Abstract Submitted
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Nonlinear Diffusive Shock Acceleration in Fast Regime[1] M.A. MALKOV, P.H. DIAMOND, CASS and Physics Dept., UCSD — We suggest a physical mechanism whereby the acceleration time of cosmic rays by shock waves can be significantly reduced. This creates the possibility of particle acceleration beyond the knee energy at 10^{15} eV. The acceleration results from a nonlinear modification of the flow ahead of the shock supported by particles already accelerated to the knee momentum. The particles gain energy by bouncing off converging magnetic irregularities frozen into the flow in the shock precursor and not so much by re-crossing the shock itself. The acceleration rate is thus determined by the gradient of the flow velocity and turns out to be formally independent of the particle mean free path. The velocity gradient is, in turn, set by the knee-particles. The acceleration rate of particles above the knee does not decrease with energy, unlike in the linear acceleration regime. The knee forms because particles above it are effectively confined to the shock while they are within limited domains in the momentum space, while other particles fall into "loss-islands," similar to the "loss-cone" of magnetic traps. This also maintains the steep velocity gradient and high acceleration rate.

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