Status of HPRF beam test

Study beam loading effect in HPRF cavity

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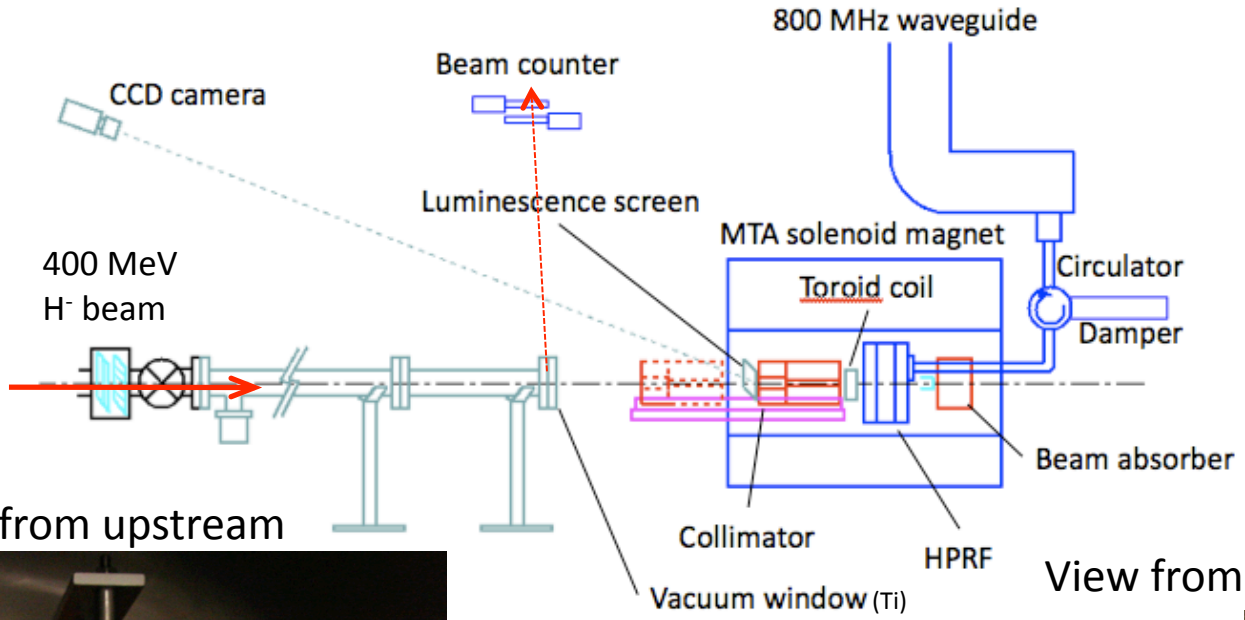
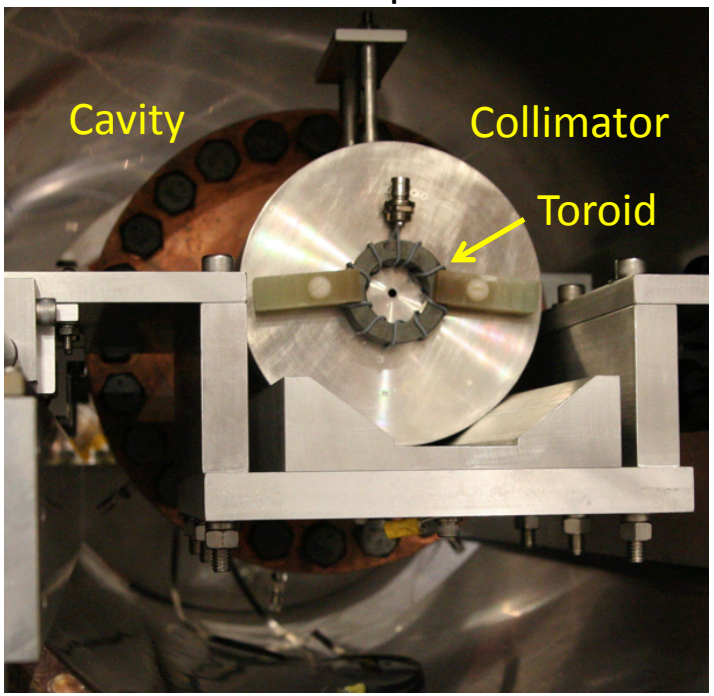
Fermilab

