THERMALIZATION OF THE ION KINETIC ENERGY IN A Ne GAS PUFF PINCH MODEL*

J. L. Giuliani, J. W. Thornhill, A. Dasgupta, J. P. Apruzese, J. Davis
Plasma Physics Division
Naval Research Laboratory, Washington DC USA

D. Osin, E. Kroupp, A. Starobinets, E. Stambulchik, V. Fisher, V. Bernshtam, and Y. Maron
Weizmann Institute of Science, Rehovot, Israel

A. Fisher
Technion University, Haifa, Israel

C. Deeney
Department of Energy/NNSA, Washington DC USA

Full understanding of the dynamics, population kinetics, and energy budget of a K-shell radiating Z-pinch remains a challenging problem in high energy density plasma physics. Recently, detailed axially-imaged spectroscopic measurements were performed on a Ne gas puff driven by the Weizmann generator (500 kA in 500 ns)[1,2]. The Gaussian line widths and measured energy input into the plasma are consistent with a Maxwellian distribution of ion kinetic energy at stagnation, possibly non-thermal, that slowly equilibrates with the electron temperature. Macroscopic turbulent motion was proposed to explain the time evolution of the observed line widths. The energy balance was examined with a radially homogeneous plasma model. The present work examines the dynamics of this gas pinch with a 1D radial magnetohydrodynamic simulation code including collisional-radiative ionization dynamics and radiation transport. A circuit model of the generator is incorporated in the simulation to follow the implosion from the breakdown phase through implosion and stagnation on axis. Comparisons with the experimental data will be made for the load current and axially-local time-dependent K-shell radiation, plasma size, electron density, and ion kinetic energy. In particular we examine if and how the radial structure in the stagnating pinch affects the line emission profiles of the Lyman-alpha satellite lines used for the measurements of the ion kinetic energy. From the results we also examine the ion-electron equilibration time relative to that determined experimentally from the electron density and temperature, as well as the theoretical consistency of macroscopic turbulent ion motion at stagnation.

1. E. Kroupp, et al., Phys. Rev. Lett., **98**, 115001 (2007).
2. D. Olsin, Ph.D. Thesis (2008).

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