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Molecular cloud formation induced by supernova explosions

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Knowledge on the formation of molecular clouds from interstellar atomic gas is indispensable to understand star formation within them. Thermal processes are one of significant factors forming molecular clouds and determining a physical state of formed clouds. Molecular clouds are thought to be formed by shock compression of the interstellar atomic medium and the subsequent thermal instability. Previous studies, simulating cloud formation via shock compression and the thermal instability, have revealed some properties on cloud formation such as turbulent structures of formed clouds and dependency of cloud formation on magnetic fields. However they do not reproduce the formation of the hydrogen molecule that is a main component of molecular clouds, and the carbon monoxide with whose line emission we can observe actual molecular clouds. Consideration of molecule formation enables us to identify molecular clouds in the way same as observation, and to take thermal processes peculiar to a molecular regime into a model.
Thus we aim to study molecule formation in the process of cloud formation via shock compression and the subsequent thermal instability using a 3-dimensional MHD simulation including thermal and chemical processes. In the part of MHD, we consider a fluid consisting of the hydrogen atom, proton, hydrogen molecule, helium atom, singly-charged helium ion, carbon atom, singly-charged carbon ion and carbon monoxide. For the 8 chemical species, chemical evolution is solved with macroscopic parameters of the density and temperature. As well as molecule formation, our model includes secondary influence of molecular cloud formation such as shielding of ultraviolet by dust and molecules, and self absorption of cooling line emission by a formed cloud. In this presentation, we will discuss results of the simulation.

Keywords: MHD