HESS J1858+020: A GeV-TeV source possibly powered by cosmic rays from SNR G35.6-0.4

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SNRs & Cosmic Rays

Supernova remnants (SNRs) have been proposed as the dominant contributor to galactic cosmic rays (Baade & Zwicky 1934).

1、SNRs have enough total power ---10%, 3 per century, CR density (1eV/cm3)；

2、 Direct evidences:

Radio emission (1948)

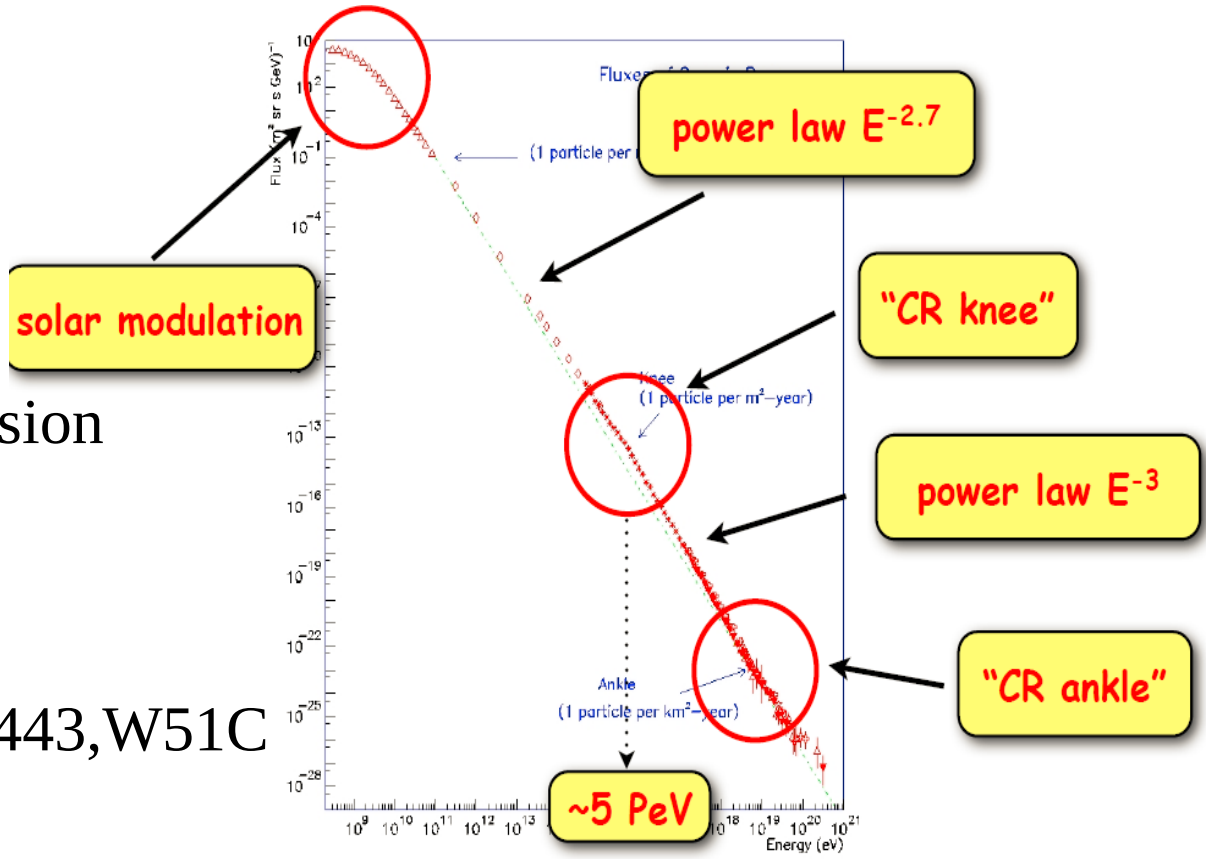
— GeV electrons

Non-thermal X-ray emission (1995)

