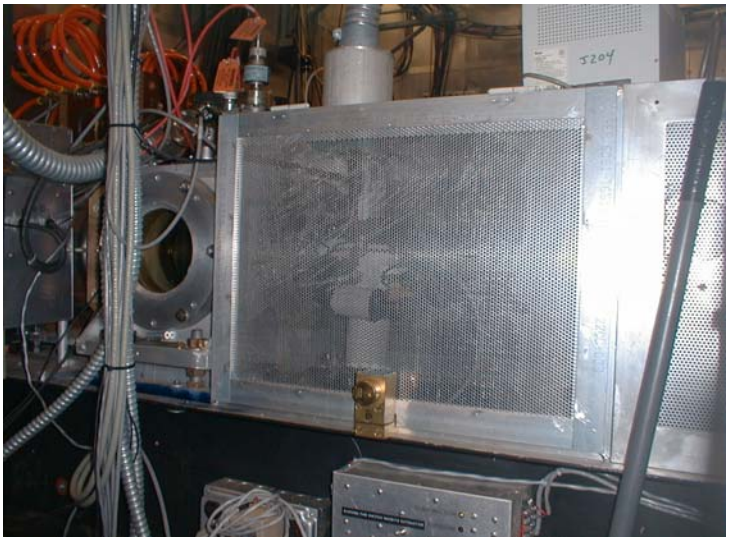
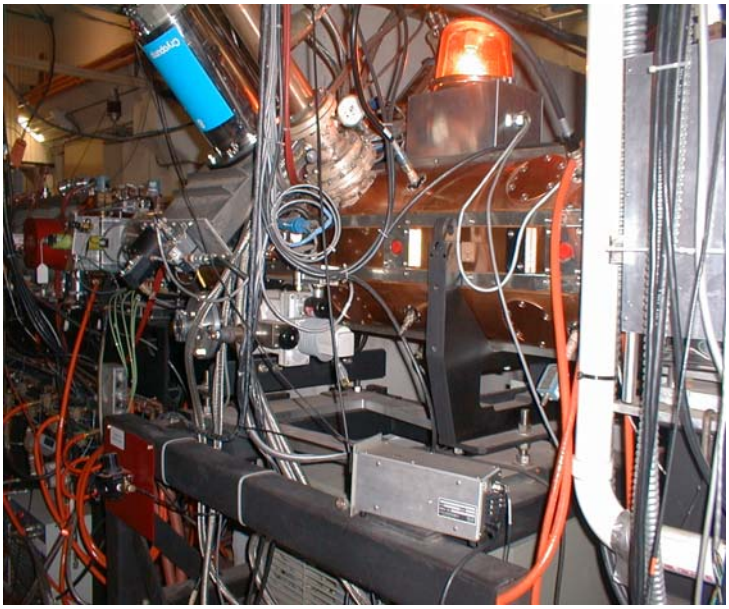
Brief Report from the BNL Trip on Feb 14-15, 06

H. Piekarz

1. Doug Moehs and I visited the Ion Source Department at BNL
   Local contact person: J. Alessi

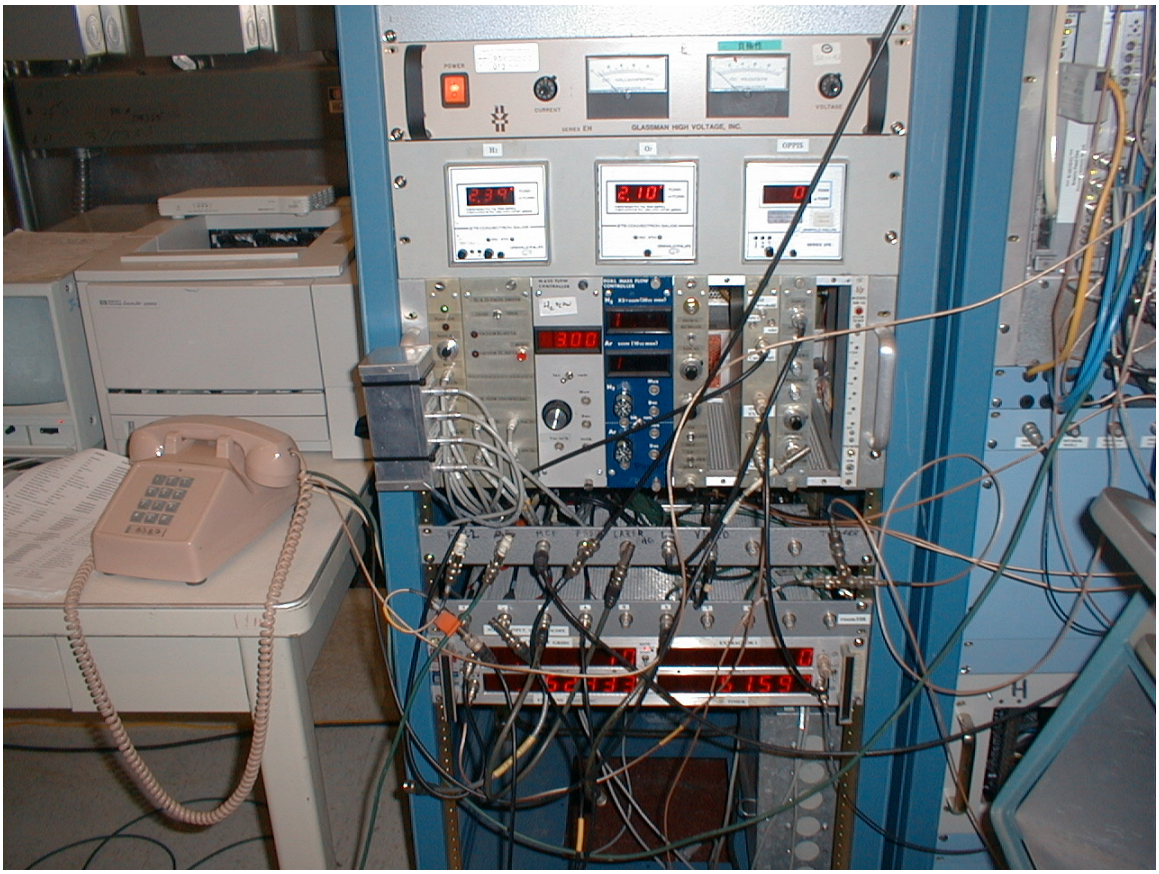
2. Viewed the LEBT system and its live operation.





