EVOLUTION OF PRIMORDIAL PROTOSTELLAR CLOUDS

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The formation of stars in proto-galactic clouds can be viewed as two step processes i.e. the fragmentation of proto-galactic clouds and evolution of these fragments into stars. We consider here the latter process, the contraction of protosteller clouds ($\sim 1M_{\odot}$) which consist of primordial gas. We investigate cooling processes by calculating the radiative transfer of H_2 rotational/vibrational lines. We consider clouds in hydrostatic equilibrium as initial conditions. Comparing two timescales, the freefall time $t_{ff} = \sqrt{3\pi/32G\rho}$ and the timescale of quasi-static contraction $t_{qsc} = \rho/(\frac{\partial\rho}{\partial t})_{quasi-static}$ ($\sim t_{cool}$, the cooling time) of these clouds, we find that as the clouds contract, the ratio of two timescales t_{ff}/t_{qsc}, i.e. the efficiency of cooling, becomes larger even under the existence of cold and opaque envelope. Especially for the fragments of primordial filamentary clouds ($t_{ff} \sim t_{qsc}$ initially), they collapse dynamically in the freefall timescale. This efficiency of cooling is utterly peculiar to the line cooling.

References

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