Jinguk[1,2], Chung-Uk Lee[5], Seung-Lee Kim[5] and Hyung-Il Sung[5]
[1]*Astronomy Program, Department of Physics & Astronomy, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Korea*
[2]*SNU Astronomical Research Center, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Korea,*
[3]*National Youth Space Center, Goheung, Jeollanam-do, 59567, Korea,*
[4]*Ulugh Beg Astronomical Institute, Uzbek Academy of Sciences, 33 Astronomical Street, Tashkent 700052, Uzbekistan,*
[5]*Korea Astronomy and Space Science Institute, 776 Daedeokdae-ro, Yuseong-gu, Daejeon 34055, Korea*

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

Gain Lee, Woong-Tae Kim
Department of Physics & Astronomy, Seoul National University

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

Gyueun Park[1,2], Min-Young Lee[1]
[1]*Korea Astronomy & Space Science Institute,*
[2]*Department of Astronomy and Space Science, University of Science and Technology*

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

densities are much denser than the model prediction. Several sources of this discrepancy, e.g., missing physical and chemical ingredients in the model such as the multi-phase ISM, non-equilibrium chemistry, and turbulence, will be discussed.

[구 IM-03] Local TIGRESS Simulations of Star Formation in Spiral Galaxies

Woong-Tae Kim[1], Chang-Goo Kim[2], Eve C. Ostriker[2]
[1]Seoul National University, Korea
[2]Princeton University, USA

Spiral arms greatly affect gas flows and star formation in disk galaxies. We use local 3D simulations of vertically-stratified, self-gravitating, gaseous disks under a stellar spiral potential to study the effects of spiral arms on galactic star formation as well as formation of gaseous spurs/feathers. We adopt the TIGRESS framework to handle radiative heating and cooling, star formation, and ensuing supernova (SN) feedback. We find that more than 90% of star formation takes place inside spiral arms. The global star formation rate (SFR) in models with spiral arms is enhanced by less than a factor of 2 compared to the no-arm counterpart. This supports the picture that spiral arms do not trigger star formation but rather redistribute star-forming regions. Correlated SN feedback produces interarm feathers in both magnetized and unmagnetized models. These feathers live short, have parallel magnetic fields along their length, and are bounded by SN feedback in the lateral direction, in contrast to instability-induced feathers formed in our previous isothermal simulations.

[구 IM-04] Star formation in nuclear rings controlled by bar-driven gas inflow

Sanghyuk Moon[1], Woong-Tae Kim[1], Chang-Goo Kim[2], and Eve C. Ostriker[2]
[1]Department of Physics & Astronomy, Seoul National University, [2]Department of Astrophysical Sciences, Princeton University

Nuclear rings are sites of intense star formation at the center of barred spiral galaxies. A straightforward but unanswered question is what controls star formation rate (SFR) in nuclear rings. To understand how the ring SFR is related to mass inflow rate, gas content, and background gravitational field, we run a series of semi-global hydrodynamic simulations of nuclear rings, adopting the TIGRESS framework to handle radiative heating and cooling as well as star formation and supernova feedback. We find: 1) when the mass inflow rate is constant, star formation proceeds in a remarkably steady fashion, without showing any burst-quench behavior suggested in the literature; 2) the steady state SFR has a simple linear relationship with the inflow rate rather than the ring gas mass; 3) the midplane pressure balances the weight of the overlying gas and the SFR surface density is linearly correlated with the midplane pressure, consistent with the self-regulated star formation theory. We suggest that the ring SFR is controlled by the mass inflow rate in the first place, while the gas mass adjusts to the resulting feedback in the course of achieving the vertical dynamical equilibrium.