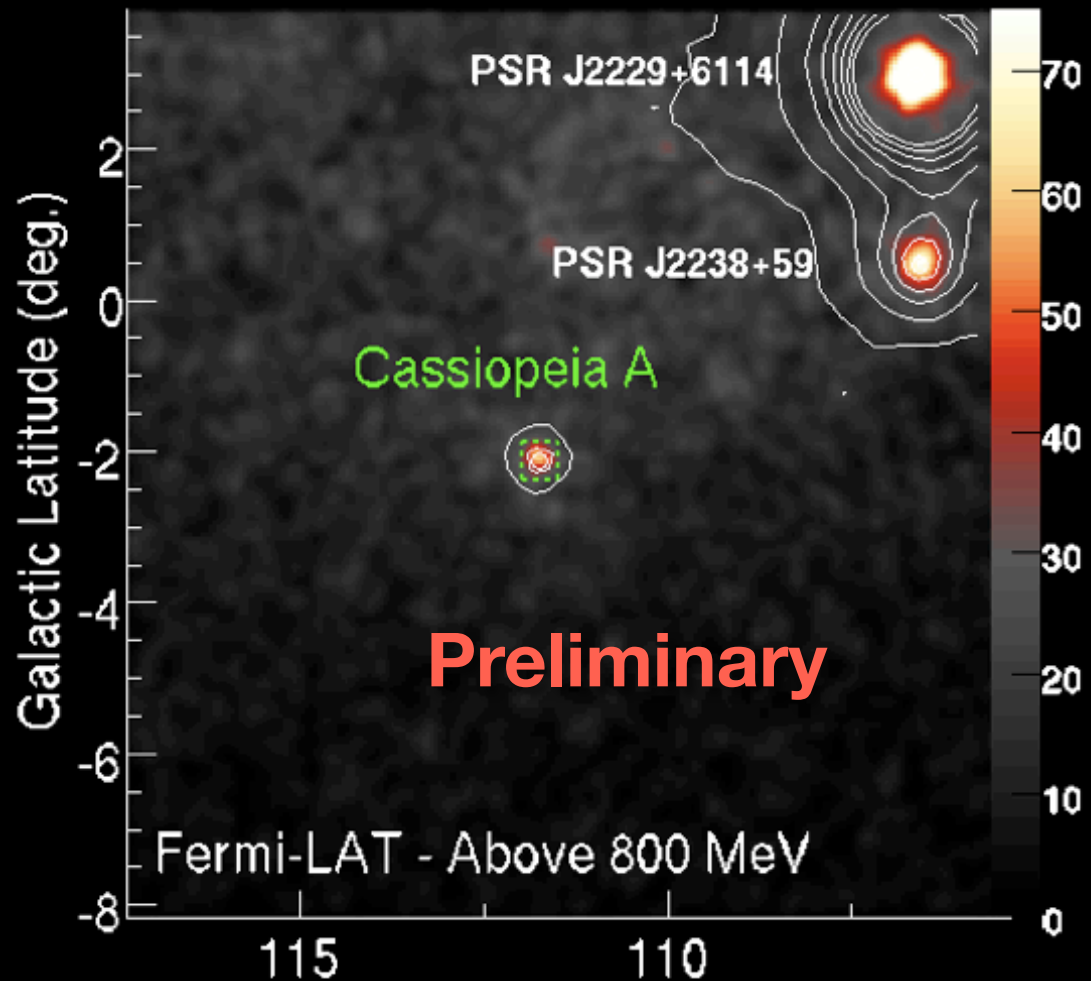
Cassiopeia A

- Last SNR witnessed by humans (AD 1680)
- Temporal X-ray brightness fluctuations (Uchiyama +2008, Patnaude+2009)
- Detected in TeV gamma-rays by HEGRA, MAGIC, VERITAS (~3% Crab flux)
 - Large synchrotron to γ -ray power implies large B-fields (~1 mG)



