Status of RFQ Injector (PIP)

C.Y. Tan
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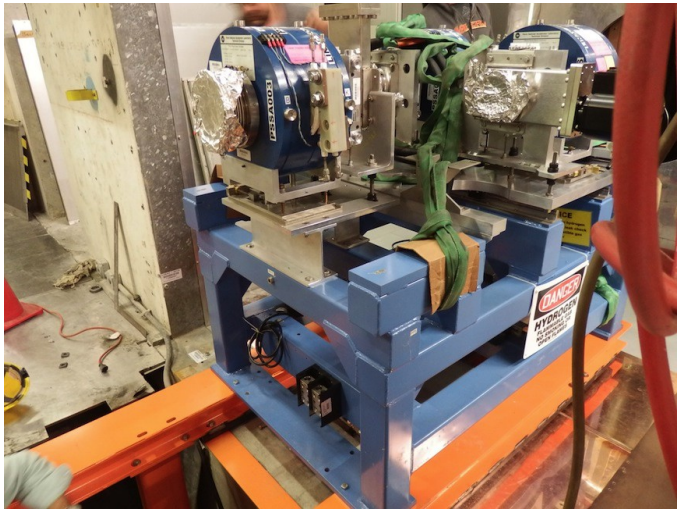
Acknowledgements

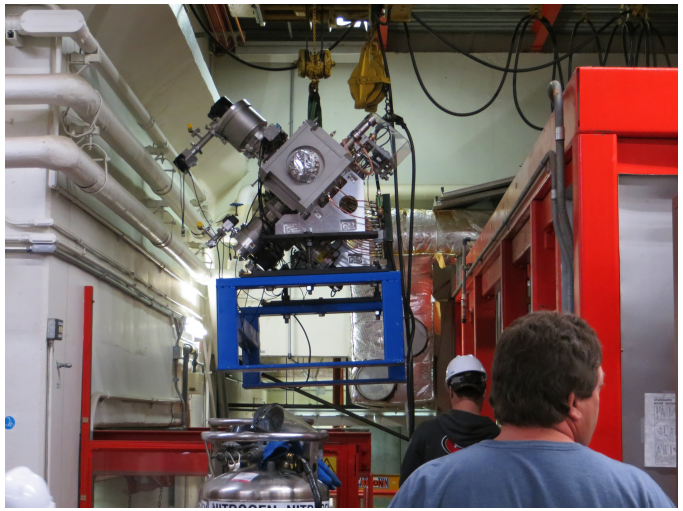
- Mechanical techs: B. Ogert, J. Briney, J. Kubinski.
- Vacuum: K. Triplett, J. Larson.
- Controls: M. Kucera, D. Arveson.
- EE support: S. Hays, M. Dilday, Brad Claypool.
- Scheduling: M. Convery (especially Mary's IMPOSSIBLE to break schedule!)
- Survey group.
- RFQ injector group.

Installation history for getting to NTF operations

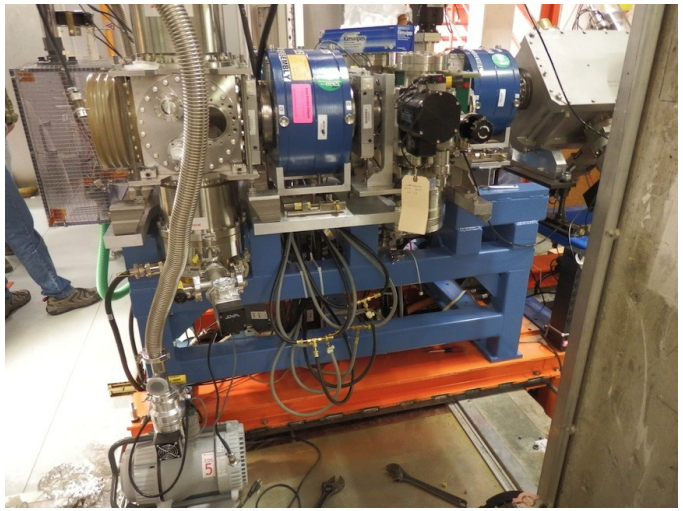
- Moved everything from test area to final injector line.
  - Connect power and controls, vacuum, water etc.
  - Align elements.
  - Test new setup without MEBT to make sure everything installed correctly!
- Connected MEBT to Tank 1
  - Beam studies to maximize beam at start of Tank 1 and Tank 3
- Install chopper
- Good for NTF operations!
- In the last possible moment: H- source stopped sparking! (But of course, we had to have a 4 day shutdown)

