DEVELOPMENT OF HIGH RESOLUTION UV LASER PROBING FOR 1-MA Z-PINCHES

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Laser probing diagnostics at the wavelength of 266 nm have been developed at the 1-MA pulsed power Zebra facility. Due to the smaller absorption and refraction at 266 nm, UV radiation penetrates deeper into the dense Z-pinch plasma. This allows the observation of fine details and structures of the Z-pinch plasma at the implosion and stagnation phases. UV interferograms and shadowgrams of the z-pinch plasma were compared to regular interferograms and shadowgrams at 532 nm. The UV laser shadowgraphy was shown to be a significant improvement in probing of wire array plasmas. Plasma distribution and dynamics in compact cylindrical, star, and planar wire arrays were studied at the wavelength of 266 nm. An electron density $N_e > 5 \cdot 10^{19}$ cm^{-3} was measured directly in the stagnated Z-pinch with the 266nm differential interferometer. Two-color shadowgraphy shows low density "corona" plasma with the 532 nm laser and dense plasma structures with the 266 nm laser in wire arrays.

A high spatial resolution UV laser channel was developed for the investigation of micro-perturbations in the Z-pinch. The anode-cathode area was recently redesigned and with the new configuration UV optics can be mounted as close as a 4-5cm distance from the Z-pinch. The UV laser beam is preferable for the high-resolution channel because of the lower diffraction limit and smaller distortion of the probing beam by the ablated plasma. A long-distance microscope can provide a spatial resolution of 2-3 µm in these conditions. A new UV shadowgraphy channel was tested and showed a spatial resolution of 4 µm limited by pixels of the CCD camera.

Experiments with high resolution laser probing are presented. High resolution UV diagnostics can provide new information about the internal processes in the pinch. The microscopic structure of the pinch could lead to conclusions about plasma turbulence, entrained magnetic bubbles, and Hall effects in the Z-pinch plasma.

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