SPECTROSCOPY OF A NITROGEN CAPILLARY DISCHARGE PLASMA AIMED AT A RECOMBINATION PUMPED X-RAY LASER

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The recombination pumping scheme for soft X-Ray lasers has better energy scaling, than the collisional-excitation pumping scheme. Implementation of an H-like $^3\rightarrow^2$ Nitrogen recombination laser, at $\lambda\sim13.4$nm requires initial conditions of at least 50% fully stripped Nitrogen, $kT_e\sim140$eV and electron density of $\sim10^{20}$cm$^{-3}$. In order to reach population inversion, the plasma cooling to below 60eV should be faster than the typical three-body recombination time. The goal of this study is achieving the required plasma conditions using a capillary discharge z-pinch apparatus. The experimental setup includes a 90mm alumina capillary coupled to a pulsed power generator of $\sim60$ kA peak current, with a rise time of $\sim60$ns.

Various diagnostic techniques are applied to measure the plasma conditions, including X-Ray diode, time-resolved pinhole imaging and time-resolved spectroscopy analysed with a multi-ion collisional-radiative atomic model. For optimization of the plasma conditions, experiments were carried out in different capillary radii and different initial N pressures. The results show a fast cooling rate to below 60eV, demonstrating the feasibility of capillary discharge lasers.