Moving! (05 Oct – 12 Oct 2012)



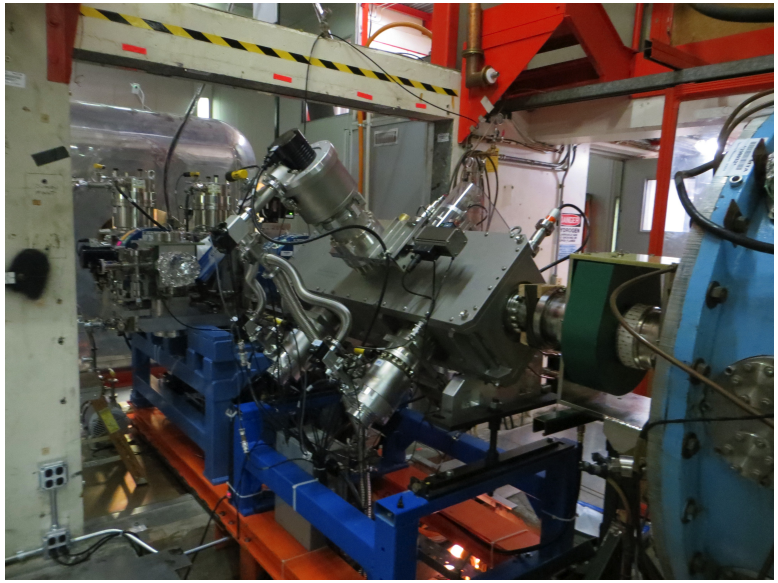


Power, water, vacuum and controls (12 Oct – 28 Oct 2012)

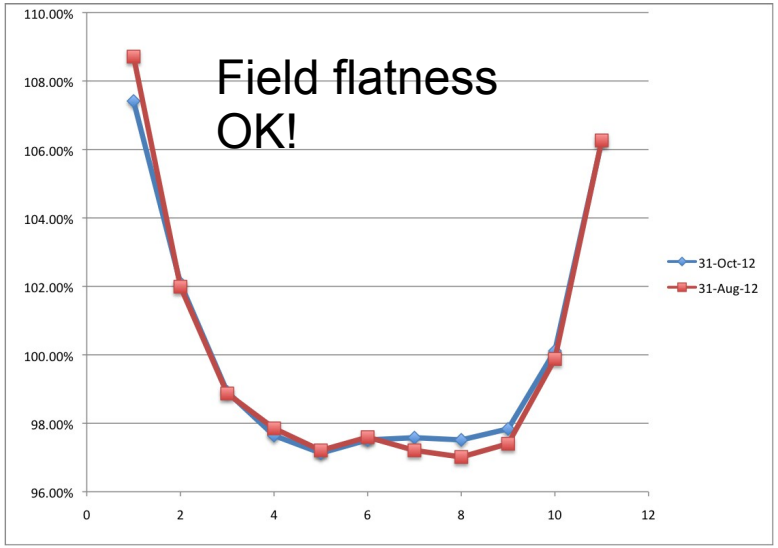


Halloween nightmare

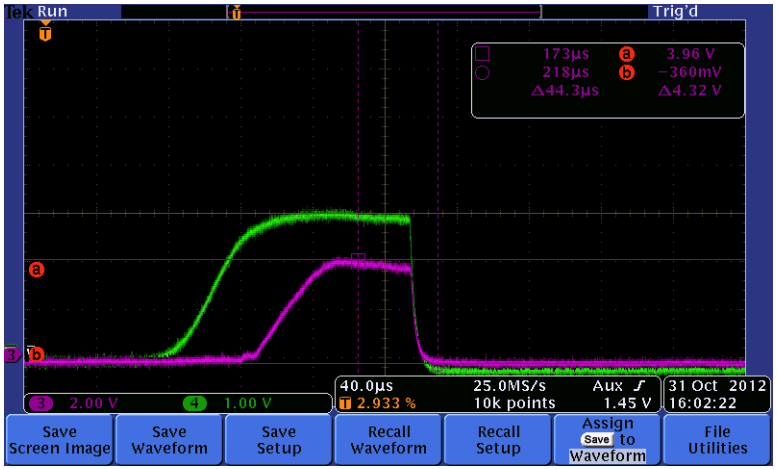
First try: we only got ~20 mA at the exit of the RFQ????