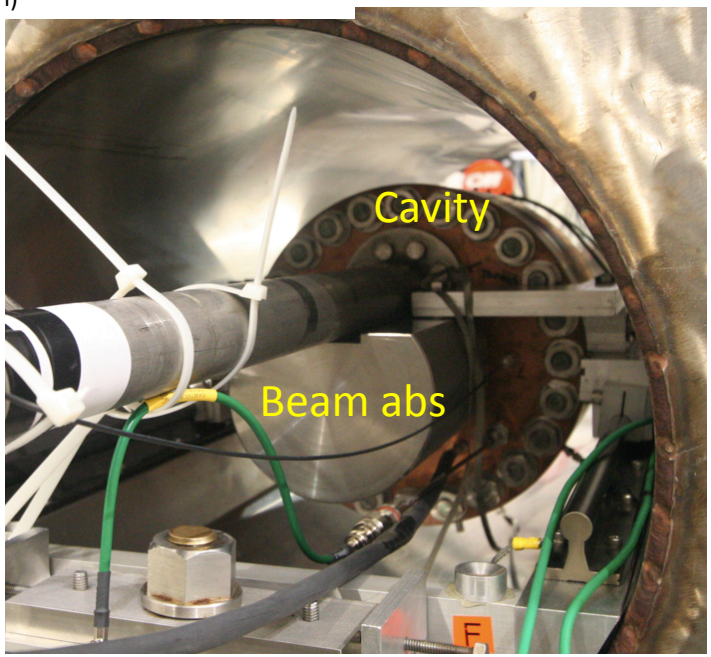
Apparatus



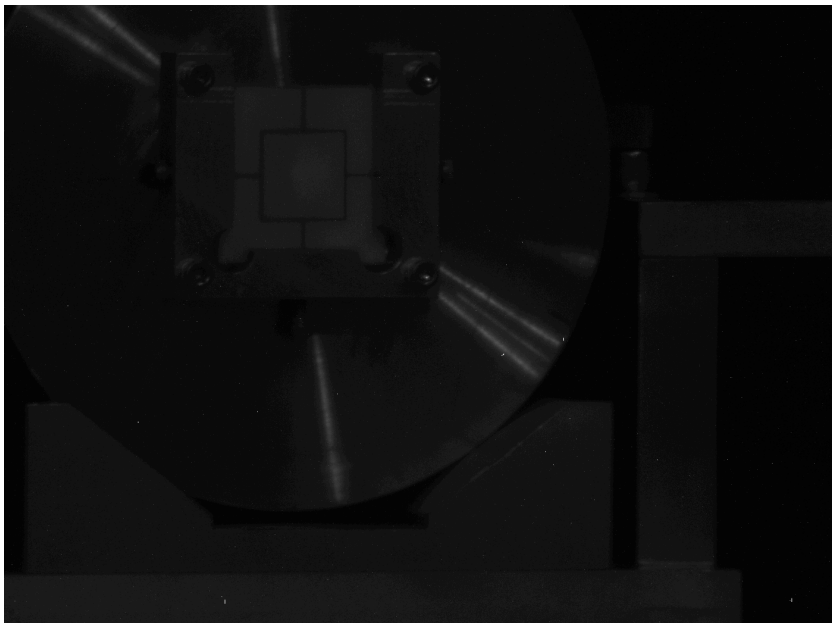
View from upstream

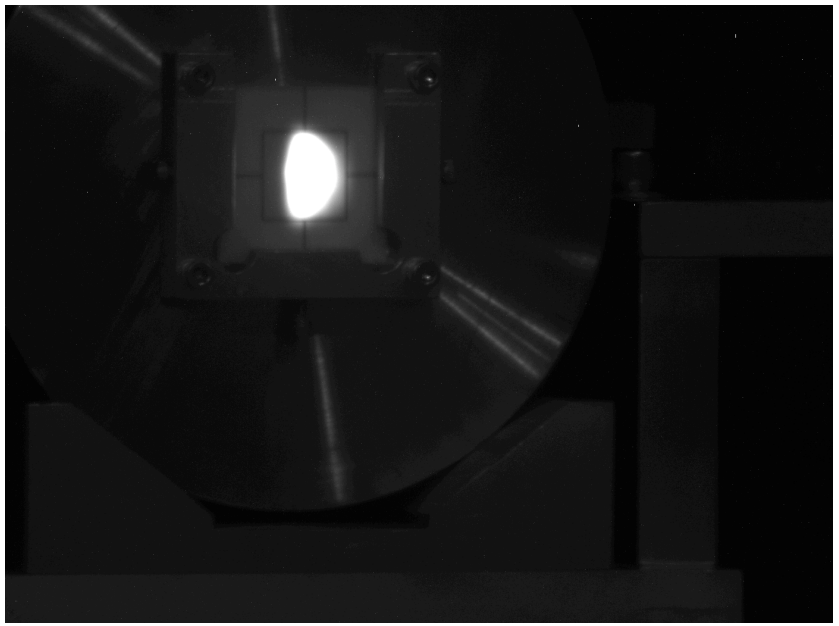


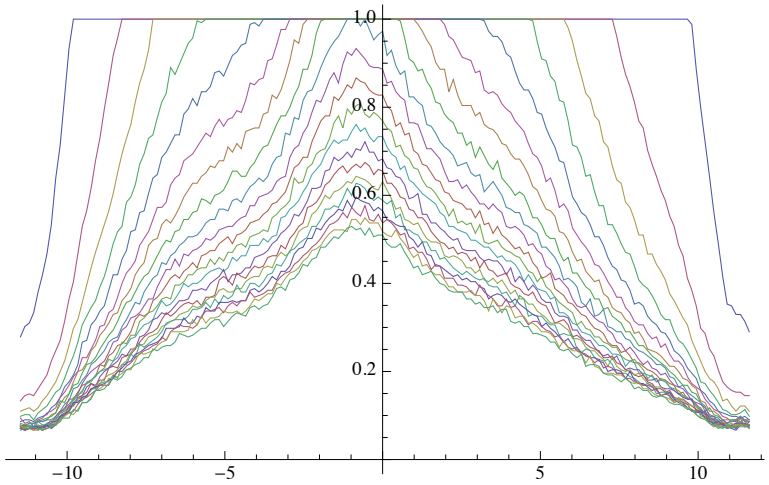
View from downstream



Beam on screen







