# Energy Conversion in Imploding Z-Pinch Plasma

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Due to important applications, Z-pinches became a subject of extensive studies. In these studies, main attention is directed towards improvement in efficiency of electric energy conversion into high-power radiation burst. At present, knowledge available on physics of Z-pinch operation, plasma motion, atomic kinetics, and energy conversion is mainly knowledge of numerical simulation results. We believe further progress require (i) *experimental* determination of spacial distribution and time history of thermodynamic parameters and magnetic field, as well as (ii) utilization of this data for *experiment-based* calculation of ***r**,t*-distribution of driving forces, mass and energy fluxes, and local energy deposition rates due to each of contributing mechanisms, what provides an insight into a process of conversion of stored electric energy into radiation burst. Moreover, experimentally determined ***r**,t*-distribution of parameters may serve for verification of computer programs developed for simulation of Z-pinch operation and optimization of radiation output.

Within this research program we performed detailed spectroscopic study of plasmas imploding in modest-size (25 kV, 5 kJ, 1.2 μs quaterperiod) gas-puff Z-pinch. This facility has reasonably high repetition rate and provides good reproducibility of results. Consistent with plasma ionization degree in the implosion period, measurements are performed in UV-visible spectral range. Observation of spectral lines emitted at various azimuthal angles $\varphi$ showed no dependence on $\varphi$. Dependence on axial coordinate $z$ is found to be weak in near-anode half of the anode-cathode gap. Based on these observations and restricting the measurements to near-anode half of the gap, an evolution of parameters is studied in time and radial coordinate $r$ only.

In present talk we report on determination of radial component of plasma hydrodynamic velocity $u_r(r,t)$, magnetic field $B_\varphi(r,t)$, electron density $n_e(r,t)$, density of ions in various ionization stages $n_i^{+q}(r,t)$, and electron temperature $T_e(r,t)$. We also show that local ion temperature $T_i(r,t)$ is close to $T_e(r,t)$. These distributions are used for experiment-based insight in dynamics and energetics of imploding plasma. In particular, we calculated and compare (i) plasma acceleration by local pressure gradient and local Lorentz force, (ii) local energy deposition rates provided by Joule heating, compression, and heat conduction; (iii) local growth rates of plasma internal energy and kinetic energy of radial motion. These results are used for analysis of conversion of discharged electric energy $E_C(t) = C(U_0^2-U_t^2)/2$.