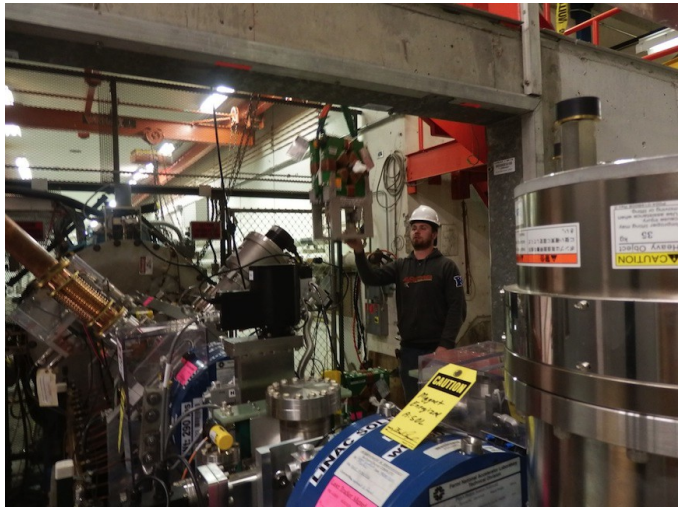
Tan working on field flatness measurements (proof that he actually does work!)

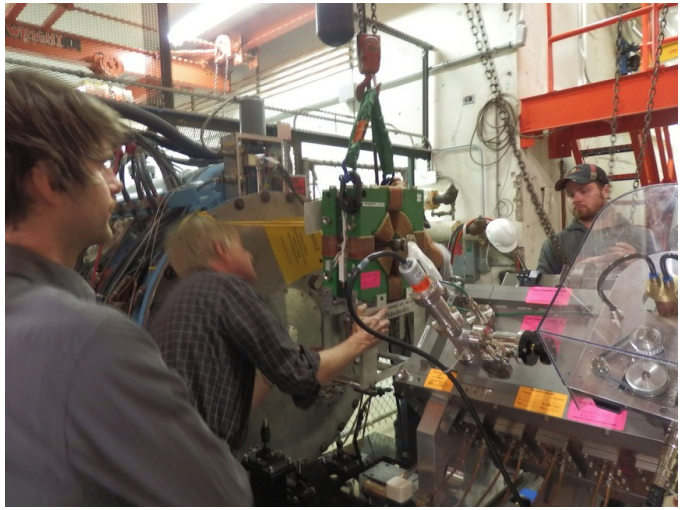


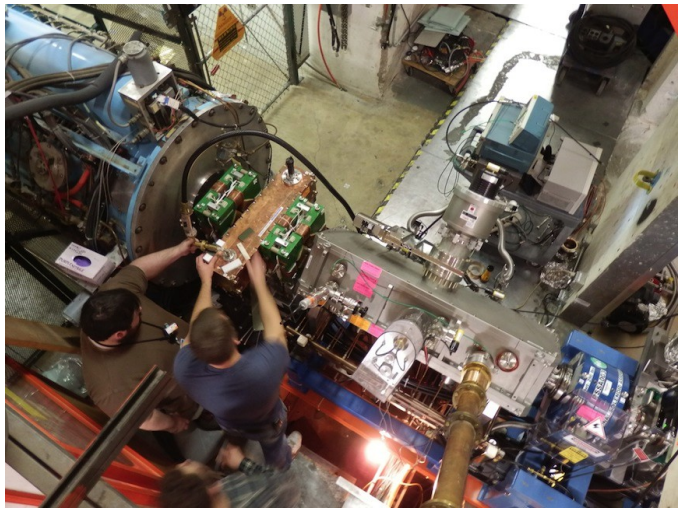
Fixed solenoid PS. Got 43 mA at exit



Install MEBT (02 Nov – 14 Nov 2012)

