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PIXIE3D: A Parallel, Implicit, eXtended MHD 3D Code LUIS CHACON, LANL — We report on the development of PIXIE3D, a 3D parallel, fully implicit Newton-Krylov extended MHD code in general curvilinear geometry. PIXIE3D employs a second-order, finite-volume-based spatial discretization that satisfies remarkable properties such as being conservative, solenoidal in the magnetic field to machine precision, non-dissipative, and linearly and nonlinearly stable in the absence of physical dissipation.[1] PIXIE3D employs fully-implicit Newton-Krylov methods for the time advance. Currently, second-order implicit schemes such as Crank-Nicolson and BDF2 (2^{nd} order backward differentiation formula) are available. PIXIE3D is fully parallel (employs PETSc for parallelism), and exhibits excellent parallel scalability. A parallel, scalable, MG preconditioning strategy, based on physics-based preconditioning ideas,[2] has been developed for resistive MHD,[3] and is currently being extended to Hall MHD.[4] In this poster, we will report on progress in the algorithmic formulation for extended MHD, as well as the the serial and parallel performance of PIXIE3D in a variety of problems and geometries.

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[3]L. Chacón, *32nd EPS Conf. Plasma Physics*, Tarragona, Spain, 2005
[4]L. Chacón et al., *33rd EPS Conf. Plasma Physics*, Rome, Italy, 2006

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