# ANALYSIS OF A NEW MIXED-FEM FOR STATIONARY INCOMPRESSIBLE MAGNETO-HYDRODYNAMICS

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## ABSTRACT

In this talk we present a new mixed finite element method for a stationary magneto-hydrodynamic (MHD) model. The method is based on the utilization of a new dual-mixed formulation recently introduced for the Navier-Stokes problem, which is coupled with a classical primal formulation for the Maxwell equations. The latter implies that the velocity and a pseudostress tensor relating the velocity gradient with the convective term for the hydrodynamic equations, together with the magnetic field and a Lagrange multiplier related with the divergence-free property of the magnetic field, become the main unknowns of the system. Then the associated Galerkin scheme can be defined by employing Raviart–Thomas elements of degree $k$ for the aforementioned pseudostress tensor, discontinuous piecewise polynomial elements of degree $k$ for the velocity, Nédélec elements of degree $k$ for the magnetic field and Lagrange elements of degree $k$ for the associated Lagrange multiplier. The analysis of the continuous and discrete problems are carried out by means of the Lax–Milgram lemma, the Banach–Nečas–Babuška and Banach fixed-point theorems, under a sufficiently small data assumption. In particular, the analysis of the discrete scheme requires a quasi-uniformity assumption on mesh. We also develop an a priori error analysis and show that the proposed finite element method is optimal convergent. Finally, some numerical results illustrating the good performance of the method are provided.

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