# Charging of positively charged dust particle in weak magnetic field[*]

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Absorption cross-section of a spherical dust particle with positive charge by an electron/ion is studied in weak uniform magnetic field. The absorption cross-section in the absence of magnetic field was expressed by the OML (Orbit Motion Limited) theory [1, 2]. The OML theory, where energy and angular momentum of a charged particle are conserved in an infinite Debye length limit, has been widely applied to charging of a dust particle in space plasmas as well as laboratory plasmas. In this study an orbit of a charged particle (an ion or an electron) heading to a charged dust particle at rest along the magnetic field is analyzed analytically and numerically. Because of the Lorentz force in the presence of magnetic force, the charged particle with the same sign as the dust charge approaches closer to the dust than the orbit without magnetic field, indicating larger absorption cross section. On the other hand the charged particle with the opposite sign of dust charge leaves further the dust, indicating the absorption cross section smaller than that in the absence of magnetic field. The dust particle immersed in relatively low temperature plasma is charged negatively because of large mobility of electrons. On the other hand, in the case of the hotter plasma than few hundreds eV, the dust particle is charged positively due to the strong thermionic emission [3]. In the previous research the charging of the negatively charged dust particle in the weak magnetic field was analyzed [4], where we clarified 1) the magnetic field effectively affects the orbit of an electron compared to an ion, 2) the charge state of the floating dust particle with a radius of 1 mm increases from $6.63 \times 10^5$ to $6.86 \times 10^5$ for the 1 eV ions and electrons in the magnetic field of 10 G and for the higher energy of plasmas with 10 eV, dust charge is found to increase from $6.63 \times 10^6$ to $6.70 \times 10^6$ due to the effects of magnetic field. In this study the charging of the positively charged dust particle by an electron is analyzed, where the effect of the weal magnetic field to the absorption cross-section is approximated as a linear dependence. The constant of proportion is calculated numerically. As a result, the decrease of the absorption cross-section is obtained. For example, the absorption cross-section of the dust particle with 1 mm radius, the charge state of $10^5$ in the magnetic field of 10 G by an electron with the energy of 1 eV decreases from 3.59 mm$^2$ to 3.47 mm$^2$.

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