DPP05-2005-020008

Abstract for an Invited Paper
for the DPP05 Meeting of
the American Physical Society

**Computational modeling of fully-ionized, magnetized plasmas using the fluid approximation**[1]

DALTON SCHNACK, Science Applications International Corp.

Strongly magnetized plasmas are rich in spatial and temporal scales, making a computational approach useful for studying these systems. The most accurate model of a magnetized plasma is based on a kinetic equation that describes the evolution of the distribution function for each species in six-dimensional phase space. However, the high dimensionality renders this approach impractical for computations for long time scales in relevant geometry. Fluid models, derived by taking velocity moments of the kinetic equation [1] and truncating (closing) the hierarchy at some level, are an approximation to the kinetic model. The reduced dimensionality allows a wider range of spatial and/or temporal scales to be explored. Several approximations have been used [2-5]. Successful computational modeling requires understanding the ordering and closure approximations, the fundamental waves supported by the equations, and the numerical properties of the discretization scheme. We review and discuss several ordering schemes, their normal modes, and several algorithms that can be applied to obtain a numerical solution. The implementation of kinetic parallel closures is also discussed [6].

[1] S. Chapman and T.G. Cowling, "The Mathematical Theory of Non-Uniform Gases", Cambridge University Press, Cambridge, UK (1939).
[2] R.D. Hazeltine and J.D. Meiss, "Plasma Confinement", Addison-Wesley Publishing Company, Redwood City, CA (1992).
[3] L.E. Sugiyama and W. Park, Physics of Plasmas 7, 4644 (2000).
[4] J.J. Ramos, Physics of Plasmas, 10, 3601 (2003).
[5] P.J. Catto and A.N. Simakov, Physics of Plasmas, 11, 90 (2004).
[6] E.D. Held et al., Phys. Plasmas 11, 2419 (2004)

[1]Work supported by UDSOE as part of the SciDAC Center for Extended Magnetohydrodynamic Modeling