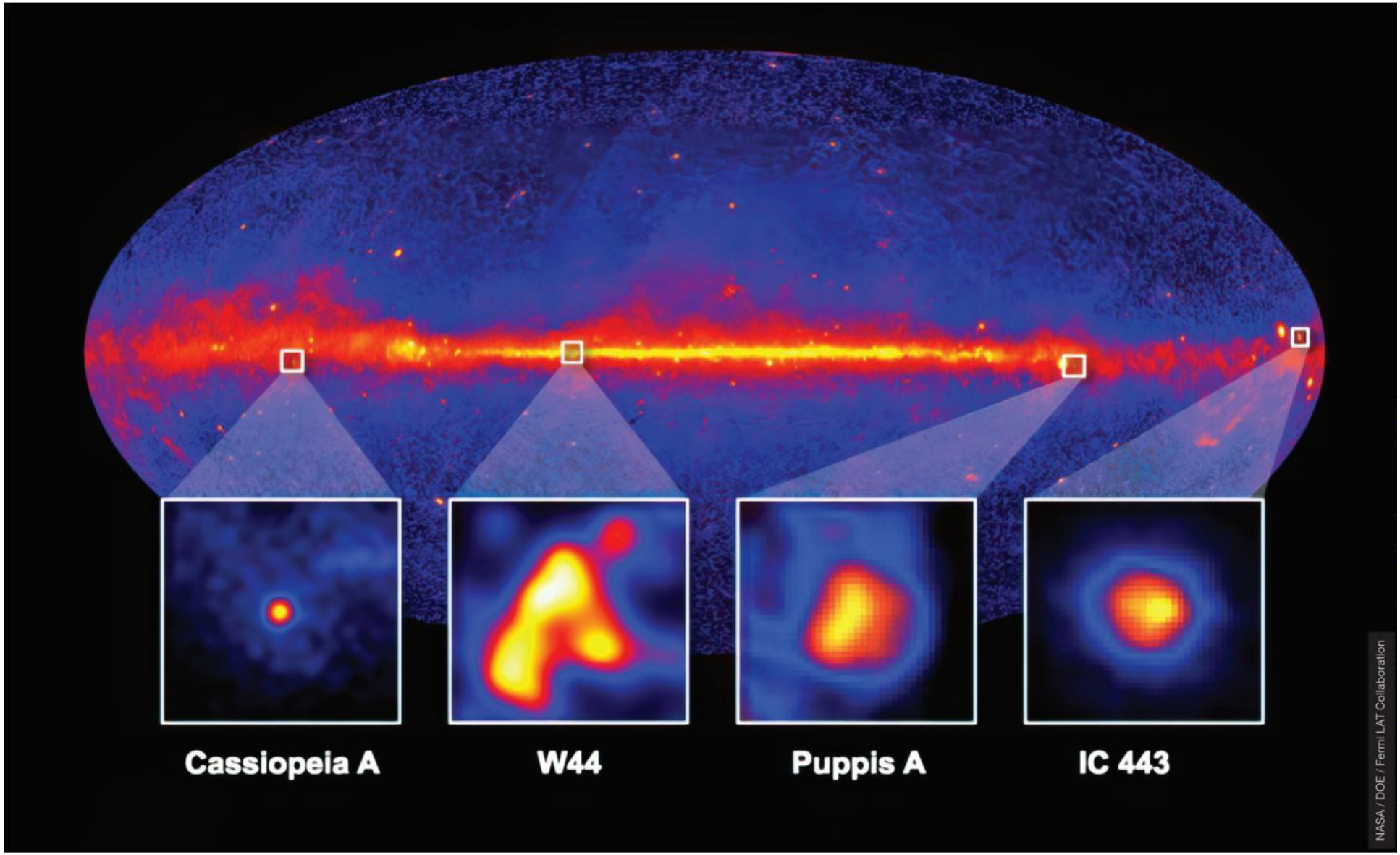
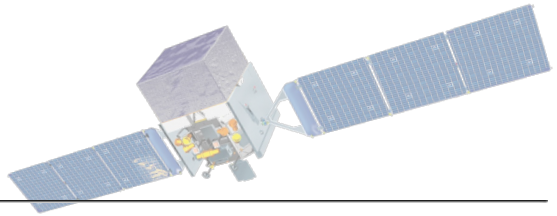
National Aeronautics and Space Administration



