Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Magnetic Field Transport in Burning Plasmas BRIAN APPELBE, SAM O' NEILL, AIDAN CRILLY, JEREMY CHITTENDEN, Imperial College London, ALEXANDER L. VELIKOVICH, Naval Research Laboratory, MARK SHERLOCK, CHRIS WALSH, Lawrence Livermore National Laboratory — Magnetized ICF and Magneto-Inertial Fusion schemes include a magnetic field in order to reduce electron thermal conduction losses from hot fuel during the implosion phase, thereby reducing the velocity required to reach ignition, and to aid confinement of alpha particles during thermonuclear burn. This work studies the dynamics of the magnetic field during thermonuclear burn in high beta plasmas in which thermal diffusivity is much larger than magnetic diffusivity. Magnetic field advection, the Nernst effect and the transverse current induced by the flux of alpha particles can all play a role in the magnetic field transport. The Nernst effect will transport the field from hot to cold fuel while ablation of the cold fuel can advect plasma in the opposite direction. However, the electron Hall parameter, on which transport coefficients depend, can vary significantly in time due to alpha heating and in space due to large temperature and density differences between hot and cold fuel. This further complicates the field transport. Numerical solutions of the induction, fuel energy and alpha energy equations show that feedback between the field transport, thermal conduction and alpha flux can significantly change the dynamics of thermonuclear burn.

Brian Appelbe
Imperial College London

Date submitted: 29 Jun 2020 Electronic form version 1.4