

subpopulations

Seungsoo Hong¹, Dongwook Lim¹, Sang-Il Han²,
and Young-Wook Lee¹

¹*Department of Astronomy, Yonsei University,
Seoul 03722, Korea*

²*Korea Astronomy and Space Science Institute
(KASI), Daejeon 34055, Korea*

The presence of multiple stellar populations is now well established in most globular clusters (GCs) in the Milky Way. The origin of this phenomenon, however, is yet to be understood. In this respect, the study of NGC 2808, an intriguing GC which hosts subpopulations with extreme helium abundances, would help to resolve this problem. In order to investigate chemical abundance patterns among different subpopulations in this GC, we have performed low-resolution spectroscopy for the red-giant-branch (RGB) stars and measured CN & CH bands, and Ca line strength. We have identified at least three subpopulations from the CN abundance distribution. This GC shows CN-CH anti-correlation following the general trend among “normal” GCs. In addition, we have cross-matched our results with the high-resolution data in literature, and found a tight correlation between CN strength and sodium abundance. However, CN is anticorrelated with oxygen abundance, as expected from the well known N(&Na)-O anticorrelation. In this talk, we will discuss the implication of these results.

[백 ST-05] A Deep Optical Photometric Study of the Massive Young Open Clusters in the Sagittarius-Carina Spiral Arm

Hyeonoh Hur^{1,2}

¹*Sejong University, ²Daegu National Science Museum*

The Sagittarius-Carina spiral arm in the Galaxy contains several massive young open clusters. We present a deep optical photometric study on the massive young open clusters in the Sagittarius-Carina arm, Westerlund 2 and the young open clusters in the η Carina nebula. Westerlund 2 is a less studied starburst-type cluster in the Galaxy. An abnormal reddening law for the intracluster medium of the young starburst-type cluster Westerlund 2 is determined to be $R_{V,cl}=4.14\pm 0.08$. The distance modulus is determined from zero-age main-sequence fitting to the reddening-corrected color-magnitude diagrams

of the early-type members to be $V_0-M_V=13.9\pm 0.14$ mag. The pre-main sequence (PMS) members of Westerlund 2 are selected by identifying the optical counterparts of X-ray emission sources from the Chandra X-ray observation and mid-infrared emission sources from the Spitzer/IRAC (the Infrared Array Camera) observation. The initial mass function (IMF) shows a slightly flat slope of $\Gamma = -1.1\pm 0.1$ down to $5 M_{\odot}$. The age of Westerlund 2 is estimated to be ~ 1.5 Myr from the main-sequence turn-on luminosity and the age distribution of PMS stars. The η Carina nebula is the best laboratory for the investigation of the Galactic massive stars and low-mass star formation under the influence of numerous massive stars. We have performed deep wide-field CCD photometry of stars in the η Carina nebula to determine the reddening law, distance, and the IMF of the clusters in the nebula. We present VRI and H α photometry of 130,571 stars from the images obtained with the 4m telescope at Cerro Tololo Inter-American Observatory (CTIO). $R_{V,cl}$ in the η Carina nebula gradually decreases from the southern part (~ 4.5 , around Trumpler 14 and Trumpler 16) to the northern part around Trumpler 15 (~ 3.5). Distance to the young open clusters in the η Carina nebula is partly revised based on the zero-age main-sequence fitting to the reddening-corrected color-magnitude diagrams (CMDs) and the (semi-) reddening-independent CMDs. We select the PMS members and candidates by identifying the optical counterparts of X-ray sources from the Chandra Carina Complex Survey and mid-infrared excess emission stars from the Spitzer Vela-Carina survey. From the evolutionary stage of massive stars and PMS stars, we obtain that the northern young open cluster Trumpler 15 is distinctively older than the southern young open clusters, Trumpler 14 (≤ 2.5 Myr) and Trumpler 16 (2.5–3.5 Myr). The slopes of the IMF of Trumpler 14, Trumpler 15, and Trumpler 16 are determined to be -1.2 ± 0.1 , -1.5 ± 0.3 , and -1.1 ± 0.1 , respectively. Based on the $R_{V,cl}$ of several young open clusters determined in this work and the previous studies of our group, We suggest that higher $R_{V,cl}$ values are commonly found for very young open clusters with the age of < 4 Myr. We also confirm the correlation between the slope of the IMF and the surface mass density of massive stars.

