

systems. However, the formation mechanism of the multiplicity is poorly understood. Theoretical studies suggest two main mechanisms for the multiplicity: turbulent fragmentation and disk fragmentation. We can testify which mechanism is more plausible by measuring the separation between companions or the alignment of stellar spins. Here we present our ALMA Cycle 2 observational results of a proto-binary system, IRAS 04191+1523, which consists of two Class I sources. We detected disks around both Class I sources, which are located in a common dense filamentary structure traced by C¹⁸O J=2-1. Two protostellar disks are separated by ~900 AU and their rotational axes are almost perpendicular, which strongly support that this binary system formed by the turbulent fragmentation.

[구 AJ-04] Survey for CO Outflow Activities in 68 VeLLOs

Gwanjeong Kim^{1,2}, Chang Won Lee^{1,2}, Mi-Ryang Kim^{1,3}, Archana Soam¹, Kiyokane Kazuhiro^{4,5}, and Masao Saito^{4,5}

¹*Korea Astronomy and Space Science Institute*, ²*University of Science & Technology*, ³*Chungbuk National University*, ⁴*National Astronomical Observatory of Japan*, ⁵*University of Tokyo*

We present a preliminary result of search for CO molecular outflows toward a sample of 68 candidate Very Low Luminosity Objects (VeLLOs: $L_{\text{int}} \leq 0.1 L_{\odot}$) to help to understand their physical properties. The sources have been identified using the data at IR to radio wavelengths by M. Kim et al. 2016 toward nearby star-forming regions in the Gould belt. These sources were observed in rotational transitions 2-1 and 3-2 of ¹²CO, ¹³CO, and C¹⁸O molecules with SRAO, CSO, JCMT, and ASTE telescopes. In the beginning of our survey we made a single pointing observation in ¹²CO 2-1 or 3-2 lines for our sample, identifying 53 sources as potential outflow candidates from their line wing features. We made full or partial mapping observations for these candidates with the same lines, finding 33 sources with bipolar or one-sided outflow features. Out of these 33 sources, 6 VeLLOs are previously known sources to have their outflows and 27 VeLLOs are found to be new outflow sources identified from this study. We estimated outflow properties with corrections for excitation temperature, optical depth, and inclination. Their outflow forces range from 8.7×10^{-10} to $6.0 \times 10^{-5} M_{\odot} \text{ km s}^{-1} \text{ yr}^{-1}$ with a median value of $3.6 \times 10^{-7} M_{\odot} \text{ km s}^{-1} \text{ yr}^{-1}$, indicating that

most of the VeLLOs are less powerful than those for protostars. Their accretion luminosities vary from 9.7×10^{-9} to $166 L_{\odot}$ with a median value of $0.004 L_{\odot}$, implying that most VeLLOs have larger ratios of the accretion luminosity to the internal luminosity but a significant number of VeLLOs have smaller ratios. This result suggests that many of the VeLLOs can be explained with episodic accretion but a significant number of VeLLOs cannot.

[구 AJ-05] BISTRO: B-fields In STar-forming Region Observations

Woojin Kwon (권우진) on behalf of the BISTRO team
Korea Astronomy and Space Science Institute
(한국천문연구원)

We introduce a magnetic field survey of the Gould Belt clouds using the James Clerk Maxwell Telescope (JCMT) POL-2: B-fields In STar-forming Region Observations (BISTRO). POL-2 with SCUBA-2 on JCMT is a unique facility, as it is the only facility world-wide that can map the magnetic field within cold dense cores and filaments on scales of ~1000 AU in nearby star-forming regions, such as Taurus and Ophiuchus. It can provide a link between the B-field measured on arc-minute scales by Planck and BLASTPOL and measurements made on arc-second scales by interferometers such as CARMA, SMA, and ALMA. BISTRO was awarded 224 hours toward 16 fields for the next 3 years and started to take data in the 2016A semester.

Note: (PI) D. Ward-Thompson, (co-PIs) P. Bastien, R. Furuya, W. Kwon, S. Lai, and D. Li

고천문/태양계

[구 HS-01] The Prehistoric Paintings in the Hall of Bulls of the Lascaux Cave are Identified as Arrays of Constellations and Dark Clouds

Kwang-Tae Kim¹ & Youngsik Kim
Department of astronomy and Space Science

프랑스 몽티냐에 위치한 라스코 동굴에는 오늘날까지 발견된 수많은 구석기시대 동굴벽화 가운데 대표적인 그림들을 보존하고 있다. 동굴 벽화는 대략 BC 15,000년 전 것으로 연구되어 왔으며 최근 몇몇 학자들에 의해서 그 가

