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Composite Grid Multigrid for Diffusion on the Sphere

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While discretization and solvers for scalar elliptic PDEs over regions in the plane or volumes in space are generally well-understood, many open questions remain when considering PDEs posed on surfaces. In this talk, we present an adaptive mesh refinement scheme for a finite-element discretization of diffusion on the sphere, motivated by numerical models of the transport of charged particles near the Fokker-Planck limit. In such problems, the right-hand side is typically highly localized and, thus, nonuniform meshes are needed to efficiently resolve the solutions. We approximate the sphere by a piecewise-triangular surface, with refinement focused around the regions where the source function is nonzero. A Fast Adaptive Composite grid (FAC) multigrid method is used to efficiently solve the resulting linear systems.