[구 ST-06] Red supergiant stars in NGC 4449, NGC 5055, and NGC 5457

Sang-Hyun Chun¹, Young-Jong Sohn², Martin Asplund³, Luca Casagrande³

¹*Astronomy Program, Department of Physics and Astronomy, Seoul National University, ²Department of Astronomy, Yonsei University, ³Research School of Astronomy and Astrophysics, Australian National University*

We present near-infrared photometric properties of red supergiant stars (RSGs) in three galaxies NGC 4449, NGC 5055 and NGC 5457. The near-infrared imaging data of WFCAM UKIRT were used and combined with optical archive data to identify the RSGs in the galaxies. We found that the RSGs can be identified from the foreground Galactic stars in (i-K, ri) colour-colour diagram. The effective temperatures and luminosities of the identified RSGs are estimated from JHK photometry using MARCS model. In the H-R diagram, the majority of RSGs in the galaxies are distributed between $\log L/L_{\odot}=4.8$ and 5.7, and their effective temperature and luminosities agree with the current evolutionary tracks with masses in the range 9–30 M_{\odot} . We also compared the spatial distribution of RSGs with the HII regions. A tight spatial correlation between RSGs and HII region was found in NGC 4449 and NGC 5457. We do not find a clear metallicity dependence on the RSG effective temperature in the three galaxies, but the maximum luminosity of the three galaxies is constant at $\log L/L_{\odot}\sim 5.6$. Additional spectroscopy data, including photometry are essential to examine whether the physical properties of RSGs change with metallicity.

특별세션 : 과학관과 천문학교육

[구 AE-01] Exhibition and Education of Astronomy in Museum of Natural History

Kang Hwan Lee
Seodaemun Museum of Natural History
(서대문자연사박물관)

우리나라 대부분의 과학관에는 천문시설이 갖추어져 있고, 천문분야 전시와 교육이 어느 정도는 이루어지고 있다. 하지만 자연사박물관에서는 천문분야가 주요 분야로 인정받고 있지 못하고 그 내용도 빈약한 편이다. 수도권에서 매우 중요한 역할을 하고, 연간 35만 명 정도의 관람객이 방문하고 있는 서대문자연사박물관에도 일부 천문 전시가 있긴 하지만 다른 분야에 비해 매우 빈약하다. 자연의 역사를 다루는 자연사박물관에서 우주의 탄생으로 보여주는 천문학은 중요한 역할을 차지할 여지가 있고, 실제 해외 유명 자연사박물관에서는 천문 분야가 큰 비중을 차지하고 있다. 국립자연사박물관의 건설도 추진되고 있는

상황에서 자연사박물관에서의 천문전시와 교육이 어떤 방향으로 이루어져야 할지 논의해 보았으면 한다.

[구 AE-02] Educational activities at DOAO using 1-m telescope in NYSC

Sun-Gill Kwon, wonseok Kang, Taewoo Kim,
Sang-Gak Lee
National Youth Space Center

국립고흥청소년우주체험센터(이하 우주체험센터)에서는 2013년부터 덕흥천문대를 활용한 프로그램을 청소년에게 제공하고 있고, 2016년부터는 1m망원경을 활용한 연구 또한 동시에 진행하고 있다.

우주체험센터에서는 청소년 및 일반대중을 위해 덕흥천문대를 활용하여 우주과학교실, 별잔치, 대학생 현장실습, 우주과학동아리 등의 사업을 운영하고 있다. 본 발표에서는 과거부터 현재까지 운영해온 사업에 대한 소개 및 공유는 물론, 올해부터 진행 중인 1m망원경을 활용한 천문연구에 대한 소개도 진행할 예정이다. 현재 NYSC 1m망원경을 이용하여 외부은하의 초신성 모니터링과 함께 외계행성 별표면 통과현상을 관측하여 분석중이다. 또한, 2016년 9월부터는 관측제안서를 통한 외부 공개관측이 진행되며 전문가 이외에도 실제 청소년 관측제안서에 멘토 역할을 하는 등 실질적 교육을 하고자 한다.

[구 AE-03] Astronomy Education and Public Events of Busan National Science Museum (국립부산과학관 천문교육과 행사)

Hyuk Park(박혁), Joon-Young Choi(최준영)
Busan National Science Museum(국립부산과학관)

2015년 12월에 개관한 국립부산과학관은 동남권 유일의 종합과학관으로 천문교육을 위한 천체관측소와 천체투영관을 보유하고 있다. 천체관측소에는 국내 최대규모의 구경 350mm 굴절망원경을 포함 다양한 천체관측 및 교육장비를 갖추고 있고, 천체투영관에는 디지털식 투영기와 직경 17m의 돔스크린, 133석 규모의 시설을 갖추고 있다. 이러한 천문시설은 일반개인관람, 학교단체교육, 학교 및 가족이 참여하는 1박 2일 캠프프로그램, 천문행사 등에 활용되고 있다. 개관 1주년을 바라보고 있는 시점에서 지속적인 천문 교육수요 창출을 위해 보다 효율적인 운영방법모색 및 다양한 콘텐츠를 개발이 요구되고 있다. 이를 기반으로 2021년 부산에서 개최되는 제31차 국제천문연맹총회(IAUGA)에서의 국립부산과학관의 역할을 증대시키고자 한다. 이번 발표에서는 국립부산과학관의 천문시설의 활용 현황을 소개하고 타 기관의 우수 사례를 공유하여 국립부산과학관 뿐만 아니라 전국 천문교육의 지속적인 발전 방법을 논의하고자 한다.

[구 AE-04] Astronomy Education in Planetarium