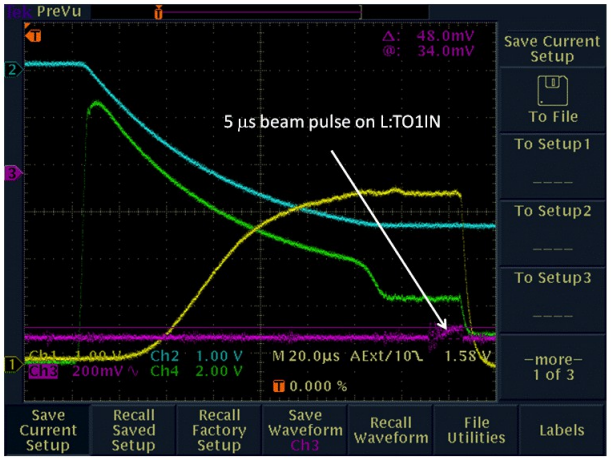




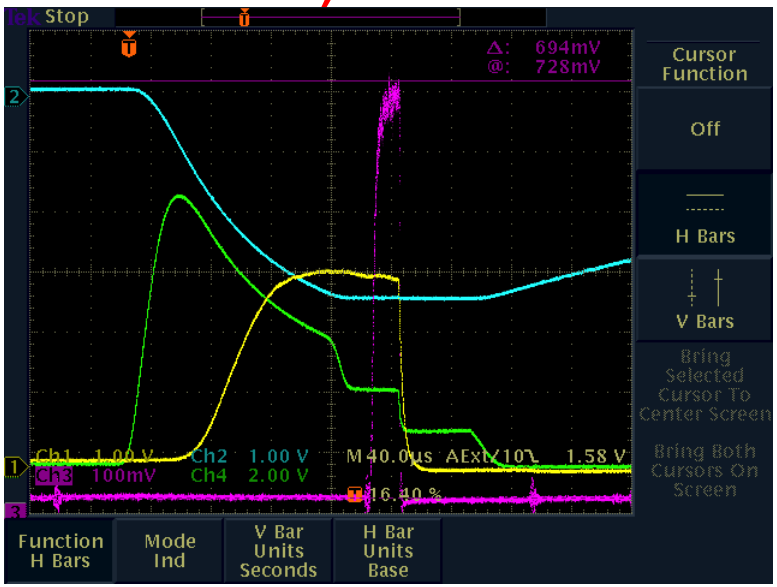


Major milestone: The new RFQ injector is linked to the Linac! But power, water and RF still needs to be connected. This was completed on 19 Nov.

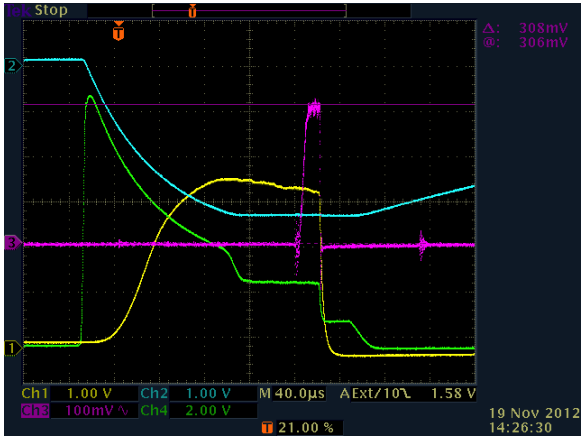
RFQ Injector Commissioning (14 Nov 2012 until present ...)



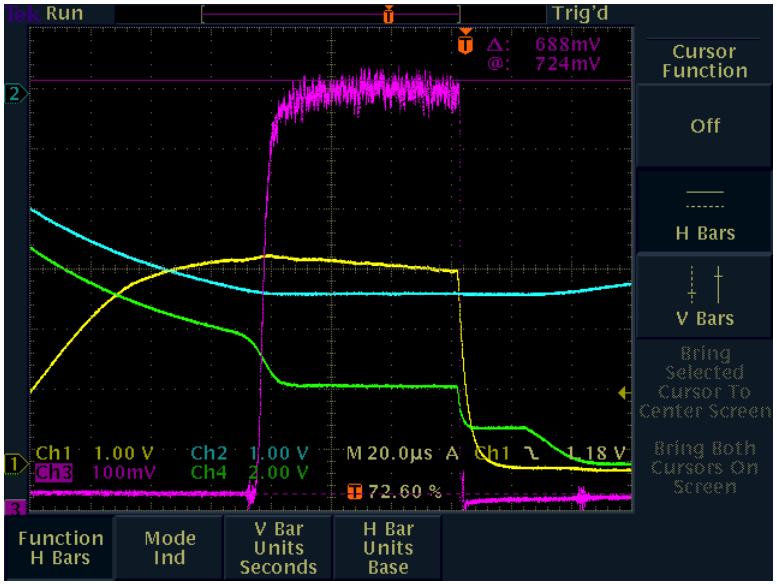
First beam through MEBT and at the beginning of Tank 1!



