CHAIN-REACTING THERMAL INSTABILITY AND ITS IMPLICATION ON STAR-FORMATION IN INTERSTELLAR CO CLOUDS

Y. Sabano* and Y. Sofue**
* Astronomical Institute, Tôhoku University, Sendai, Japan
**Department of Astrophysics, Nagoya University, Nagoya, Japan

A new type of non-linear, chain reacting instability is presented that a sequential condensation occurs in a thermally unstable interstellar CO cloud, triggered by a local density perturbation. Non-linear growth of the instability was followed numerically with a one-dimensional and slab symmetric hydrodynamical code. The result shows that a local, small density enhancement onto initial density of n_0=510 cm^{-3} around x=0 (x: spatial coordinate) grows to a maximum density of n_{max}=1300 cm^{-3} in a time scale of 0.6×10^6y, and at the same time the gas in neighbouring region at x=0.1-0.2 pc shifts into a low-density phase of n_{min}=200 cm^{-3}. Since we assume a constant heating per particle by photons and cosmic rays, the gas in low density region is relatively more heated so that the pressure therein becomes higher than the background pressure. Then the low density gas pushes its neighbouring gas foward increasing x to lead to a second density enhancement at x=0.2 pc. In this way many further condensations are produced in a sequential manner. The spacings and sizes of condensations are uniquely determined by the characteristic parameters, the growth time of instability and the sound velocity of the background gas alone. The present calculation gives the spacing, 0.24 pc, and the mass of each fragment, $0.2M_\odot$. This mechanism could be related to sequential formation of less-massive stars in interstellar CO clouds, if the condensations evolve further into star formation sites.

DISCUSSION

<u>Mouschovias</u>: Your graphs showed a pressure of a few $\times10^3$ $K\cdot cm^{-3}$ at the instability region and a density of $\sim10^3$ cm^{-3}. This implies a temperature of T~5 K. Isn't this too cool for a molecular cloud and, if such a phase exists, shouldn't it be observable in absorption?

<u>Sabano</u>: The temperature in CO molecular clouds is observed as 20 K $\gtrsim$ T $\gtrsim$ 7 K, which may correspond to the condensations in our computation. The absorption of the CO line is indeed detected in the direction of the galactic nucleus and implies T $\lesssim$ 10 K. So the temperature of our condensations is not so unusual, although our simplified analysis might overestimate the cooling efficiency by CO molecules.

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