

Solar energetic particle events observed by the PAMELA mission

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Despite the significant progresses achieved in recent years, the physical mechanisms underlying the origin of Solar Energetic Particles (SEPs) are still matter of debate. The complex nature of both particle acceleration and transport poses challenges to developing a universal picture of SEP events that encompasses both the low energy ($>$ tens of keV) observations made by space-based instruments and the GeV particles detected by the worldwide network of neutron monitors in Ground Level Enhancements (GLEs). The high precision data collected by the PAMELA satellite experiment offer the unique opportunity to study the SEP fluxes between ~ 80 MeV and a few GeV, significantly improving the characterization of the most energetic events. In particular, PAMELA can measure for the first time with good accuracy the spectral features at moderate and high energies, providing important constraints for current SEP models. Reported results are consistent with diffusive shock acceleration theory predicting spectral roll-overs attributed to particles escaping the shock region during acceleration. In addition, the PAMELA observations allow the relationship between low and high energy particles to be investigated, enabling a clearer view of SEP origin. No qualitative distinction between the spectral shapes of GLE, sub-GLE and non-GLE events is observed, suggesting that GLEs are not a separate class, but are the subset of a continuous distribution of SEP events that are more intense at high energies.

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