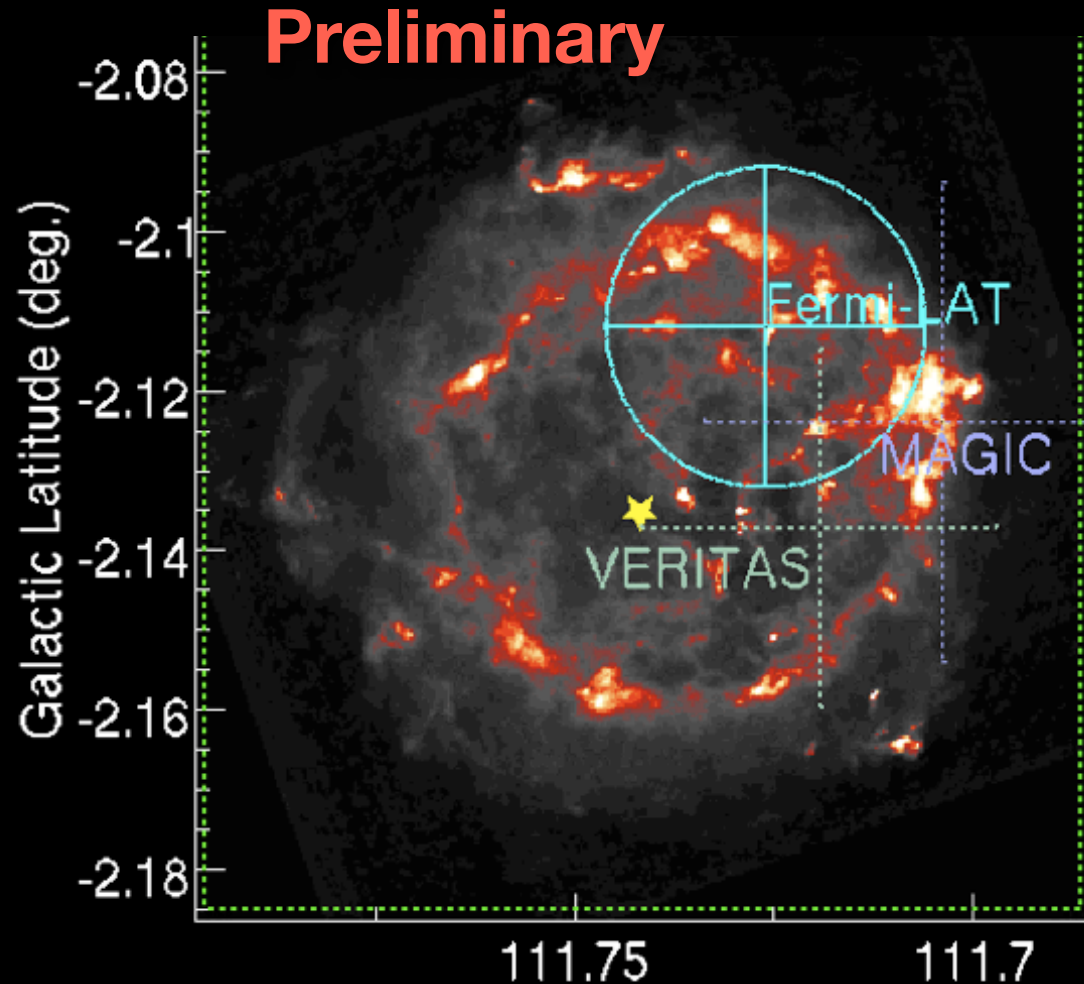
Fermi-LAT view of Cas A

- Smoothed count map of the region (no diffuse emission subtraction)
- Overlaid are TS contours (TS=25, 50, 100, 500, ...)
- Clear detection of Cas A at 12.2σ (TS=148)
- Upper limit on size: $3.5'$



