sources lensed by QSO hosts, i.e. the number of lensing QSO host galaxies (hereafter QSO lenses).

SMBH masses in the literature are transformed into the velocity dispersions of their host galaxies using the M_BH -sigma relation, and in turn the Einstein radii for each QSO -source redshift combination is calculated, assuming singular isothermal spherical mass distributions. Using QSOs and galaxies as potential sources, the probability of a QSO host galaxy being a QSO lens is calculated, as a function of limiting magnitude. The expected numbers of QSO lenses are estimated for ongoing and future wide-imaging surveys, and the Hyper Suprime-Cam Wide survey is illustrated as an example.

우주론

[구 GC-22] Impact of Massive Neutrinos and Dark Radiation on the High-Redshift Cosmic Web

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With upcoming high-quality data from surveys such as eBOSS or DESI, improving the theoretical modeling and gaining a deeper understanding of the effects of neutrinos and dark radiation on structure formation at small scales are necessary, to obtain robust constraints free from systematic biases. Using a novel suite of hydrodynamical simulations that incorporate dark matter, baryons, massive neutrinos, and dark radiation, we present a detailed study of their impact on Lyman-Alpha forest observables. In particular, we accurately measure the tomographic evolution of the shape and amplitude of the small-scale matter and flux power spectra and search for unique signatures along with preferred scales where a neutrino mass detection may be feasible. We then investigate the thermal state of the intergalactic medium (IGM) through the temperature-density relation. Our results indicate that the IGM at z ~ 3 provides the best sensitivity to active and sterile neutrinos.

[구 GC-23] Graphical study of cosmic inhomogeneity using CMASS galaxy sample

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Sloan Digital Sky Survey 12번째 Data release의 CMASS catalog를 이용하여 우주의 균일, 등방성 여부를 조사하였다. Redshift 범위에 따라 얻은 2차원 영역들을 조사한 결과, CMASS 은하들은 통계조사가 가능한 최대 규모인 반지름 300Mpc/h에서도 여전히 Random catalog에 비해 불균일하게 분포하고 있음을 보였다. 결과를 더 명확하게 보여주기 위해 은하의 분포가 불균일함을 나타내는 통계량을 여러 방법으로 시각화하는 연구를 진행하였다. 밀도 분포를 입체적으로 나타낸 그림에서 최대, 최소 밀도의 차이는 300Mpc/h규모에서 약 27%에 달한다. 이는 같은 규모에서 최대 약 4.5%의 차이만이 나타나는 Random catalog의 밀도 분포와는 상이한 결과로, 이 규모에서조차 우주에서 은하는 균일하게 분포하고 있지 않다는 것을 밝혔다.

[구 GC-24] Understanding reionization and cosmic dawn with galaxies and 21-cm

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The properties of unseen high-redshift sources (and sinks) are encoded in the 3D structure of the cosmic 21-cm signal. Here I introduce a flexible parametrization for high-z galaxies' properties, including their star formation rates, ionizing escape fraction and their evolution with the mass of the host dark matter halos. With this parametrization, I self-consistently calculate the corresponding 21-cm signal during reionization and the cosmic dawn. Using a Monte Carlo Markov Chain sampler of 3D simulations, 21CMMC, I demonstrate how combining high-z luminosity functions with a mock 21-cm signal can break degeneracies, resulting in ~ percent level constraints on early universe astrophysics.

[석 GC-25] Regional anomalies of cosmic microwave background power spectrum

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We analyze the Planck 2015 cosmic microwave background temperature fluctuation data to find any anomaly in the angular power spectra

measured for partial regions on the sky. For disks with radius of 20°, 45° and 90°, which are densely overlapping on the sky, we estimate the power excess and its statistical significance relative to the LambdaCDM expectation for some chosen ranges of angular scales. We also investigate the dipolar asymmetry using the power excess maps obtained for some chosen angular scales, and confirm the previously announced consistent dipole directions. The average dipole amplitude and the inner products of dipoles have been measured from the power excess maps at different angular scales. We conclude that although dipole directions are consistent the measured amplitudes are not statistically significant compared to the LambdaCDM model prediction.

[구 GC-26] Physical mechanism of gamma-ray bursts: recent breakthroughs

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Although it is agreed that the gamma-ray bursts (GRBs) invoke highly relativistic jets with bulk Lorentz factors of a few hundreds, the exact physical mechanism producing such powerful gamma-rays still remains debated. Three outstanding and important questions in the field concern (1) the composition of GRB jets (i.e., matter-dominated vs Poynting-flux-dominated), (2) the involved radiative process responsible for the observed gamma-rays (i.e., synchrotron mechanism vs photospheric radiation), and (3) the distance of the emitting region from the central engine where the prompt gamma-rays are released (i.e., ~10^12 cm vs 10^14 cm vs 10^16 cm). I will present recent important breakthroughs that we have made, which answer these three questions.

[구 GC-27] Observing the central engine of GRB170817A

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GW170817/GRB170817A establishes a double neutron star merger as the progenitor of a short gamma-ray burst, starting 1.7 s post-coalescence. GRB170817A represents prompt or continuous emission from a newly formed hyper-massive neutron star or black hole. We report on a deep search for broadband extended gravitational-wave emission in spectrograms up to 700 Hz of LIGO O2 data covering this event produced by butterfly filtering comprising a bank of templates of 0.5 s. A detailed discussion is given of signal-to-noise ratios in image analysis of spectrograms and confidence levels of candidate features. This new pipeline is realized by heterogeneous computing with modern graphics processor units (GPUs). (Based on van Putten, M.H.PM., 2017, PTEP, 093F01.)

KMTNet

[구 KMT-01] The Status and Plan of KMTNet Operation

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외계행성 탐색시스템 운영현황과 계획을 소개한다. 2017년 관측장비 가동율은 97.4% 이며, 시스템이 설치된 3개 천문대에서 천문박명시간을 기준으로 총 10,157 시간이 연구에 할당되었고 총 7,178 시간 관측이 이루어졌다. 관측시스템의 성능개선을 위해 주경 코팅, 돔 레벨조정, 망원경 구동롤러 정렬, 주경 배플 마스크 설치 등 돔과 망원경의 기계부 업그레이드와 카메라 전자부 조정 및 앰프 보드 교체 등이 이루어졌다. 관측효율 향상을 위해 1년간 관측된 약 177,000 장의 자료를 분석하여 불량자료 태깅 기반을 마련했고, 시상모니터링과 관측 스크립트 코드를 개발하여 현재 관측에 적용하고 있다. 관측 자료는 각 연구 프로그램의 자료공개 정책에 따라 영상형태 또는 측광 파일형태로 이용이 가능하며, 관측로그는 홈페이지를 통해 확인할 수 있다. 2020년 10월부터 시작되는 2단계 관측 프로그램 선정을 위해 2019년 상반기에 관측제안서를 접수받아 하반기에 선정을 마칠 계획이며, 다양한 연구주제 발굴을 위해 파일롯 프로그램을 선별 지원할 계획이다.

[구 KMT-02] Maintenance and Improvement of KMTNet Telescope and Enclosure (외계행성 탐색시스템 광시야 망원경과 돔 인클로져의 유지보수 및 성능개선)

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KMTNet 광시야 망원경의 성능 개선을 위해 2017년에