

MTA RF work

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(thanks to Al Moretti, Yagmur Torun and Katsuya
Yonehara for providing the content)



Outline

- MTA hall status and plans
- Experimental program status and plans
- Preview of results from recent HPRF tests



Status of

MTA HALL



MTA Hall Reconfiguration

- Hall mechanical and electrical
 - 201 MHz cavity on new platform, magnet and valve box on new stands
 - New cables installed, new detector stands to be built Dec
 - Clean room raised, fans/lighting to be upgraded next week
 - Manlift replaced, mobile crane, lifting fixtures to be delivered Dec



Housekeeping

- Upgrade clean room to around class-100 for RF cavity inspection.
 - Everything in hall wiped down, hall and entryway floors sealed
 - New rules (no drilling, cutting; wipe down new equipment; wear shoe covers)
 - Upstairs entrance reconfigured with new door, cabinet to be installed for shoe/shoecover storage
 - Clean room to be cleaned next week
 - New instrumentation to monitor particle counts, temperature, humidity in clean room



Cryo status

- Move from Dewar operation to cryo plant
 - Valve box in hall and transfer line installed
 - Plumbing, controls, instrumentation to be finished this week
 - Commissioning, magnet cool-down expected Dec/Jan



Beam line

- Beam commissioned to 1st stop, beam absorber installed
- Rate limiter built, controls integration shake-down Dec
- Waveguides rerouted, shielding replaced in pit and hatch, small amount to be installed in refrigerator room (and possibly hall)
- Radiation assessment to be submitted to DOE Dec/Jan
 - Rad Safety have first draft
- Commissioning to hall when approved (Spring 2010)



Status of, and plans for

MTA RF PROGRAM



Laundry list

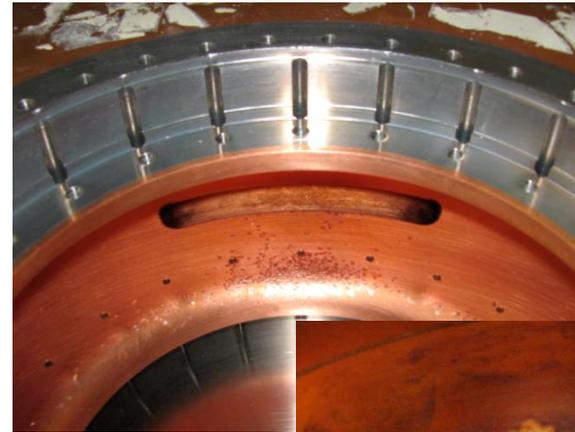
- Refurbished pillbox
- Rotatable square box cavity ($E \parallel B$)
- HPRF beam test

- Rotatable square box cavity ($E \perp B$)
- Beryllium pillbox
- ALD cavity?
- Dielectric filled cavity?



805MHz pillbox status

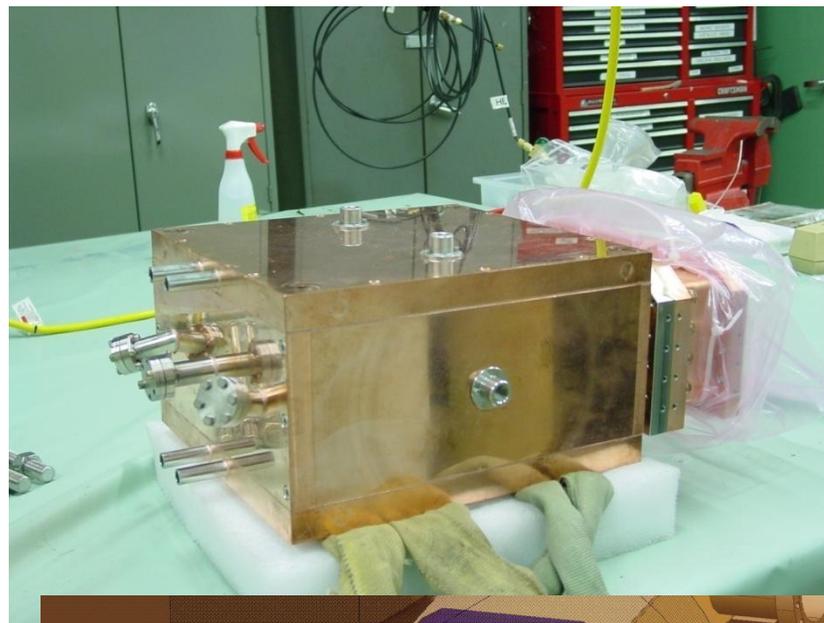
- Goal is to refurbish the cavity, ensure that breakdown is confined to button surfaces and redo button studies
- Cavity repaired at JLab
 - Interior surface polished, coupler slot edges rounded
 - but not leak tight after assembly
- New tin seals (vacuum) built at LBNL (sent to JLab this week)
- Button hardware machined at Mississippi
 - 2 new button holders (sent to Jlab this week)
 - 2 new Cu disks (under button holder) to be finished mid-Dec
 - 2 Cu and 2 Be buttons with new design (x 2.25 field enhancement, up from 1.7)
 - Also 2 old style button holders
 - to be paired with unused Cu and possibly other old buttons
 - as well as fresh ones from Cockcroft
- Parts to be TiN coated at Jlab (Jan)
- Final assembly, leak check afterward
- Installation at Fermilab (Jan)
 - Minor changes to vacuum system to accommodate new configuration



