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BECOOL: a magnetohydrodynamic ballooning mode eigenvalue solver based on variable order Legendre polynomial basis functions GUY A. COOPER, RANDOLPH S. PETERSON, University of the South, Sewanee, TN 37383, RALF GRUBER, W. ANTHONY COOPER, JONATHAN P. GRAVES, Ecole Polytechnique Federale de Lausanne CRPP, Association Euratom-Suisse, Lausanne, Switzerland — An incompressible variational ideal ballooning mode equation is discretized with the COOL finite element discretization scheme using basis functions composed of variable order Legendre polynomials.[1] This reduces the second order ordinary differential equation to a special block pentadiagonal matrix equation that is solved using an inverse vector iteration method. A benchmark test of BECOOL (Ballooning Eigensolver using COOL finite elements) with second order Legendre polynomials recovers precisely the eigenvalues computed by the VVBAL shooting code.[2] Timing runs reveal the need to determine an optimal lower order case. Eigenvalue convergence runs show that cubic Legendre polynomials construct the optimal ballooning mode equation for intensive computations.

[1]G. A. Cooper, J. P. Graves, W. A. Cooper, R. Gruber and R. S. Peterson, J. Comput. Phys. **228** (2009) 4911-4916.
[2]A. Cooper, Plasma Phys. Control. Fusion **34** (1992) 1011-1036.

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