Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Magnetohydrodynamic Simulation of the Chordal Wire-Array Plasma Flow Switch MATTHEW DOMONKOS, DAVID AMDAHL, Air Force Research Laboratory — The coaxial plasma flow switch (PFS) using a chordal wire array armature was first studied experimentally and computationally in the 1980's. That work revealed significant current interruption (dI/dt $\sim$ 5 MA/μs) as well as continuum x-ray emission representative of 30-45 keV bremsstrahlung. The work concluded that the voltage spike associated with the current interruption accelerated highly magnetized ions downstream at high velocity, and that energy exchange between the ions and electrons and their subsequent acceleration at the downstream boundary of the apparatus were responsible for the x-ray production. This work revisits the PFS operation up to and just beyond the point of armature lift-off from the coaxial section, where the magnetohydrodynamic model is valid and relevant. The early-time energy deposition in the wires from the pulse discharge is modeled in high-resolution 1-D and is used to set the initial conditions for the full-scale 3-D calculation. The wire array is assumed to have expanded from the initial r=0.01 cm uniformly and only in the axial direction, while the areal mass density retains its intended variation with radius. 3-D calculations are used to examine the armature, including magnetic field diffusion, as it is propelled along the coaxial geometry. These calculations will be used to set the initial conditions for follow-on particle or particle-fluid hybrid calculations of the propagation of ions and electrons to downstream obstacles and to calculate the x-ray production from the interactions of the flowing plasma with the obstacles.

Matthew Domonkos
Air Force Research Laboratory

Date submitted: 31 Jul 2015 Electronic form version 1.4