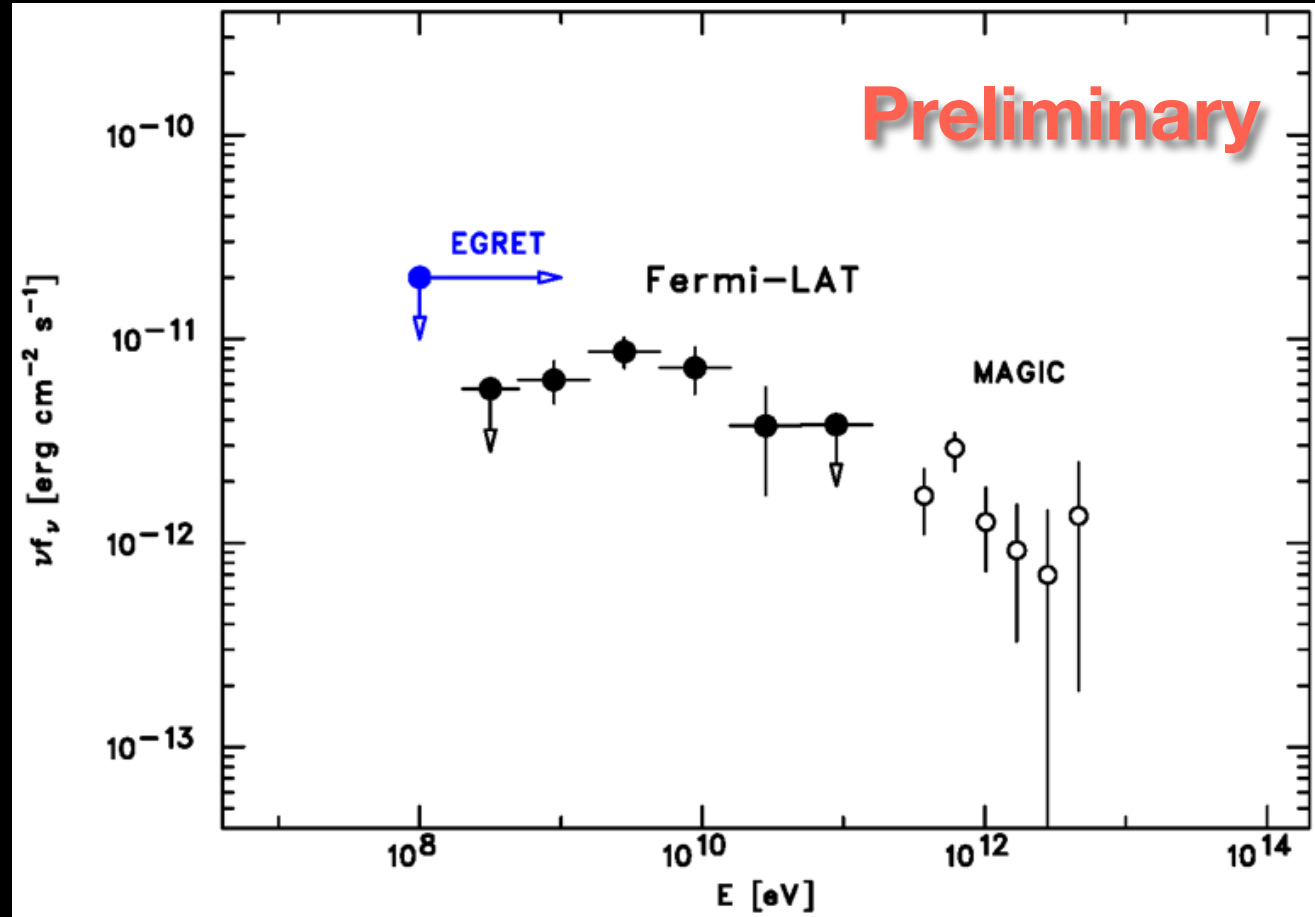
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