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Diffusive shock acceleration at cosmological shock waves

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Cosmological shock waves result from supersonic flow motions induced by hierarchical clustering of nonlinear structures in the universe. These collisionless shocks are thought to accelerate high-energy cosmic rays (CRs) via diffusive shock acceleration (DSA) mechanism. In this talk, we will review 1) the properties and energetics of shocks formed in cosmological structure formation simulations, 2) recent studies on how magnetic field amplification by CR streaming instabilities and Alfvenic drift may affect the DSA efficiency at strong shocks, 3) importance of re-acceleration of CRs at weak cosmological shocks and its implications on radio relics, 4) the nature and roles of infall shocks that form mostly in cluster outskirts, and 5) the possibility of the acceleration of ultra-high energy CRs at cluster accretion shocks.

Presenter: KANG, Hyesung (Pusan National University, Korea)