- Signal is saturated
- Need to add neutralizer on camera
- Need to investigate acceptable beam intensity of phosphor screen

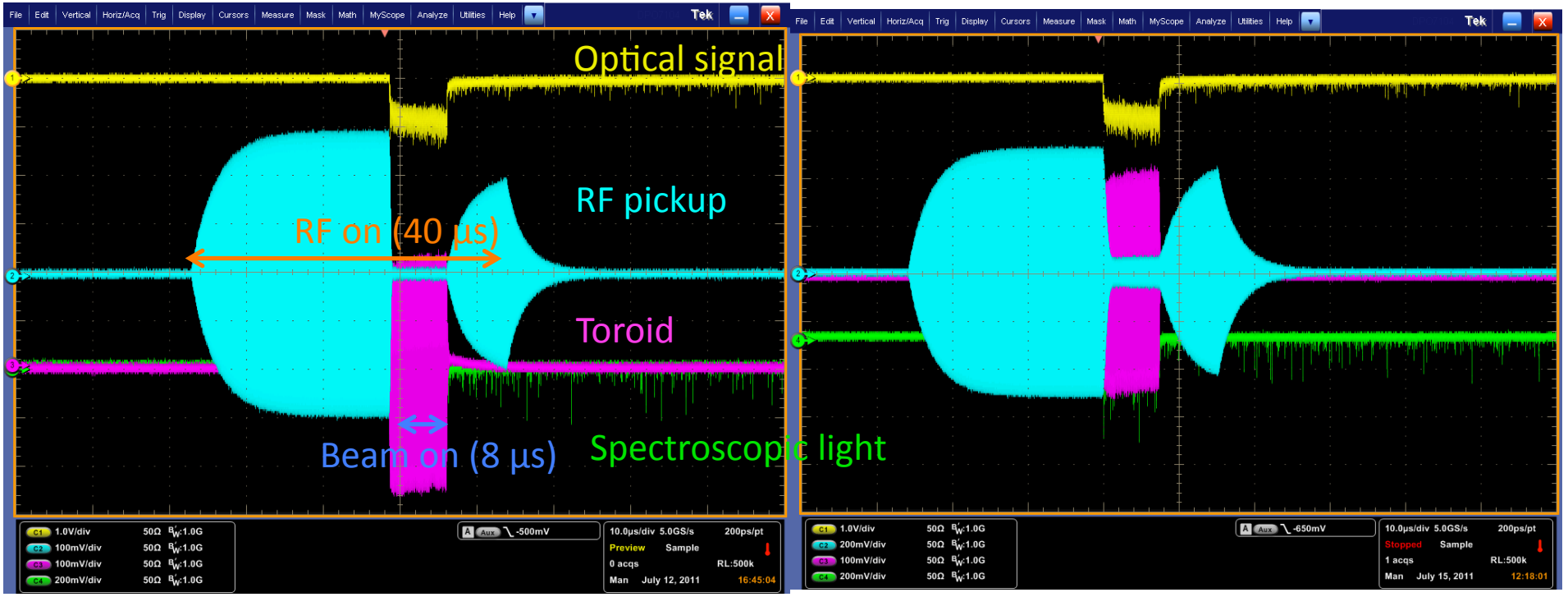
Horizontal beam profile from phosphor screen frame by frame