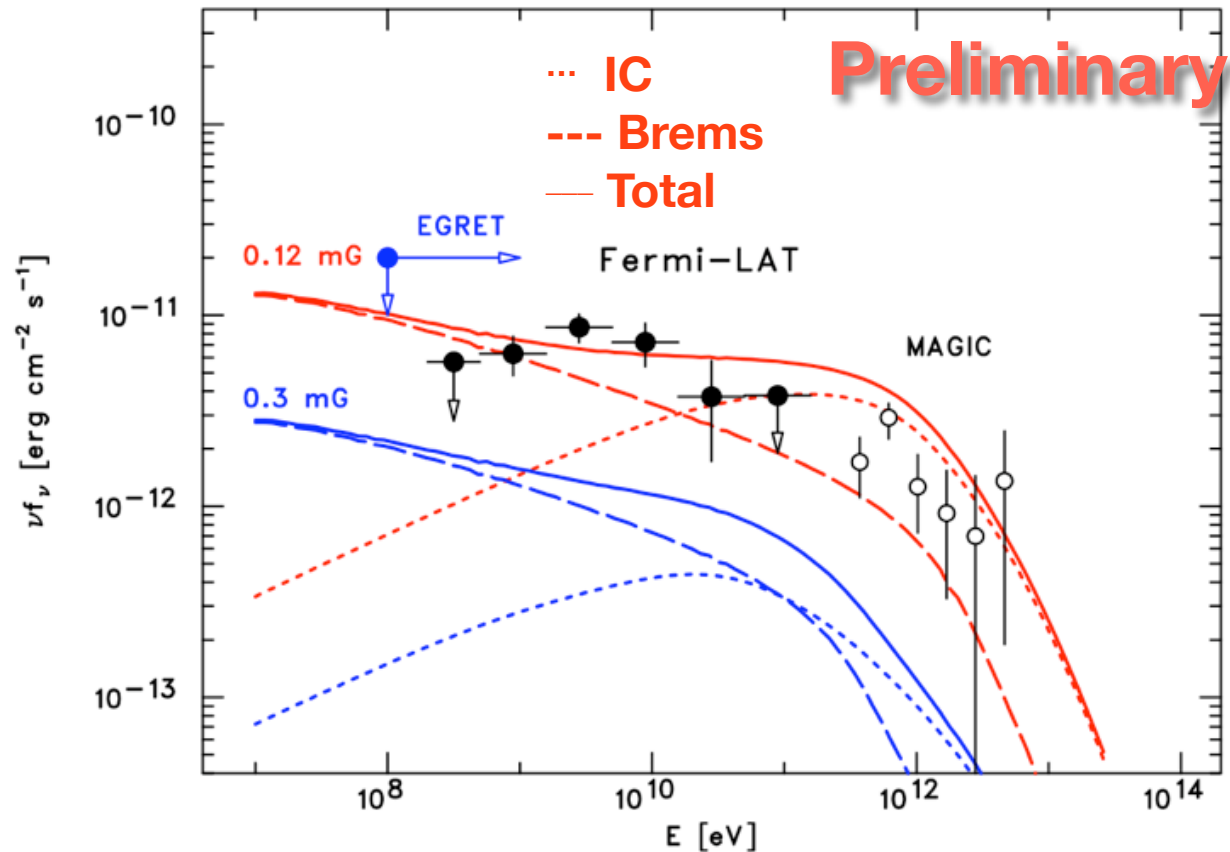
Spectrum

