the probabilty of identifying the true UHECR sources in terms of the angular distance. We also calculate the cross correlation between the simulated UHECR events and the sources and estimate the angular correlation length. Due to the absence of any satisfactory observational description of magnetic fields within the Local Group, we study the above statistics of angular distance in terms of the strength of the magnetic fields at the observer location as well. To compare our simulation result, we study the similar statistic with Auger detected events and a good agreement is observed. Implications of this study on the nature of UHECRs sources are discussed.

[GC-03] Energy Dissipation of Cosmological Shock Waves in the Large Scale Structure

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To investigate the complex cosmological shocks, we explore the statistic properties of cosmological shock waves in terms of preshock density and temperature. It is shown that the most frequent shocks are the external shocks that formed around shee-like structures, and for the WHIM and intercluster medium (ICM), internal shocks dominate over external shocks both in frequency and shock kinetic energy flux at present epoch. The mean properties of weak internal shocks depend mainly on the pre- or post-shock temperature. More importantly, as previous paper we calculate the acceleration effency of the shocks by adopting a DSA model for quasi-parallel shocks, but more complete set of parameters are considered. The efficiencies for different parameters are fitted with algebric formula. We further calculate the time integrated energy fluxes that pass through the shocks. It is found that the energy density of the accumulated cosmic ray (CR) protons can be consistent with the upper limits constrained by observations.

[GC-04] Galactic Spiral Shocks with Thermal Instability in Self-Gravitating, Vertically-Stratified Disks

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Galactic spiral shocks are dominant morphological features and believed to be responsible for substructure formation of sprial arms in disk galaxies. They can also provide a large amount of kinetic energy for the interstellar gas by tapping the rotational energy. In this work, we use numerical hydrodynamic simulations to investigate the turbulence driving and clump formation by two-dimensional galactic spiral shocks in self-gravitating, vertically-stratified disks subject to radiative cooling and heating. We initially consider an isothermal disk in vertical hydrostatic equilibrium. Due to cooling and heating, the disk rapidly evolves to a dense slab near the midplane surrounded by rarefied, hot gas at high-altitude regions. The imposed stellar spiral potential forms a vertically curved shock that exhibits strong flapping motions along the direction perpendicular to the arm. The flows across the spiral shock are characterized by transitions from rarefied to dense phases at the shock and from dense to rarefied phases at the postshock expansion zone. The shock flapping motions stirs the disk, supplying the gas with random kinetic energy. The flows achieve a quasi-steady state after a few orbits. The density-weighted velocity dispersions in the vertical directions are measured to be $\sigma z \sim 1.5-3$ km/s for the rarefied gas and $\sigma z \sim 0.5-1.5$ km/s for the dense gas. Despite clumpy structure of spiral shocks with thermal instability, time-averaged profiles of surface density are similar to those of viscous isothermal spiral shocks. When self-gravity is included, spiral shocks form large dense condensations by collecting high-altitude gas that falls toward the midplane right after the shock compression. Internal motions of these condensations gradually change from supersonic to subsonic values as they move downstream from the shock front.

[GC-05] Nonlinear Effects of Dynamical Friction in a Gaseous Medium

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Dynamical friction of orbiting objects is of great importance in various astronomical systems ranging from protoplanetary disks to galaxy clusters. In analytic studies of dynamical friction, it has been usually assumed that the density wake produced by a moving perturber has low amplitude and is thus in the linear regime. However, there are many astronomical situations such as in a merger of black holes near a galaxy center, where a perturber is so massive that the induced wakes are well in the nonlinear regime. In this work, we consider a perturber in a wide mass range, and study the nonlinear effects of dynamical friction by running high-resolution numerical simulations using the FLASH code. Unlike in the linear cases where Mach waves are attached to a perturber, a very massive perturber quickly develops nonlinear flows that produce a detached bow shock in front