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Probing Dusty Plasma Simulation Structure Parameter Space
DUSTIN SANFORD, KYLE DAVIS, KHANDAKER SHARMIN ASHRAFI, SINA ROSTAMI, ETHAN DICKEY, LORIN MATTHEWS, TRUELL HYDE, Baylor University — A complex (dusty) plasma consists of ions, electrons, and micron-sized solid particles, commonly referred to as dust. The complex plasma research space includes research in astrophysics, planetary science, atmospheric physics, fusion research, materials physics, and advanced manufacturing. Traditional simulation design patterns are unable to cope with this large problem space. Switching between physical systems or numerical models normally requires significant program modifications. Here we present DRIAD (DRIAD Runs Ions And Dust), a highly generic physics simulation generation framework implemented as a domain specific embedded language written in C++. DRIAD allows for rapid simulation development and extensive code reuse between disparate physical environments and numerical algorithms. Examples include simulations modeling aggregate dust grain charging in protoplanetary disks, effects of microsecond DC discharge inhomogeneities on millisecond time-scale dust dynamics, electrostatically-confined equilibrium dust structures in lab experiments, and dust self-organization in the PK-4 experiment on-board the international space station.

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