Even more tuning, we get 30 mA

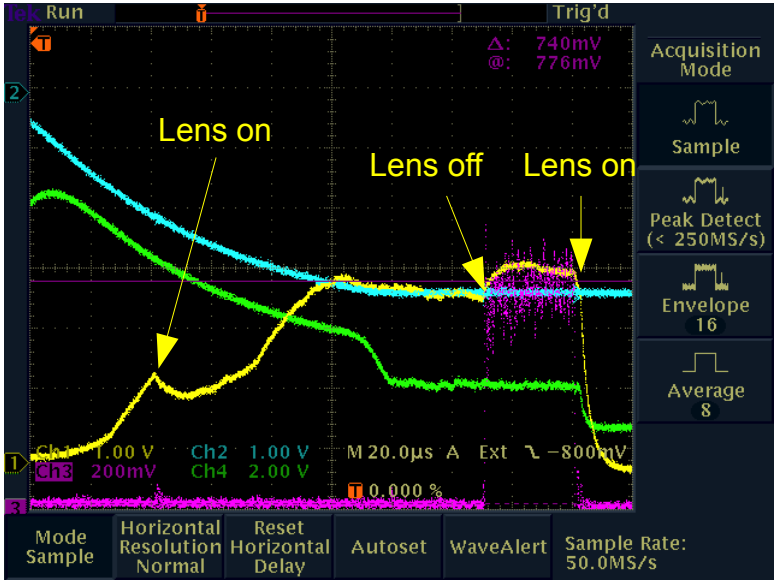


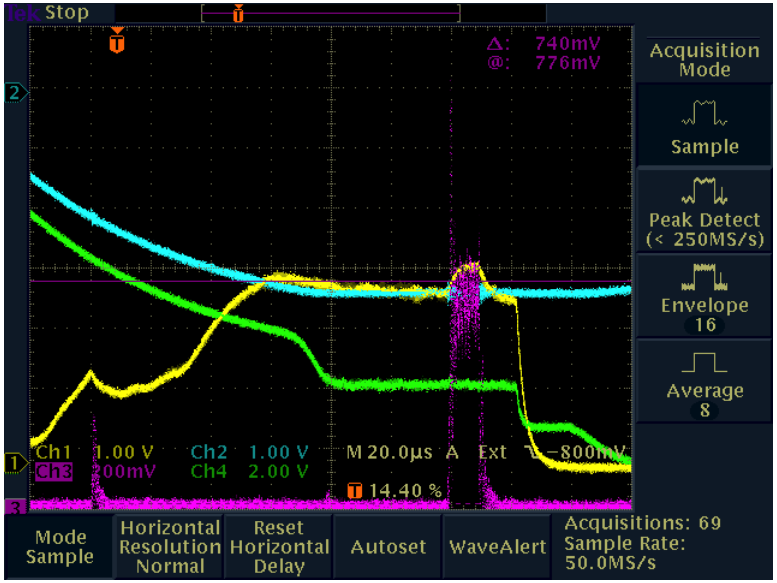
More tuning 14 mA



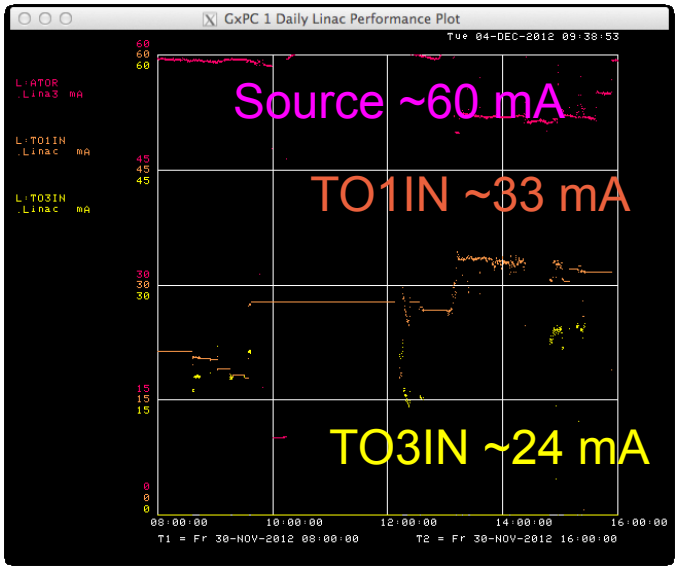
Increased pulse width for NTF

Einzel lens chopper





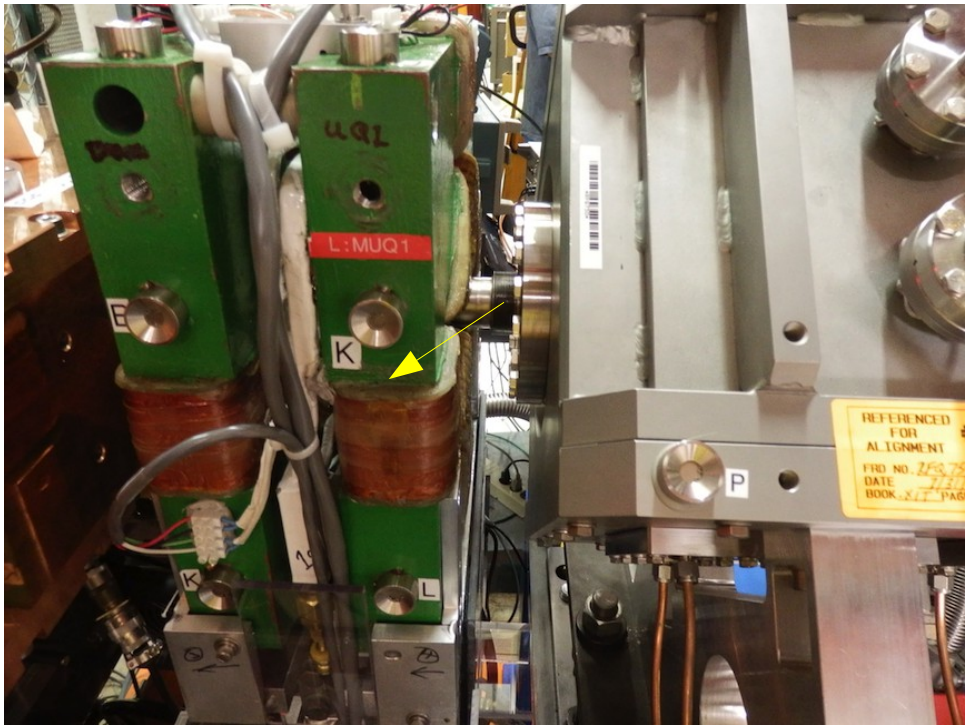
We get MORE beam with chopper on. 33.6 mA!



Needs more tuning. No tuning since chopping started.