More E(B) data for different button materials next year

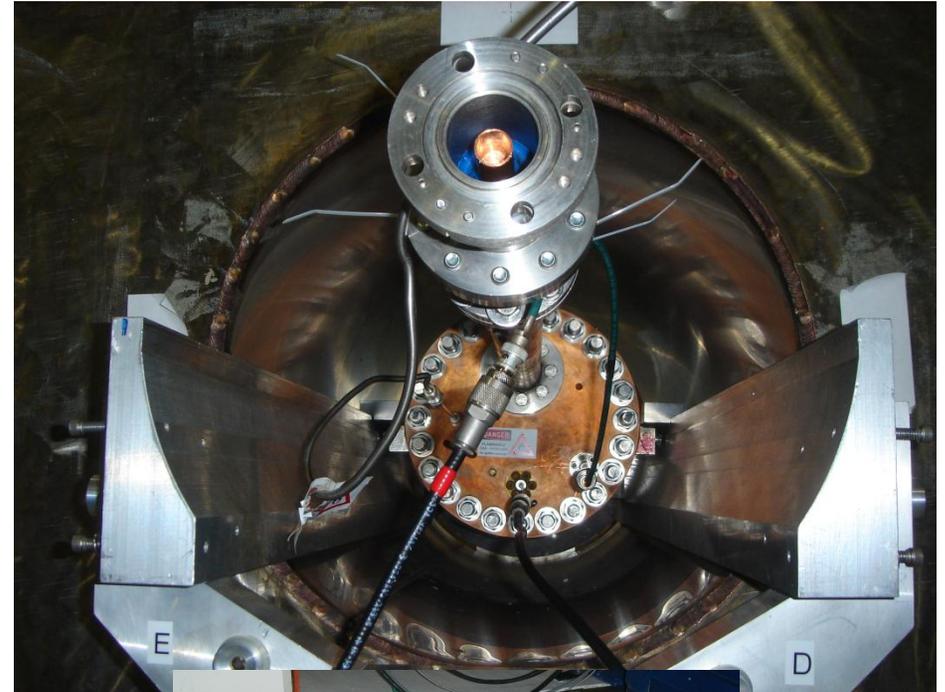
Rotatable cavity

1. The Orthogonal box cavity has been connected to its $\frac{1}{4}$ waveguide coupling section through a Tin seal and successfully vacuum leak checked in the A0 test lab, Figures 1, 2 and 3.
2. After the Holidays, Test WG Power Coupling Section, Figure 4 and 5, will be attached and Network Analyzer measurements of the match, Frequency, and Q_0 made. The frequency with probes has been made and F_0 was found to be within calculated range at 804.978 MHz.
3. The rotatable (to over 12 Degrees in very small steps) magnet support frame is in the machine shop currently being fabricated; Should be available Dec. 14th for installation in the magnet. Long lead time items on order.
4. The outside support fixture to for inserting the cavity in the magnet is about 90 % complete. It is schedule to be ready shortly after Dec. 14th. Long lead time items are on order.
5. The vacuum system has been designed with a Flexible vacuum hose section that allows full rotation. All parts are on hand; installation and testing schedule for the week of Dec. 21 st.
6. Installation completion First week of the New Year.
7. Installation of signal cables, Flexible WG sections to accommodate the rotation, and calibration scheduled to be completed by Second week of the New Year.
Operation will begin shortly after.