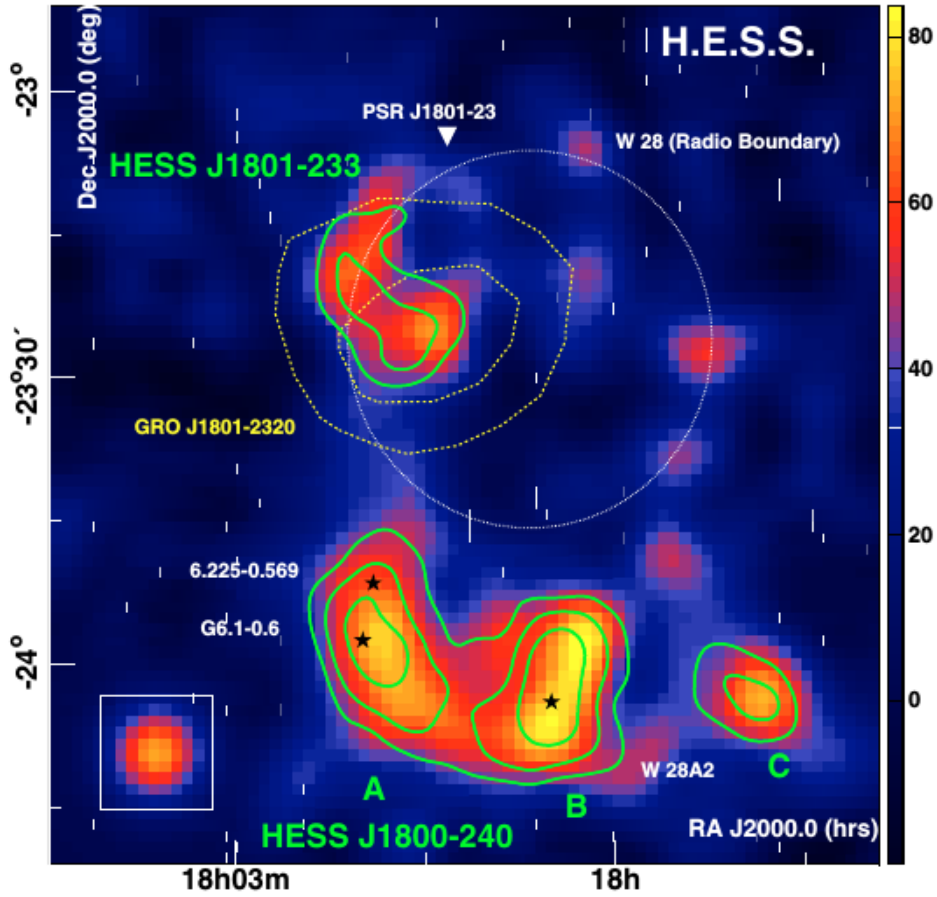
— TeV electrons

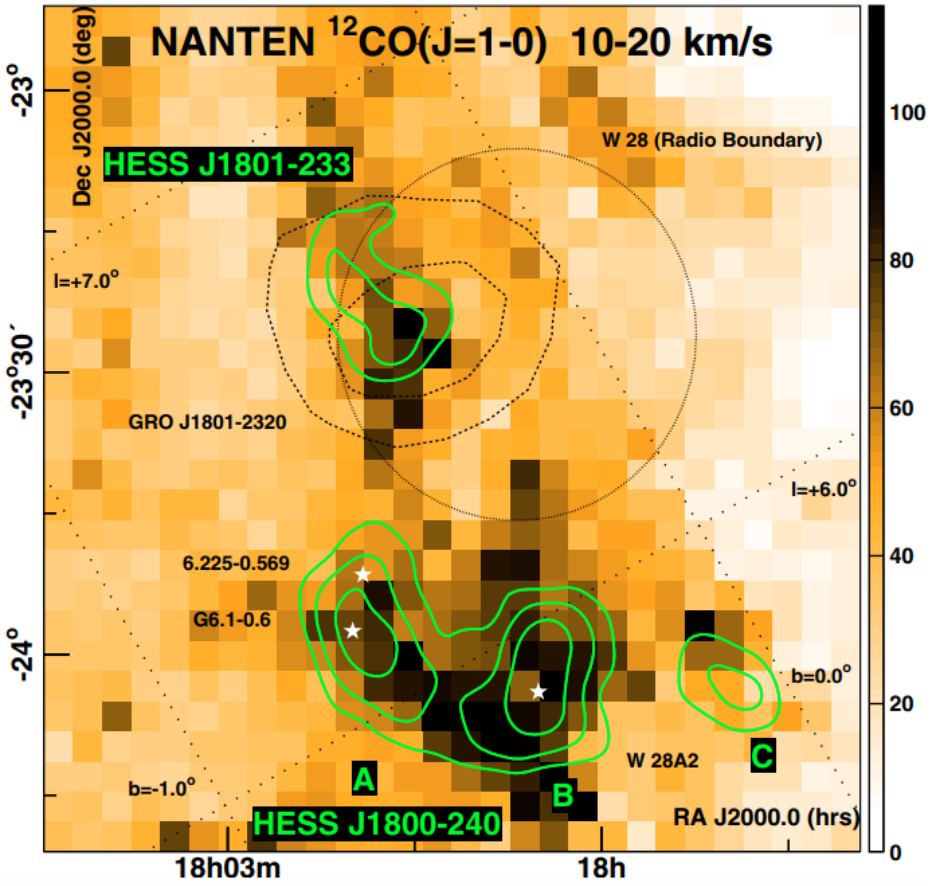
π^0 bump (2013)W44,IC443,W51C

— GeV protons



Escaping CRs & Molecular Clouds

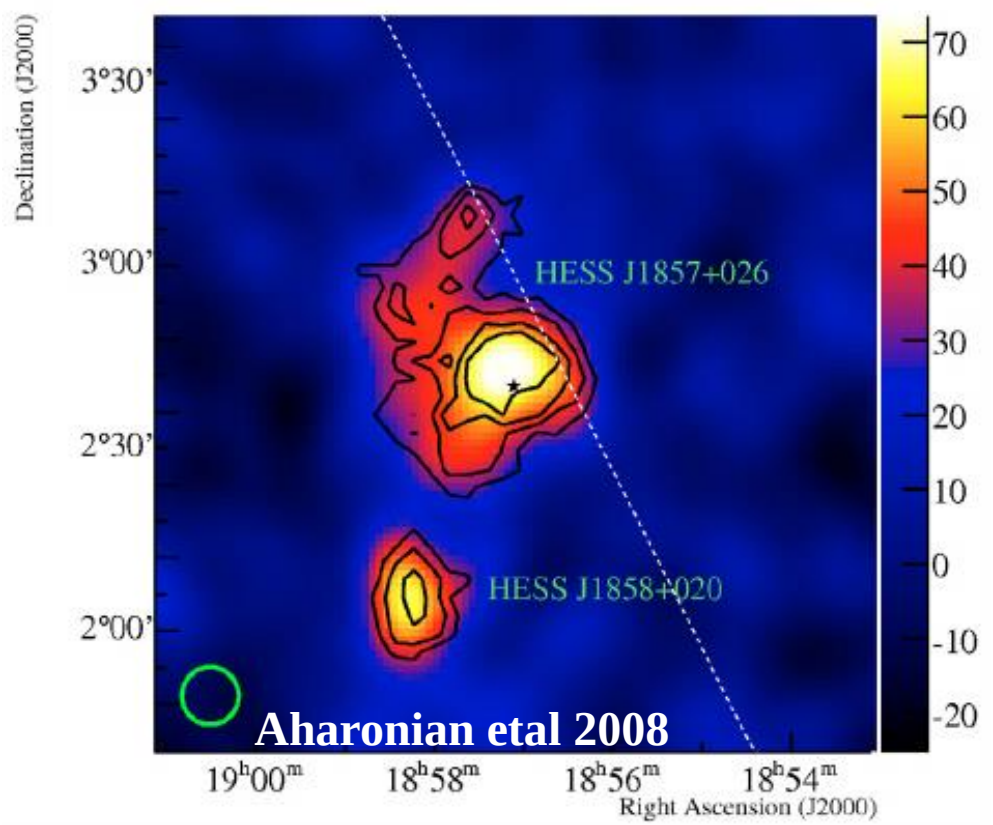


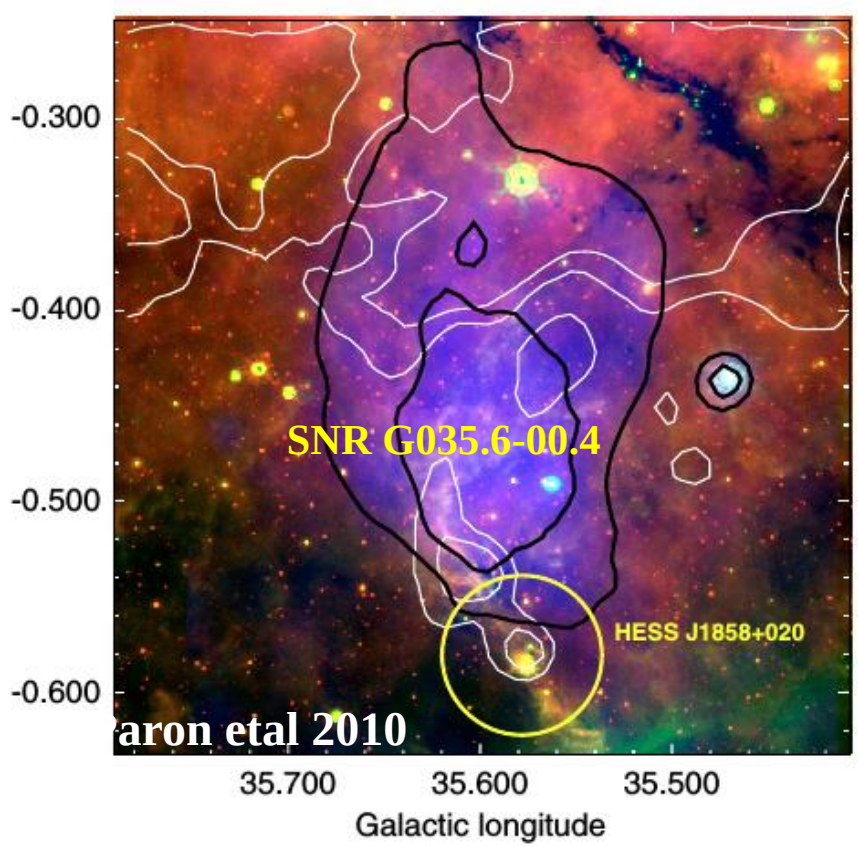