What happened to 10 mA in the MEBT?

Beam out of RFQ has a large angle!



Angle may be as large as 2 deg! (mostly vertical)

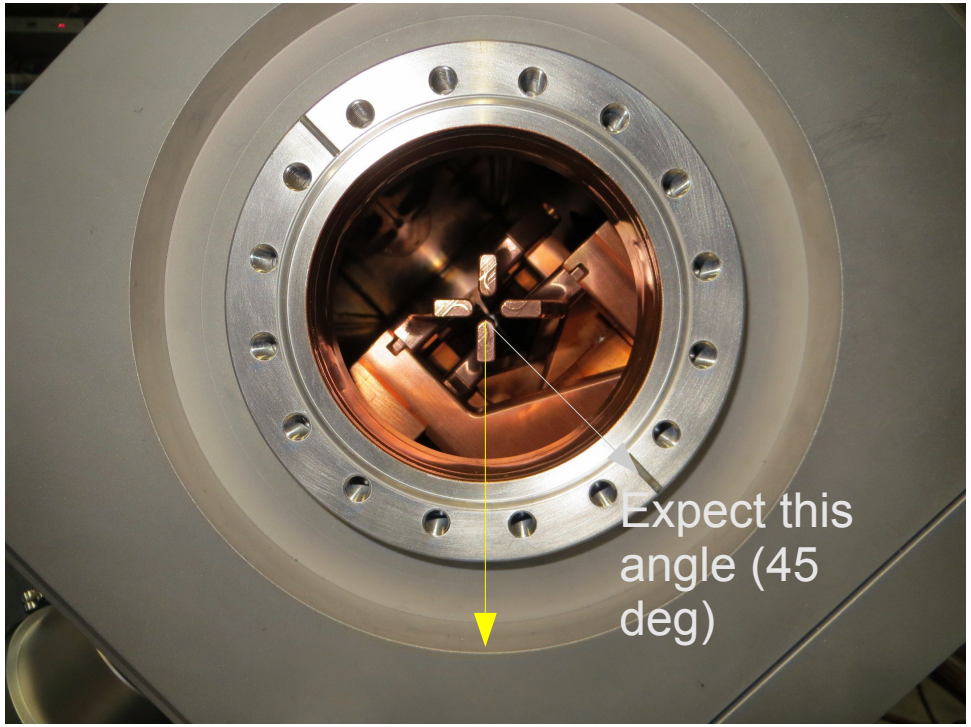
Indications of the problem is that the first vertical corrector has to run VERY HARD ~ 2.5 A. Emittance probes show this angle. Downstream quads deflect beam vertically.

