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

of the perturber. The flows behind the shock are initially non-steady, causing the detached shock distance to oscillate and vortex rings to form around the perturber. The vortex rings are eventually shed downstream and the flows evolve toward a quasi-steady state. Increasing the perturber mass enhances the detached shock distance and symmetrizes the density wake near the perturber, resulting in a diminished drag force on a massive perturber compared to the prediction of the linear analysis. This implies that the decay time of a perturber does not scale as the inverse of the perturber mass.

[GC-06] Dynamical Evolution of Globular Clusters within Mini Dark Matter Halos

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According to the primordial scenario of globular cluster formation, star clusters were formed within mini dark matter halos in the early universe. If globular clusters initially had a dark matter halo around them, their early dynamical evolution could be different from the case without the halo, which has been the usual assumptions made for the studies of the dynamical evolution of globular clusters. With the most advanced 2-dimensional Fokker-Planck models, we study the effects of the presence of the dark matter halo on the dynamical evolution and the present mass-to-light ratios of globular cluster systems. Moreover, we test a possibility of globular clusters as building blocks of galaxies using comparison between models and observations.

[GC-07] CFHT/OSASIS에 의한 Seyfert 은하 분광연구 - 1. NGC 5728

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OASIS는 능동 광학(adapted optics) 기술과 마이크로 렌즈 배열이 적용되어, 한 번의 노출로 1100여개 지역의 스펙트럼을 동시에 얻을 수 있는 장점을 가진 3D(α, δ, λ) 분광기이다. 1998년부터 CFHT 3.6 m 망원경에 부착되어 5년간 운영되면서 Seyfert과 LINER 형 나선 은하들을 관측해왔다. 우리는 이중에서 2001년 3월에 관측된 7개 Seyfert 은하들의 핵 주위 중심영역을 연구하고 있다. 이러한 3D 분광기를 이용한 연구방법을 소개하고, 첫 번째 연구대상인 Seyfert 2 은하 NGC 5728의 시선 속도 영상과 방출선 비 등을 이용해 중심 12″×10″ 영역의 운동과 물리적 상태를 연구한 결과를 발표한다. 처음으로 이 은하 내부 ring의 운동에 대해 다루었다. 영상에서 나타난 기하학적 구조와 분광선의 시선 속도를 통해 ring의 회전 및 팽창 모델을 만들고, 이 ring은 반경이 5″.4인 원형이고, 시계방향으로 245 km s-1 정도로 회전하고 있으며, 동시에 62 km s-1 정도의 팽창 속도를 가짐을 밝혔다. 방출선 영상에서 밝게 나타나는 두 core는 서로 반대방향의 시선 속도를 보이는데, [O III]5007 시선 속도 연구에서 두 core는 서로 회전하는 것으로 보이며, core 내부에서는 물질들이 안쪽으로 흘러들어가는 양상을 보였다. [S II]6716/6731 비를 이용해 구한 두 core 영역의 전자밀도는 약 500 cm-3 정도이며, IUE 자료의 Si III]1892/C III]1909 비를 이용한 BLR의 전자밀도는 1010 cm-3 정도로 추정하였다.

■ Session : 초청강연 (IS)

4월 29일(수) 14:00 - 14:30 제1발표장

[IS-01] International Collaboration is the Most Crucial Challenge for Astronomy in the Future

Seok Jae Park

KASI

While working on the KVN (Korean VLBI Network) project, I realized that cooperation with astronomers of Japan was most essential because KVN is similar to VERA (VLBI Exploration of Radio Astrometry) of Japan. Collaboration is crucial in the field of optical astronomy also. For example, KASI joined the GMT (Giant Magellan Telescope) project from 2009. The GMT is a next-generation 25m ELT (Extremely Large Telescope) founded by six American and two Australian institutions. Construction of telescopes like the GMT that are costly and large in scale cannot be accomplished by one country alone. Many expensive projects await for us, and the importance of international cooperation should never be overlooked.

■ Session : 은하/우주론 II (GC)

4월 29일(수) 14:40 - 15:55 제1발표장

[GC-08] Early-type galaxies prevailed by super-Helium-rich EHB populations: Evidence from the UV upturn and the Balmer absorption lines

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A growing body of evidence is suggesting that peculiar globular clusters (GCs) with the extended HB (EHB) are most likely the remaining relics of primordial galaxy building blocks. Far-UV photometry of M87 GCs is also suggesting the prevalence of EHB population in early-type galaxies (ETGs). Here we have included the super-He-rich EHB