“分子雲と原始銀河雲の分裂と降着過程の研究” 成果報告：
On the Elongation of Gravitationally Collapsing Sphere

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ABSTRACT
In order to help understand the fragmentation in collapsing cloud cores, we investigate elongation of a collapsing cloud core. Local linear analysis of elongation in the central region of a runaway collapsing cloud core with the effect of pressure without rotation is performed by means of spheroid model. It is found that the growth of elongation is affected by the ratio of pressure gradient force to the gravitational force in the centre during the collapse. A sphere with radial pressure gradient force smaller than 62% of radial gravitational force is unstable to change its shape toward a filament monotonically during the collapse. If this pressure/gravity ratios is constant as the self-similar flow, degree of elongation defined by $z/r-1$ can be written by ρ^n and n is derived analytically. For example, In the case of pressure-less collapse n is 0.354 and in the case with pressure gradient force 3/5 of gravity as the isothermal Larson-Penston type self-similar flow, n is found to be 1/6. Predictions given by spheroid model is compared with the results of three-dimensional hydrodynamical calculations. Growth rate of elongation tends to be universal in the high density limit. However the total growth factor of elongation depends on early non-self-similar evolution. Examples to show that the initial fraction of pressure gradient force to the gravitational force highly controls the growth factor of elongation is shown.

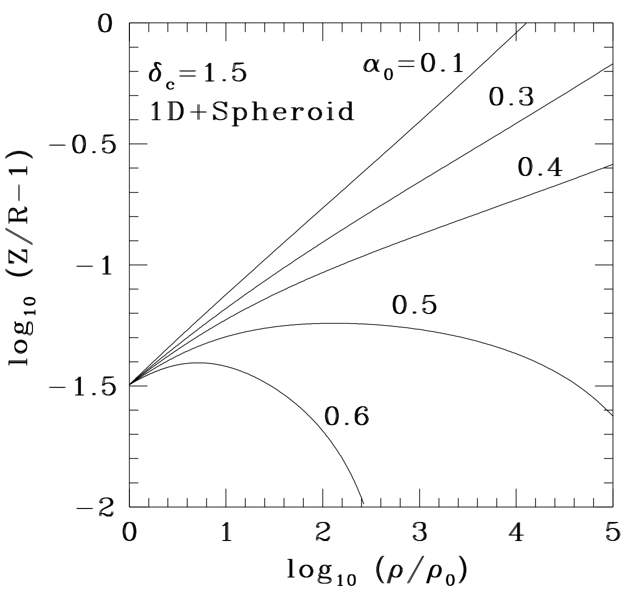

Figure 1. Evolution of elongation amplitude calculated by spheroid model for non-self-similar unperturbed flow. Isothermal equation of state is assumed. Results for $\alpha_0 = E_{th}/E_{gr} = 0.1, 0.3, 0.4, 0.5$ and 0.6 with $\delta_c = \rho_c/\bar{\rho} = 1.5$ are shown. α_0 is for unperturbed uniform sphere without density central concentration or elongation.

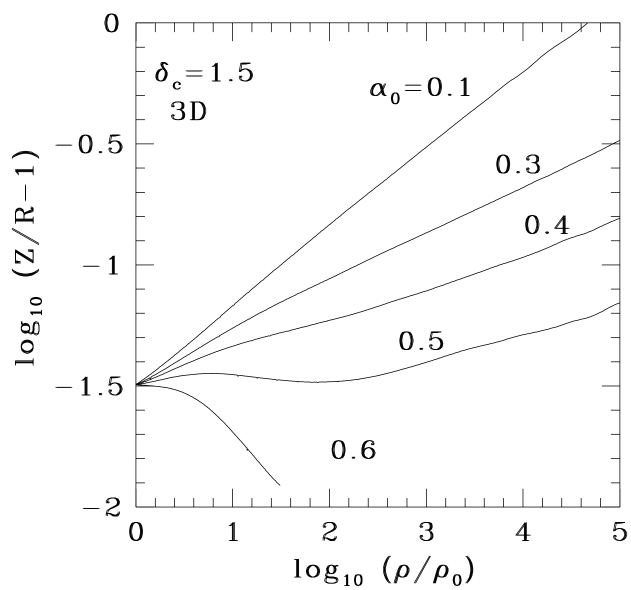

Figure 2. Evolution of elongation amplitude calculated by three-dimensional hydrodynamical calculation with $N = 10^6$ SPH particles. Axis ratio at the half of maximum density is used.