HPRF cavity

- Cavity modified
 - Added 2nd optical port
 - Added magnetic pick-up
- New optical diagnostics
 - Faster PMT
 - Spectrometer/Monochromometer
- Planning for beam test
 - RF re-routing
 - Design collimator to define beam



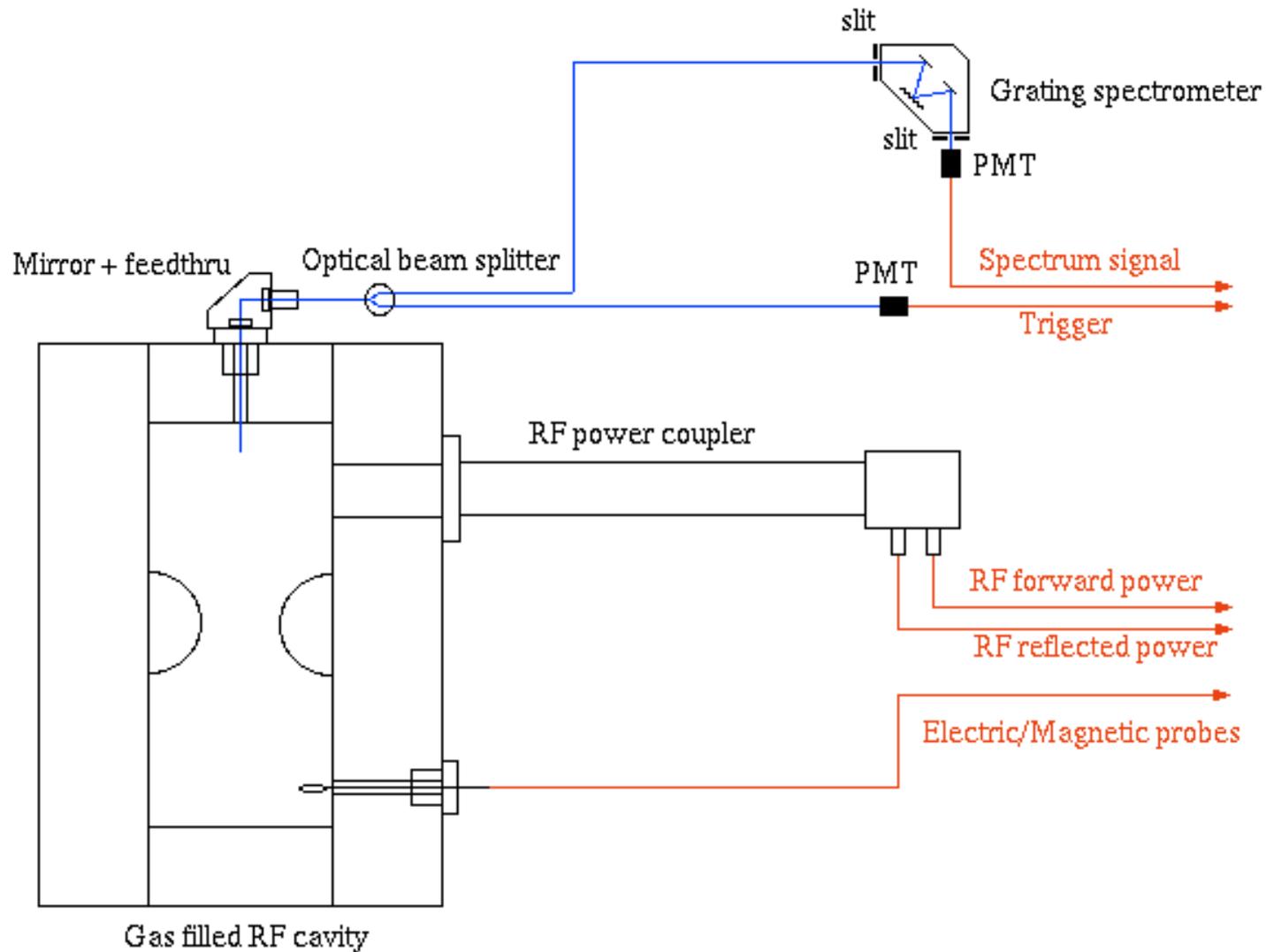


Preview of

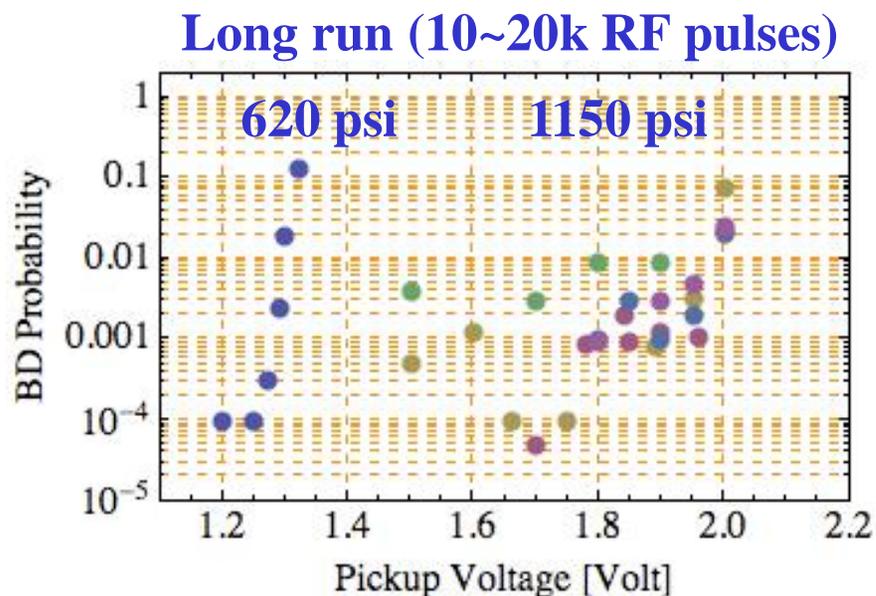
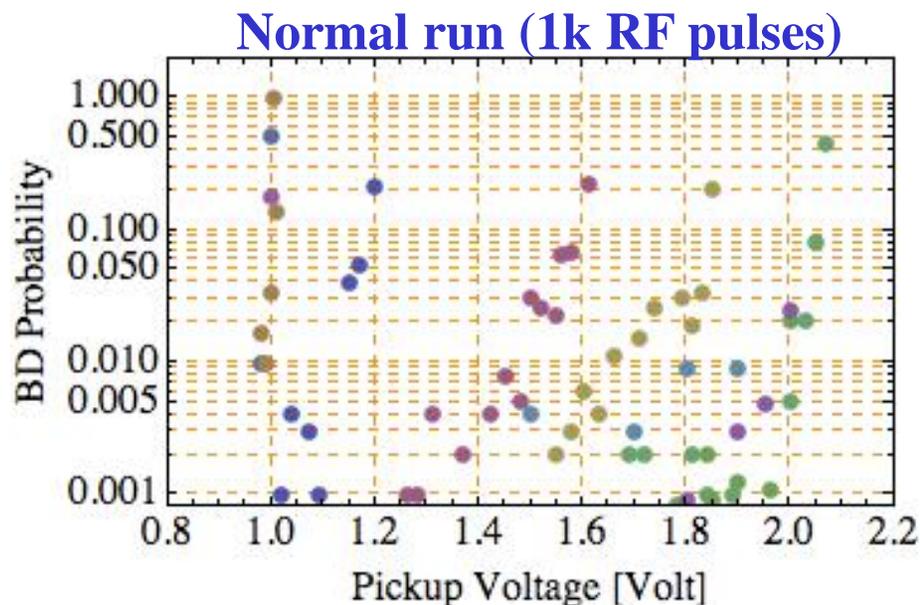
RECENT HPRF RESULTS



