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Study of spatio-temporal dynamics of laser-hole boring in near critical plasma[1] SERGEI TOCHITSKY, CHAO GONG, University of California at Los Angeles, FREDERICO FIUZA, SLAC National Accelerator laboratory, JEREMY PIGEON, CHAN JOSHI, University of California at Los Angeles — At high-intensities of light, radiation pressure becomes one of the dominant mechanisms in laser-plasma interaction. The radiation pressure of an intense laser pulse can steepen and push the critical density region of an overdense plasma creating a cavity or a hole. This hole boring phenomenon is of importance in fast-ignition fusion, high-gradient laser-plasma ion acceleration, and formation of collisionless shocks. Here multi-frame picosecond optical interferometry is used for the first direct measurements of space and time dynamics of the density cavity as it is pushed forward by a train of CO_2 laser pulses in a helium plasma. The measured values of the hole boring velocity into an overdense plasma as a function of laser intensity are consistent with a theory based on energy and momentum balance between the heated plasma and the laser and with two-dimensional numerical simulations. We show possibility to extract a relative plasma electron temperature within the laser pulse by applying an analytical theory to the measured hole boring velocities.

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