운데 몇몇 그림들이 별자리를 그린 것이라는 이론이 제기되었다. 본 논문에서는 동굴 그림 가운데 황소 전당에 그려진 벽화를 별자리로 동정해 보았다. 그 결과 이것들이 성좌화임을 발견했다. 그림은 흥미롭게도 별자리와 암흑 성간운을 구별했는데 별자리는 윤곽선으로 그린 반면 검은 성간운은 검은 바탕의 그림으로 나타냈다. 그림은 벽화들의 특징과 구도 그리고 배열순서로 볼 때 전천 성좌도를 그린 것으로 동정되었는데 이는 당시 밤하늘에 보이는 별자리들과 암흑 성간운들의 구도와 배열의 일치에서 신뢰할 수 있었다. 벽화에는 황소자리, 플레이아데스, 오리온삼성, 오리온자리-쌍둥이자리, 사자자리-처녀자리-뱀자리, 천칭자리-사수자리-전갈자리가 그려져 있으며, 특히 은하중심의 사수자리에서 고물자리에 이르는 길다란 은하 평면상의 검은 암흑성간운들의 특징적 나열을 들판을 뛰어가는 검은색 동물로 나타냈다. 적도를 감안해서 볼 때, 그림의 구도와 배열순서가 밤하늘에 보이는 것과 거의 같다 할만큼 사실적으로 그려져 있어서 구석기인들이 지적 능력이 오늘날 현대인들과 다를 바 없는 수준에 이르렀다고 추정된다.

[구 HS-02] Study for the observation record of constellation Crux in the ancient time of China and its deformation with the identification of the Chinese constellation 'Goru(庫婁)'

Daeyoung Park^{1,2}, Yong-Sam Lee², Yong-Ki Kim²

¹Muju Firefly-Star Astronomical Observatory

²Chungbuk National University

남십자자리(Crux)는 현재 북반구 중위도 지역에서는 관측할 수 없는 별자리지만 고대 중국의 전통 별자리 체계가 성립되던 시기인 춘추전국시대만 하더라도 지평선 부근에서 쉽게 관측할 수 있는 별자리였다. 우리는 세차운동 계산을 통해 남십자자리가 출몰성에서 전몰성으로 변했음을 확인하였고, 고대 중국의 문헌 기록과 성표, 성도의 별자리 그림 분석을 통해 남십자자리의 밝은 4개의 별이 중국의 전통 별자리인 고루성(庫婁星)과 일치함을 확인하였다. 또한 남십자자리가 관측되던 시기와 관측되지 않던 시기에 각각 작성되었던 성표와 성도 분석을 통해 고루성의 별자리 모양이 점차 변형되어 갔음을 제시하였다. 마지막으로 서양의 천문기술이 중국에 전해진 이후 진행된 동서양의 별자리 상호 비교 및 동정 결과들을 분석하여 중국의 전통 별자리 체계에서 어떻게 고루성이 완전히 배제되었는지에 대한 논의를 포함, 본 연구의 초기 결과들을 발표할 예정이다.

[구 HS-03] DEEP-South: The Progress and the Plans of the First Year

Hong-Kyu Moon¹, Myung-Jin Kim¹, Dong-Goo Roh¹, Jintae Park¹, Hong-Suh Yim¹, Hee-Jae Lee², Young-Jun Choi¹, Young-Seok Oh³, Young-Ho Bae¹, and DEEP-South Team¹

¹Korea Astronomy and Space Science Institute,

²Chungbuk National University,

³School of Space Research, Kyung Hee University

The wide-field and the round-the clock operation capabilities of the KMTNet enables the discovery, astrometry and follow-up physical characterization of asteroids and comets in a most efficient way. We collectively refer to the team members, partner organizations, the dedicated software subsystem, the computing facility and research activities as Deep Ecliptic Patrol of the Southern Sky (DEEP-South). Most of the telescope time for DEEP-South is devoted to targeted photometry of Near Earth Asteroids (NEAs) to push up the number of the population with known physical properties from several percent to several dozens of percent, in the long run. We primarily adopt Johnson R-band for lightcurve study, while we employ BVI filters for taxonomic classification and detection of any possible color variations of an object at the same time. In this presentation, the progress and new findings since the last KAS meeting will be outlined. We report DEEP-South preliminary lightcurves of several dozens of NEAs obtained at three KMTNet stations during the first year runs. We also present a physical model of asteroid (5247) Krylov, the very first Non principal Axis (NPA) rotator that has been confirmed in the main belt (MB). A new asteroid taxonomic classification scheme will be introduced with an emphasis on its utility in the LSST era. The progress on the current version of automated mover detection software will also be summarized.

[구 HS-04] DEEP-South: Performance of Moving Object Detection Program in Different Observation Modes

Young-Seok Oh¹, Yeong-Ho Bae², Myung-Jin Kim², Dong-Goo Roh², Ho Jin¹, Hong-Kyu Moon², Jintae Park², Hee-Jae Lee^{2,3}, Hong-Suh Yim², Young-Jun Choi², and the DEEP-South Team

¹School of Space Research, Kyung Hee University,

²Korea Astronomy and Space Science Institute,

³Chungbuk National University

We have five different types of observation modes with regard to the Deep Ecliptic Patrol of the Southern Sky (DEEP-South): Opposition Census (OC) for targeted photometry, Sweet Spot Survey (S1) for discovery and orbit characterization of Atens and Atiras, Ecliptic Survey (S2) for asteroid family studies and comet census, NEOWISE follow-up (NW) for near simultaneous albedo measurements in the visible bands, and Target of Opportunity (TO) observation for follow-up either