Global magnetohydrodynamic stability with COOL finite elements

W. ANTHONY COOPER, RALF GRUBER, Ecole Polytechnique Federale de Lausanne CRPP, Association Euratom-Confederation Suisse, Lausanne, Switzerland — The COOL finite element scheme relies on the construction of basis functions using variable order Legendre polynomials [1]. We have implemented this approach in the global linear ideal magnetohydrodynamic code TERPSICHERE [2]. The standard version of this code uses a hybrid method that combines piecewise constant and piecewise linear basis elements. The COOL method with Legendre polynomial order $p = 1$ exactly recovers the original formulation. So far, we find that the optimal polynomial order lies around $p = 3$ to 4 (cubic to quartic). At higher order, numerical problems develop in the regions within half-interval mesh points of the magnetic axis and the edge of the plasma because extrapolation of poorly resolved equilibrium quantities at the Gauss-points of the Legendre polynomial can drive very local fictitious near-axis and/or edge mode structures.


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