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Steep Cosmic Ray Spectra in Supernova Remnants[1] REBECCA DIESING, DAMIANO CAPRIOLI, University of Chicago — Galactic cosmic rays (CRs) are accelerated at the forward shocks of supernova remnants (SNRs) via diffusive shock acceleration (DSA), an efficient acceleration mechanism that predicts power-law energy distributions of CRs. However, observations of nonthermal SNR emission imply CR energy distributions that are generally steeper than E^{-2}, the standard DSA prediction. Recent results from hybrid simulations suggest that such steep spectra may arise from the motion of magnetic structures with respect to the thermal plasma downstream of the shock. Using the Cosmic Ray Analytical Fast Tool (CRAFT), a semi-analytic model of non-linear DSA, we generalize this result to a wide range of SNRs. By accounting for the motion of magnetic structures in the downstream, we produce CR energy distributions that are substantially steeper than E^{-2} and consistent with observations of a wide range of SNRs. Our formalism reproduces both the modestly steep spectra of historical supernova remnants ($\propto E^{-2.2}$) and the very steep spectra of young radio supernovae ($\propto E^{-3}$).

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