[초IT-04] Particle Acceleration at Astrophysical Shocks

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Diffusive shock acceleration (DSA) is widely accepted as the primary mechanism through which cosmic rays (CRs) are produced in a variety of astrophysical environments. Detailed nonlinear treatments of DSA predict that a small fraction of incoming thermal particles can be injected into the CR population, and accelerated to very high energies through their interactions with resonantly scattering Alfv′en waves in the converging flows across collisionless shocks. Indeed, multi-band observations of nonthermal radio to gamma-ray emissions have confirmed the acceleration of CR electrons and protons up to 100 TeV at young supernova remnants.

During the last several decades significant progress has been made at both theoretical and observational fronts in understanding various physical processes related to plasma and astroparticle physics of collisionless shocks. However, it is not yet possible to make precise quantitative predictions for the CR injection and acceleration from first principles, because the nature and excitation of electromagnetic fluctuations and their impacts on particle scattering and transport are not fully understood yet. I will review the recent progress and the key remaining challenges in DSA theory.