Aharonian etal 2008

SNR W28

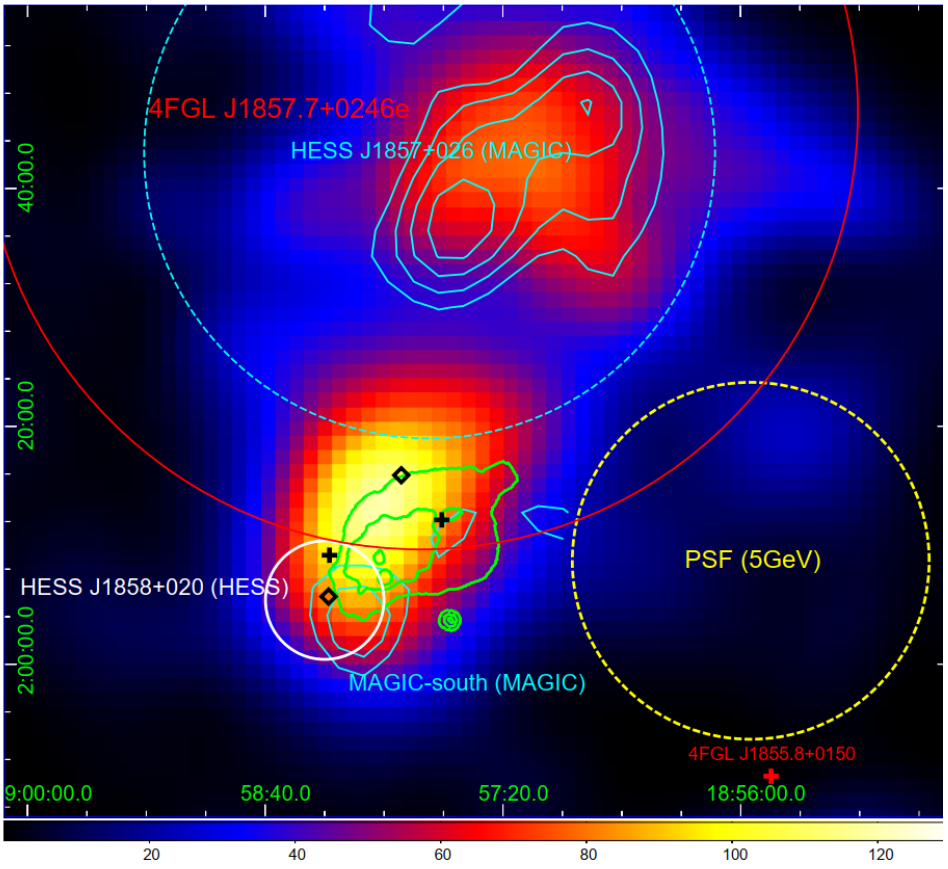
HESS J1858+020 & SNR G35.6-0.4

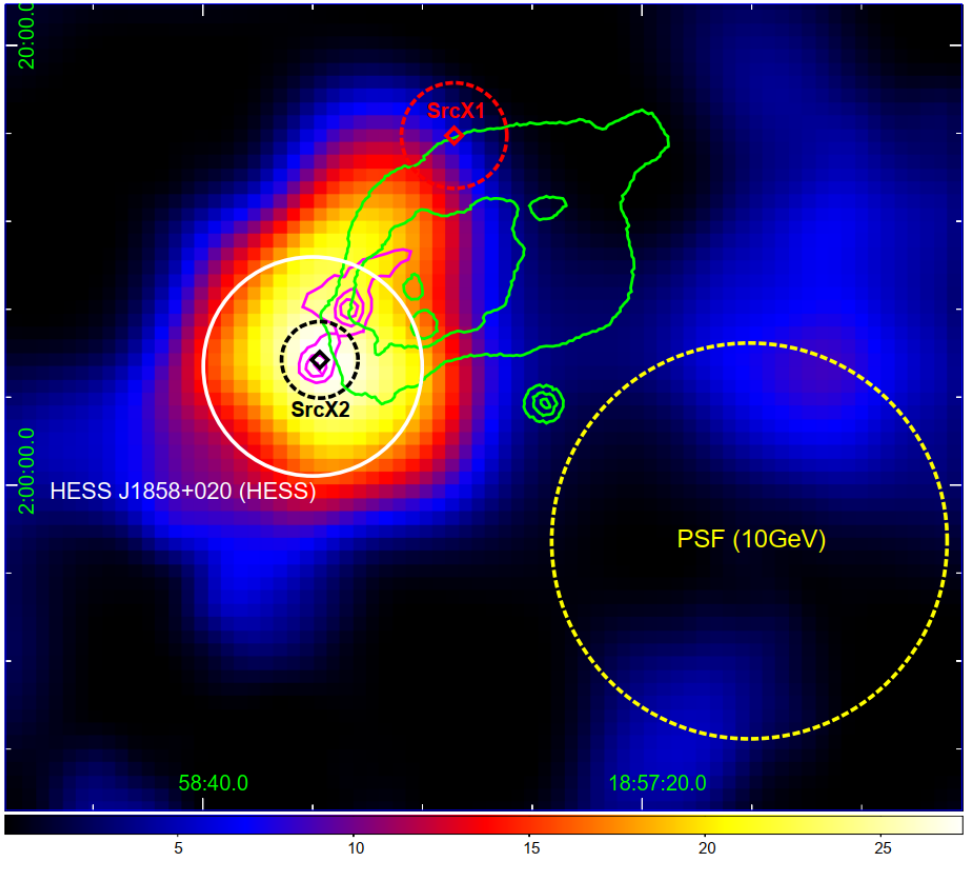




TeV gamma-ray emission of HESS J1858+020 may origin from the hadronic interaction