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# Interactions of two dust grains in plasmas with and without photoemission studied by numerical simulations

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The interactions between two elongated dust grains in a supersonic plasma flow are studied by a particle-in-cell numerical method. If only plasma currents are considered, dust grains are usually negatively charged. Studies of interactions between two charged dust grains are important for the understanding of structures and dynamics of systems comprising many such grains [1]. For the case of two small spherical grains, the dust alignment in the direction of the flow has been predicted and observed [2,3]. Theoretical descriptions of non-spherical grains are difficult, and numerical simulations have to be used to address this nonlinear problem in a self-consistent way.

We study interactions between two spherical or alternatively two elongated grains in flowing plasmas for different alignments with respect to the flows and different relative positions. Both conducting and insulating spherical grains are considered, while elongated grains are insulating. We find that the spatial variations of the charge distribution and the plasma potential strongly depend on the orientation of the dust grains. For the case of two grains aligned with the ion flow, a single wake and a region of enhanced ion density can be observed between the grains, provided that the distance between grains is small [4]. For a dust grain placed behind another similar grain, the resulting wake is not a linear superposition of the two individual wakes. The characteristic features, such as ion focusing, can be destroyed. For such grains, the charge and interaction potential strongly depend on their orientations.

Since radiation contribution to the charging of objects in space is significant, we also analyze the interactions in the presence of photoemission. Photoemission can lead to a positive charge on the dust and polarization of the plasma, thus allowing for strong interactions between several grains [5]. This problem is studied in comparison with the case without photoemission. Our numerical simulations are carried out the in two spatial dimensions, treating ions and electrons as individual particles.

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