- ✦ LAT spectrum connects well with MAGIC TeV gamma-rays
- ✦ No sign for a cutoff (as in pulsars)



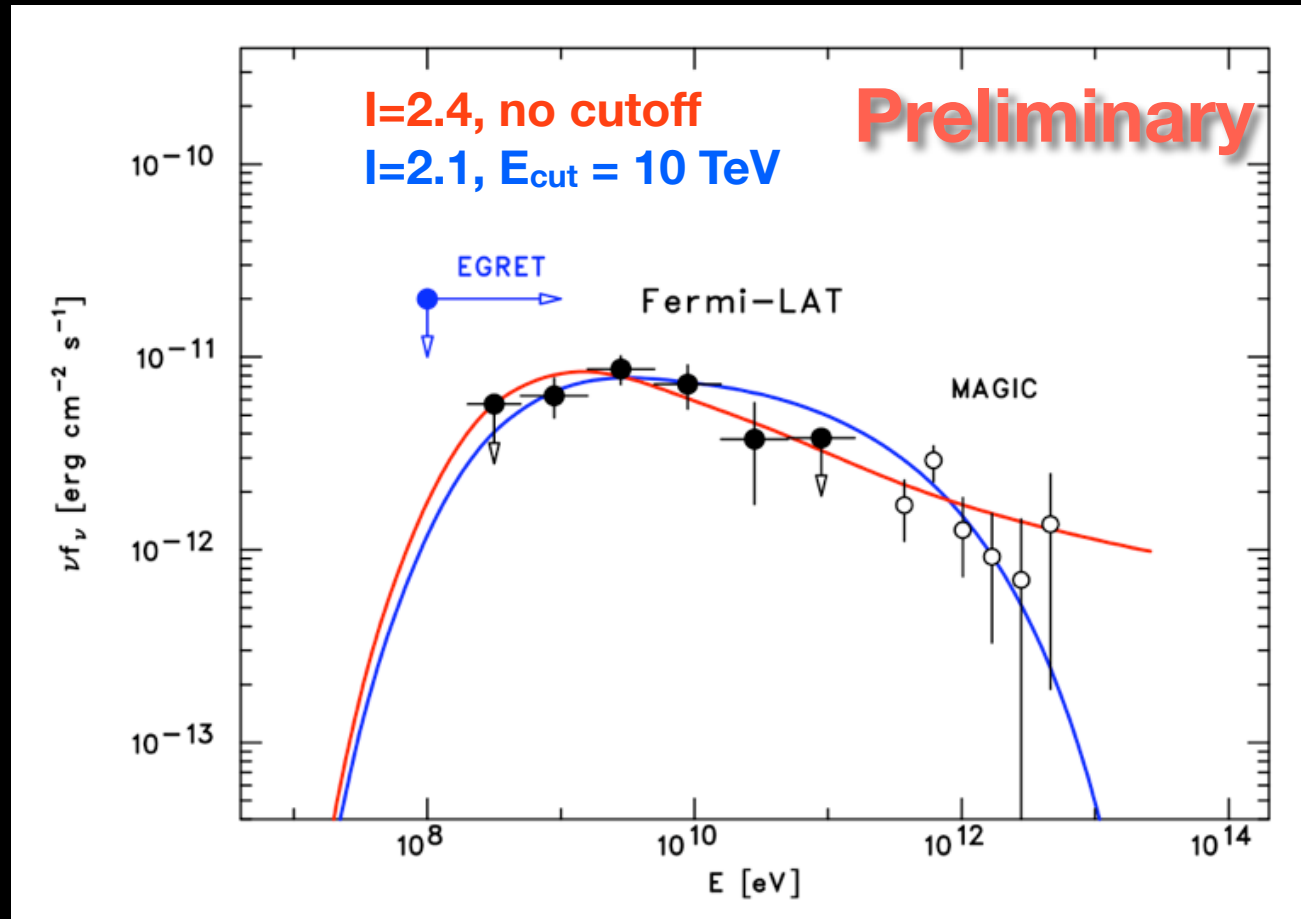
