# COMPARISON OF PARTICLE TRANSPORT IN RF AND DC GLOW DISCHARGE COMPLEX PLASMAS

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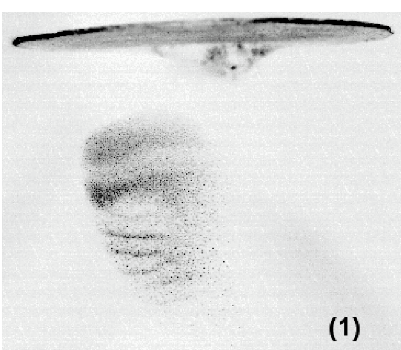
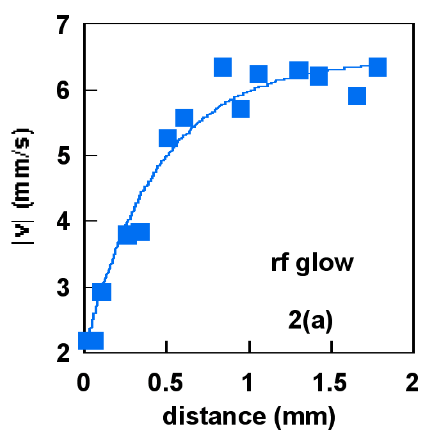
Complex or dusty plasma research involves the study of the interactions between charged microparticles and plasma in which the microparticles are suspended. Over the past fifteen years, the investigation of these plasma systems has evolved from early studies of dust in the astrophysical environment [1] and the characterization of contaminants in industrial processing plasmas, to a significant experimental and theoretical scientific research enterprise that currently involves several dozen laboratories around the world.

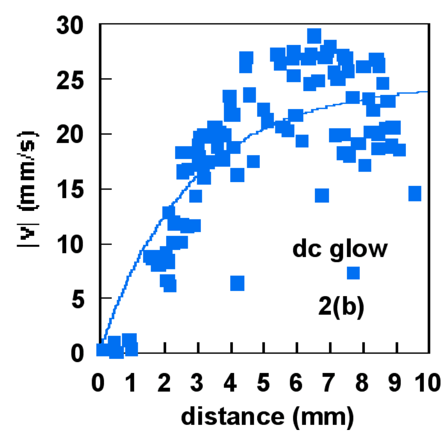
Much of this effort has focused on strongly coupled phenomena, e.g, the plasma crystal state [2], or on collective modes, e.g., the dust acoustic waves [3] in these systems. Recently, through the use of new optical diagnostic techniques, e.g., particle image velocimetry (PIV) [4] and laser flashing, it is now possible to perform detailed measurements of two dimensional particle transport in complex plasmas.

For the first time, a comparison between recent measurements of microparticle transport in both rf-generated and dc-generated glow discharge plasmas is made. In the vast majority of laboratory complex plasma experiments, microparticle clouds are formed in the plasma that have very sharp boundaries. An example of such a cloud is shown below in Fig. 1. Here, a cloud of 2.9 micron diameter silica microparticles are suspended in an argon dc glow discharge plasma.

The focus of these studies has been to characterize the microparticle cloud – plasma boundary. This is accomplished by measuring the trajectories of microparticles approaching the could – plasma interface. From the motion of the particles near the interface, it is possible to measure the effect of the microparticle cloud on the potential structure of the plasma [5]. Figs. 2(a) and (b) show a measurement of the spatial evolution of the microparticle velocity near the cloud – plasma interface. In Fig. 2(a), the measurement is performed in a rf glow discharge argon plasma using 2.6 micron diameter melamine-formaldehyde microspheres. In Fig. 2(b), the measurement is performed in a dc glow discharge argon plasma using 2.9 micron diameter silica microparticles. In both cases, there is a rapid deceleration of the particles as they approach the cloud boundary – suggesting the formation of a sheath-like structure at the boundary.




[1] C. K. Goertz, Rev. Geophys. **27**, 271 (1989).
[2] H. Thomas and G. E. Morfill, Nature, **379**, 29 (1996).
[3] A. Barkan, R. L. Merlino, and N. D'Angelo, Phys. Plasmas, **2,** 3563 (1995).
[4] E. Thomas, Jr., Phys. Plasmas, **6**, 2672 (1999).
[5] E. Thomas, Jr., Phys. Plasmas, **9**, 17 (2002).