[IM07] Test of A Hydrodynamics Code for the Dusty Cloud Collapse

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Interstellar clouds composed of gas and dust are usually bounded by inter-cloud medium, which is much hotter and rarefied than the cloud medium. To simulate dynamics involved with such clouds the code should handle the dust and multi-species gas. To follow discontinuity in fluid properties between the cloud and inter-cloud media we adopted the arbitrary Langrangian-Eulerian description for coordinate frame, and employed HLLC scheme in calculating flux at each cell boundaries. The scheme handles the contact discontinuity nicely. We treat dusts of different size as pressureless fluids, and take into account the gas-dust drag. The resulting 1D hydrodynamics code, ALEHLLC_1D, undergoes various tests. To check performance in speed and accuracy we have solved the Sod's shock tube problem. We have also checked how long the code keeps equilibrium of Bonnor-Ebert sphere and self-gravitating, infinitely extended, gaseous disk, and maintains steady state of the solar wind phenomenon. The code is shown to describe the dust flow in a uniform dust-gas fluid as accurately as the analytical solution. As an astrophysical example, we have simulated collapse of gaseous cloud bounded by hot medium, and the results are compared with the density and velocity profiles determined empirically from observations of many molecular lines (Lee, et al. 2007).

[IM08] Metal Abundance and Dust Dynamics in Collapsing Cloud

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To trigger gravitational instability in the solar proto-planetary disk, the dust-to-gas ratio should be enhanced by more than an order of magnitude over its ISM value 10^{-2} (Sekiya 1999). If the dust enrichment occurs globally in a collapsing cloud, the stellar metal abundance could be at least 10^{-1}, which is unacceptable. Yet, the probability of finding planets around a star seems to increase with metal abundance of the star itself (Santos *et al.* 2003). The dust enrichment is thus necessary in PROPLYDs to form planets; question then is how much enrichment can be achieved by gravitational segregation of dust from gas. With ALEHLLC_1D we have simulated collapse dynamics of dusty clouds under various initial conditions. The degree of dust enhancement is followed as functions of time and radial distance. Enhancement of dust content is shown to develop preferably in outer region of cloud, with negligible enhancement done in the central part. But the final amount of enhancement turns out to be too low to trigger gravitational instability. To have sufficient enrichment, we need to consider accretion/coagulation growth of dust particles and also pressure due to impinging radiation from inter-cloud space.