Experimental setup



STUDY OF BREAKDOWN PROBABILITY

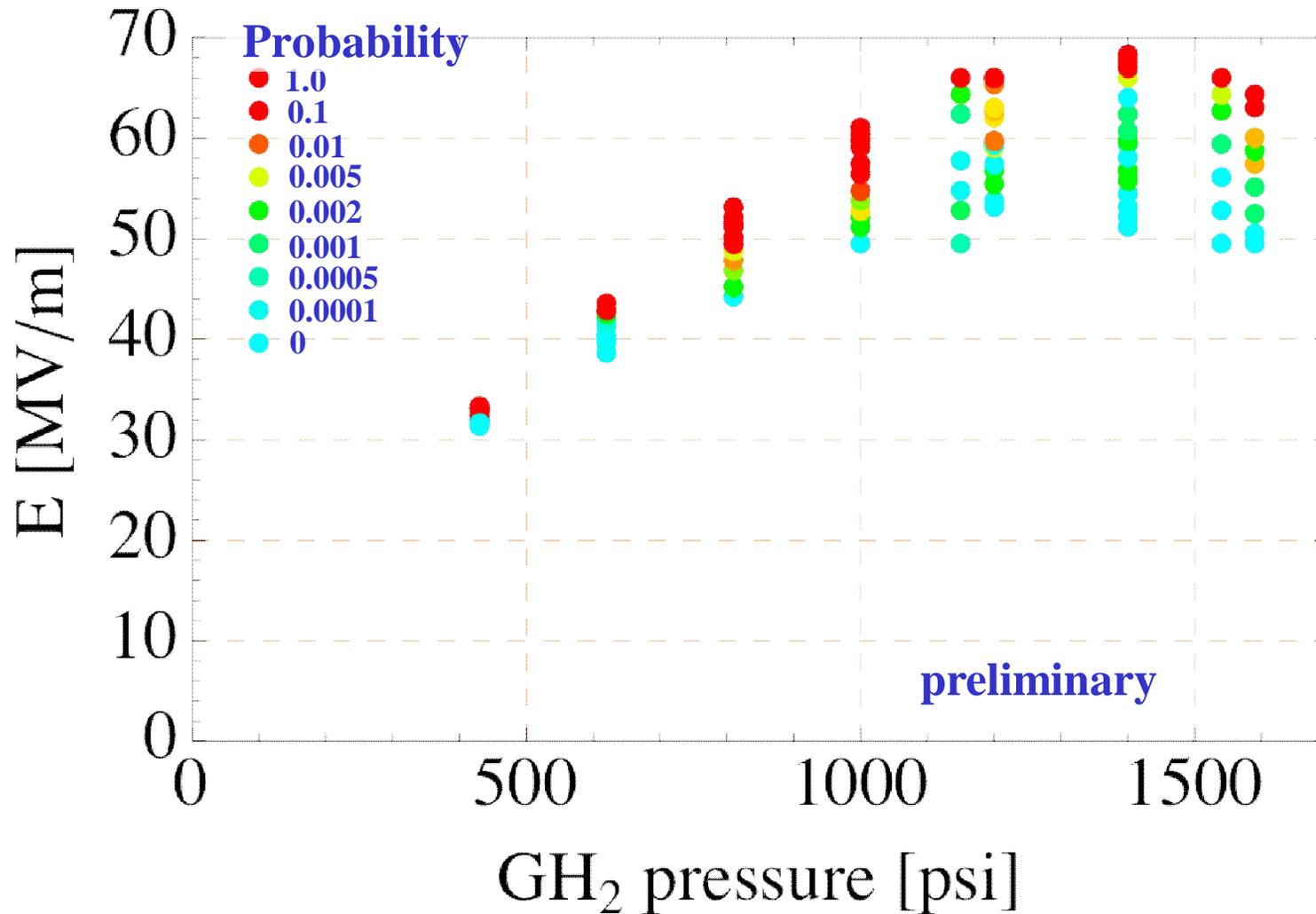


$$Probability = \frac{N_{BD}}{N_{RF}} \quad \begin{array}{l} N_{BD} : \# \text{ of breakdowns} \\ N : \# \text{ of RF pulses} \end{array}$$

