
Ravi Samtaney
**An all-speed projection method for
magneto-hydrodynamics**

Bldg 2
Rm 4337
KAUST
Thuwal 23955-6900
Kingdom of Saudi Arabia
`Ravi.Samtaney@kaust.edu.sa`
Mark Adams
Phillip Colella
Daniel T. Graves
Terry J. Ligoeki
Brian van Straalen

We present an all-speed algorithm for magneto-hydrodynamics (MHD) similar to the work of Colella Pao (J. Comput. Phys. 1999) for low-speed hydrodynamics. The method is based on an asymptotic ordering of scales relevant for tokamak MHD physics. The central idea is to Hodge decompose the velocity, and split the magnetic guide field in a manner analogous to the pressure splitting into a thermodynamic and incompressible parts for hydrodynamics. We present the derivation of the ideal MHD equations into slow (advective), intermediate and fast scales. The algorithm treats the slow advective scales using a Godunov-procedure while the intermediate and fast scales are treated implicitly using backward Euler. Results from numerical tests will be presented as well the challenges of designing solvers for the intermediate scales.