ROLE OF GRAINS IN THE DRIFT OF PLASMA AND MAGNETIC FIELD IN DENSE INTERSTELLAR CLOUDS

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The magnetic flux through an interstellar cloud or through a part of the cloud must decrease considerably by the drift of plasma and magnetic field in order that stars form in the cloud. Because most grains are negatively charged in dense clouds (Elmegreen 1979; Umebayashi and Nakano 1980), they retard magnetic flux leakage in addition to ions (Elmegreen 1979). We investigate this effect for different situations and obtain the following results (for details, see Nakano and Umebayashi 1980):

1. For nearly spherical clouds of mass $\gtrsim 10^3 M_\odot$ sustained by magnetic force the friction of grains is efficient at $n_H \gtrsim 10^5 \mathrm{cm}^{-3}$, and the magnetic flux leakage time t_B is greater than a few million years at any density. Grains drift as fast as ions and electrons.
2. For spherical clouds of smaller mass and disk-shaped clouds, t_B becomes much smaller and the drift of grains is much slower than ions and electrons at $n_H \gtrsim 10^6 \mathrm{cm}^{-3}$.
3. Thus magnetic flux leakage occurs mainly in the condensations described in 2, and the abundance of heavy elements in stars deviates little from that of the parent clouds because of small grain drift.

REFERENCES

Elmegreen, B.G. 1979, Astrophys. J., 232, 729.
Nakano, T. and Umebayashi, T. 1980, submitted to Publ. Astron. Soc. Japan.
Umebayashi, T. and Nakano, T. 1980, Publ. Astron. Soc. Japan, 32, No.3.

DISCUSSION

Unno: How do you estimate the charge of a grain?
Umebayashi: In a dense cloud shielded from the interstellar ultraviolet radiation, the photoelectric effect is not efficient at all. Then the charge state of a grain is determined by the collision of ions and electrons with the grain surface. We have calculated the sticking probability, and have found that it is between 0.3 and 1.0 and almost 1.0 for electrons and ions, respectively. Using these values, we have estimated the charge state of a grain in a steady state condition.

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