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The Gkeyll framework for fluid, gyrokinetic and full kinetic simulation of plasmas: current capabilities and recent results[1] MANAURE FRANCISQUEZ, MIT, AMMAR HAKIM, GREGORY W. HAMMETT, LIANG WANG, RUPAK MUKHERJEE, PPPL, NOAH R. MANDELL, Princeton, JAMES JUNO, UMD, PETR CAGAS, VT, TESS N. BERNARD, GA — Comprehensive study, understanding and forecast of plasmas using direct numerical simulation requires an examination of scales vastly separated in space and time. Their analysis is facilitated by using models with varying levels of complexity. The Gkeyll framework aims to simulate plasmas at all scales with fluid, gyrokinetic and full kinetic models under the same infrastructure and interface. Gkeyll offers a multi-fluid moment model with a local collisionless closure and support for magnetosphere geometries, a gyrokinetic model for open-field line sheath-limited calculations, and a full kinetic Vlasov solver. Excluding the multi-fluid model, Gkeyll leverages and extends state-of-the art high-order discontinuous Galerkin methods to produce conservative and efficient algorithms. Gkeyll has been used for several physics investigations, like simulating Mercury's magnetosphere, analyzing electromagnetic effects in an NSTX-like scrape-off layer, and exploring magnetic field generation in 6D kinetic dynamos. We provide a description of Gkeyll and its capabilities, review recent physics results, and report on recent activities which include adding support for new geometries, neutral interactions, Vlasov-Poisson simulations, collisions with the Fokker-Planck operator, and using GPUs.

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Manaure Francisquez
Massachusetts Institute of Technology MIT

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