sub-galactic structures around isolated dwarf galaxies using cosmological hydrodynamic zoom simulations. For this, we modify a cosmological hydrodynamic code, GADGET-3, in a way that includes gas cooling down to T~10K, gas heating by universal reionization when z < 8.9, UV shielding for high density regions of n_{shield} > 0.014cm^{-3}, star formation in the dense regions (n_H > 100cm^{-3}), and supernova feedback. To get good statistics, we perform three different simulations for different target galaxies of the same mass of ~$10^{10}M_{sun}$. Each simulation starts in a cubic box of a side length of 1Mpc/h with 17 million particles from z = 49. The mass of dark matter (DM) and gas particle is M_{DM} = 4.1×10^3 M_{sun} and M_{gas} = 7.9×10^2 M_{sun}, respectively, thus each satellite sub-galactic structure can be resolved with more than hundreds or thousands particles. We analyze total 90 sub-galactic structures that have formed outside of the main halos but infall the main halos. We found that 1) mini halos that interact more with the other mini halos tend to accrete the more mass, 2) mini halos that interact more before the reionization tend to form more stars, 3) mini halos with the more interaction tend to approach closer to the galactic center and have the lower orbital circularity, 4) survivals even in the strong tidal fields evolve baryon dominated system, such as globular clusters.

[구 GC-26] Rotation of galaxies and the role of galaxy mergers

Hoseung Choi, Sukyoung Yi.
Department of Astronomy, Yonsei University, Seoul 120-749, Korea

Recent integral-field spectrograph surveys have found that similar-looking early type galaxies have wide range of rotational properties (Emsellem et al. 2007). This finding initiated a new point of view to the galaxies; rotation of galaxy as the first parameter of galaxy classification (Emsellem et al. 2011, Cappellari et al. 2011, for example).

Some theoretical studies tried to address the origin of galaxy rotation. Idealized galaxy merger simulations have shown that galaxy-galaxy interactions have significant effects on the rotation of galaxies. Cosmological simulations by Naab et al. 2014 also added some more insights to the rotation of galaxies. However, previous studies either lack cosmological background or have not enough number of samples.

Running a set of cosmological hydrodynamic zoom-in simulations using the AMR code RAMSES(Teyssier 2002). we have constructed a sample of thousands of galaxies in 20 clusters. Here we present a kinematic analysis of a large sample of galaxies in the cosmological context. The overall distribution of rotation parameter of simulated galaxies suggests a single peak corresponding to fast rotating galaxies. But when divided by mass, we find a strong mass dependency of galaxy rotation, and massive galaxies are distinctively slow rotating. The cumulated effective of mergers seems to neutralize galaxy rotation as suggested by previous studies (Khochfar et al. 2011, Naab et al. 2014, and Moody et al. 2014). This is consistent with the fact that massive galaxies tend to rotate more slowly after numerous mergers. However, if seen individually, merger can either increase or decrease galaxy rotation depending on mass ratio, orbital parameter, and relative rotation axis of the two galaxies. This explains the existence of some non-slow rotating massive early type galaxies.

[구 GC-27] A 3-D BICONICAL OUTFLOW MODELING OF GAS KINEMATICS FOR TYPE 2 AGNs

Hyun-Jin Bae[1,2], Jong-Hak Woo[2]
[1]Department of Astronomy, Yonsei University
[2]Astronomy Program, Department of Physics and Astronomy, Seoul National University

To understand the observed kinematics in the narrow-line region (NLR) of type 2 AGNs, we construct a model of 3-D biconical outflow combined with a thin dust plane. The model consists of two identical cones whose apex is located at the nucleus, and the cones are axisymmetric with respect to the bicone axis. After we define the properties of the bicone and the dust plane, we calculate a spatially integrated velocity and velocity dispersion along the line-of-sight using various physical parameters. As we test the effect of model parameters, we find three key parameters determining the integrated kinematics: intrinsic outflow velocity, bicone inclination, and the amount of dust extinction. The velocity dispersion increases as the intrinsic outflow velocity or the bicone inclination increases, while the velocity shift increases as the amount of dust extinction increases. We confirm that the integrated velocity dispersion can be a good indicator of the intrinsic outflow velocity unless dust extinction is not very strong (>～80%), while the effect of dust extinction can be alleviated by combining the integrated velocity and the velocity dispersion. Based on the simulated velocity distributions using the 3-D models, the variety of the observed [O III] line profiles of type 2 AGNs can be well reproduced. In addition, we perform Monte Carlo simulations based on the different sets of model parameters. By comparing the model results with the observed [O III] kinematics of ~39,000 SDSS type 2 AGNs (Woo et al. 2016), we find that the observed [O III] velocity-velocity dispersion distribution is well reproduced by the biconical outflow model, enabling us to constrain the intrinsic physical parameters of outflows.

