nearby young moving groups from Gaia EDR3

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In this study, we aim to identify low-mass members of nearby, young stellar moving groups (NYMGs) from Gaia EDR3. The spatio-kinematic membership probabilities of the NYMGs were calculated utilizing the Bayesian membership probability calculation tool developed in our previous study. The youth of these spatio-kinematic members were assessed using positions on color-magnitude diagrams. We identified ~2200 new low-mass NYMG candidate members, that can be confirmed by follow-up spectroscopic observations. We performed pilot spectroscopic observation with WiFeS at Siding Spring Observatory observing 79 candidates, and about 80 per cent of them were confirmed as members.

[구 SA-04] A kinematic study of young stars in Monoceros OB1 and R1 associations

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The Gaia mission opens a new window to study the kinematics and dynamics of young stellar systems in detail. The kinematic properties of young stars provide vital constraints on the formation process of their host systems. Here, we present a kinematic study of the two associations Monoceros OB1 (Mon OB1) and R1 (Mon R1). Member candidates are first selected from the published list of member candidates, a compilation of OB star catalogues, and the classification of young stellar objects with the AllWISE data. According to the conventional wisdom, we selected a total of 728 members with similar proper motions at almost the same distance. Mon OB1 and Mon R1 have high levels of substructures that are also kinematically distinct. We identify six stellar groups in these associations, of which five show a pattern of expansion. In addition, the signature of rotation is found in two stellar groups of Mon OB1. Star formation history is inferred from a color-magnitude diagram. As a result, star formation in Mon OB1 has been sustained for several million years, while Mon R1 formed at almost the same epoch as the recent star formation in Mon OB1. Some old members in the outskirt of Mon OB1 have outward motions, which rules out the previously proposed outside-in star formation scenario. Star-forming regions including Mon OB1 and Mon R1 are found along a large arc-like gas structure. Hence, the formation of these two associations may originate from the hierarchical star formation along filaments in a turbulent molecular cloud.

[구 SA-05] Metallicity-dependent mixing length in evolution models of red supergiant stars in IC 1613

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There is increasing evidence that the convective mixing length (α) in stellar evolution models depends on metallicity of stars. In order to confirm a more precise metallicity-dependent mixing length trend, we investigate the effective temperature and metallicity of 14 red supergiant stars (RSGs) in the irregular dwarf galaxy IC 1613 using the near-infrared spectra observed with the MMIRS on the MMT telescope. From the synthetic spectral fitting to the observed spectra, we find that the mean metallicity is about [Fe/H]=0.69 with a weak bimodal distribution. We also find that the effective temperature of RSGs in IC 1613 is higher by about 250 K than that of the SMC on average. We compare the RSG position with stellar evolutionary tracks on the HR diagram, finding that models with α = 2.2-2.4 H_p can best reproduce the effective temperatures of the RSGs in IC 1613. It is evident that the mixing length values for IC 1613 is lower than that of the Milky Way. This result supports our previous study on a metallicity-dependent mixing length: mixing length decreases with decreasing metallicity of host galaxies. However, this dependency becomes relatively weak for RSGs having a metallicity equal to or less than the SMC metallicity.

[구 SA-06] Observational Feature of Ejecta-Companion Interaction of A Type Ia SN 2021hpr Via The Very Early Light Curve

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The progenitor of Type Ia supernovae is largely expected as a close binary system of a carbon/oxygen white dwarf (WD) primary and its secondary non-degenerate (single degenerate; SD) or degenerate companion (double degenerate; DD). Here we present a high-cadence monitoring observation of SN 2021hpr in a spiral galaxy, NGC 3147. SN 2021hpr shows typical characteristics as a normal type Ia supernova from its photometric ($\Delta m_{15}(B)=1.01\pm0.03$, dust free $M_{B,max}=-19.45\pm0.02$) and spectroscopic data. To investigate its progenitor system, we fit the early part of *BVRI*-band light curve simultaneously with a combined version of ejecta-companion and simple power-law model. As a result, we found a significant feature of an early excess possibly from a $7.63\pm0.52R_{\odot}$-sized companion at the optimal viewing angle while the fit is not successful at the common viewing angle. No possible red sources brighter than F555W=-7.01 AB mag is detected at the SN location in Hubble Space Telescope (HST) pre-explosion images, excluding massive stars with initial mass of $>16M_{\odot}$ as companions. We suggest the progenitor system of SN 2021hpr can be a fairly large companion such as a main sequence, a low mass subgiant, and a helium giant star. In addition, a possibility of the ejecta-Disk Originated Matter (DOM) interaction for the DD scenario considering linearly-rising early flux still remains.

고에너지/이론천문학

[구 HA-01] Preexsiting Suprathermal Electrons and Preacceleration at Quasi-Perpendicular Shocks in Merging Galaxy Clusters

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Merger shocks with $M_s<\sim3-4$ have been detected in galaxy clusters through radio observations of synchrotron radiations emitted from cosmic-ray (CR) electrons. The CR electrons are believed to be produced by the so-called diffusive shock acceleration (DSA) at the merger shocks. To describe the acceleration of electrons, the injection into DSA has to be understood. Recent studies have showed that electrons could be energized through stochastic shock drift acceleration (SSDA), a mechanism mediated by multi-scale plasma waves at shock transition zone. However, such preacceleration process seems to be effective only at the supercritical shocks with $M_s>\sim2.3$, implying that further studies should be done to explain radio relics with weaker shocks. In this talk, we present the results obtained by fully kinetic 2D particle-in-cell (PIC) simulations, which include pre-existing suprathermal electrons possibly ejected from active galactic nuclei (AGNs) or produced by previous episodes of turbulence/shocks. The simulations indicate that the pre-existing electrons enhance the upstream plasma waves in shocks with $M_s<\sim2.3$. However, the wavelength of such waves is not long enough to scatter off suprathermal electrons and energize them to the injection momentum for DSA. Hence, we conclude that preexciting suprathermal electrons alone would not solve the problem of electron acceleration at radio relic shocks.

[구 HA-02] Features in broadband SEDs of young pulsar wind nebulae: existence of two different electron populations

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Pulsar Wind Nebula(PWN)는 radio부터 TeV band까지 넓은 파장에 걸쳐 복사를 하며 이 복사는 Spectral Energy Distribution(SED)으로 측정된다. 관측된 SED는 두 개의 주요한 bump를 보이는데 low-energy emission bump는 synchrotron radiation에 의해 만들어지고 high-energy emission bump는 inverse Compton scattering에 의해 만들어진다. 대부분 PWN들의 SED는 단일 전자 분포로 설명이 가능하지만 최근 연구 결과에 의하면 Crab nebula, G21.5-0.9 같은 일부 young pulsar wind nebula의 X-ray SED에서 단차나 기울기의 변화 등 단일 전자 분포로 설명하기 어려운 부분이 관측되기도