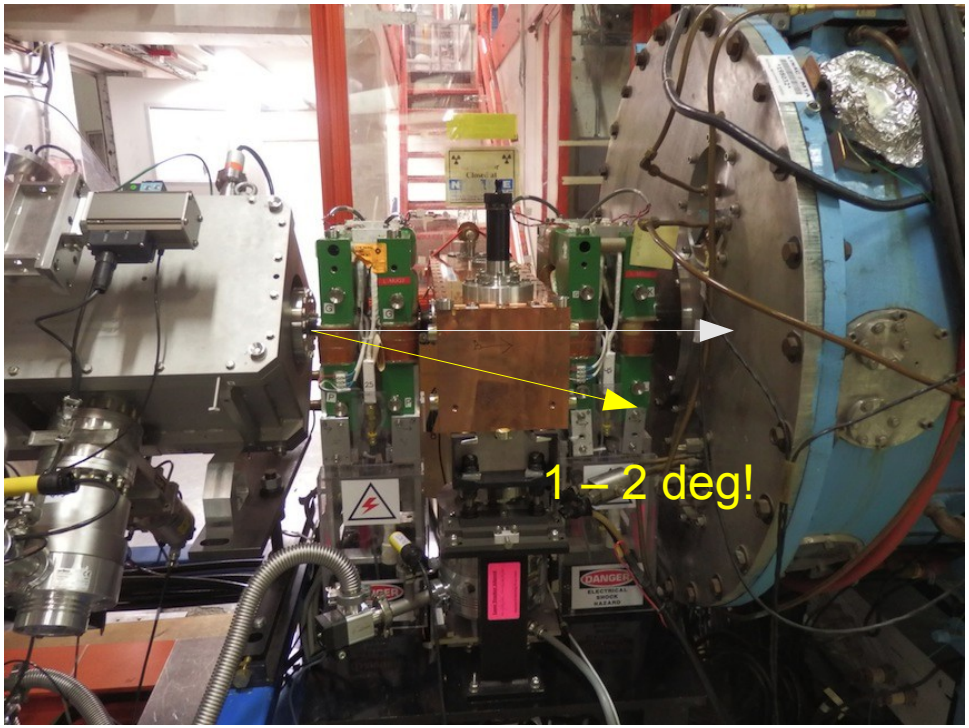
More studies to better quantify and model the angle.

One solution is to build BNL style thin corrector.

Large angle may be causing beam loss by scraping – Fixing this can possibly give us more beam.