HV rack size is 54” x 50”. Distance from Ion Source to HV rack is 82”.
The Extractor Pulser rack is placed on the side between the Source and HV rack.

The monitoring electronics is on the other side of the isle, as shown below:



3. Vacuum system:

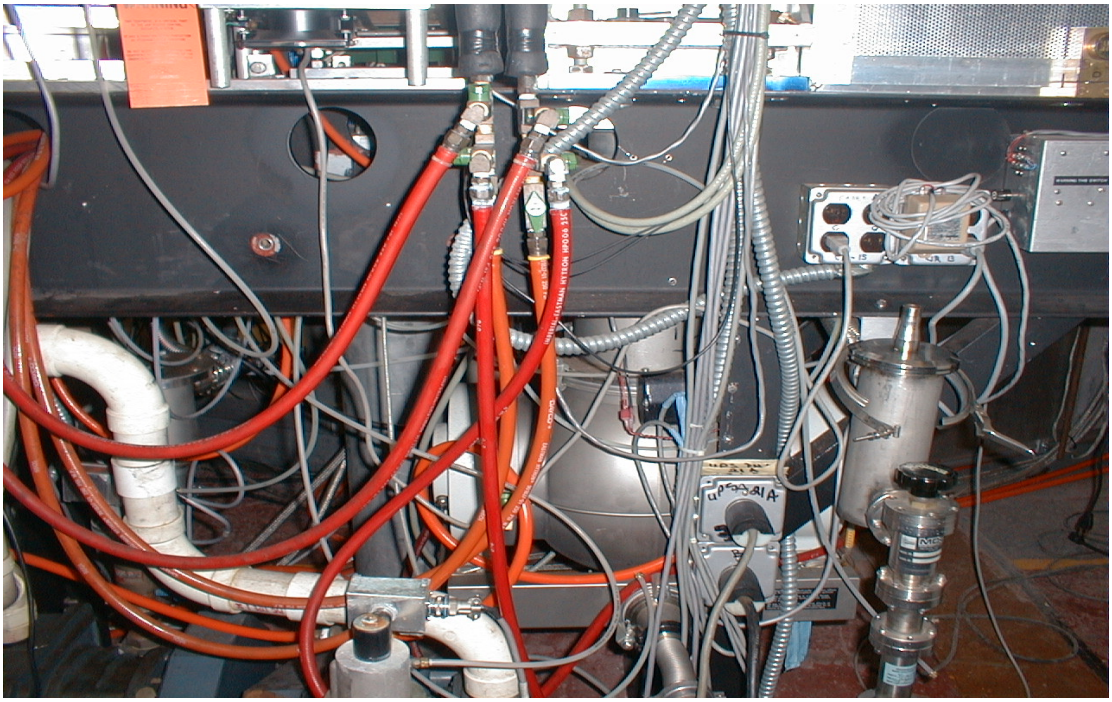
   Ion source total pumping speed: 3000 L/s
   Pumps: TPU 2200, and Cryo Plex 8

   RFQ and Chopper, each has one TPU 2200 with the Cryo Plex 8

   Ion source vacuum: < 10 ^{-8} Torr,
   ~ 7 x 10^{-7} while running with H2 gas

   RFQ vacuum: < 10^{-8} Torr.