between the molecular gas and the cosmic rays accelerated by the shock front of the SNR G35.6-0.4.

Fermi-LAT Data Analysis





TS maps with photons above 5 GeV (left) and 10 GeV (right)

Fermi-LAT Data Analysis

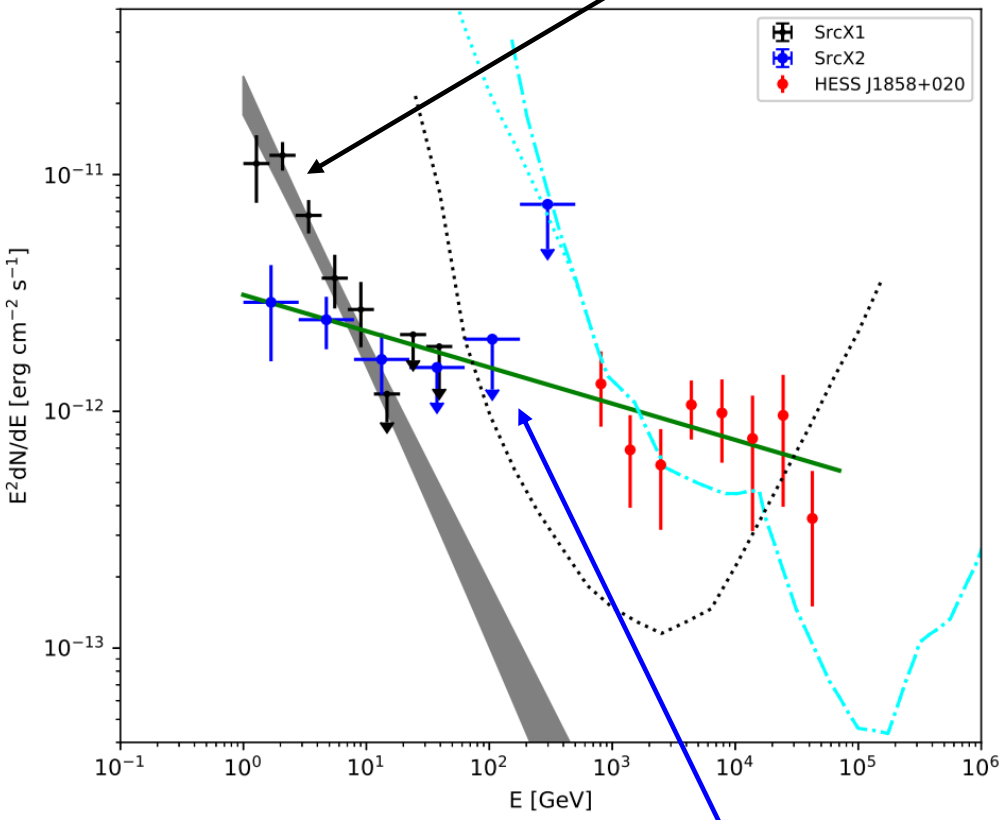
5–500 GeV	RA & Dec	1σ error radius	Spectral index	Photon flux (10^{-10} ph cm^{-2} s^{-1})	TS value
SrcX1	284.476° & 2.265°	0.040°	3.73 ± 0.49	2.62 ± 0.49	49.1
SrcX2	284.578° & 2.095°	0.029°	2.31 ± 0.27	1.99 ± 0.45	39.3
5–10 GeV					
SrcX1	284.452° & 2.251°	0.038°	3.02 ± 0.94	2.54 ± 0.47	48.6
SrcX2	284.578° & 2.095°(fixed)		2.31(fixed)	1.15 ± 0.39	13.3
10–500 GeV					
SrcX1	284.476° & 2.265°(fixed)		3.73(fixed)	<0.37	0.2
SrcX2	284.554° & 2.076°	0.037°	2.30 ± 0.41	0.85 ± 0.22	28.2

