Magnetic Alignment of Major Rock-forming Minerals and Detection of Magnetic Field in Circum-Stellar and Planetary Formation Region

CHIAKI UYEDA, KEIJI HISAYOSHI and SHUN KANOU
Institute of Earth and Space Sci. Graduate School of Sci. Osaka Univ.

Magnetic alignment of a mineral grain is believed to occur only when it bears spontaneous magnetic moment. During the last two decades, alignment was newly observed at low field intensity for many of the rock forming mineral which doesn't include spin networks [1]. Anisotropy of diamagnetic or paramagnetic susceptibility was the origin of these alignments [2]. New type of magnetic effect on ordinary natural material may be proposed in various cosmic and terrestrial conditions based on alignment experiments preformed in laboratory. For example, mechanizm of dust alignment in planet formation region can be discussed from experiment on grain alignment below T=100K performed for micron-sized crystal of forsterite and enstatite; these minerals are identified as major dust components in the above-mentioned region. Magnetic field is a major factor that control evolution of stars and planets; field directions are usually estimated from polarimetry data caused by dust alignment. Mechanism of dust alignment is not clear as yet in the dense region. hence the above-mentioned experiment serve as a basis to estimate field structure from polarization data in planetary formation region [3]. Dust alignment is also applicable in estimating field direction of star envelopes having temperature above 1000 K; conventional spontaneous moment is usually lost at this temperature. Alignment of solid body is measured for the first time above 1000K for SiC, forsterite and graphite, which are components of pre-solar grains produced in envelopes of Red Giant stars. Partial alignment is expected for the minerals at field-intensity that is theoretically predicted for an envelop;B~0.2T. Field intensity of ordinary stars can be determined for the first time from this study.
Keywords: Dust Alignment, Magnetic Anisotropy, Circum-Stellar Magnetic Field, Rock-forming Minerals. Planetary Formation Region. Red Giant Envelops

References

[1] C.Uyeda et al: Phys. Chem. Minerals, 20 369,(1993).
[2] C.Uyeda et al: Appl. Phys. Lett., 28, 094103, 2005.
[3] C.Uyeda et al: Astron. Astrophys. 400. 805 (2003).