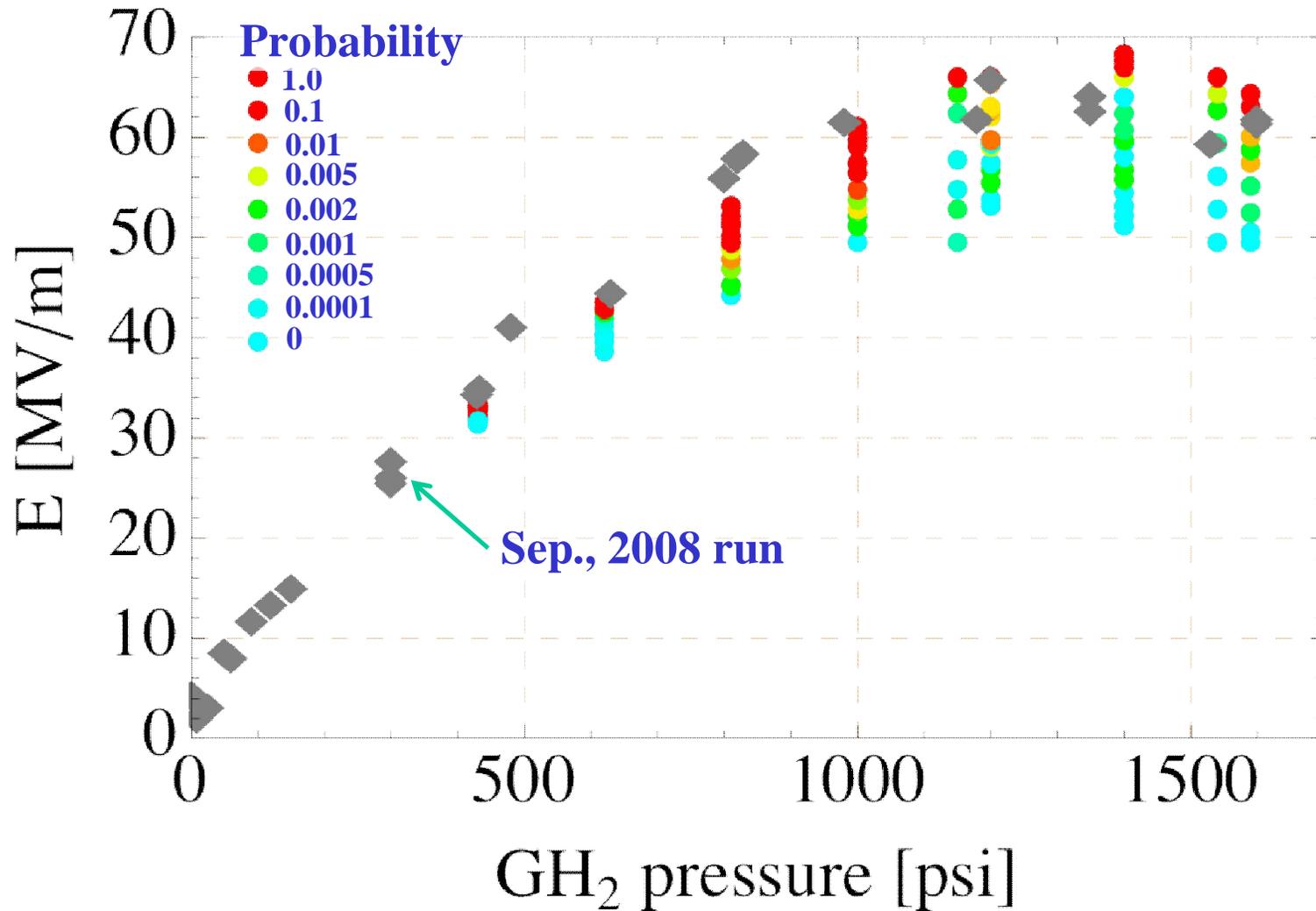
- BD probability curve is very clear shape at low pressure region
- Boundary becomes fuzzy at high pressure region (> ~1000 psi)