Log

- 7/12/11 Run HPRF cavity with 500 psi N2
- 7/14/11 Run HPRF cavity with 800 psi H2
- 7/15/11 Run HPRF cavity with 950 psi H2
- 7/19/11 Run HPRF cavity with 500 psi H2
  - We could not detect RF pickup signal

  - Beam intensity in front of collimator: 1.2 10^{12} protons/pulse
  - Pulse length: 8000 ns
  - # of beam bunches: 8000/5 = 1600
  - Readout transmission efficiency from toroid: 16 %
  - # of protons in cavity: 10^{8} protons/bunch
  - Note! Beam size is very small (2mm in diameter)

Snapshot



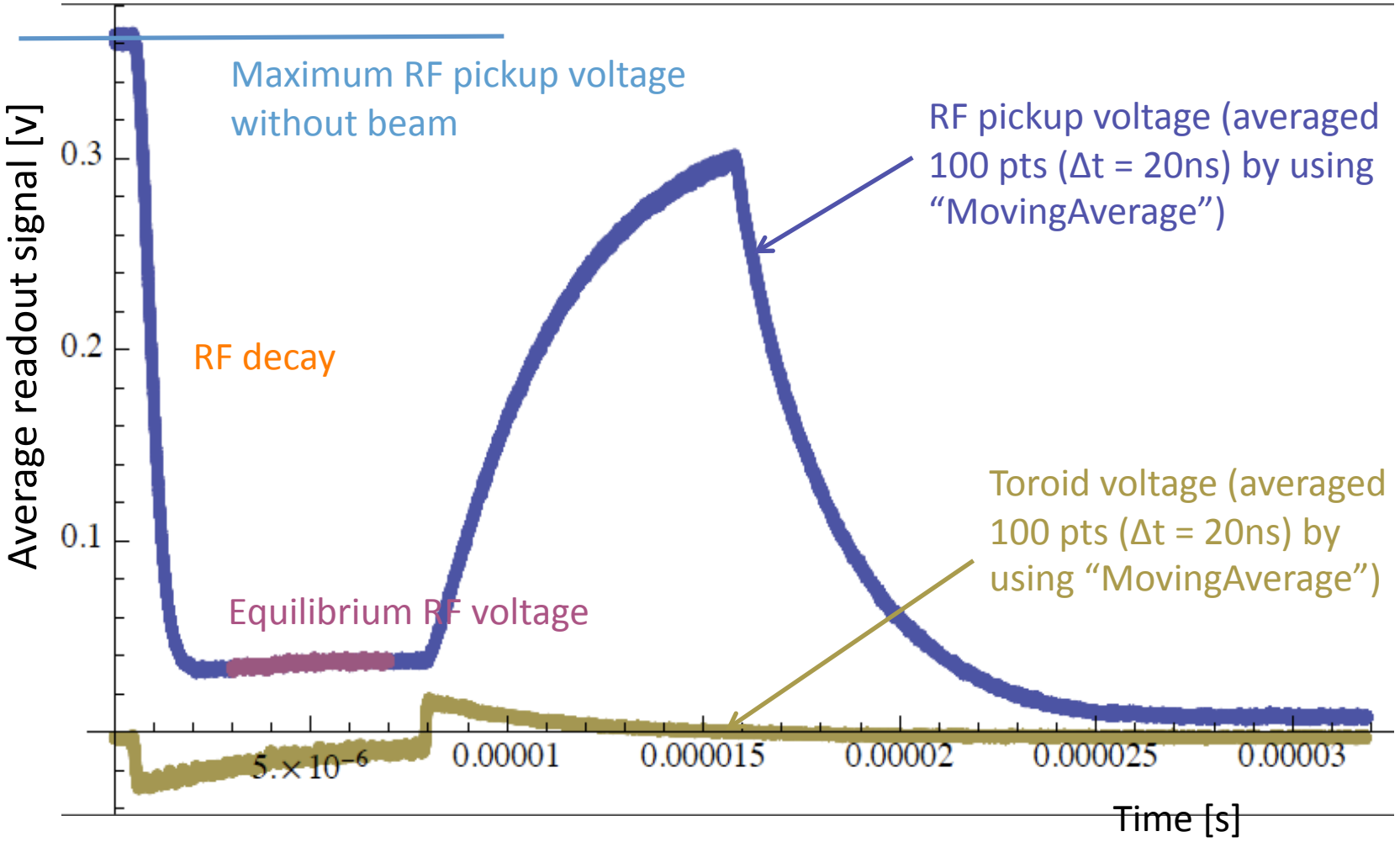
500 psi N_2 run

950 psi H_2 run

- No RF breakdown, no short
- Clear beam loading due to ionized electrons is observed
- Beam loading in N_2 is more severe than in H_2

