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On the Mechanism for Breaks in the Cosmic Ray Spectrum[1]

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Recent observations of galactic supernova remnants by the Fermi spacecraft observatory strongly support the idea that the bulk of galactic cosmic rays are accelerated in such remnants by a Fermi mechanism, also known as diffusive shock acceleration. However, the remnants most visible in gamma rays expand into weakly ionized dense gas, and so a significant revision of the basic mechanism is required. In this talk, I provide the necessary modifications and demonstrate that strong ion- neutral collisions in the remnant lead to steepening of the energy spectrum of accelerated particles by exactly one power. The spectral break is caused by Alfven wave evanescence leading to fractional particle losses. The gamma-ray spectrum generated in collisions of the accelerated protons with the ambient gas is also calculated and successfully fitted to the Fermi data. The parent proton spectrum is best represented by a classical test particle power law E^{-2}, steepening to E^{-3} at E_{br}=7GeV due to deteriorated particle confinement.

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