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Two major radiative transfer (RT) techniques have been developted to model late-type galaxies: approximate RT and Monte Carlo (MC) RT. In the approximate RT, first proposed by Kylafis & Bahcall, only two terms of unscattered (direct) and single-scattered intensities are computed and higher-order multiple scattering components are approximated, saving computing time and cost compared to MC RT. However, the approximate RT can yield errors in regions where multiple scattering effect is significant. In order to examine how significant the errors of the approximate RT are, we compare results of the approximate RT with those of SKIRT, a state-of-the-art MC RT code, which is basically free from the approximation errors by fully incorporating all the multiple scattered intensities. In this study, we present quantitative errors in the approximate RT for late type galaxy models with various optical depths and inclination angles. We report that the approximate RT is not reliable if the central face-on optical depth is intermediate or high (τ_V > 3).

[구 IM-03] An Implementation of the Adaptive Ray Tracing Method in the Athena Code

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The incorporation of radiation from massive stars is essential for modeling the dynamics and chemistry of star-forming clouds, yet it is a computationally demanding task for three-dimensional problems. We describe the implementation and tests of radiative transfer module due to point sources on a three-dimensional Cartesian grid in the Eulerian MHD code Athena. To solve the integral form of the radiation transfer equation, we adopt a widely-used long characteristics method with spatially adaptive ray tracing in which rays are split when sampling of cells becomes coarse. We use a completely asynchronous communication pattern between processors to accelerate transport of rays through a computational domain, a major source of performance bottleneck. The results of strong and weak scaling tests show that our code performs well with a large number of processors. We apply our radiation hydrodynamics code to some test problems involving dynamical expansion of HII regions.

[구 IM-04] Estimation of Fuel Rate on the Galactic Disk from High Velocity Cloud (HVC) Infall

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Continuous accretion of metal-poor gas can explain the discrepancy between the number of observed G-dwarfs and the number predicted by the “simple model” of galactic evolution. The maximum accretion rate estimated based upon approaching high velocity clouds (HVCs) can be up to ~0.4 $M_\odot \cdot yr^{-1}$ which is comparable with the accretion rate required by many chemical evolution models that is at least ~0.45 $M_\odot \cdot yr^{-1}$. However, it is not clear to what extent the exchange of gas between the disk and the cloud can occur when an HVC collides with the galactic disk. Therefore, we examined a series of HVC-Disk collision simulations using the FLASH 2.5 hydrodynamics simulation code. The outcomes of our simulations show that an HVC will more likely take away substances from the galactic disk rather than adding new material to the disk. We define this as an HVC having a “negative fuel rate”. Further results in our study also indicate that the process and amount of fuel rate change can have various forms depending on the density, radius and velocity of an approaching HVC. The simulations in our study covers HVCs with a neutral hydrogen volume density from 1.0×10^{-2} cm^{-3} to 41.0 cm^{-3}, radius of 200 pc to 1000 pc and velocity in the range between 40 $km \cdot s^{-1}$ and 100 $km \cdot s^{-1}$.

[구 IM-05] Formation of star cluster clumps in the strong tidal field with initial fractal distribution

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산개 성단이 형성 되는 시기에 성단 내 별들이 가지는 공간 분포는 구대칭에서 상당히 멀 것으로 추정되며, 프랙