Initial Observations of Beam Transmission vs. RF Power for the HINS RFQ

Summaries by Jim Steimel and Dave Wildman, January 19, 2010

For the 2.5 MeV beam studies through the RFQ, the pulse of protons out of the ion source is longer than the RF drive gate to the RFQ. This means that the timing of the beam transport through the RFQ is dictated by the RF drive. In this experiment, we monitor the beam from a BPM pickup just downstream of the RFQ, and we monitor the RFQ field using a pickup loop located in the middle of the RFQ. Figure 1 shows a plot of the BPM signal and the RFQ field together. It shows when beam turns on relative to RFQ field level.

The RFQ field was calibrated on the scope by setting the power into the RFQ to a known 400 kW level. Once the volts to power ratio was calibrated, the beam turn-on power and full transmission power level were calculated. The beam turn-on power is about 237 kW, and the full transmission power is about 267 kW. The full transmission point was determined subjectively because of the large amount of modulation on the BPM signal.

--- Jim Steimel

During last Friday's RFQ study period, Robyn and I made some measurements to determine at what RFQ power levels we saw the:

1.) first transmission of beam through the RFQ

2.) point at which the beam transmission reached some steady-state value

The first measurement was relatively straightforward, since it was easy to determine when the beam first made it through the RFQ. The second measurement was more arbitrary because the ion source current was not particularly stable during the 100 us pulse length. The measurements were made by comparing the direct signal from the #1 BPM (top plate) downstream of the RFQ with the RF signal from one of the RFQ e-field probes (middle, east side) on a digital scope sampling at 5 GS/s. A typical scope file is shown below. The e-field signal was normalized to 400 kW during the flat portion of the 100 us RF pulse. The 400 kW number was obtained from a directional coupler looking at the forward power to the RFQ. This number is consistent with the directional coupler looking at the output of the klystron and the klystron drive level (15 dBm through 6 dB attenuation.) All of the scope files and data are in the HINS logbook under entry # 879. The first beam occurs at 237 kW with full transmission at ~ 267 kW.

It would be useful to repeat these measurements when the ion source current is more stable.

--- Dave Wildman

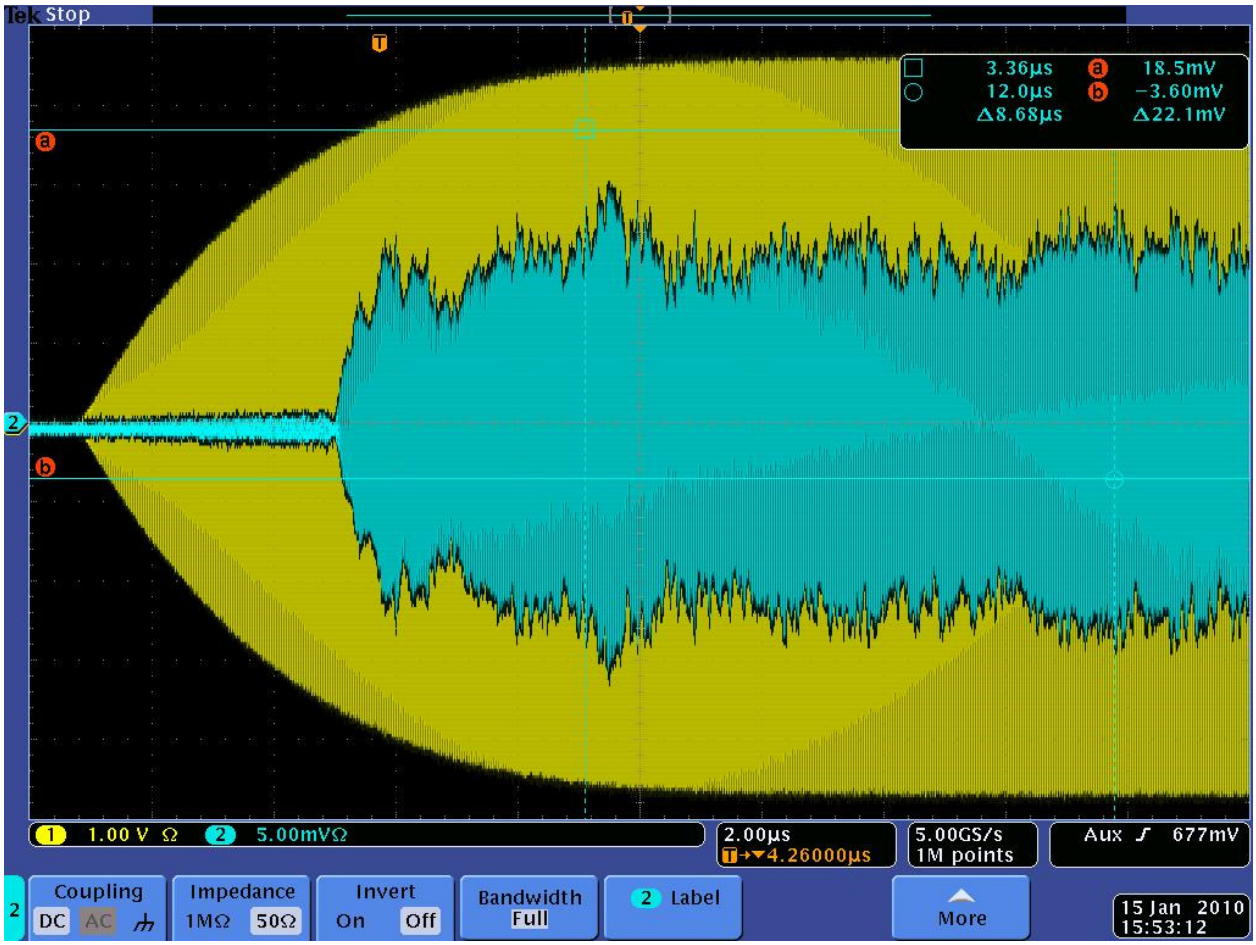

Figure 1: RFQ field and BPM signal. Blue trace is BPM signal and yellow trace is RFQ field. Calibration of field is about 1.16V/100kW drive.