**Adaptive Grid PIC Capability for Dusty Plasma Studies**

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We have developed an innovative Particle-in-Cell (PIC) code for dusty plasma studies. The main novelty is that our code couples a grid generation/adaptation strategy to the standard PIC algorithm. This is beneficial for two reasons. First, without an adaptive grid, standard PIC codes model dust grain surfaces using a stair-stepping technique, which highly distorts the shapes of small (relative to the plasma Debye length) grains. This can become quite problematic in simulations of small grains, as is often the case in space and astrophysical applications, or when calculating forces on the grains surface. Our grid generation strategy conforms to objects of arbitrary shape and solves this problem. Second, we will be able to adapt our computational mesh in time as required by the physics of the simulation. These two features allow us to not only simulate more complicated physical structures much more accurately.

Our initial computational grid is generated using Winslow's method (*A. Winslow, J. Comp. Phys., vol. 1, p.149, 1967 and A. Winslow, UCID-19062, LLNL, 1981*), in which grains of arbitrary shape and size are modeled exactly as boundaries of the system. This gridding technique allows us to initially concentrate the finest meshing within the Debye sphere surrounding the grains, leaving coarser meshes where the accuracy and particle statistics are less important. The time-dependent grid adaptation will be handled by the Monge-Kantorovich optimization method of Delzanno and collaborators (*Journal Comp. Phys., in press*), allowing us to further concentrate our mesh on areas of interest.

The new code is validated using the OML charging theory for spherical and cylindrical dust grains. Further tests include the charging of an electron emitting dust grain in a uniform plasma, with the goal of studying the forces between two emitting grains of like charge. Furthermore, we plan to use this tool to more realistically study the interaction of satellites and space-crafts in the magnetospheric plasma.