Galactic Pulsars and Cosmic Rays

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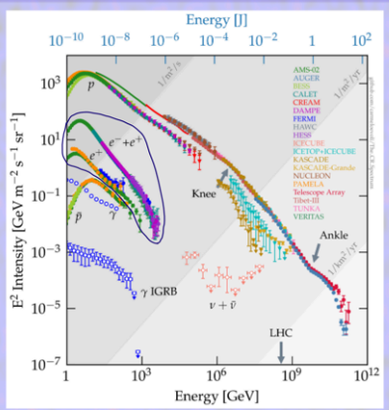
Galactic cosmic ray leptons

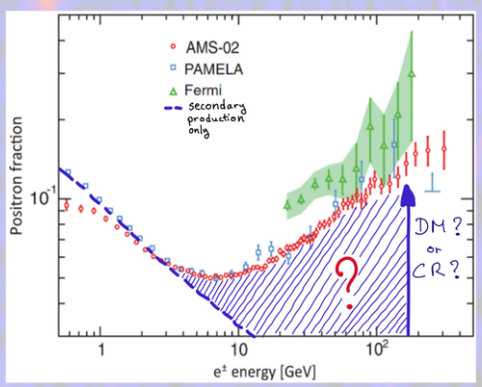


Evoli (2020)

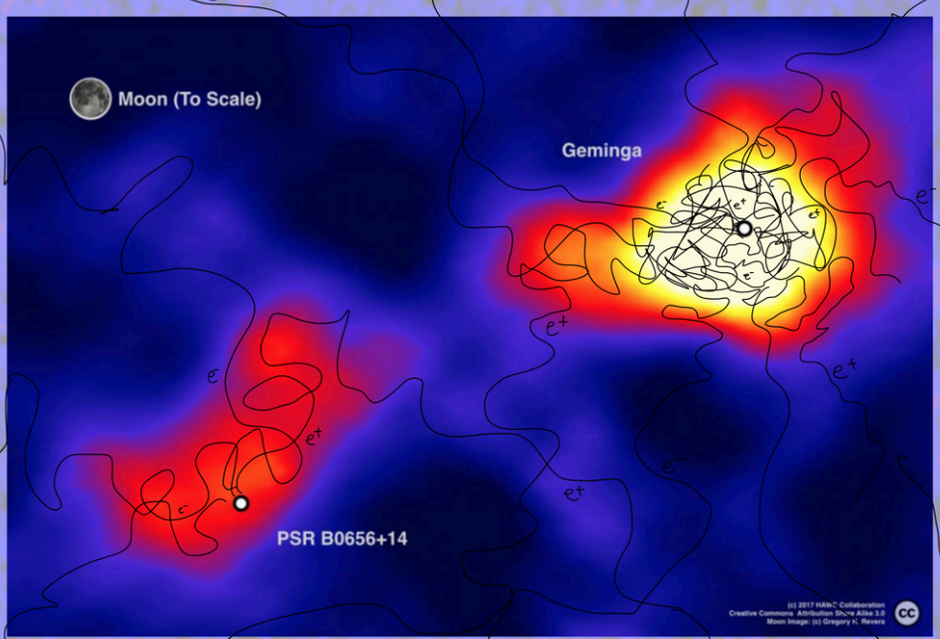
The anomalous positron fraction

In 2009, PAMELA found that the positron fraction increased after 10 GeV: there is a missing source of high energy positrons.

Astrophysical production and acceleration of lepton pairs in the vicinity of pulsars was proposed as a solution.



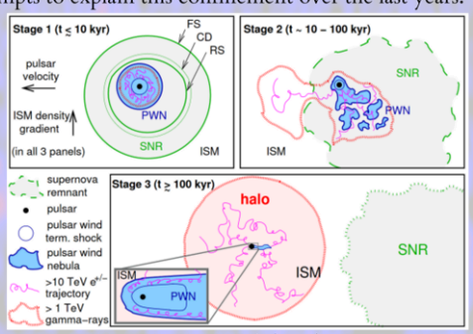
AMS Collaboration (2013)



The impact of TeV Halos

Discovered in 2017 by HAWC: there is an unexplained containment zone of ~1 pc that traps the leptons in a very-low diffusivity region.

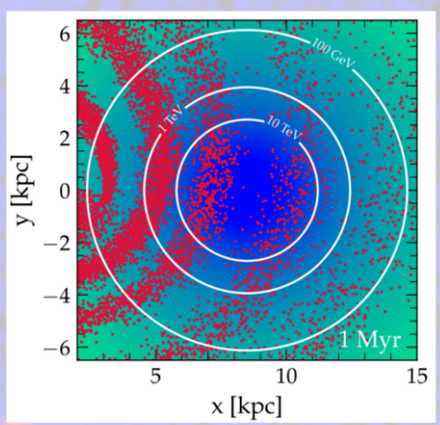
Since pulsars and PWNe are crucial to explain the lepton spectra and the positron fraction, there were many attempts to explain this confinement over the last years.



Giacinti et al. (2019)

Pulsars in the Galaxy

We use propagation models for CRs in the Galaxy and Monte Carlo galaxy simulations to place the pulsars in the arms.



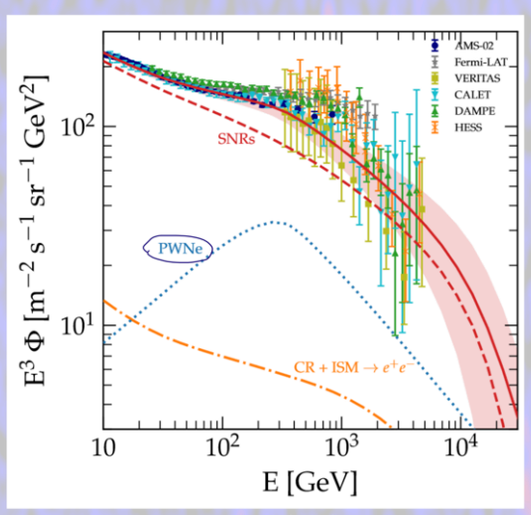
Evoli et al. (2021)

The uncertainty on the source configuration

Only nearby sources contribute to the high energies.

For both the positron fraction and the electron spectrum break, found at ~1 TeV by HESS (and confirmed by DAMPE and CALET with direct measurements), it is unclear if the spectrum depends on a stochastic distribution of sources or a single source with specific parameters.

→ Heavy reliance on astrophysics.



Evoli et al. (2021)