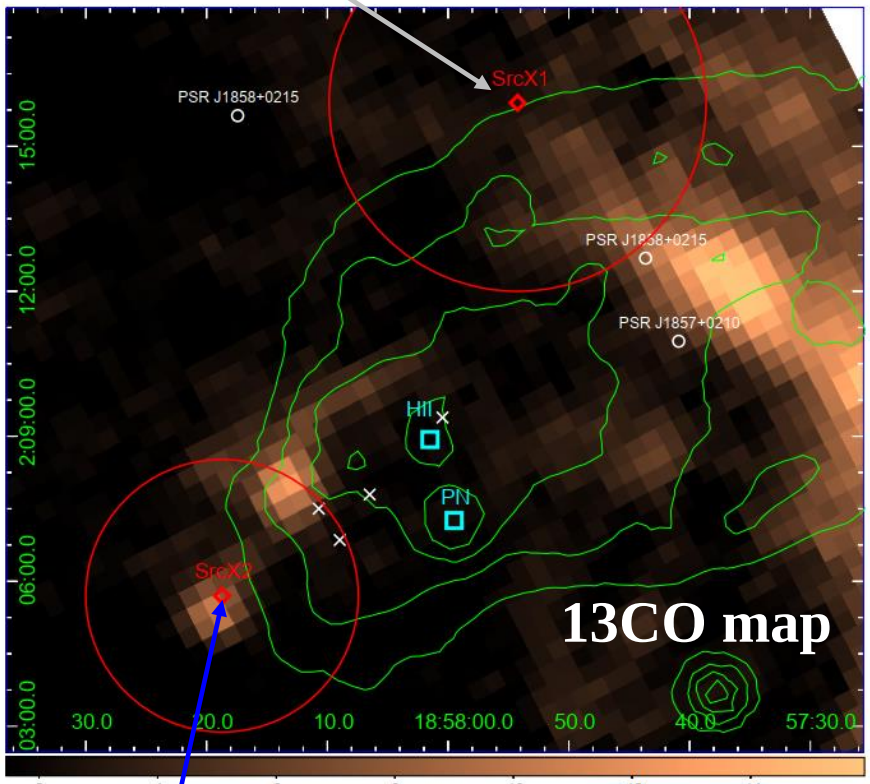
SNR G35.6-0.4(SrcX1?): soft spectrum with low energy emission