RF & beam signals

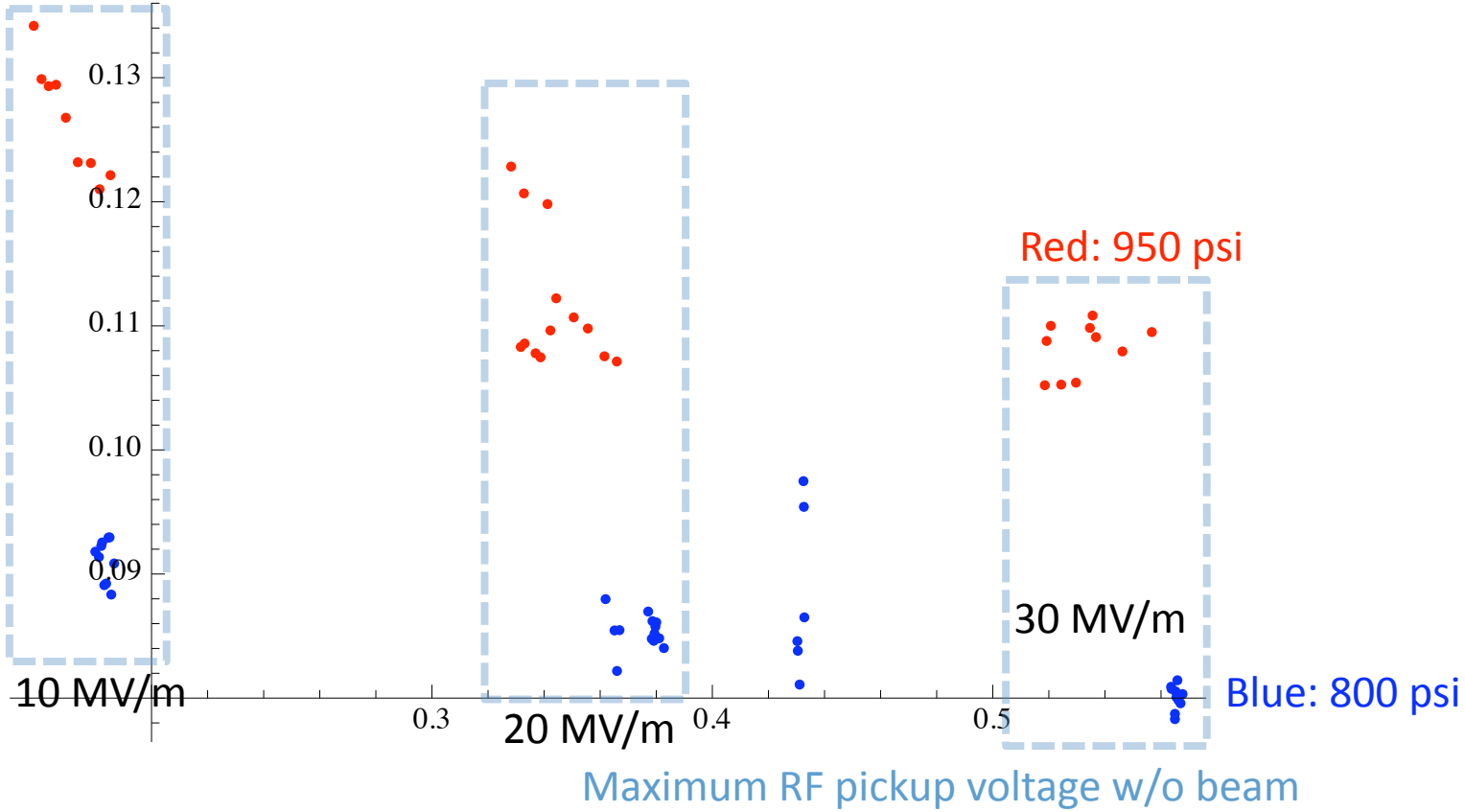
Envelop of RF pickup signal after full loading



