scenarios of formation of these transitional galaxies.

[포 GC-10] Nonlinear Color-Metallicity Relations of Globular Clusters: an Observational Approach

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The origin of globular cluster (GC) color bimodality, which is one of the salient phenomena observed in most large galaxies, has not yet been fully resolved. The phenomenon has conventionally been interpreted as a bimodal metallicity distribution based on an assumption of linear GC color-metallicity relations (CMRs). Recent studies however suggest that nonlinear GC CMRs can cause a bimodal color distribution even from a single-peaked metallicity spread. Using photometric and spectroscopic data on GCs in NGC 5128 (Cen A) and NGC 4594 (Sombrero), we investigate the nonlinearity of GC CMRs and compare the observed GC CMRs with the predictions of stellar population simulation models. Our careful selection of old GCs effectively reduces the scatter and reveals the nonlinear nature of the GC CMRs for various colors. The overall shape of the observed CMRs agrees well with that of the modeled CMRs, while offsets are present for some colors. We discuss the implications of our results in terms of the GC color bimodality and GC formation in NGC 5128 and NGC 4594.

우주론/암흑물질에너지

[포 CD-01] A Study of Halo-Galaxy Correspondence from the Horizon Run 4

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The Horizon Run 4 is a huge cosmological simulation intended for the study of evolution of dark matter halos in a side of volume of 3150 h-1 Mpc.
Using the halo merger trees of most bound particles, we test various models on the survivals of satellites in clusters and will compare them with observed satellite galaxies in a one-to-one correspondence model.
We estimate the abundances of central and satellite subhalos, and compare them with the SDSS main-galaxy group catalogue provided by Tempel et al. (2014).
Based on these comparisons we will study the mass-to-light relations, environmental effects on morphology and luminosity function, halo occupations in clusters, and nonlinear dynamics of clusters of galaxies.

[포 CD-02] Cosmological Research with Isolated Galaxy Pairs

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고립된 은하쌍 내의 두 은하의 스핀 각운동량의 각도 차이의 분포를 구하고 이를 통계적으로 분석한 결과를 관측 데이터와 수치 시뮬레이션 데이터 간에 비교함으로써 ΛCDM 모형이 아닌 다른 우주 모형의 주요 변수를 규제할 수 있다. 이 연구에서는 결합된 암흑 에너지 (coupled dark energy, cDE) 모형의 주요 변수인 결합 함수를 규제하기 위해 서로 다른 조건의 cDE 모형과 ΛCDM 모형에 따라서 생성한 수치 데이터의 스핀 정렬을 Argudo-Fernandez et al. (2015) 에서 인용한 관측 데이터의 스핀 정렬과 비교하였고, ΛCDM 모형과 대부분의 cDE 모형의 수치 데이터는 관측 데이터와 부합하나 일부 cDE 모형은 부합하지 않아서 제외될 가능성이 높음을 확인하였다.

[포 CD-03] Convolution and Deconvolution Algorithms for Large-Volume Cosmological Surveys

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Current and planned deep multicolor wide-area cosmological surveys will map in detail the spatial distribution of galaxies and quasars over unprecedented volumes, and provide a number of objects with photometric redshifts more than an order of magnitude bigger than that of spectroscopic redshifts. Photometric information is statistically more significant for studying cosmological evolution, dark energy, and the expansion history of the universe at a fraction of the cost of a full spectroscopic survey, but

intrinsically carries a bias due to noise in the distance estimates. We provide convolution- and deconvolution-based algorithms capable of removing this bias -- thus able to exploit the full cosmological information -- in order to reconstruct intrinsic distributions and correlations between distance-dependent quantities. We then show some direct applications of our techniques to the VIMOS Public Extragalactic Redshift Survey (VIPERS) and the Sloan Digital Sky Survey (SDSS) datasets. Our methods impact a broader range of studies, when at least one distance-dependent quantity is involved; hence, they will be useful for upcoming large-volume surveys, some of which will only have photometric information.

태양계

[포 SS-01] A Study on Rima Hadley Region of the Moon Using Moon Mineralogy Mapper(M3) Spectra (M3 스펙트럼 데이터를 이용한 달 Rima Hadley 지역 연구)

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달의 지형 중 계곡과 같아 보이는 곳을 Rima 또는 Rille 지형이라고 부르며 국제천문연맹(IAU : International Astronomical Union)과 미국지질조사국(USGS : United States Geological Survey)에서 관리하는 행성 지명 사전(Gazetteer of Planetary Nomenclature)에 명명된 달의 Rima 지역은 111개에 이른다. 그 중 Rima Hadley 지역은 아폴로 15호가 착륙한 지점으로 잘 알려져 있다. 본 연구에서는 2008년에 발사된 Chandrayaan-1 위성의 적외선 초분광 영상 탑재체인 Moon Mineralogy Mapper(M3) 데이터를 통해 Rima Hadley 지역의 분광학적 특성을 살펴보았다. M3 데이터는 감람석(olivine)이 풍부한 지역에서는 1 um 를 중심으로 흡수선이 나타남을 보이며, (Peter J. Isaacson et al., 2011) 2.8 um 중심의 흡수선을 통해 달의 OH(hydroxyl) 분포에 대해 설명한다. (Carle M. Piters et al., 2009, Georgiana Y. Kramer et al., 2011) 본 연구에서는 Rima Hadley 지역이 1 um 파장 근처에서 강한 흡수선을 가지는 것을 볼 수 있었고, 감람석이 풍부한 지역임을 확인할 수 있었다. 이처럼 감람석이 풍부한 곳은 현무암 지역으로 과거 용암이 분출되어진 곳으로 추측 해 볼 수 있다. 본 연구를 발전시킨다면 Rima Hadley 지역의 생성과 다른 Rima 지형의 형성 과정에 대해 더욱 많은 정보를 얻을 수 있을 것으로 기대된다.

고에너지천문학/이론천문학

[발표취소] Gravitational Lensing by an Isothermal Sphere with a Supermassive Black Hole

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Gravitational lensed quasar systems are usually explained by a source quasar lensed by a galaxy that can be approximated by an isothermal sphere. But most galaxies have a supermassive black hole (SMBH) at its center. We study the lensing by an isothermal sphere with a central SMBH. The additional lensing effects of a SMBH on the number, position, and magnification of lensed images are investigated. We apply the analysis to observed lens systems including Q0957+561. We also study the lensing by an elliptical mass distribution with a SMBH.

[포 HA-02] The Relation between the Spectral Lag and the Collimation-Corrected Luminosity in Gamma-Ray Bursts

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Gamma-Ray Bursts(GRBs) are the most violent event in the universe, whose detection rate is a few in a day. The spectral lag, which is commonly observed in the observed light curves of GRBs, is a difference in arrival times of the high-energy and low-energy photons. The relation between the spectral lag and the luminosity of the observed GRBs is shown to be anti-correlated in previous studies. In reported relations to date, the isotropic luminosity has been assumed. On the other hand, GRBs are likely to emit its energy through a beamed jet. In this study, we attempt to obtain the relation between the spectral lag and the collimation-corrected luminosity. We have