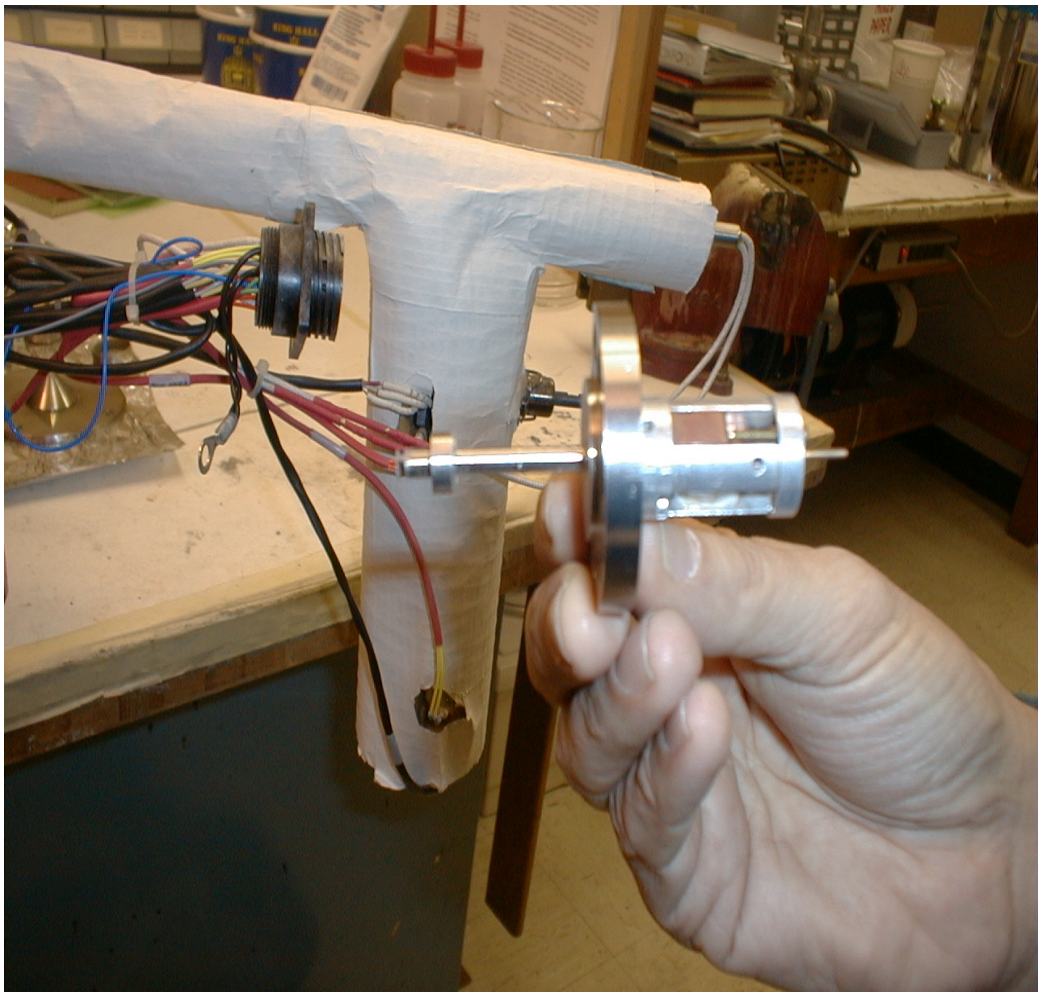
The mount of one of the turbo pumps is shown below. Note the extraction of the H2 pumped-out gas to the outside of the LEBT enclosure with a 2” plastic pipe.



4. H2 gas supply: small cylinder (600-700 psi), lasts 2 months
   Gas fed with 1/8” ss tubing of ~ 2.5 m length

5. H2 gas injection valve:

   BNL tried with mixed success Piezo, and fuel injection valves.
   Using successfully at present a “home” made valve from Russia.
   Contact persons: Vadim Dudnikov
   Brookhaven Technology Group (Paul Farrel, www.btg.com)



6. H- ion beam formation and extraction:

   The source components are shown below.

   Discharge volume: ~ 1 cc.

