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Implementation of higher-order velocity mapping between marker particles and grid in the particle-in-cell code XGC[1] ALBERT MOLLEN, Princeton Plasma Physics Laboratory, MARK F. ADAMS, Lawrence Berkeley National Laboratory, MATTHEW G. KNEPLEY, State University of New York at Buffalo, ROBERT HAGER, CHOONG-SEOCK CHANG, Princeton Plasma Physics Laboratory — To exchange particle distribution function between coupled codes in the ECP-WDM project and to evaluate the dissipative operations, such as plasma collisions, the total-f gyrokinetic particle-in-cell code XGC [S. Ku et al. *Phys. Plasmas* **25** 056107 (2018)] implements a velocity grid and a bilinear mapping between marker particles (continuous in velocity space) and velocity grid [Yoon, Chang *Phys. Plasmas* **21** 032503 (2014)]. The bilinear operation ensures conservation of particle density and momentum, but fails to conserve particle energy with enough accuracy. In the present work we have updated XGC to instead use a novel mapping technique, recently included in the PETSc library [S. Balay et al. PETSc Users Manual ANL-95/11 - Revision 3.13 (2020)], which employs a pseudo-inverse to preserve moments up to the order of the discretization space [Hirvijoki et al. arXiv:1802.05263]. We demonstrate the functionality and that 2^{nd}-order elements, in addition to particle and momentum conservation, also conserve energy.

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