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Exploring improved simulation techniques for analysis and design of auto-magnetizing liner experiments

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Auto-magnetizing (AutoMag) liners [1] are designed to produce strong internal axial magnetic field (30-100 T) to premagnetize the fuel in MagLIF without external field coils. AutoMag liners are made of discrete helical conductors encapsulated by electrically insulating material. Initially, internal axial field is generated as current flows through the conductors. When the driver current rises more rapidly, the insulating material undergoes dielectric flashover (ceasing axial field production) and the helical liner implodes. Dielectric breakdown processes are notoriously difficult to model; thus, experiments are crucial to developing and tuning simulation techniques. Recent AutoMag experiments on Mykonos diagnosed the evolution of dielectric breakdown with photodiodes and 12 frame gated imaging; data have helped to construct a novel method for approximating the insulator flashover process in MHD simulations of AutoMag. The method is based on insertion of "broken down" insulator material at prescribed moments during the current pulse (informed by experimental data). Implementation has improved agreement of simulations with internal axial field and radiographic data [2] captured on Z.

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[1] Slutz at al., Phys. Plasmas **24**, 012704 (2017).
[2] G. A. Shipley et al., Phys. Plasmas **26**, 052705 (2019).