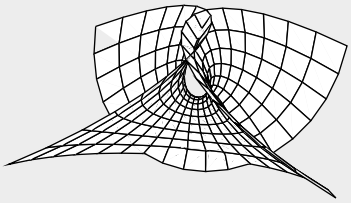

Oberseminar Mathematische Strömungsmechanik

Institut für Mathematik der Julius-Maximilians-Universität Würzburg

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University of Bochum, Germany

A Split-Step Active Flux Method for Vlasov Systems

Abstract: Active Flux (AF) is a modified finite-volume method that evolves additional degrees of freedom (DoF) located on cell interfaces to compute high-order approximations to the numerical fluxes through each interface. In this talk, we propose second- and third-order versions of a scheme that combines AF with operator splitting for the solution of the Vlasov equation within the Vlasov - Maxwell system and its electrostatic limit, the Vlasov - Poisson system. The resulting one-dimensional advection equations can be solved efficiently and with low implementation complexity. The scheme is designed for scalability, addressing the major challenge posed by the high dimensionality of the equation. We compare the performance of our solver to a related finite-volume method based on a semi-Lagrangian approach. We find that, owing to its compact stencil, the AF-based scheme exhibits lower dissipation artifacts and can reduce simulation time at comparable accuracy by a factor of two. Vlasov systems are used to describe the time evolution of collisionless plasmas as they occur in many astrophysical environments. Operating in up to six-dimensional phase space (plus time), they model the velocity distribution and thus enable the capture of non-equilibrium dynamics. In this way, fast and small-scale kinetic effects such as wave - particle interactions can be retained, which have proven to be a driving factor in the macroscopic evolution of the plasma up to very large system scales.

room 40.03.003 (Emil Fischer Str. 40)

Thursday, Nov 26, 2026 at 12:30 pm,

Zu diesem Vortrag sind Sie herzlich eingeladen.

gez. Christian Klingenberg