1125-35-3165 **Nathaniel Trask*** (natrask@sandia.gov), Sandia National Laboratory. *Compatible meshfree discretization with applications to electrophoretic suspension flows.*

Meshless methods promise an effective means of discretizing Lagrangian hydrodynamics and interfacial flows by avoiding the computational expense of maintaining high quality deforming meshes at each timestep. By abandoning a mesh however, we lose the exterior calculus framework that forms the foundation for mesh-based compatible discretizations. In this work, we present a new discretization generalizing classical staggered discretization on primal/dual meshes to an epsilon-ball graph constructed from particle locations. This meshless discretization enjoys high-order convergence and stability properties typical of compatible mesh-based methods. For the div-grad model problem, equal order L2 and H1 convergence is obtained for smooth diffusivities, while nearly-monotone fluxes are maintained for the discontinuous case. For the steady Stokes problem, equal-order convergence is obtained for both pressure and velocity. For both of these problems, a sparse discretization is obtained that can be efficiently preconditioned using standard AMG techniques. We present fundamental approximation properties of these schemes along with results that use this approach as a foundation to develop monolithic solvers to study problems in dense suspension flows driven by electrokinetic effects. (Received October 03, 2016)