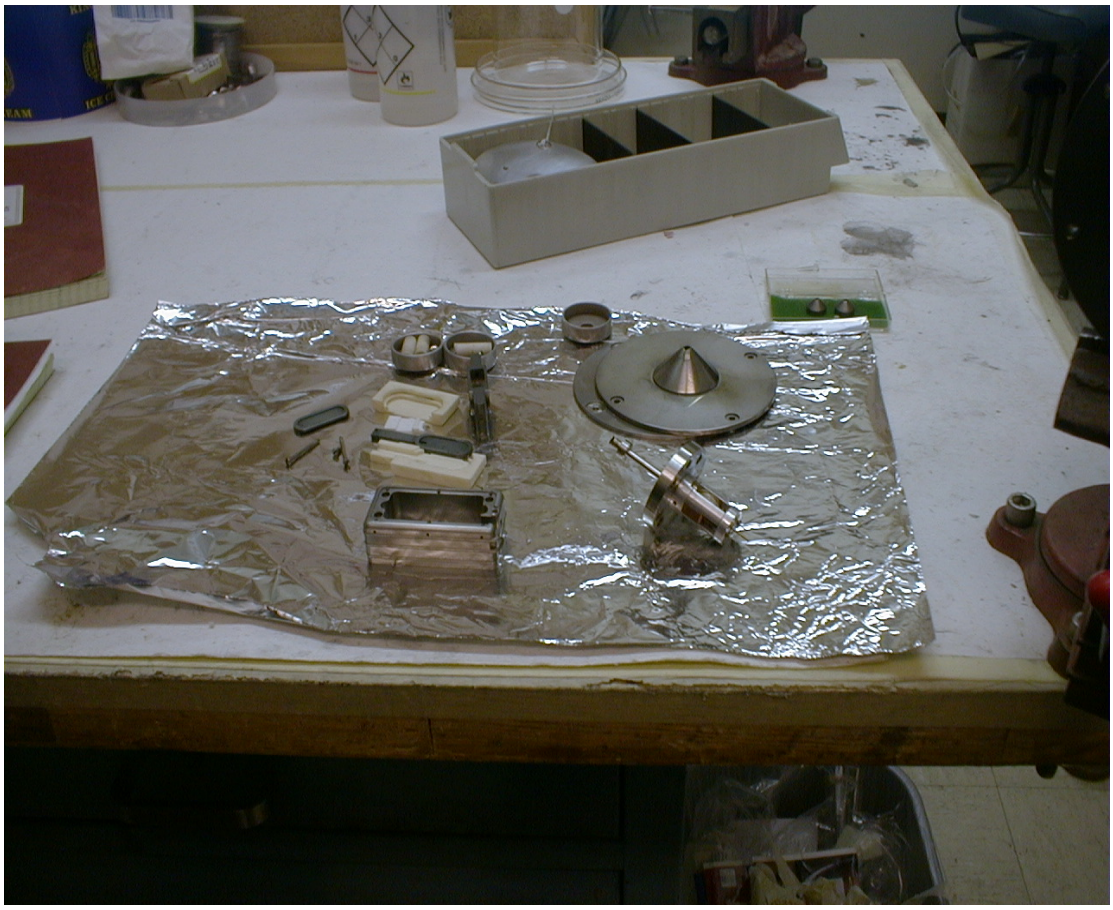
   Arc voltage: 160-180 V.

   Two permanent magnets (Sm-Co, 800 Gauss) placed outside cathode chamber.

   Cs flow is kept as low as possible, typically < 5 mg/hr?.

   The Cs deposits cleanup is simple, just wiping them with a cloth.

   The extractor cone tip (made of tungsten) erosion time is ~ 4 month.



7. H- transport to RFQ

   A pair of pulsed solenoid magnets (2.5 kG) with a “scraping” orifice, and the “steering“ solenoids between them forms the beam transport to RFQ. The four steering solenoids are mounted on a short squared frame.

   The pulsed solenoids rise time is 4 ms followed by a flat top of 8 ms with a decay time of ~ 1 ms.

   This system takes at input e.g. 100 mA H- current, then exits ~ 60 mA with an effective current of ~ 40 mA at the exit of the RFQ.

   The beam vacuum pipe through the solenoids is 4” in diameter.

   Number of sparks in RFQ is less than 0.05% of the operation time.

8. Possible application of the BNL H- source for the Proton Driver tests

   Basic characteristics of the BNL source and the 1st stage PD one are not much different, e.g.:

Current:	<100 mA vs 12 mA
Rep. Rate:	7.5 Hz vs 10 Hz
Duty Factor:	0.5% vs 1%
Pulse length:	500 us vs 1 ms

   Test “in situ” (see Doug’s report) has shown that >>1 ms pulse length can be successfully made.

   J. Alessi made a suggestion that the typical BNL source emittance of ~ 0.4 Pi-mm-mrad perhaps can be trimmed down to the PD required emittance of 0.2 Pi-mm-mrad by imposing the space charge limitations for the output current at the extractor electrode. These limitations can be enforced by adjusting both the extractor voltage V, and its orifice d. The output current density, J, follows the approximate low:

   $$J \sim (V^{3/2}) / d^{2}$$

9. We received a complete set of drawings for the fabrication of the BNL H- source.

10. We consider our BNL visit as a very useful one.