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Simulating the charging of a particle on a surface in a plasma

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It is common knowledge that a floating surface will charge negative when a plasma is applied over it. One can imagine that any macroscopic dust particle on the surface will also get charged. The theory that describes this charging is, however, underdeveloped. It has been suggested that the particle will share its charge with the surface, leading to roughly the same surface charge density. This is, however, only valid when both the surface and the particle are electrically conductive. In this contribution, we show a novel model to simulate the charge on a non-conducting particle on a surface in a plasma. It is based on balancing the ion and electron fluxes through the plasma sheath towards the particle. With this, we show that the charge on a particle on a surface can be five orders of magnitude higher than what was previously assumed. Knowledge of the charge on a particle on a surface is important, because it, combined with the plasma sheath electric field, will lead to an electric force on the particle. It has been proposed that this force is important in the lofting of dust from the surface of extra-terrestrial bodies. Additionally, it has been suggested, that it can be used for cleaning in high-tech applications, such as lithography machines and spacecrafts.

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