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## The Plasma Physics of Cosmic Ray Acceleration: Where We Stand After 30 Years<sup>1</sup> MIKHAIL MALKOV, University of California, San Diego

Cosmic rays (CRs) are long believed to be accelerated in SNR shocks by the Fermi mechanism. Accelerated electrons have already been convincingly demonstrated to be the major TeV emitter in a number of SNRs. However, electrons make only 1-2% of the entire CR spectrum. Therefore, distinguishing between leptonic and hadronic origin of the observed TeV emission is a key to the proof of the supernova origin of CRs. With the advent of the ground based Cerenkov telescopes, it is possible to tackle this difficult problem. The quality of the spectra measured is becoming sufficient to provide a sharp test of diffusive shock acceleration theory, which is built on a foundation from basic plasma physics and devised some thirty years ago. The first observational attempt to prove the proton acceleration in the only available candidate (SNR RXJ 1713.7-3946) has triggered hot debates in the community and clearly requires refinements of the theory. We discuss a new mechanism of spectrum formation in partially ionized dense gases, near SNRs. This is the most favorable situation for detecting hadrons as when they interact with dense gases, they generate gamma-radiation. Using a self-consistent analytic model of nonlinear diffusive shock acceleration, we calculate the spectra of protons and estimate the resulting gamma-ray emission occurring when the SNR shock approaches a molecular cloud. We show that the spectrum develops a break in the TeV range and that its GeV component is suppressed. These modifications to the standard theory occur because of the physics of particle and Alfven wave propagation inside the gas. Applications of the obtained spectra to the recent CANGAROO and HESS observations of the SNR RXJ 1713.7-3946 and key plasma physics problems at the forefront of cosmic ray research will be discussed.

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