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# A TWO-LEVEL DISCRETIZATION METHOD FOR THE STATIONARY MHD EQUATIONS*

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**Abstract.** We describe and analyze a two-level finite-element method for discretizing the equations of stationary, viscous, incompressible magnetohydrodynamics (or MHD). These equations, which model the flow of electrically conducting fluids in the presence of electromagnetic fields, arise in plasma physics and liquid-metal technology as well as in geophysics and astronomy. We treat the equations under physically realistic ("nonideal") boundary conditions that account for the electromagnetic interaction of the fluid with the surrounding media.

The suggested algorithm involves solving a small, nonlinear problem on a coarse mesh and then one large, linear problem on a fine mesh. We prove well-posedness of the algorithm and optimal error estimates under a small-data assumption.

**Key words.** magnetohydrodynamics, Navier-Stokes equations, Maxwell's equations, variational methods, finite elements.

**AMS subject classifications.** 76W05, 65N30, 35Q30, 35Q35, 35Q60, 35A15, 65N12, 65N15.

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