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4P35 - Development of an electron-beam pumped, argon fluoride laser for inertial confinement fusion*

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The U.S. Naval Research Laboratory has converted the repetitively pulsed Electra krypton fluoride (KrF) laser system to an electron-beam (e-beam) pumped argon fluoride (ArF) laser. Operating at 193 nm, ArF has the potential of being the most efficient excimer laser and is a good candidate for an inertial confinement fusion (ICF) driver. The shorter ultraviolet wavelength increases energy coupling to the target due to increased absorption at higher density and reduction of laser-plasma instabilities (from both smaller wavelength and a cooler plasma). The shorter wavelength also increases hydrodynamic efficiency due to the higher ablative pressure.

Measurements of the small signal gain, non-saturable absorption, and saturation intensity of ArF as a function of laser gas pressure were made in an e-beam pumped amplifier experiment. A gated, intensified camera was used to study the time-resolved e-beam deposition in the laser gas as a function of gas pressure. These measurements allow an evaluation of the intrinsic efficiency as function of energy deposition in the gas. Converting to an oscillator configuration with a 10 cm x 10 cm aperture, the laser yield, time-dependent laser intensity, and amplified spontaneous emission (ASE) were measured as a function of laser gas pressure. Data from the amplifier experiments as well as the oscillator measurements provide a rigorous evaluation of the NRL-developed, ArF kinetics code Orestes. The program goals are to evaluate the laser performance as a function of pressure, e-beam deposition, and gas composition; advance the NRL Orestes code to be a reliable and predictive tool for designing large scale e-beam pumped ArF lasers for optimal output; and develop the required e-beam technologies to fabricate large scale ArF lasers for fusion applications.

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