
ABSTRACTS (MASTER THESIS)

**Study on orbital evolution of small space debris
in consideration of the Lorentz force**

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The effects of the Lorentz force on micron-sized space debris has been studied. Their motion can be affected by the Lorentz force because space debris are charged by an interaction with the ambient plasma. In addition, the electromagnetic influence becomes remarkable for smaller debris. Thus, in this study, an orbital model considering the Lorentz force has been developed. Performing the orbital calculation with the model, two significant results have been obtained. The Lorentz force merely rotates orbital planes of debris and strongly shorten time required particular debris to re-enter the atmosphere.

First, the Lorentz force simply rotates orbital planes of small space debris. The Lorentz force causes a monotonically decrease of the right ascension of the ascending node and thus their orbital plane rotates against the Earth's rotation axis. On the contrary, the Lorentz force does not cause the meaningful secular changes in the orbital inclination, even though both the deviation of the actual geomagnetic field from dipole magnetic field and the charge variation during their orbital motion are taken into consideration. As a result, it can be thought that the orbital distribution doesn't change because all orbital planes of debris merely rotate due to the Lorentz force.

Secondly, the Lorentz force generates sparse regions of micron-sized debris because the Lorentz force strongly shortens their lifetime in a particular orbit. Simulation results show that the Lorentz force generally decrease the lifetime of debris and the effect becomes greater for debris in orbits with an orbital inclination of approximately 60 or 120 degrees. This means that it is difficult for micron-sized debris to survive in regions with the declination of around ± 60 degrees. As a result, debris' flux density is thought to be relatively smaller in the area. Therefore, it can be thought that the Lorentz force is likely to change the orbital distribution in the perspective of the lifetime variation.