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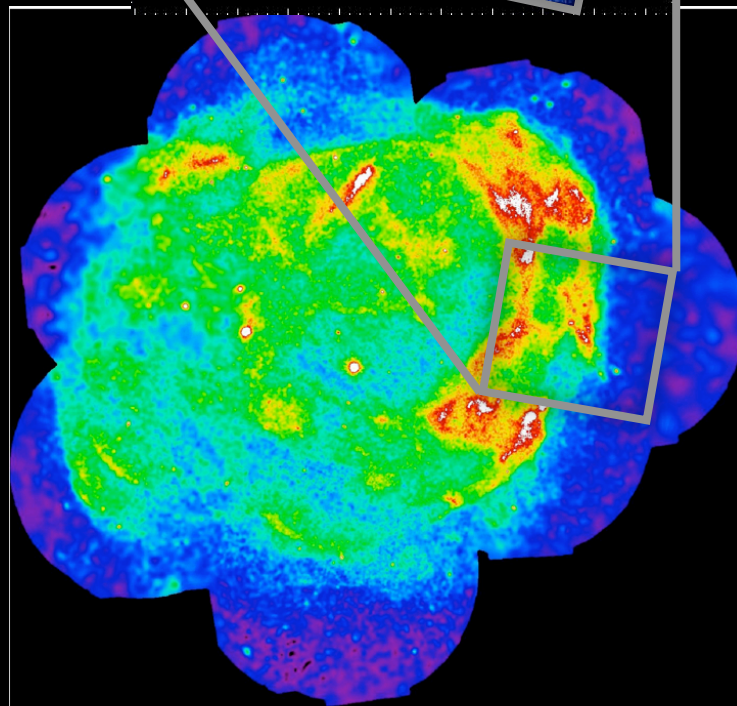
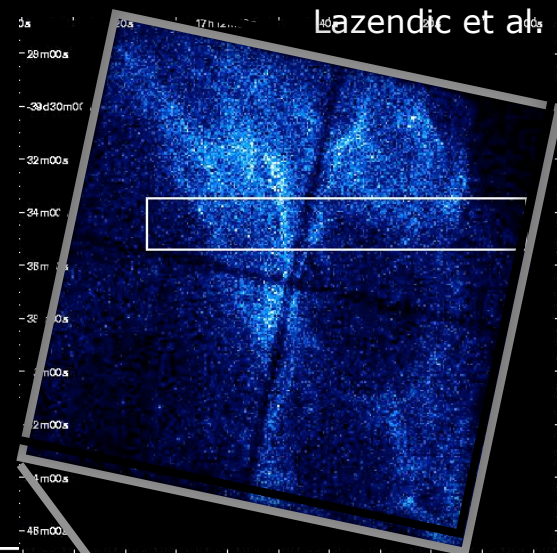


