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Particle escape in middle-aged SNRs and related gamma-ray signatures

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The escape process of particles accelerated at supernova remnant (SNR) shocks is one of the poorly understood aspects of the shock acceleration theory. In this talk I will describe a phenomenological approach to study the particle escape and its impact on the gamma-ray spectrum resulting from hadronic collisions both inside and outside of a middle-aged SNR. Under the assumption that in the spatial region immediately outside of the remnant the diffusion coefficient is reduced with respect to the average Galactic one, I will show that a significant fraction of particles are still located inside the SNR long time after their nominal release from the acceleration region. This fact results into a gamma-ray spectrum that resembles a broken power law, similar to those observed in several middle-aged SNRs. Above the break, the spectral steepening is determined by the diffusion coefficient outside of the SNR and by the time dependency of the maximum energy. Consequently, the comparison between the model prediction and actual data will contribute to determining these two quantities, the former being particularly relevant within the predictions concerning the gamma-ray emission from the halo of escaping particles around SNRs which could be detected with future Cherenkov telescope facilities.

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