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Models of cosmic-ray origin

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Abstract. Two models of cosmic-ray genesis are compared: (a) the author s red-dwarf hypothesis requiring the injection of seed particles from coronal mass ejections (CME) prior to shock acceleration, and (b) the direct acceleration of thermal ions and of grains in the ISM, proposed by Meyer, Drury and Ellison. Both models agree that shocks in the expanding envelopes of supernova remnants are principally responsible for acceleration to cosmic-ray energies. Both are designed to overcome the mismatch between the source composition of the Galactic cosmic rays (GCR) and the composition of the thermal ISM gas. Model (a) utilizes the prolific emissions of energetic particles from active dMe and dKe stars via their CME as the agents of seed-particle injection into the ISM. The composition of these seed particles is governed by the FIP (first-ionization potential) selection mechanism that operates for both Galactic cosmic rays and solar energetic particles. Hence it is consistent with the cosmic-ray source composition. Model (b) relies on the sputtering and acceleration of grains in the ISM (along with acceleration of thermal ions) to provide the known source composition. This model considers the FIP ordering of GCR abundances as purely coincidental, and it attributes the relative source abundances to selection according to volatility. Recent cosmic-ray observations in favor of each model are cited.