고에너지천문학/이론천문학

[구 HT-01] Estimating Mass and Radius of a Neutron Star in Low-Mass X-ray Binary

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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] Dependence of tidal disruption flares on stellar density profile and orbital properties

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Tidal disruption events (TDEs) provide evidence for quiescent supermassive black holes (SMBHs) in the centers of inactive galaxies. TDEs occur when a star on a parabolic orbit approaches close enough to a SMBH to be disrupted by the tidal force of the SMBH. The subsequent super-Eddington accretion of stellar debris falling back to the SMBH produces a characteristic flare lasting several months. It is theoretically expected that the bolometric light curve decays with time as proportional to $t^{-5/3}$.

However, some of the observed X-ray light curves deviate from the $t^{-5/3}$ decay rate, while some of them are overall in good agreement with the $t^{-5/3}$ law. Therefore, it is required to construct the theoretical model for explaining these light curve variations consistently. In this paper, we revisit the mass fallback rates semi-analytically by taking account of the stellar internal structure, orbital eccentricity and penetration factor. We find that the mass fallback rate is shallower than the standard $t^{-5/3}$ decay rate independently of the polytropic index, and the orbital eccentricity only changes the magnitude of the mass fallback rate. Furthermore, the penetration factor significantly can modify the magnitude and variation of mass fallback rate. We confirm these results by performing the computational hydrodynamic simulations. We also discuss the relevance of our model by comparing these results with the observed light curves

[구 HT-03] FAR-INFRARED SPECTRAL ENERGY DISTRIBUTION OF THE PULSAR WIND NEBULA 3C 58

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We present analysis results of far infrared (IR) data for 3C 58. We use Herschel observations to measure the IR spectral slope of the source. Our measurements add new IR data points to exisiting high-frequency ones and allow us to improve the IR spectral energy distribution (SED) of 3C 58, and so a cooling break expected in the optical band can be located more precisely. We interpret the SED and the break using a synchrotron+ inverse-Compton model for PWNe and infer flow properties in 3C 58. Because the IR data are contaminated by foregrounds and backgrounds, we discuss impacts of the contamination on our conclusion.

[석 HT-04] Why Are Cool Structures in the Universe Usually Filamentary?

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Small-scale shear flows are ubiquitous in the universe, and astrophysical plasmas are often magnetized. We study the thermal condensation instability in magnetized plasmas with shear flows in relation to filamentary structure formation in cool structures in the universe, representatively solar prominences and supernova remnants. A linear stability analysis is extensively performed in the framework of magnetohydrodynamics (MHD) with radiative cooling, plasma heating and anisotropic thermal conduction to find the eigenfrequencies and eigenfunctions for the unstable modes. For a shear velocity less than the Alfven velocity of the background plasma, the