Approximate beam trajectory out of RFQ

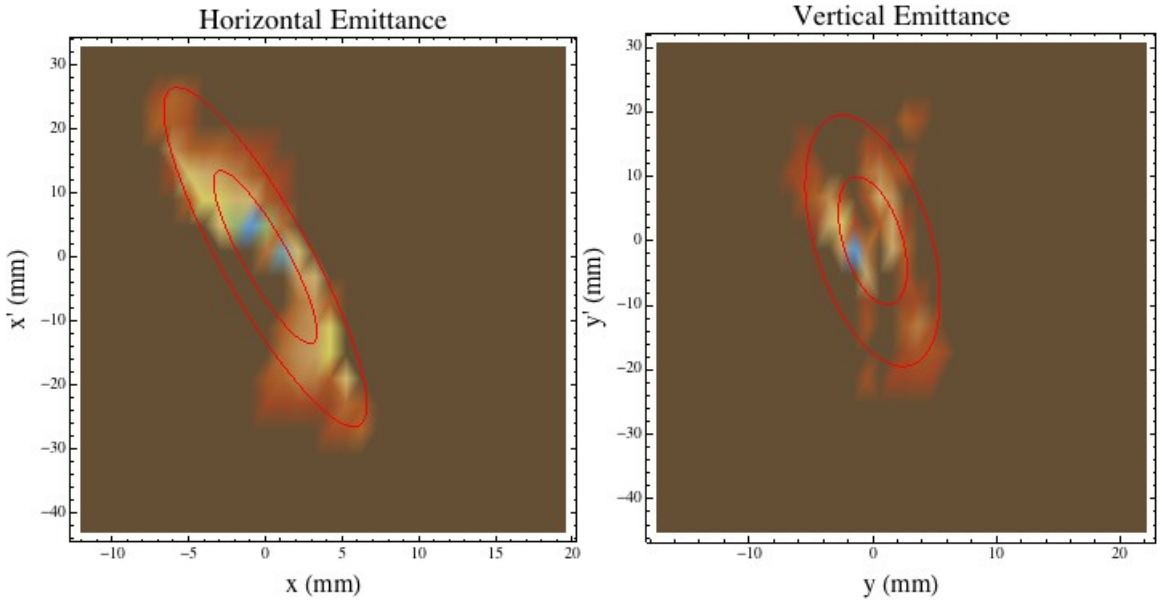




Initial measurements with emittance probes show 1 – 2 deg angle out of the RFQ. More machine studies to confirm.

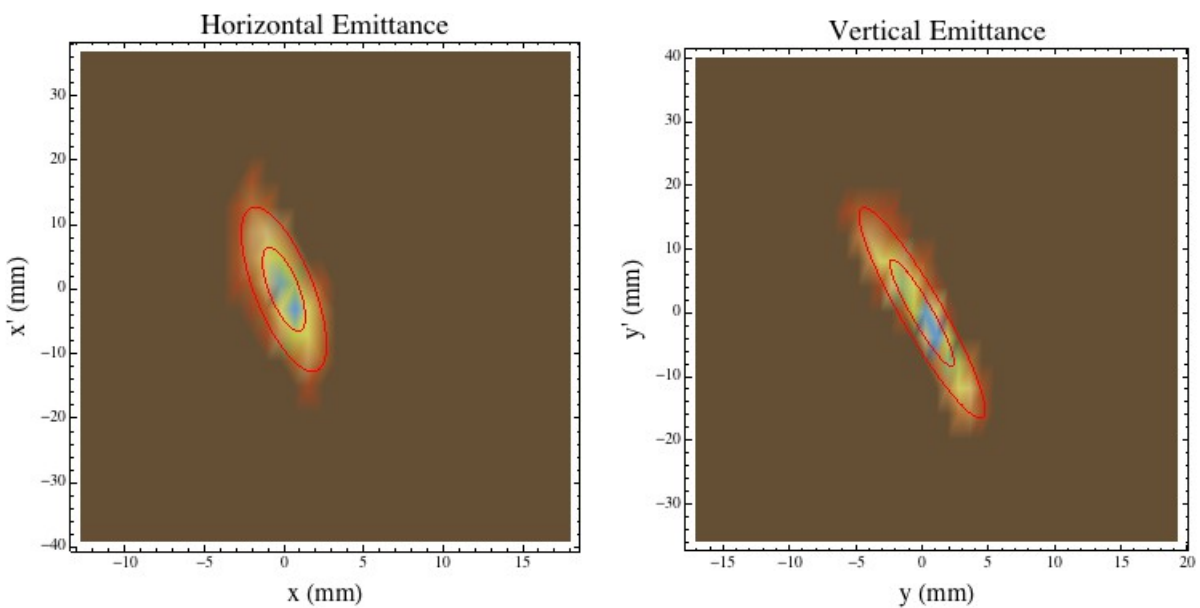
From the asymmetry of the RFQ mounting, I would have expected a 45 deg azimuthal angle and not vertically down. However, this is PRELIMINARY and subject to change!

Emittance Measurements



"Flat" beam before shutdown
εx = 0.9π mm mrad
Ɛy = 1 π mm mrad
@ 46 mA in buncher

All emittances are normalized rms.



RFQ beam at start of Tank 1.

Ɛx = 0.26π mm mrad
εy = 0.31π mm mrad
@ 30 mA at Tank 1

Exit of RFQ measured in test room:
Ɛx = 0.6π mm mrad
εy = 0.5π mm mrad
@ 40 mA

Scraping? Space charge

Plans

- Figure out whether there is an angle out of the RFQ.
- Add power power to the buncher for better matching into Tank 1.
- More tuning with chopper on.
- Goal is to get 40 mA at the start of Tank 1. Only 7 mA to go!!!!!