Contribution ID: **934** Type: **Talk**

Cosmic rays in the GeV-TeV energy range from two types of supernovae

Thursday 15 July 2021 19:18 (12 minutes)

The AMS-02 experiment has reported precise measurements of energy spectra of several cosmic-ray species in the energy range of ~ (0.5-2000) GeV/n. An intriguing finding is the differences in the spectral shape between the different species. Protons exhibit the steepest spectrum of all the species, and helium, carbon, oxygen and iron spectra are found to be harder than that of neon, magnesium and silicon. These observations are difficult to explain as diffusive shock acceleration, the currently most plausible theory for cosmic particle acceleration at high energies, expects independence of the spectral index from mass and charge of the accelerated particle. Moreover, propagation in the Galaxy has been shown to not being able to compensate for this discrepancy. In this work, we present an explanation based on two-component model for the origin of cosmic rays in the Galaxy. The first component originating from regular supernova remnants in the interstellar medium and the second component from Wolf-Rayet supernovae. Considering a recently proposed model for cosmic ray injection enhancement at astrophysical shocks and apply it (a) to interstellar-medium elemental abundances for the regular supernovae and (b) to the wind composition for the Wolf-Rayet component, we show that the combination of the two components may explained most of the behavior observed by the AMS-02 experiment.

Keywords

particle diffusion, supernova remnants, wolf-rayet stars, galaxy

Collaboration

other Collaboration

Subcategory

Theoretical Methods

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Session Classification: Discussion

Track Classification: Scientific Field: CRD | Cosmic Ray Direct