

X-ray lasing in capillary discharges based on charge exchange between ions

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In a brief introduction the problems of x-ray lasers and the major schemes and approaches of their realization are elucidated as well as achievements obtained with capillary discharge plasmas employing the collisional excitation scheme.

This presentation then focuses on a scheme which uses an ablative capillary discharge and charge exchange between ions. The plasma is produced during the first half-cycle of the sliding discharge, the wall material being polyacetal. In the second half-cycle a $m=0$ instability leads to a chain of hot (neck regions) and cold plasmas. Fully stripped carbon ions stream from the hot plasmas into the cold regions, and charge exchange between fully stripped carbon ions and CIII ions, which is preferentially into the $n=3$ levels, results in an effective overpopulation and thus to population inversion between the $n=3$ and $n=2$ levels. Lasing is at 18.22 nm.

The $m=0$ instability can be influenced by modulation of the return conductor. Experimental observations will be discussed as well as experiments with colliding laser-produced plasmas to support the magnitude of charge exchange between ions.