Supernova Remnants. For more information visit http://fermi.gsfc.nasa.gov/

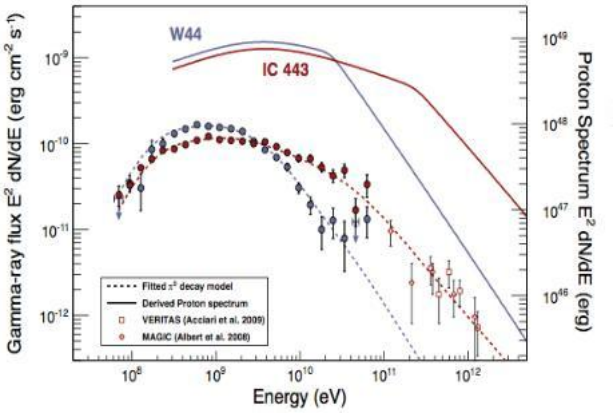
Supernova Remnants



New Insights into SNRs From Fermi

Supernova remnants (SNRs) are structures formed by the explosive death of stars: either at the end of a massive star's life or as the result of a white dwarf accreting material from its companion star. Among the most energetic particle accelerators, SNRs are widely thought to supply the Galaxy with cosmic rays.

Fermi LAT gamma-ray observations of SNRs reveal the underlying emission mechanisms, tracing the populations of relativistic particles, the physics of acceleration and the surrounding environment. To date, observations have associated 45 SNRs in the fourth Fermi LAT source catalog. A key result from the Fermi LAT study of SNRs has been to unambiguously show that SNRs accelerate cosmic-ray protons to the high energies needed to explain the Galactic cosmic ray spectrum.



Spectral energy distributions of the Crab pulsar (red) and PWN (black) as seen by the LAT and other gamma-ray telescopes. The red curve shows the spectral fit of the pulsar using LAT data. The nebula spectrum during the brightest flare in April 2011 (MJD 55666.997-55667.366) is also shown.

Fermi LAT SNRs and Cosmic Ray Protons
A detection of a pion decay bump near 67.5 MeV (characteristic of interactions between relativistic protons and gas) in the spectra of two interacting SNRs (W44 and IC 443) has been made by Fermi LAT. This detection, for the first time, directly identifies SNRs as sites of cosmic ray proton acceleration

SNR Science with the LAT

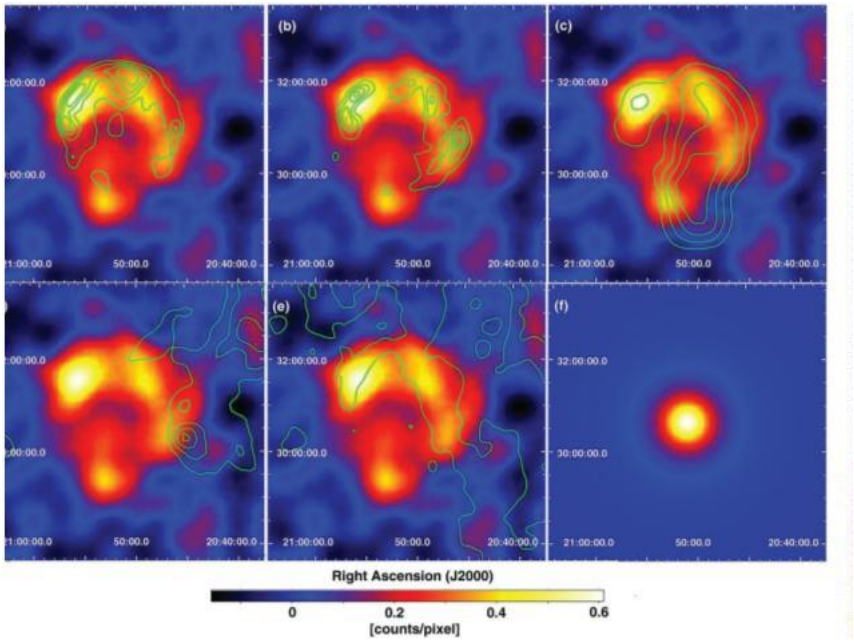
Fermi's unprecedented spatial resolution provides unambiguous SNR identification and allows the GeV morphology to be correlated with other wavelengths.

The LAT energy range covers more than 3 decades in energy, allowing spectral curvature to be identified. Spectral curvature is commonly observed for SNRs interacting with a dense environment.

Older SNRs (e.g. W44) in dense environments tend to have bright GeV emission, indicative of interactions between the SNR and nearby molecular clouds.

Young TeV-bright SNRs (e.g. RX J1713.7) often show GeV emission rising to a peak in the TeV. However, the historical SNR Cas A has a much softer spectral index and a lower-energy cutoff. These contrasting results indicate different emission mechanisms, environments, or changes in the accelerated particle distribution with time.

In the first Fermi LAT SNR Catalog we have systematically characterized GeV emission in regions containing the known radio SNRs, challenging previously sufficient emission models.



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