PARTICLE ACCELERATION AND PITCH ANGLE TRANSPORT NEAR A THIN SHOCK, A COMPRESSION REGION, AND A STRUCTURED SHOCK

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In the interplanetary medium cosmic ray particles can be accelerated near an oblique, discontinuous shock by the first-order Fermi acceleration mechanism. In compression regions, the magnetic field, though continuously curved, is similar to that at an oblique shock and can also accelerate particles. Actual shocks in the interplanetary medium are structured shocks that incorporate both these features. To numerically study particle acceleration in all three situations, we solve an equation of pitch angle transport by a finite difference method. Even for a thin shock, there are substantial deviations from classic results based on the diffusion approximation. The recently discovered jump in the particle density just upstream of a shock is also found for a narrow compression region, in this case as an enhancement throughout that region. The amplitude of this enhancement over the downstream flux can be a few times u/v (fluid speed divided by particle speed) and is hence quite important for moderately energetic particles, such as 100 keV/n ions near an interplanetary shock or compression region. The spectrum of accelerated particles softens for a wider compression, as found in previous work for a parallel magnetic configuration, and for a narrow compression it hardens for lower v/u.