Particle-in-Wavelets scheme for the 1D Vlasov-Poisson equations[1]

ROMAIN NGUYEN VAN YEN, Institut fuer Mathematik, Freie Universitaet Berlin, Berlin, Germany, ERIC SONNENDRUCKER, IRMA-CNRS, Universite de Strasbourg, 67084 Strasbourg, France, KAI SCHNEIDER, M2P2-CNRS & CMI, Aix-Marseille University, Marseille, France, MARIE FARGE, LMD-CNRS-IPSL, Ecole Normale Superieure, Paris, France — A new numerical scheme called particle-in-wavelets is proposed for the Vlasov-Poisson equations, and tested in the simplest case of one spatial dimension. The plasma distribution function is discretized using tracer particles, and the charge distribution is reconstructed using wavelet-based density estimation. The latter consists in projecting the Delta distributions corresponding to the particles onto a finite dimensional linear space spanned by a family of wavelets, which is chosen adaptively. The stability and accuracy of the scheme is supported by numerical computations of Landau damping and of the two-stream instability. By direct comparison with a reference solution obtained by a very precise semi-Lagrangian method, we show that the precision is improved roughly by a factor three compared to a classical PIC scheme, for a given number of particles. Ref.: Nguyen van yen et al., ESAIM: Proc, 32 (2011), 134-148.

Kai Schneider
M2P2-CNRS & CMI, Aix-Marseille University, Marseille, France

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