RX J1713.7-3946

Chandra

Uchiyama et al. 2003

Lazendic et al. 2004



ASCA

1-3 keV

Koyama et al. '97

Slane et al. '99

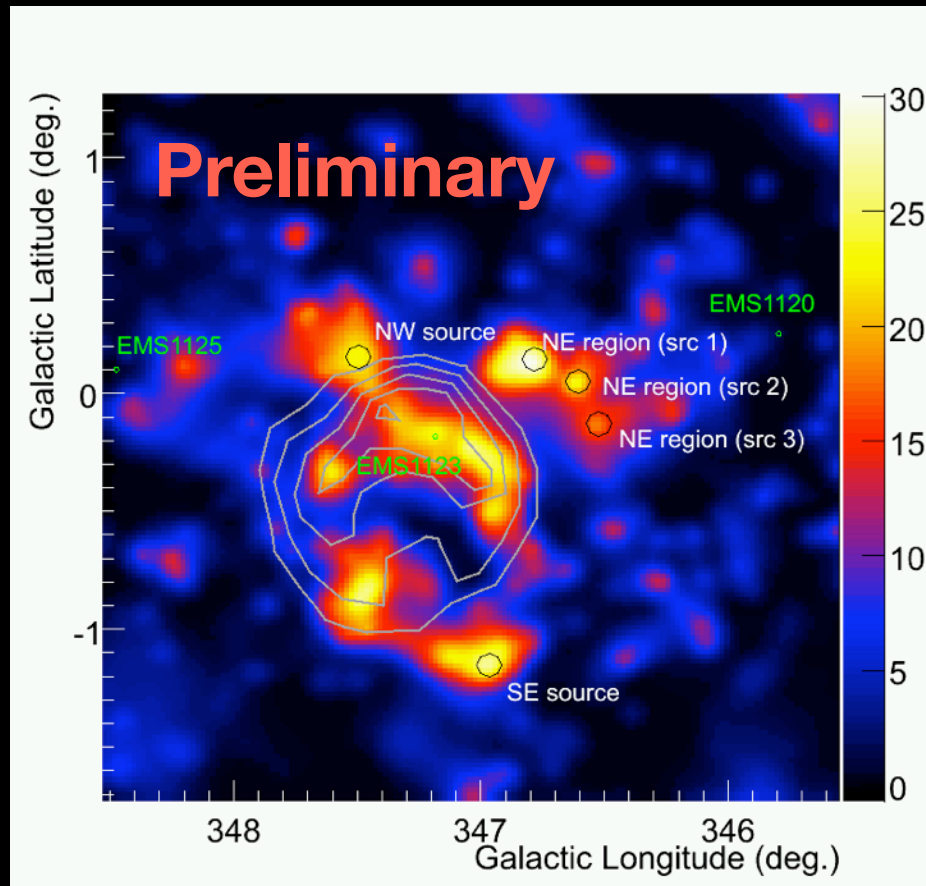
Uchiyama et al. '02

XMM

Acero et al. 2009

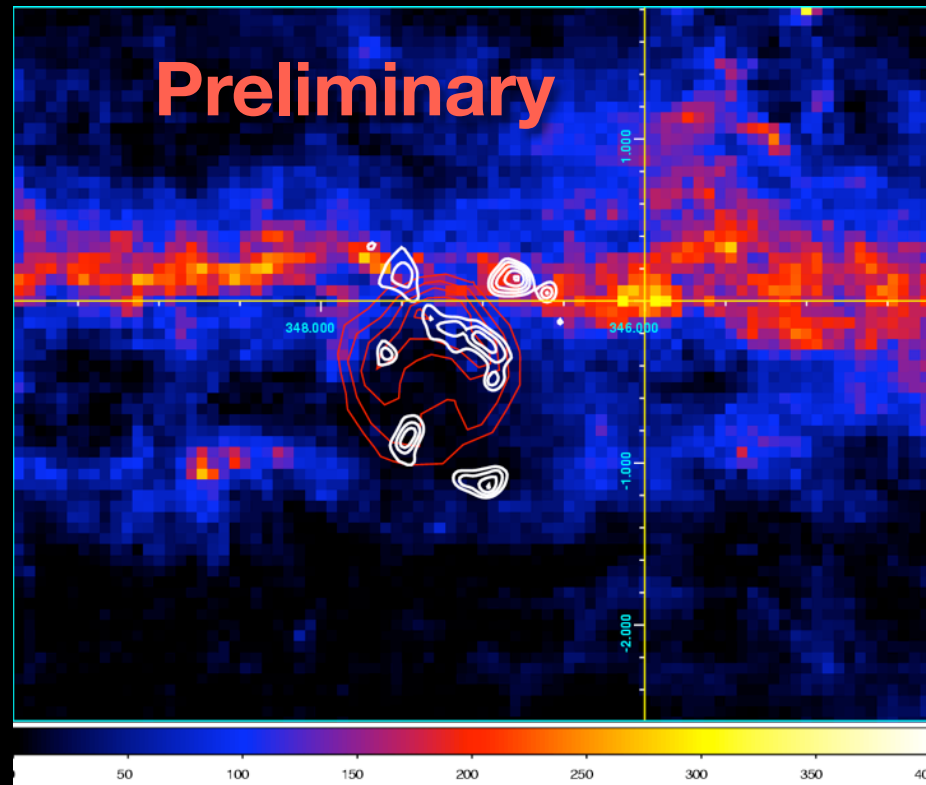
Fermi-LAT view of RX J1713.7-3946

- ✦ Faint source in a complicated region
- ✦ TS Map after subtraction of 11-month catalog sources
- ✦ Sources to the north coincide with molecular material (CO and HII region)



