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A new preconditioning strategy for fully implicit, asymptotic-preserving, semi-Lagrangian algorithm for the time dependent anisotropic heat transport equation OLEKSANDR KOSHKAROV, LUIS CHACON, Los Alamos National Laboratory — Large transport anisotropy ($\chi_{\|}/\chi_{\perp} \sim 10^{10}$), chaotic magnetic fields, and non-local heat closures make solving the electron transport equation in magnetized plasmas extremely challenging. A recently developed asymptotic-preserving semi-Lagrangian method[1] overcomes this complexity by an analytical treatment of the direction parallel to the magnetic field. Further, a fully implicit, second order extension of the method has been recently proposed.[2] In principle, the method is able to deal with arbitrary anisotropy ratios, different parallel heat-flux closures, and non-trivial magnetic topologies accurately and efficiently. However, in order to achieve competitive performance, implicit time integration requires fast and scalable preconditioning. Here, we propose and analyze a new preconditioning strategy that builds on the Lagrangian character of the algorithm, and ensures optimal scaling for different temporal and spatial resolutions, as well as for different anisotropy ratios. We demonstrate the merits of the method with a two dimensional boundary layer problem, which admits an exact analytical solution.

[1]Chacón, et al., *JCP*, **272**, 719, 2014
[2]Koshkarov, et al., *JCP*, submitted

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