Beam loading effect on RF pickup signal

Ratio =

Equilibrium RF voltage/Maximum RF pickup voltage w/o beam

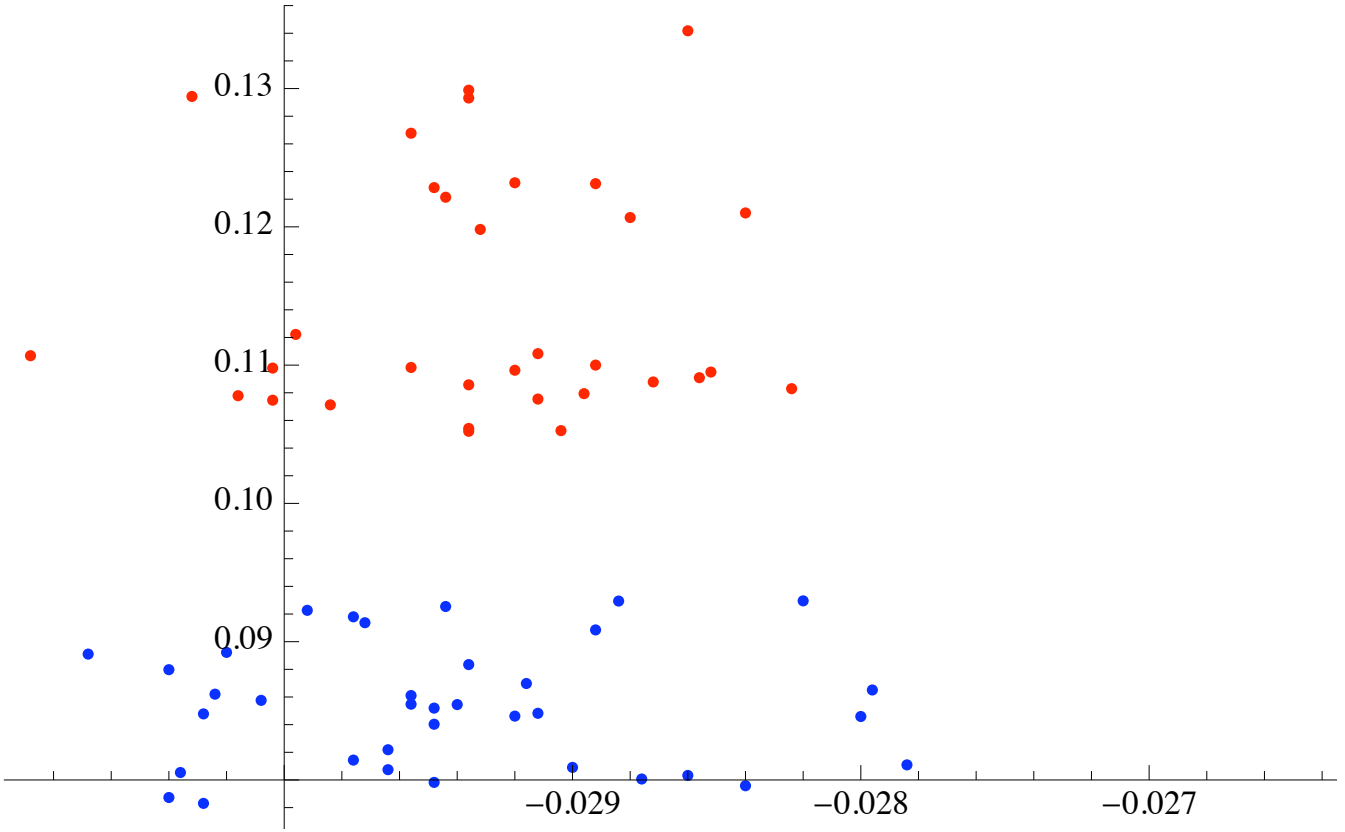


1. Higher pressure gets better recovery rate
2. Some correlation between RF field gradient and recovery process
   - Plasma temperature dependence?