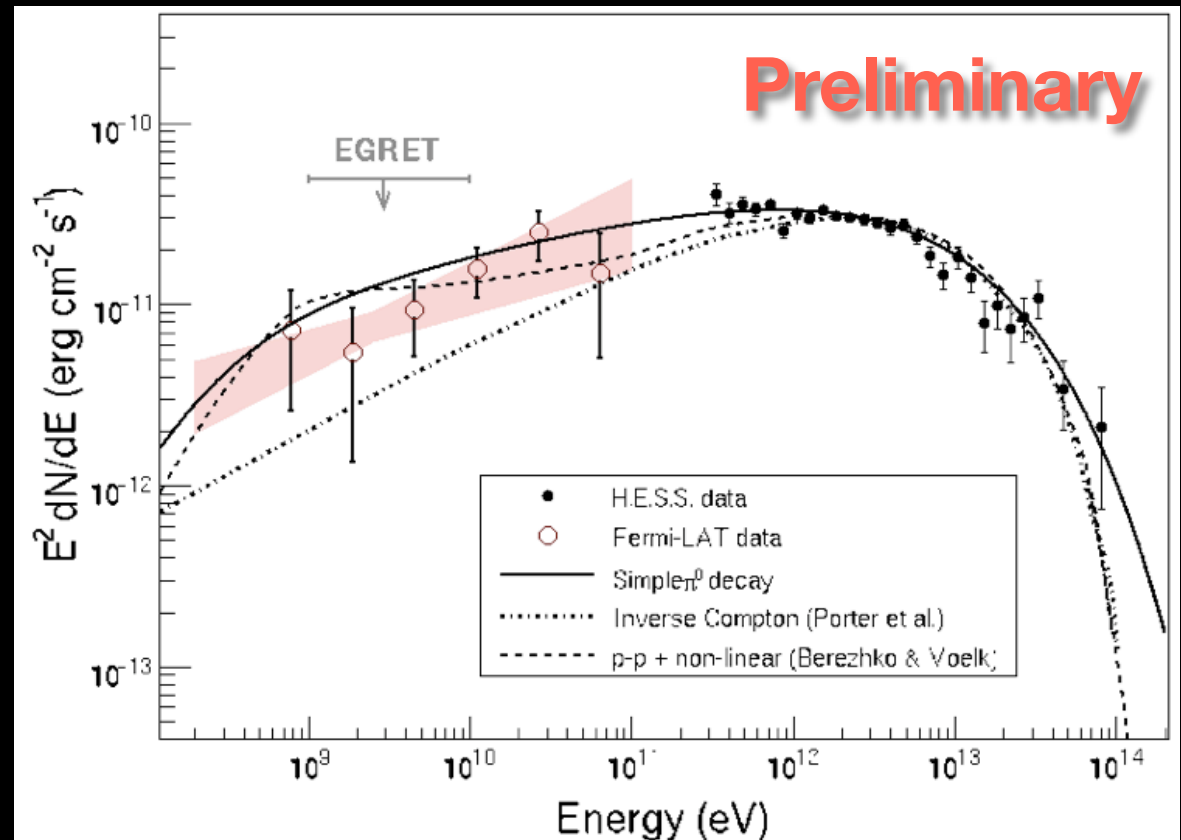
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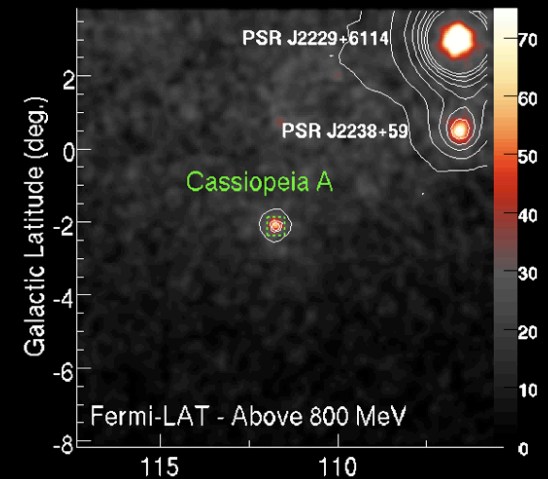


Fermi-LAT view of RX J1713.7-3946

- Hard spectrum in the Fermi-LAT band.



Summary



- ✦ Fermi-LAT detects emission from Cas A
 - ✦ Solid detection (TS = 148), spectrum suggests 10^{49} ergs in accelerated hadrons or leptons
 - ✦ Spectral shape suggests hadronic emission
- ✦ Fermi-LAT detection emission from RX J1713.7-3946
 - ✦ Very preliminary (faint source in a complicated region)