항성

[구 ST-01] KIC 6220497: A New Algol-type Eclipsing Binary with δ Sct Pulsations

Jae Woo Lee
Korea Astronomy and Space Science Institute, Daejeon 34055

We present the physical properties of KIC 6220497 exhibiting multiperiodic pulsations from the Kepler photometry. The light curve synthesis represents that the eclipsing system is a semi-detached Algol with a mass ratio of q=0.243, an orbital inclination of i=77.3 deg, and a temperature difference of ΔT=3,372 K, in which the detached primary component fills its Roche lobe by ~87% and is about 1.6 times larger than the lobe-filling secondary. To detect reliable pulsation frequencies, we analyzed separately the Kepler light curve at the interval of an orbital period. Multiple frequency analyses of the eclipse-subtracted light residuals reveal 32 frequencies in the range of 0.75-20.22 d^{-1} with semi-amplitudes between 0.27 and 4.55 mmag. Among these, four frequencies (f_1, f_2, f_5, f_7) may be attributed to pulsation modes, while the other frequencies can be harmonic and combination terms. The pulsation constants of 0.16-0.33 d and the period ratios of P_{pul}/P_{orb} = 0.042-0.089 indicate that the primary component is a δ Sct pulsating star in p modes and, thus, KIC 6220497 is an oscillating eclipsing Algol (oEA) star. The dominant pulsation period of about 0.1174 d is considerably longer than the values given by the empirical relations between the pulsational and orbital periods. The surface gravity of log g_1 = 3.78 is significantly smaller than those of the other oEA stars with similar orbital periods. The pulsation period and the surface gravity of the pulsating primary demonstrate that KIC 6220497 would be the more evolved EB, compared with normal oEA stars.

[구 ST-02] The first photometric analysis of the close binary system NSVS 1461538

Hyoun-Woo Kim, Chun-Hwey Kim
Department of Astronomy and Space Science, Chungbuk National University, Cheongju, 28644, Korea

The follow-up BVRI photometric observations of NSVS 1461538, which was discovered as an Algol/β Lyr eclipsing variable by Hoffman, Harrison & McNamara (2009), were performed for three years from 2011 to 2013 by using the 61-cm telescope and CCD cameras of Sobaeksan Optical Astronomy Observatory (SOAO). New light curves have deep depths both of the primary and secondary eclipses, rounded shapes outside eclipses and a strong O'Connell effect, indicating that NSVS 1461538 is a typical W UMa close binary system rather than an Algol/β Lyr type binary star. A period study with all the timings shows that the orbital period may vary in a sinusoidal way with a period of about 5.6 yr and a small semi-amplitude of about 0.008 d. The cyclical period variation was interpreted as a light-time effect due to a tertiary body with a minimum mass of 0.66M☉. The first photometric solution with the Wilson-Devinney binary model shows that the system is a W-subtype contact binary with the mass ratio ($q=m_c/m_h$) of 3.46, orbit inclination of 85.6 deg and fill-out factor of 30%. From the existing empirical relationship between parameters, the absolute dimension was estimated. The masses and radii of the component stars are 0.28M☉ and 0.71R☉ for the less massive but hotter primary star, respectively, and 0.96M☉ and 1.21R☉, for the more massive secondary, respectively. Possible evolution of the system is discussed in the mass-radius and the mass-luminosity planes.

[구 ST-03] The First Photometric Study of the Neglected Contact Binary GX Aurigae

Jang-Ho Park[1,2], Jae Woo Lee[1], and Chun-Hwey Kim[2]
[1]*Korea Astronomy and Space Science Institute,*
[2]*Chungbuk National University*

New CCD photometric observations of GX Aur have been made between 2004 and 2015. Our light curves are the first ever compiled and display the variable O'Connell effect. The light variations are satisfactorily modeled by including time-varying cool-spots on the component stars. Our light curve synthesis indicates that the eclipsing pair is an A-type contact binary with parameters of i = 81.1 deg, ΔT = 36 K, q = 0.950 and f = 46%. Including