NRL LASER FUSION PROGRAM
September-October 2002
Bimonthly Highlights

First High-Rep Laser Light from Electra

Electra is a repetitively pulsed, electron beam pumped Krypton Fluoride (KrF) laser that is developing the technologies that can meet the Inertial Fusion Energy (IFE) requirements for durability, efficiency, and cost. The technologies developed on Electra should be directly scalable to a full size fusion power plant beam line.

Electra has run as a laser oscillator mode as shown in Fig. 1. The oscillator includes two pulsed power systems, 30x100 cm^2 cathodes, pressure foil support structures (hibachi); a laser cell with a double sided e-beam pumped cross-section of 30x30 cm^2, laser cell windows, and oscillator optics. The two electron beams are counter-propagating with parameters 500 keV, 90 kA, and 100 ns flat-top pulse duration.

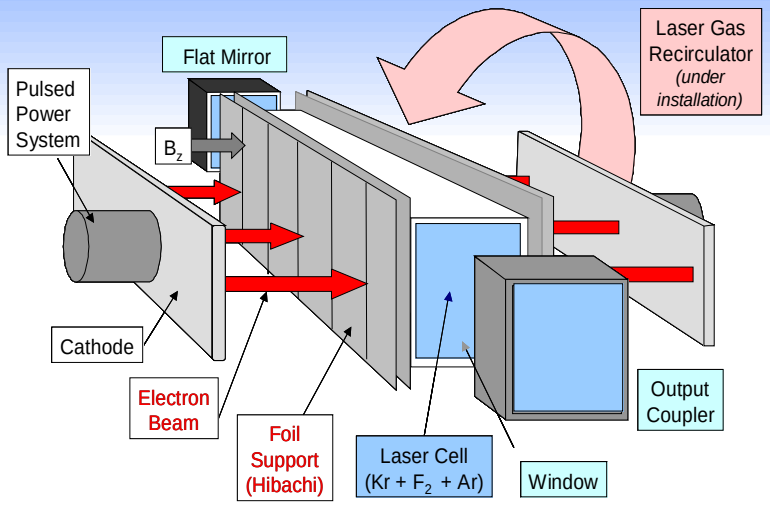

Figure 1: Schematic of Electra in Oscillator operation

The Electra oscillator has a rectangular flat mirror (32x36 cm^2) with a 98.5% reflectance coating at 248 nm. Two single sided 248 nm AR coated fused silica windows (33x35 cm^2) enclose the laser gas of argon, krypton, and fluorine with the uncoated surfaces exposed to the laser gas. The laser cell has an aperture of 30x30 cm^2 with an average window separation of 130 cm. The output coupler, parallel to the mirror (Plane-Parallel Resonator), is an uncoated fused silica window (33x35 cm^2) with a reflectivity of 8% total from both surfaces.

The laser output was measured to be 400 J with a gas composition of 39.7% Kr, 60.0% Ar and 0.3% F_2 at a pressure of 1.5 atmospheres. The full laser energy was measured with a 33x33 cm^2 Scientech calorimeter. Figure 2 shows a 10 shot burst at 1 Hz demonstrating an average energy of more than 300 J (Run #6). A laser gas recirculator that is currently being installed will allow longer runs at repetition rates up to 5 Hz. The insert in figure 2 shows the time response of the oscillator pulse compared to the sidelight emission attributed to amplified spontaneous emission (ASE). These were measured with fast photodiodes and 220-260 nm bandwidth interference filters. The difference between the 100 ns FWHM response of the oscillator pulse to the 140 ns FWHM ASE is due to the build-up time of the gain in the oscillator. When Electra is used in an amplifier configuration, most of the 140 ns pulse width of the electron beam in the gain medium should be available.

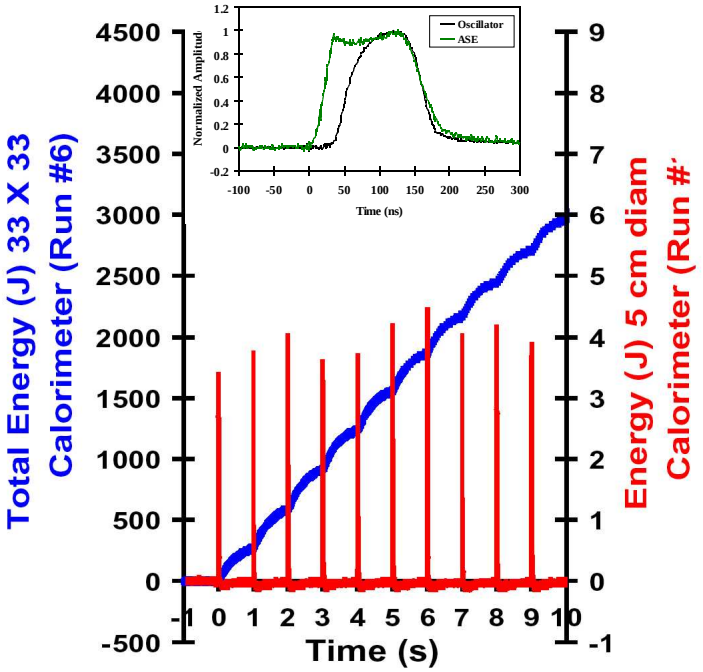

Figure 2: The left axis (Run #6) Total Energy gas mixture 39.7% Kr, 60% Ar and 0.3% F_2 at 1.5 atm. The right axis (Run #1) gas mixture 99.4% Kr and 0.6% F_2 at 1.2 atm. The insert shows the measured photodiode response of the oscillator pulse and ASE~x20 in nanoseconds.

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