Virtual National Laboratory for Heavy Ion Fusion

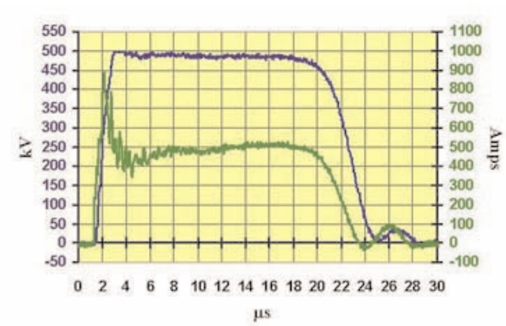
January 2002

HIF News

LBNL-PUB-844-02-01

500 kV ion source test stand commissioned

STS-500, the 500 kV ion-source test stand pictured, successfully operates at full voltage for a 17 µs pulse with a 1.2 µs rise time, as shown, which is well within the acceptance criteria. By fine-tuning the pulse forming network, the flat top pulse width, flatness, and rise time should improve slightly. We also achieved our vacuum requirement (< 1x10^{-7} Torr) for the column and diagnostic tank.



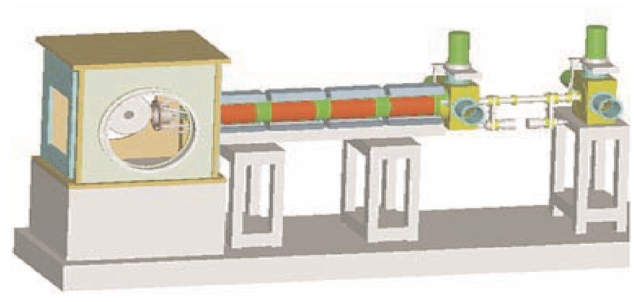
STS-500 is an important new tool for development of ion sources for heavy ion fusion. Heavy ion fusion not only requires high current ion sources, typically ~1 amp of beam current, but also high brightness, with ion temperatures ≤1 eV, in a compact structure. These requirements motivate advances in both source technology, and our physics understanding of ion extraction and low energy beam transport.

In designing this system, we require high enough voltage to extract a high-current beam and transport it to diagnostics for measurement, and flexibility to test a wide variety of sources and provide easy access for changes to the system. Thus, the system was designed as a 500 kV system in air. The pulsed power system provides a 500 kV pulse to a hot box, that is supported by fiberglass legs above a ceramic insulator column which grades the voltage back down to ground potential. The insulator column together with a diagnostic tank provides the vacuum chamber in which sources will be placed, ions extracted, and measurements performed. *– Larry Ahle*

Neutralized Transport Experiment (NTX)

A power plant driver beam can be transported through the final focus section by several strong magnetic quadrupoles that will focus it onto a target. Achieving a sufficiently small focal spot at the target, with ballistic transport of ions with GeV-range energy, depends on reducing space-charge forces with neutralizing plasma in low-density (millitorr) gas. To investigate nonlinear phenomena, in the magnetic section and in the neutralized transport section, construction of the Neutralized Transport Experiment (NTX) has begun at LBNL. The experimental setup shown consists of three major sections, a low-emittance potassium-ion source, a magnetic transport section with 4 pulsed quadrupoles, and a 1-m long drift section with plasma neutralization. The plasma source is being constructed by PPPL. It will be characterized, and then installed in the NTX beamline. The pulsed quadrupoles are under construction, and the ion source is being tested, using a refurbished 400kV Marx pulser at the former MBE-4 machine.

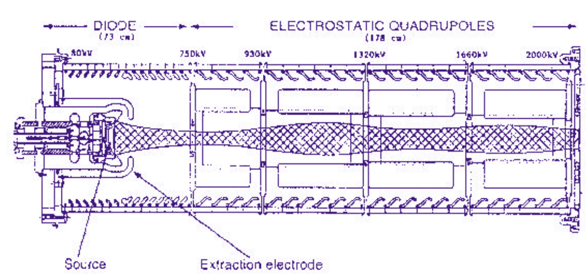
The WARP-3D code has been used to design the ion source and the magnetic lattice, and predict nonlinear forces. The MRC electromagnetic code LSP has been used to specify the requirements for the plasma source, and the degree of neutralization as a function of the various beam and plasma parameters. These predictions will be compared against the NTX experiments. Higher order corrections to quadrupoles can be implemented in the later stages of NTX *– Simon Yu*



2 MV Injector upgrade for HCX completed

The LBNL 2-MV Heavy-Ion Injector is a one-beam prototype injector for a heavy-ion fusion driver. In order to produce a total beam charge of about a millicoulomb, a typical heavy-ion fusion driver requires a number of parallel beamlines, each supplied by an injector capable of delivering a heavy ion beam of approximately 0.25 µC/m line charge density. The 2-MV Injector contains a 10-cm-diameter surface ionization source, an extraction diode, and an electrostatic quadrupole (ESQ) accelerator as shown, with an operational current of 0.55 A of potassium ions at 1.8 MeV, and a beam pulse length of 4 µs.

Preparations to use the Injector for the High Current Experiment (HCX) are complete. We have refurbished and upgraded the Injector pulsed-power equipment and diagnostics. We have characterized the source emission, radial beam profiles at the diode and ESQ regions, and the beam emittance at the end of the ESQ region. These measurements have been compared with EGUN and WARP simulations. A retrofit, aimed at decreasing beam aberrations and modifying beam parameters for improved compatibility with the downstream matching section and with HCX, is completed and preliminary characterization was completed in November 2001. The matching section and the first set of HCX ESQs have been installed downstream of the Injector and first beam for the combined configuration is slated for January 2002. *– Frank Bieniosek*



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This work was performed under the auspices of the U.S. Department of Energy by the University of California Lawrence Livermore National Laboratory under contract No. W-7405-ENG-48 and by Lawrence Berkeley National Laboratory under contract No. DE-AC03-76SF00098 (LBNL), and by Princeton Plasma Physics Laboratory performed under the auspices of the U.S. Department of Energy under contract No.DE-AC02-76CH-O3073.