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We reconstruct the underlying dark matter (DM) density distribution of the local universe within 20Mpc/h cubic box by using the galaxy position and peculiar velocity. About 1,000 subboxes in the Illustris-TNG cosmological simulation are used to train the relation between DM density distribution and galaxy properties by using UNet-like convolutional neural network (CNN). The estimated DM density distributions have a good agreement with their truth values in terms of pixel-to-pixel correlation, the probability distribution of DM density, and matter power spectrum. We apply the trained CNN architecture to the galaxy properties from the Cosmicflows-3 catalogue to reconstruct the DM density distribution of the local universe. The reconstructed DM density distribution can be used to understand the evolution and fate of our local environment.

[구 CD-07] Model-independent constraints on the light-curve parameters and reconstructions of the expansion history from Type Ia supernovae

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We use iterative smoothing reconstruction method along with exploring in the parameter space of the light curves of the JLA supernova compilation (Joint Light-curve Analysis) to simultaneously reconstruct the expansion history of the universe as well as putting constrains on the light curve parameters without assuming any cosmological model. Our constraints on the light curve parameters of the JLA from our model-independent analysis seems to be closely in agreement with results assuming ΛCDM cosmology or using Chevallier-Polarski-Linder (CPL) parametrization for the equation of state of dark energy. This implies that there is no hidden significant feature in the data that could be neglected by cosmology model assumption. The reconstructed expansion history of the universe and properties of dark energy seems to be in good agreement with expectations of the standard ΛCDM model. Our results also indicate that the data allows a considerable flexibility for expansion history of the universe.

고에너지천문학/이론천문학

[초 HT-01] Recent results on IceCube multi-messenger astrophysics

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Mass and radius of a neutron star in low-mass X-ray binary (LMXB) can be estimated simultaneously when the observed light curve and spectrum show the photospheric radius expansion feature. This method has been applied to 4U 1746-37 and the mass and radius were found to be unusually small in comparison with typical neutron stars. We re-estimate the mass and radius of this target by considering that the observed light curve and spectrum can be affected by other X-ray sources because this LMXB belongs to a very crowded globular cluster NGC 6441. The new estimation increases the mass and radius but they do not reach the typical values yet.

[구 HT-02] A Model for Diffusive Shock Acceleration of Protons in Intracluster Shocks and Gamma-ray and Neutrino Emissions from Clusters of Galaxies

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During the formation of large-scale structures in the universe, shocks with the sonic Mach number Ms <~ 5 are naturally induced by supersonic flow motions of baryonic matter in the intracluster medium (ICM). Cosmic rays (CRs) are expected to be accelerated via diffusive shock acceleration (DSA) at these ICM shocks, although the existence of CR protons in the ICM remains to be confirmed through gamma-ray observations. Based on the results obtained from kinetic plasma simulations, we build an analytic DSA model for weak, quasi-parallel shocks in the test-particle regime. With our DSA model, the CR acceleration efficiency ranges ~ 0.001 – 0.02 in supercritical quasi-parallel shocks with sonic Mach number Ms ~ 2.25 – 5, and the acceleration would be negligible in subcritical shocks wth Ms <~ 2.25. Adopting our DSA model, we estimate gamma-ray and neutrino