HESS J1858+020(SrcX2): hard spectrum with high energy emission

Fermi-LAT Data Analysis

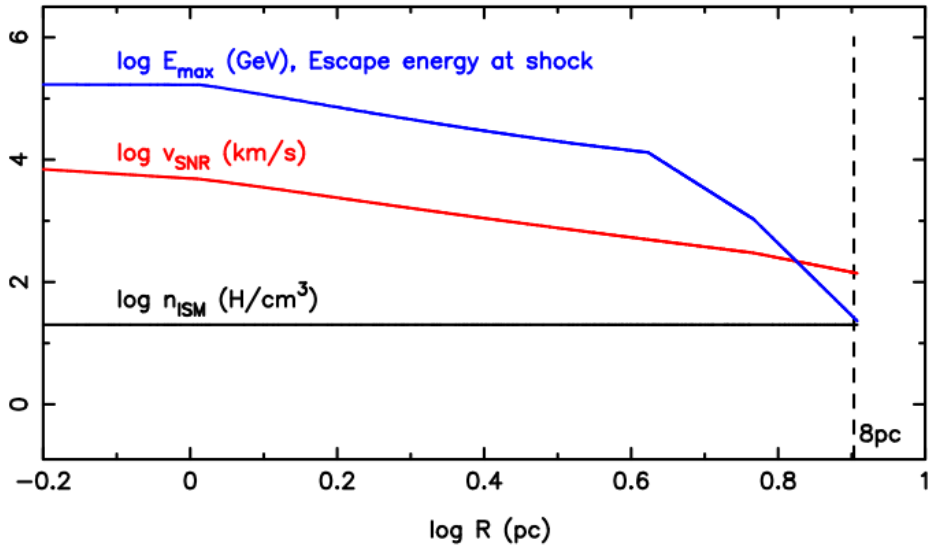
SNR G35.6-0.4 ?

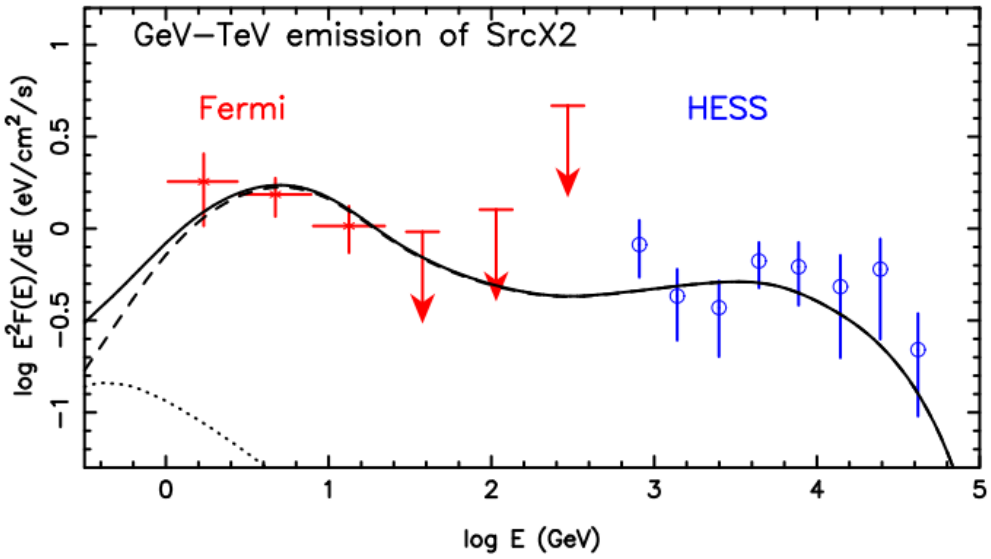




HESS J1858+020

A hadronic explanation for HESS J1858+020





- SNR G35.6-0.4 -- a possible middle-aged SNR;
- SNR evolution profile with a homogeneous circumstellar medium;
- acceleration theory with nonresonant streaming instability -- to generate CRs with energies of >100 TeV in the early SNR stage;
- the damping of the magnetic waves by the neutrals in the late SNR stage -- for the release of CRs with energies down to ~10 GeV;
- a diffusion coefficient that is much lower than the Galactic value and, in particular, a hard index of diffusion coefficients is needed to suppress the diffusion of early-released TeV CRs.

Thanks for your attention!