Excitation and Line Profiles of CO Molecules in Clumpy Interstellar Clouds: Radiative Interaction and Interclump Media

Y. S. Park[1,2], S. S. Hong[2], Y .C. Minh[1]
1 Korea Astronomy Observatory
2 Department of Astronomy, Seoul National University

With a three dimensional Monte Carlo code of rdlative transfer, we have investigated haw the clump and interclump media affect radiatively each other in exciting the CO molecules in clumpy interstellar clouds. A spherical volume of the cloud is devided into $\sim 4/3 \times 153$ cubic cells of equal size. Some of the cells filled with cold (T_{kin}=10K) and dense gas are considered to be the clumps; while the rest with hot(T_{kin}=40K) rarefied gas the interclump medium. The clump density $n_{clump}(H_2)$ = $(4\sim8) \times 10^{-4} cm^{-3}$ is kept an order of magnitude higher than the interclump density $n_{int}(H_2)=(2\sim4) \times 10^{-3} cm^{-3}$. For optically think ^{12}CO transitions, the excitation conditions in one medium are siginificantly affected by the presence of th other. As the volume filling factor of the clumps increase, the excitation temperatures in both media approach each other. This trend becomes more apparent for the ^{12}CO transitions of high J than for the ones of low J. An inclusion of the interclump gas with density as low as 2×10^{2} cm^{-3} makes the whole cloud optically so thick that the emerging ^{12}CO line emission is mostly from the cloud surface and exhibit flat top features or self-absorption dips. For optically thin transitions of ^{13}Co, on the other hand, the excitation conditions in the interclump medium are rather insensitive to the clump vloume filling factor. Calculations of line synthesis show that the bumpy structures of the ^{13}CO lines are originated mainly from the dense clumps. For the optically thin transitions the presence of interclump gas simply increases the line intensities, without changing their shapes. Taking MBM12 as an example of clumpy clouds we observed its core part with the 14m telescope of TRAO. Application of our model calculations to the resulting CO(J=1 0) spectra of hight S/N ratio and fine velocity resolution yields the physical conditions inside. In order for the clumpy cloud model to be compatible with the pbservations, either the CO molecules are depleted from the interclump gas or the interclump space is not completely filled with molecular gas.

Two-Dimensional Equilibria of a Magnetized Gas Disk in Point-Mass-Dominated Gracitational Fields

Kim, Jong Soo
Korea Astronomy Observatory
Hong, Seung Soo
Department of Astronomy, Seoul National University

Stratified initial states of a system composed of an isothermal gas disk, magnetic