RF pickup voltage vs beam intensity

Ratio =

Equilibrium RF voltage/Maximum RF pickup voltage w/o beam

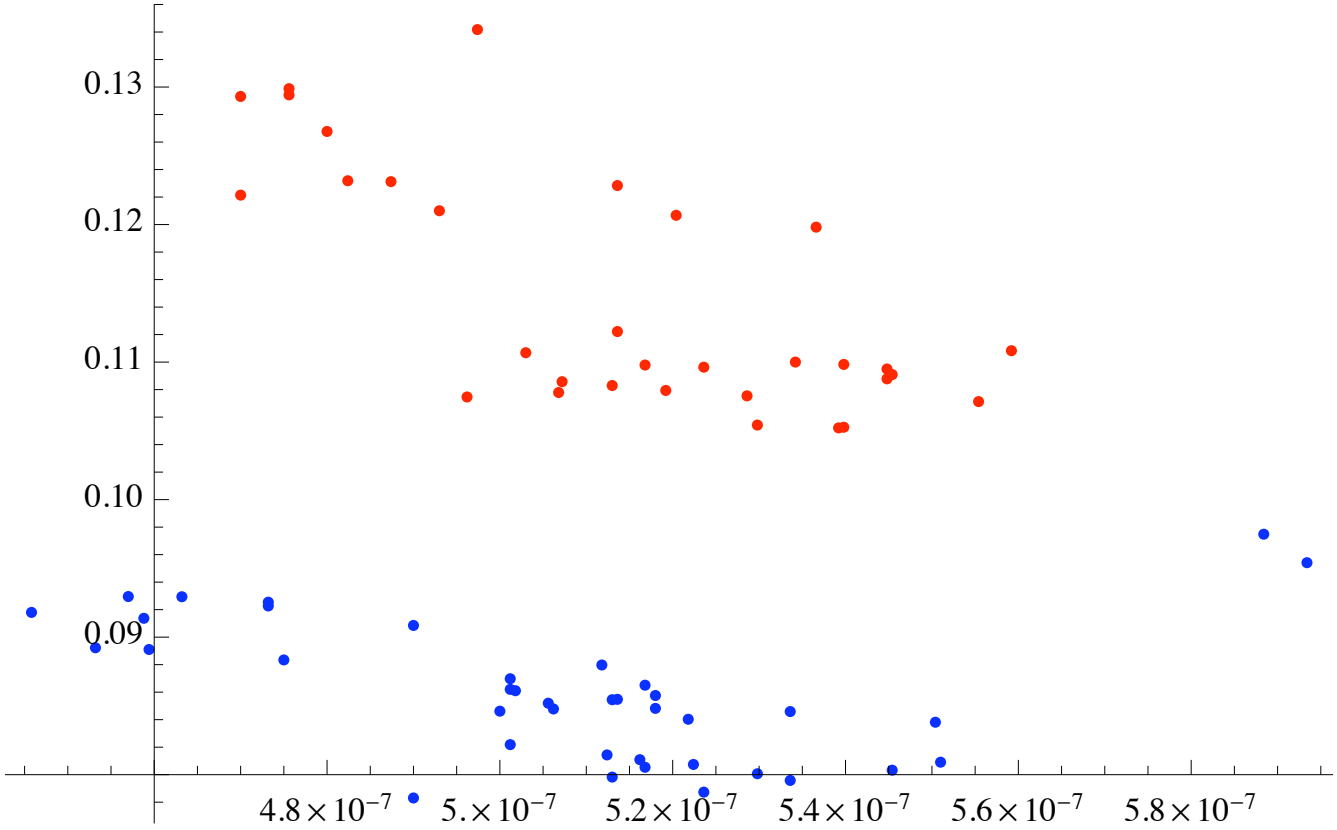


1. Beam intensity was moved ± 10 %
2. Ratio is flat with this fraction

Decay time

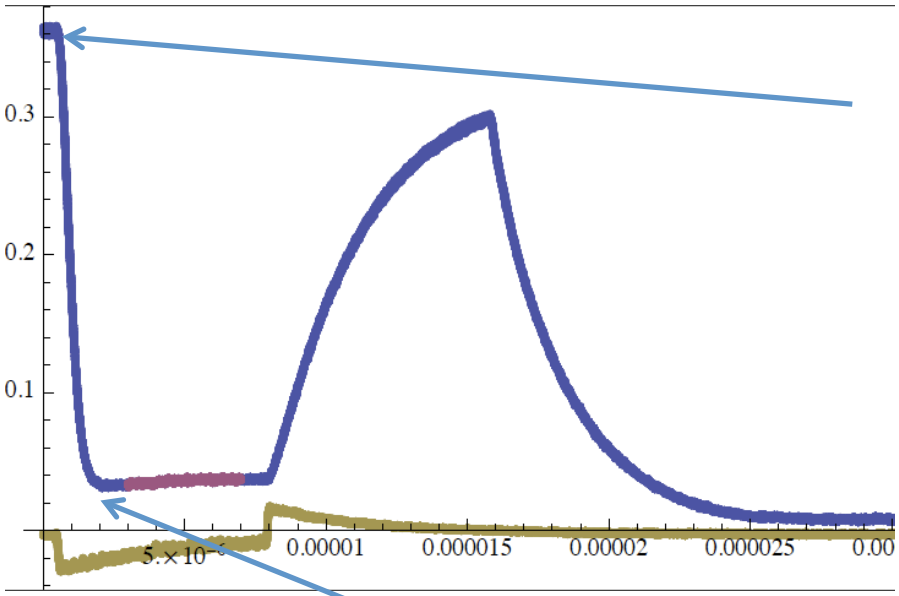
Ratio =

Equilibrium RF voltage/Maximum RF pickup voltage w/o beam

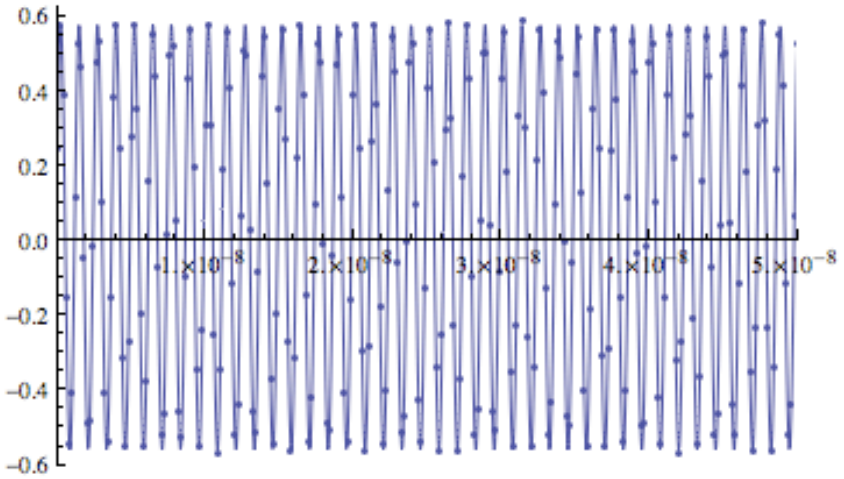


1. Decay time (1/e) is ~ 500 ns
2. Decay time tends to be longer in denser hydrogen gas

RF frequency modulation




```
Show[{ListPlot[ch2, PlotRange → {{0, 0.5 × 10^-7}, All}],
  Plot[yfit[t] /. acFit, {t, 0, 0.5 × 10^-7}]}]
```

