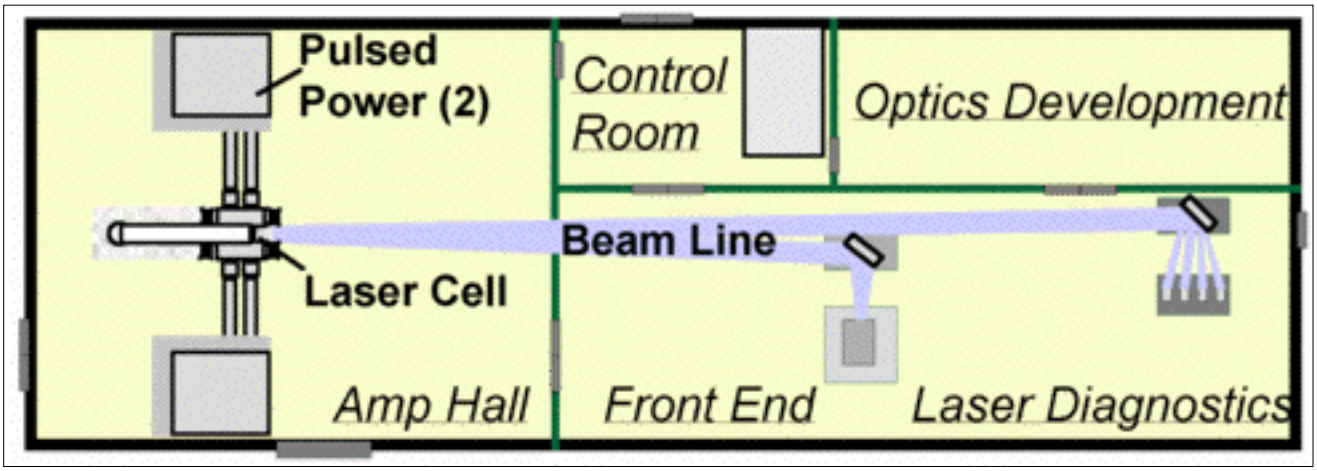
THE ELECTRA KrF LASER[1,2]

Plasma Physics Division, Naval Research Laboratory, Washington DC
Issue #1
15 February 2000

Introduction

Electra is an R & D program to develop a rep-rate, reliable, efficient, high energy, high average power Krypton Fluoride (KrF) laser. A primary motive for this program is to develop a driver for inertial fusion energy (IFE).[3] But there are other applications as well, including an x-ray source or material processing. We will use advanced scientific research to develop the necessary technologies. These technologies will then be integrated into a single 5 Hz, 700 J rep-rate laser. This size is small enough to be manageable, but large enough to convincingly scale to higher energy (30-100 kJ) systems. The laser technologies that need development are: an efficient pulsed power system; a durable electron beam emitter; a long life, transparent, pressure foil support; an efficient acoustic suppressor for the laser gas; and long life optical windows. To develop these technologies we will perform advanced research in the fields of: electron beam propagation, advanced gas kinetics, 3-D radiation and laser transport, hydrodynamics, solid state electronics, pulsed power, materials, and optics.



The Electra Laser Laboratory

A new laboratory was built for Electra. The walls, ceiling, and all services were finished in Oct. 1999. We started installing equipment in October. The interior walls will be in by March.

First Generation Pulsed Power System

Electra will be pumped by two 500 kV, 110 kA, 100 nsec, electron beams. The durable and efficient pulsed power system that will eventually be needed will require several years of advanced R & D. To give us a test bed to allow us to start addressing the other laser issues right away, we have built a First Generation Pulsed Power System. This system uses existing spark gap technology, and has been designed and built by Pulse Sciences, Inc (PSI). It has two identical and independent sides. One side was sent to NRL for installation, the other kept at PSI for testing. The side at NRL is shown below:

First Generation Power Supply (at NRL)

The tests at PSI showed the system can run at 5 Hz, at full voltage, for 90,000 shots. This five hour run exceeds the original lifetime specification nine-fold, and is unprecedented for a spark gap based system of this energy. (After 180,000 shots the main electrodes are replaced. This takes two hours.) The run time is more than enough for our initial laser research. We expect both sides to be ready for electron beam studies by June, 2000.

[1]For further information, contact John Sethian: sethian@this.nrl.navy.mil; (202) 767-2705.

[2] This work is supported by the US Department of Energy, Defense Programs.

[3] For IFE, the ultimate goals are: overall efficiency: 6-7%; cost: $10.00/ e beam joule; durability: 2 x108 shots.