Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Data-driven approach for the Rosenbluth-Fokker-Planck Equation KYOUNGSEOUN CHUNG, FEI FEI, ETH Zurich, HOSSEIN GORJI, EPFL, PATRICK JENNY, ETH Zurich — In this study, we demonstrate a data-driven technique to efficiently obtain an accurate approximation of the transport coefficients in the Rosenbluth-Fokker-Planck equation. Our approach is based on an end-to-end mapping between the statistical moments of plasma particles and the high-dimensional transport coefficient fields in the velocity space. The probability density functions are approximated based on the maximum-entropy closure and then parameterized. This allows us to compute the transport coefficients from a physically realizable set of moments without assuming thermodynamic equilibrium. In order to obtain training data, Direct Simulation Monte Carlo (DSMC) was performed starting with specified initial conditions, which resulted in temporal information of moments. We adopted an artificial neural network model to accurately approximate the training data set. In order to utilize the trained model in the existing particle simulation framework, the evaluated transport coefficient fields have to be interpolated to the particle locations, and the evolution of particle positions and velocities are based on a Langevin equation. Our approach successfully demonstrates correct anisotropic relaxation behavior and shows improved computational efficiency.

Kyoungseoun Chung
ETH Zurich

Date submitted: 03 Aug 2020 Electronic form version 1.4