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The UPSF code: a metaprogramming-based high-performance automatically parallelized plasma simulation framework XIATIAN GAO, XIAOGANG WANG, BINHAO JIANG, Harbin Institute of Technology — UPSF (Universal Plasma Simulation Framework) is a new plasma simulation code designed for maximum flexibility by using edge-cutting techniques supported by C++17 standard. Through use of metaprogramming technique, UPSF provides arbitrary dimensional data structures and methods to support various kinds of plasma simulation models, like, Vlasov, particle in cell (PIC), fluid, Fokker-Planck, and their variants and hybrid methods. Through C++ metaprogramming technique, a single code can be used to arbitrary dimensional systems with no loss of performance. UPSF can also automatically parallelize the distributed data structure and accelerate matrix and tensor operations by BLAS. A three-dimensional particle in cell code is developed based on UPSF. Two test cases, Landau damping and Weibel instability for electrostatic and electromagnetic situation respectively, are presented to show the validation and performance of the UPSF code.

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