Global Model of Particle Acceleration at a Supernova Blast Wave

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***Abstract*. We have carried out a global test-particle simulation of cosmic-ray acceleration at a spherical blast wave propagating into a uniform external magnetic field. We have solved the basic Parker cosmic-ray transport equation, including a spherical, modified Sedov blast wave. We find that although most of rapid particle acceleration occurs in the "equatorial" band, where the upstream magnetic field is quasi-perpendicular, the ongoing temporal evolution of the shock brings most of the particles to the quasi-parallel "polar" part of the shock. This is in agreement with the observational constraints, and, furthermore allows the rapid acceleration to the cosmic-ray "knee", at the quasiperpendicular shock. This model also includes the amplified magnetic field resulting from pre-existing turbulent density fluctuations. We do not include amplification of the upstream magnetic field by cosmic-ray instabilities.**

We conclude that a model in which the magnetic-field amplification occurs because of the upstream turbulence and rapid acceleration to the knee occurs at the quasi-perpendicular part of the shock is consistent with the observations. Amplification of the upstream magnetic field is not necessary.

***Keywords*: Shock acceleration, Supernova blast wave, Magnetic field amplification**