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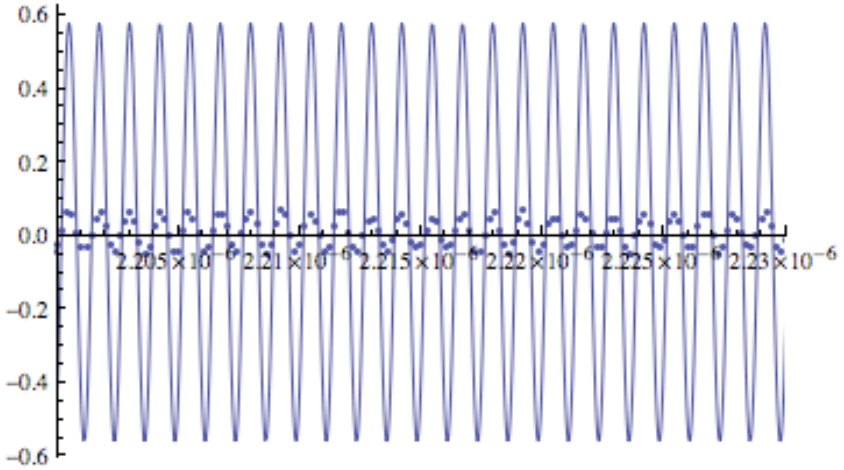
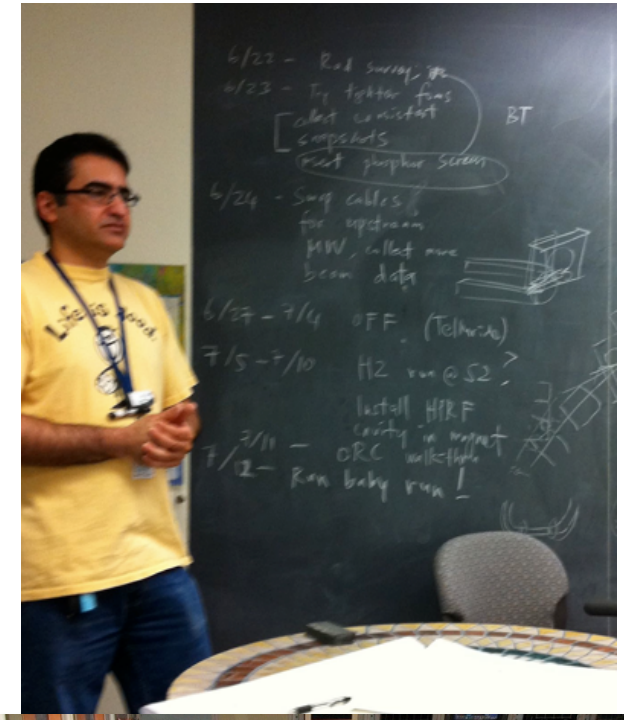


Neither RF frequency shift nor phase shift observed

Conclusion

- First beam test just begun
- No breakdown in cavity (no explosion)
- Denser gas has better recombination rate
- Plan to take beam intensity dependence
- Plan to take electronegative gas effect


6/23 - Rad survey
6/23 - Try tighter fins
collect accident
snapshots
BT
Fast phosphor screens
6/24 - Swap cables
for upstream
MW, collect more
beam data
6/27 - 7/4 OFF (Telluride)
7/5 - 7/10 H2 run @ 52?
Install HBRF
cavity in magnet
7/11 - ORC walkthrough
7/12 - Run baby run!