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Nanoparticle charging in weakly ionized gases[1] MARCO FRANCESCO GATTI, UWE KORTSHAGEN, University of Minnesota — Charging dominates the behavior of nanoparticles immersed in weakly ionized gases. The nanoparticle charge is virtually always modeled through the Orbital Motion Limited (OML) theory, even though serious doubts exist about its validity. The approach adopted in this study allows one to overcome most of the simplifying assumptions of the OML theory, providing insight into the behavior of nanoparticles in real laboratory plasmas. The method adopted is a self-consistent molecular dynamic-Monte Carlo simulation in which the ion motion is tracked, and the collisions between ions and background gas are treated statistically, while electrons are modeled through an analytical expression. This method allows for the investigation of the effects of ion-neutral collisions (elastic scattering and charge exchange) and of high particle density. Simulations are performed over a wide range of particle concentration, gas pressure, particle size, and electron temperature. The results show a strong dependence of the nanoparticle charge on the particle density, and a non monotonic dependence on gas pressure. Furthermore, the role of particle size and electron to ion temperature ratio is highlighted. An analytical model capable of predicting the dependence of the nanoparticle charge upon all the aforementioned parameters is derived.

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Uwe Kortshagen
University of Minnesota

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