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Multilevel Solvers for High Resolution Electric Field Calculations

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High fidelity electric field calculations are a critical component in plasma simulations. In this this talk we consider the problem of a dielectric barrier discharge (DBD) wherein the electric field is calculated to support a compressible flow, thus requiring a highly efficient global solve. The electric field is constructed on a logically structured but mapped mesh which yields anisotropy in the operator, along with jumps in the permittivity. Another challenge arises in the modeling of a dielectric barrier discharge, where dielectrics result in localized Dirichlet blocks within the domain. In a multilevel solver, these interior blocks are not resolved on coarse grids, leading to a deterioration in convergence with a strong dependence on the alignment and size relative to the coarse levels. We investigate the dependence of various multilevel solvers in this context and in a parallel setting. In particular, we detail the convergence of multilevel methods for high resolution electric field calculations in the presence of warped meshes with jumping coefficients.