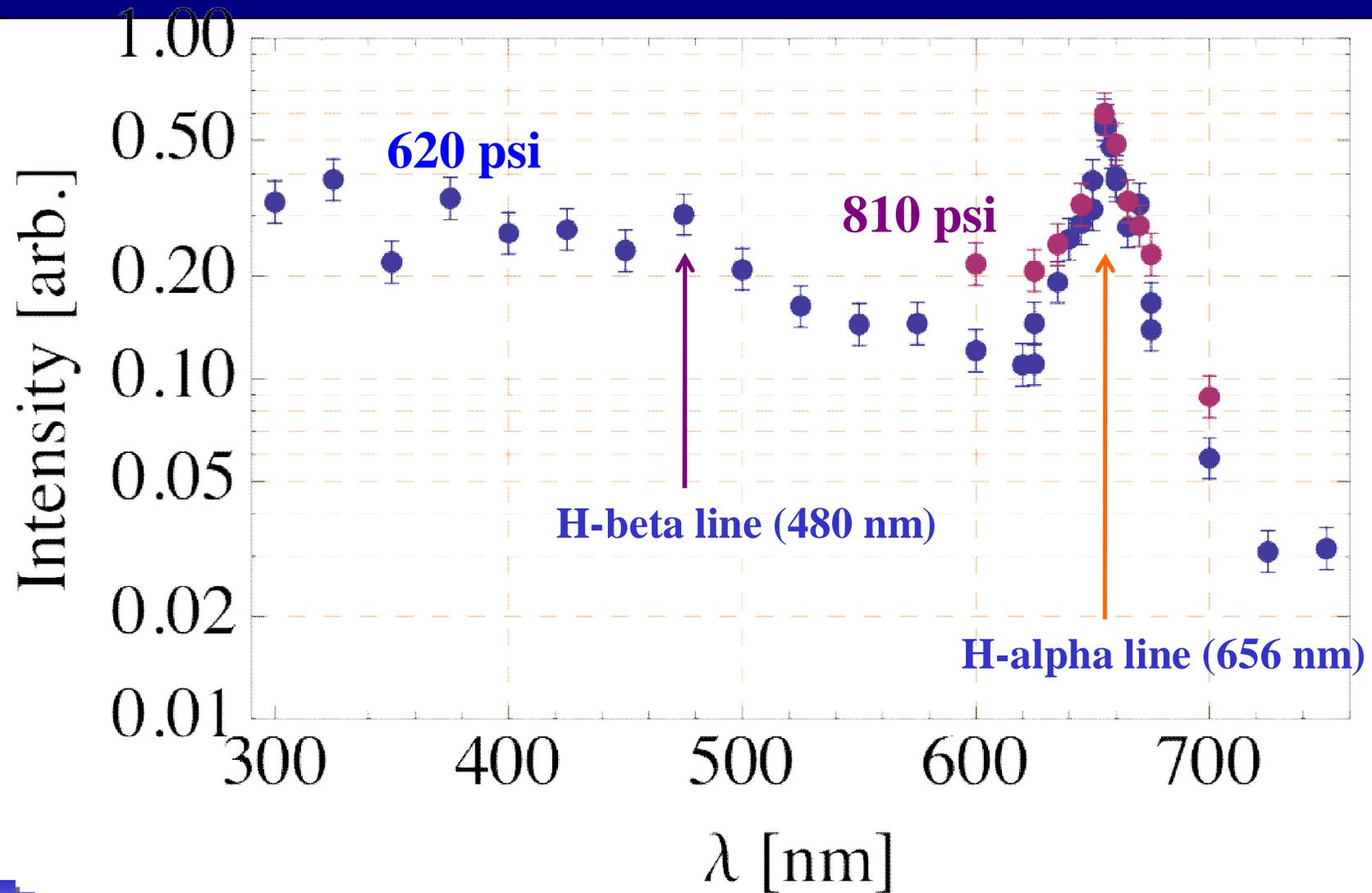
BREAKDOWN PROBABILITY

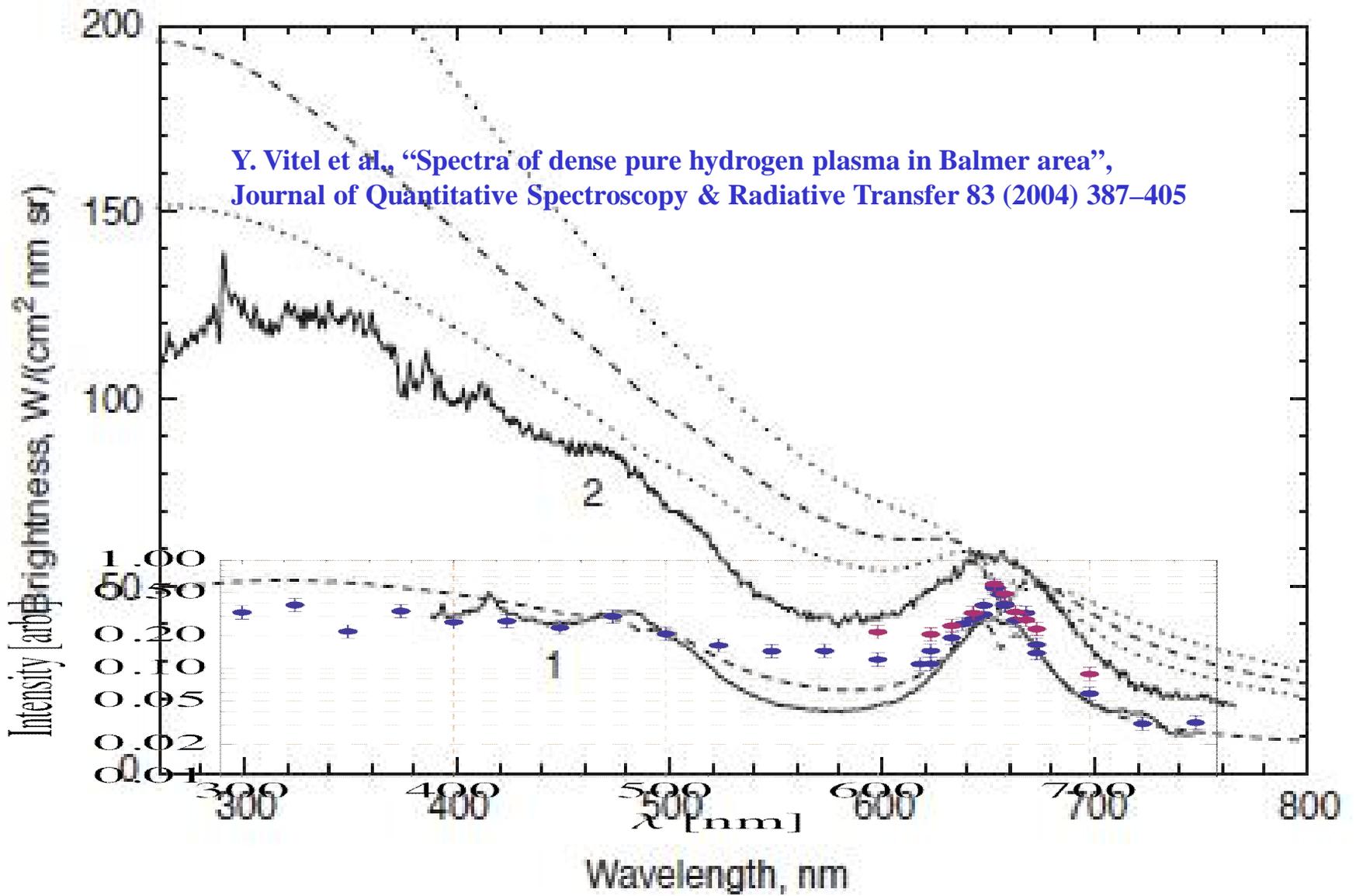


Compare with past result

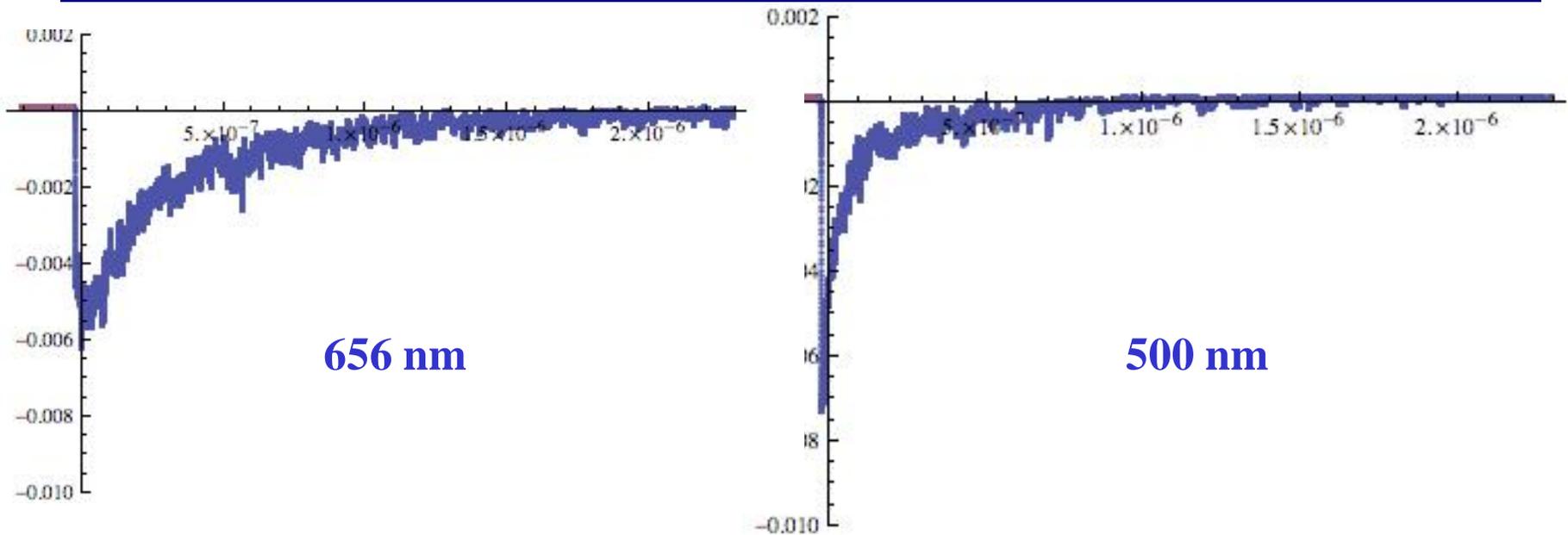


SPECTROSCOPIC STUDY





SPECTROSCOPIC STUDY



- **656 nm is near H-alpha line**
- **500 nm is none of any atomic lines**
- **Decay slope in 656 nm spectrum is ~ 500 ns, that is matched to the spontaneous emission lifetime (inverse of Einstein constant)**



HPRF summary

- Very successful run!
- Probability of breakdown as a function of voltage mapped out for various gas pressures
- First spectroscopic measurement in HPRF has been done,
 - Hydrogen lines observed
 - Broad band spectra was observed (may be able to extract plasma temperature from this)
- More detailed results will be reported once analysis is complete



Conclusions

- It is critical that we understand the limitations of the various cooling channel RF options
 - Gradient limits as function of B (and orientation) in vacuum cavities
 - Cavity Q change and recovery rate for HPRF cavities interacting with beam.
- MTA will be very busy for the next couple of years!

