CIDMA CENTRO DE I&D EM MATEMÁTICA E APLICAÇÕES
CENTER FOR R&D IN MATHEMATICS AND APPLICATIONS

universidade de aveiro

Gravitational Geometry and Dynamics Group Seminar

Wed., January 14, 2026, at 11h00.

Room: Sala 11.2.21 and **Teams ID:** 375 407 298 429 3

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Part 1: kobra: A Vlasov Code with AMR

Plasma behavior in fusion devices is typically modeled using magnetohydrodynamics (MHD). However, in regions near the plasma–wall interface, particle interactions can be effectively collisionless, violating a fundamental assumption of MHD: the existence of a Maxwellian velocity distribution. To adequately model these regions, one must therefore employ a kinetic approach. We introduce kobra, a grid-based, finite-volume, 3D-3V Vlasov solver equipped with an AMR scheme. The accuracy of kobra is validated by reproducing the analytic growth rate of the two-stream instability. We then apply the code to the modeling of the edge plasma transition layer by implementing a floating-potential boundary condition and successfully reproducing the formation of an electrostatic plasma sheath.

Part 2: Hyperbolicity of the DGREM system

Both the Einstein and Maxwell equations admit formulations as hyperbolic evolution systems supplemented by elliptic constraints that must be preserved in time. The DGREM formulation of 3+1 gravity, based on the evolution of tetrad bases, exhibits a close analogy with Maxwell's equations in material media that could be used in principle to recycle many of the techniques developed over decades for numerical electrodynamics. However, no formal proof of symmetric hyperbolicity for the DGREM system is currently available. In this work, we exploit the similarities between the DGREM system and electrodynamics to investigate its hyperbolicity properties using the approximately-plane waves formalism developed by Perlick (2011) for covariant electrodynamics with local constitutive laws.

More about Gr@v at: gravitation.web.ua.pt

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