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A machine learning algorithm for the nonlinear Fokker-Planck-Landau collision operator in XGC MARCO ANDRES MILLER, Columbia University, RANDY MICHAEL CHURCHILL, CHOONG-SEOCK CHANG, ROBERT HAGER, Princeton Plasma Physics Laboratory — XGC1 is a gyrokinetic particle in cell code that uses the Lagrangian equation of motion for time advancing marker particles to solve the gyrokinetic Boltzmann equation. It includes a two-dimensional solver of the nonlinear Fokker-Planck-Landau collision operator, which simulates small-angle collisions in velocity space. The run time for the current implementation of the operator is $O(n^2)$, where n is the number of plasma species. As the XGC1 code begins to attack problems including more impurity species, the collision operator will become expensive computationally. An alternative to the Picard iteration algorithm used currently for the collision operator is presented in the form of a deep neural network. Various types of neural networks, primarily convolutional, are considered in the attempt to predict the nonlinear transformation of the collision operator. While initial training was begun on JET simulation data, a wide enough range of collisionality has been considered to ensure the full domain of collision physics is captured. Special attention has also been paid to ensuring the machine learning algorithm does not violate conservation properties of the collision operator.

Marco Andres Miller
Columbia University

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