THE UNIVERSITY OF CHICAGO

COMPUTATIONAL AND APPLIED MATHEMATICS COLLOQUIUM

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Structure and Computation of Magnetofluid and Other Matter Models

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Eckhart 202, 5734 S. University Avenue

ABSTRACT

Physical models that describe the dynamics of matter, whether they be discrete, like those for interacting particles or dust, or continuum models, like those for fluids and plasmas, possess structure. Structure may manifest by sets of conservation laws resulting from Galilean or Poincare invariance, or by the property of entropy production giving relaxation to thermal equilibrium. Ultimately, structure arises from an underlying Hamiltonian form that may or may not be maintained in approximations and/or reductions of various kinds.

I will survey the Hamiltonian structure possessed by a variety of models, with an emphasis on a general magnetofluid model and Vlasov-Maxwell theory. In addition I will discuss structure preservation in numerical implementation. Although symplectic integration has been well studied and widely used for finite-dimensional systems, the preservation of the structure that occurs in continuum models such as extended magnetohydrodynamics with generalized helicities, is considerably more difficult to implement. Progress in developing a discrete version of the Maxwell-Vlasov system that preserves its Hamiltonian structure, and its numerical implementation will be discussed.

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