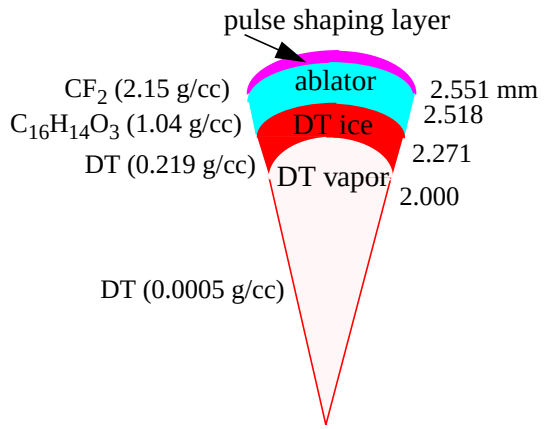
October 1995 Highlights of the Pulsed Power Inertial Confinement Fusion Program



Fuel capsule design for LIBRA-SP based on BUCKY-1 code calculations. X-ray pulse shaping layer optimizes timing of shocks at the inner DT-ice boundary so that the time-dependent pressure in the fuel is close to the Fermi-degenerate adiabat.

As recommended by the Inertial Confinement Fusion Advisory Committee (ICFAC), a new technical contract was prepared and a first draft sent to the Department of Energy in mid October. The final draft will be transmitted to DOE and ICFAC members at the beginning of November. The new contract is shorter than the May 1994 version and the readability has been improved. Specific goals and milestones for FY98 have been added to the contract, which is based on the 10-page light ion ICF appendix prepared for the June 30, 1995 ICF Five-Year Program Plan. Our specific milestones for FY96 include: begin experiments on Nova and Saturn applicable to the foot of the NIF (National Ignition Facility) drive pulse; operate the PBFA-X extraction ion diode in both the low-voltage (8 MV, 0.8 MA) and high-voltage (15 MV, 0.8 MA) modes; and fire the first shot on the accelerator in the PBFA-Z (imploding plasma load) configuration.

The present peak operating voltage in the extraction mode on PBFA X is 8 MV with a current of 0.3 MA. After the ion diode is suitably optimized, we will test the 15-MV mode, which uses both the top and the bottom half of the accelerator in series. A shot rate capability in the low-voltage (8-MV) extraction ion mode of two per day has been demonstrated. This represents a substantial improvement over the average shot rate of two per week in the radially focusing, barrel geometry configuration on PBFA II. A September 1994 program goal was to increase the average shot rate to two per week in the radially focusing geometry. Except during a series of two-stage ion diode experiments in the fall of 1994, when a sustained rate of one per day was achieved, we had not been able to obtain a higher shot rate in the barrel geometry. An increased shot rate is important because of the faster learning rate that it implies. The extraction ion diode geometry provides better diagnostic access and simpler hardware components.

The 5-MV SABRE accelerator provides, on a smaller scale, the capability to investigate extraction ion diodes and magnetically insulated transmission line coupling and develop electrode surface cleaning techniques, improved vacuum conditions, and advanced ion sources. The shot rate is five per week; an increase to 7 - 10 per week is being planned. To support this objective, several subsystems are being modified incrementally, including the vacuum system, the control system, and the data acquisition system.

As a result of the 1994 ICF declassification, interaction with universities and other nations on target design has increased. Implosion and burn of an indirect-drive LIBRA-SP reactor target were simulated on a Sandia HP workstation in October using University of Wisconsin's new 1-D radiation-hydrodynamics code BUCKY-1. The capsule (see figure) uses a polycarbonate ablator with a Teflon pulse shaping layer embedded within a spherical, foam-filled hohlraum. These calculations predict a yield of > 200 MJ for 20 - 30 MeV lithium beams. As a second example, at the conclusion of his three-month stay, Peter Hoppé of Karlsruhe Research Center gave a seminar on the German ICF program; it is hoped that this interaction will continue, with a Sandian visiting Karlsruhe for a few months in the near future.

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