[구 STN-02] Observations of exoplanets with small telescopes

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SomangNet team aims to make use of small- to medium-sized telescopes for photometric follow-up observations of transiting extrasolar planets orbiting a bright host star. Newly discovered transiting planets need frequent monitoring in order to maintain knowledge of the transit ephemeris. DOAO 1.0 m telescope and CBNUO 0.6 m telescopes are used for our monitoring. We will present some preliminary results of our observations and analysis.

[구 STN-03] Development of automatic vacuum control system to improve CCD cooling performance

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천체관측은 무한대 거리에서 오는 광자의 양을 측정하는 분야로 미량의 광자를 측정하기 위하여 측정기의 냉각은 아주 중요한 문제가 되었다. 과거에는 측정기 냉각에 드라이아이스가 사용되어 왔으며, 1980년대에는 액체질소를 이용한 냉각이 주를 이뤘다. 액체질소를 이용한 냉각 방식은 액체질소를 생성하거나 구입하여야 하는 불편함이 있었으며, 주입시 낮은 온도로 인하여 항상 안전사고에 대비하여야 했다. 1990년대 이후 다양한 상업용 CCD의 개발로 인하여 상대적으로 저렴한 CCD를 판매하였으며, 상업용 CCD는 이전 -110℃의 냉각이 아닌 -30℃의 냉각 성능을 보였다. 상업용 CCD는 CCD 칩 내부의 진공 구현이 미비하였으며, 초기 판매시 아르곤 가스 또는 실리카겔 등으로 CCD 칩 내부의 습도를 낮춰왔으나, 구입 후 1~2년이 지나면 점차 가스 누설로 인하여 CCD 칩 내부에 얼음이 생기는 문제가 발생하기 시작하였다. 이번 연구는 CCD 칩 내부 공간에 진공튜브를 삽입하여 실시간 진공상태를 측정하는 한편, 10Torr 이상 진공 도달시 자동으로 내부 공기를 흡입하여 CCD 칩 내부를 항시 10Torr 이하로 유지하도록 개발하였으며, 10Torr 이하의 진공 유지시 습도 99%의 환경에서 최대 냉각인 -35℃를 유지하여도 전혀 얼음이 생기지 않음을 확인하였다. 이번연구로 개발된 자동 진공조절시스템이 각 천문대에서 사용중인 상업용 CCD에 적용된다면, 날씨환경에 관계없이 항상 최대냉각 상태로 천체관측을 진행할 수 있으리라 기대된다.

[구 STN-04] Performance evaluation of the 76 cm telescope at Kyung Hee Astronomical Observatory (KHAO)

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The 76 cm telescope in Kyung Hee Astronomical Observatory is participating in the small telescope network of the SomangNet project, which started in 2020. Since the installation of the telescope in 1992, the system configuration has been changed several times. The optical system of this telescope has a Ritchey-Chrétien configuration with 76 cm in diameter and the focal ratio is f/7. The mount is a single fork equatorial type and its control system is operated by TheSkyX software. We use a science camera with a 4k × 4k CCD and standard Johnson-Cousins UBVRI filters, which cover a field of view of 23.7 × 23.7 arcmin. We are also developing the Kyung Hee Automatic Observing Software for the 76 cm telescope (KAOS76) for efficient operations. In this work, we present the standard star calibration results, the current status of the system, and the expected science capabilities.

[구 STN-05] Time-series CCD photometry of the open cluster M44

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We Present a B and V band time-series CCD photometry of the Delta scuti stars, BV Cnc, BN Cnc, BU Cnc, BS Cnc, in the open cluster M44. The observation was carried out for 36 nights between February, 2020 and February 2021 with a 0.6m telescope equipped 2K CCD camera at Gyeonggi Science High School for the Gifted(GSHS). To detect pulsational frequencies, we wuse Discret Fourier Transformation(DFT) method. We have detected resonable pulsational frequencis compare to previous study.

[구 STN-06] Optical follow-up observation of three long GRBs with SomangNet facilities

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We report the optical follow-up observations of three long γ-ray burst events, GRB 201020A, GRB 201103B and GRB 210104A by the network of telescopes in the SomangNet project. We show light curves, color evolution and SED evolution, and fit them to a single power law function to derive decay index and compare their properties with other long GRBs samples. Also, we show a good observational example that 0.4-1m class telescopes in SomangNet have potential to catch dim light from high red shift object (R>22 mag) by deep imaging. In conclusion, we found that three GRBs have optical afterglow properties of long GRB and our results are consistent with the reports of high energy analysis.

성간물질

[구 IM-01] Gravitational Instability of Protoplanetary Disks around Low-mass Stars

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Gravitational instability (GI) can produce massive gas giants on wide orbits by fragmentation of protoplanetary disks (PPDs). While most previous works focus on PPDs around solar mass stars, gas giants have been observed in systems with a wide range of stellar masses including M dwarfs. We use the GIZMO code to perform global three-dimensional simulations of self-gravitating disks around low-mass stars. Our models consider heating by turbulent viscosity and stellar irradiation and the β cooling occurring over the dynamical time. We run various models with differing disk-to-star mass ratio q and disk temperature. We find that strongly gravitating disks either produce spirals or undergo fragmentation. The minimum q value for fragmentation is 0.2 - 0.7, with a smaller value corresponding to a more massive star and/or a smaller disk. The critical q value depends somewhat sensitively on the disk temperature, suggesting that the stellar irradiation is an important factor in determining GI. We discuss our results in comparison with previous work as well as recent ALMA observations.

[구 IM-02] Probing the Conditions for the Atomic-to-Molecular Transition in the Interstellar Medium

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Stars form exclusively in cold and dense molecular clouds. To fully understand star formation processes, it is hence a key to investigate how molecular clouds form out of the surrounding diffuse atomic gas. With an aim of shedding light in the process of the atomic-to-molecular transition in the interstellar medium, we analyze Arecibo HI emission and absorption spectral pairs along with TRAO/PMO 12CO(1-0) emission spectra toward 58 lines of sight probing in and around molecular clouds in the solar neighborhood, i.e., Perseus, Taurus, and California. 12CO(1-0) is detected from 19 out of 58 lines of sight, and we report the physical properties of HI (e.g., central velocity, spin temperature, and column density) in the vicinity of CO. Our preliminary results show that the velocity difference between the cold HI (Cold Neutral Medium or CNM) and CO (median ~ 0.7 km/s) is on average more than a factor of two smaller than the velocity difference between the warm HI (Warm Neutral Medium or WNM) and CO (median ~ 1.7 km/s). In addition, we find that the CNM tends to become colder (median spin temperature ~ 43 K) and abundant (median CNM fraction ~ 0.55) as it gets closer to CO. These results hints at the evolution of the CNM in the vicinity of CO, implying a close association between the CNM and molecular gas. Finally, in order to examine the role of HI in the formation of molecular gas, we compare the observed CNM properties to the theoretical model by Bialy & Sternberg (2016), where the HI column density for the HI-to-H2 transition point is predicted as a function of density, metallicity, and UV radiation field. Our comparison shows that while the model reproduces the observations reasonably well on average, the observed CNM components with high column