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First Results on a New 1.3 GHz Coupler Component Test Stand*

B. Rusnak (LLNL) (presenting), C. Adolphsen, F. Wang, G. Bowden, E. Doyle, L. Ge, K. Jobe, L. Laurent, B.D.McKee, C. Nantista, R. Swent, J. Tice, N. Yu (SLAC)

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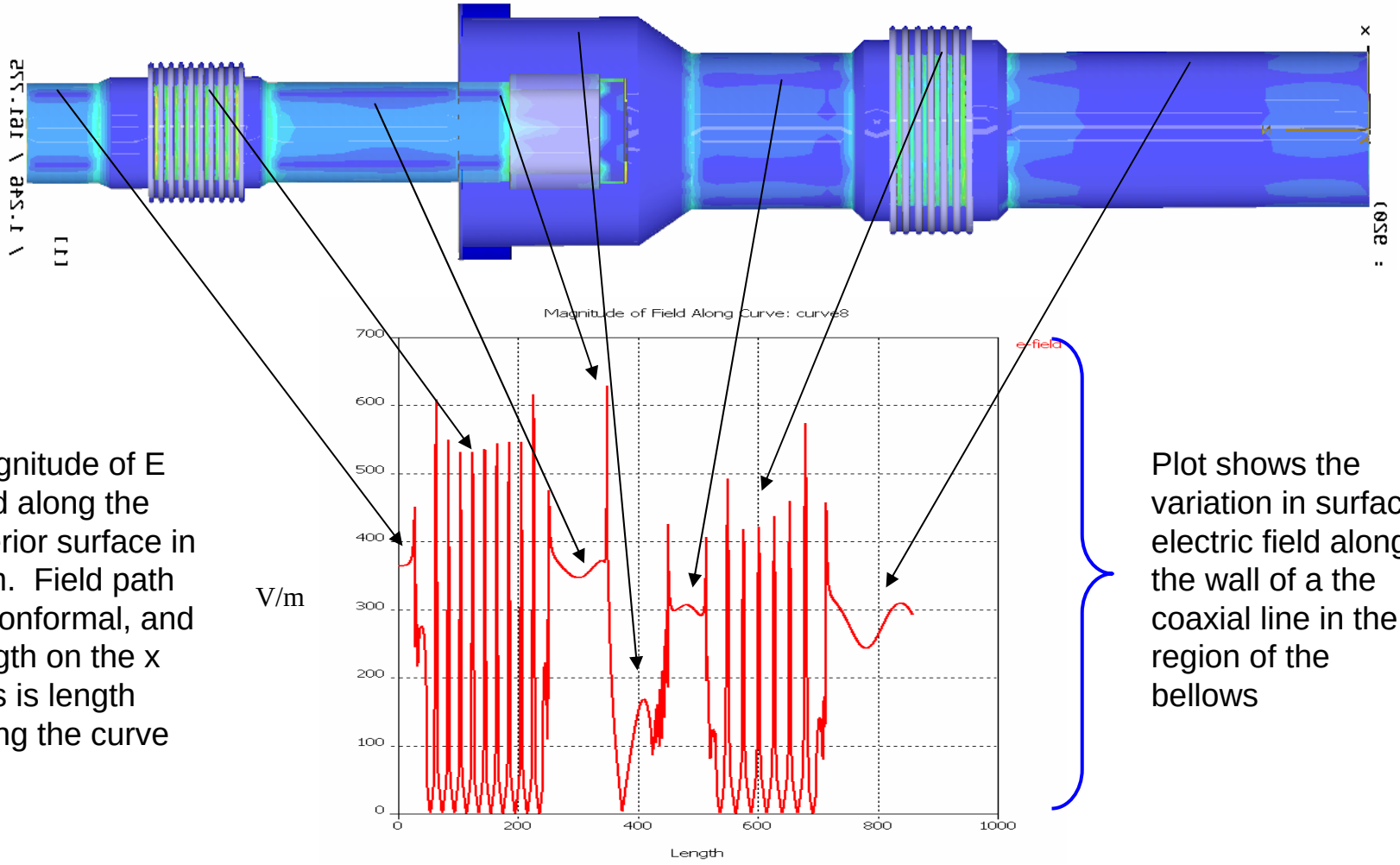
Outline

- Objectives and approach
- Experimental apparatus and set up
- Initial measurement data and modeling

Objective is to understand conditioning impact from specific design features of the TTFIII coupler design



Magnitude of E field along the interior surface in V/m. Field path is conformal, and length on the x axis is length along the curve

Plot shows the variation in surface electric field along the wall of a the coaxial line in the region of the bellows

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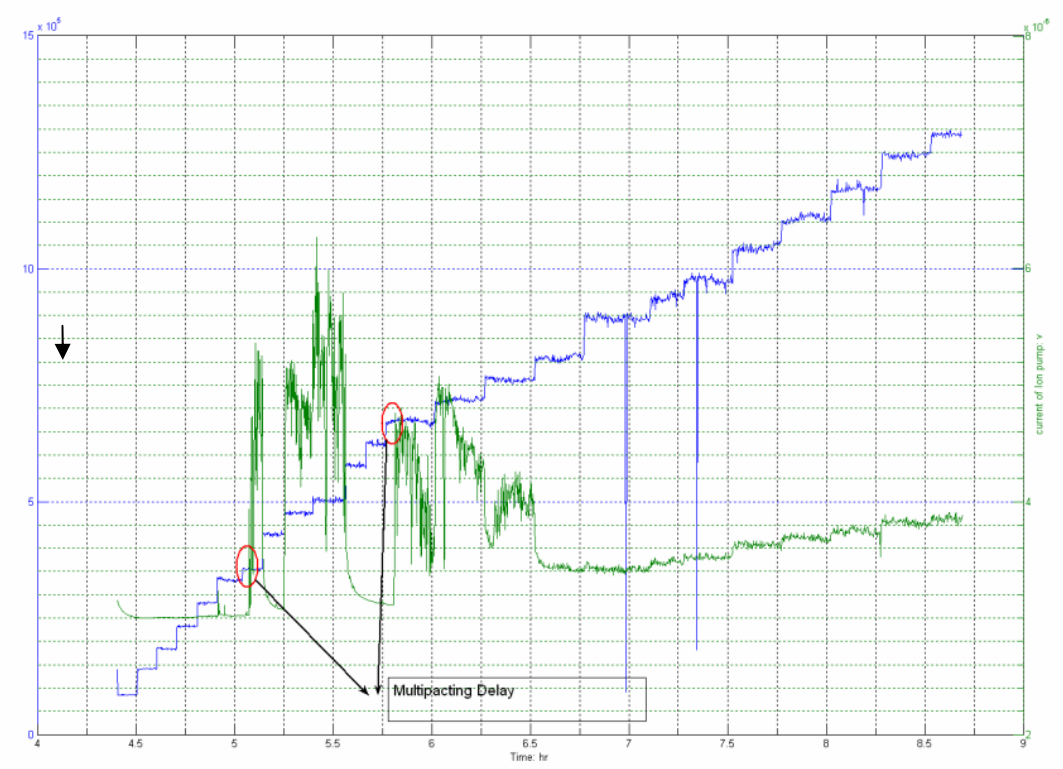
Approach is to test part types at power to evaluate the conditioning response and calculate gas load

Plot shows the system vacuum response (green) as a function of power (blue)

Qualitatively, vacuum response indicates processing activity which shows which components contribute

Quantitatively, by numerically integrating the pressure curve, we hope to calculate the total gas load evolved to allow comparisons



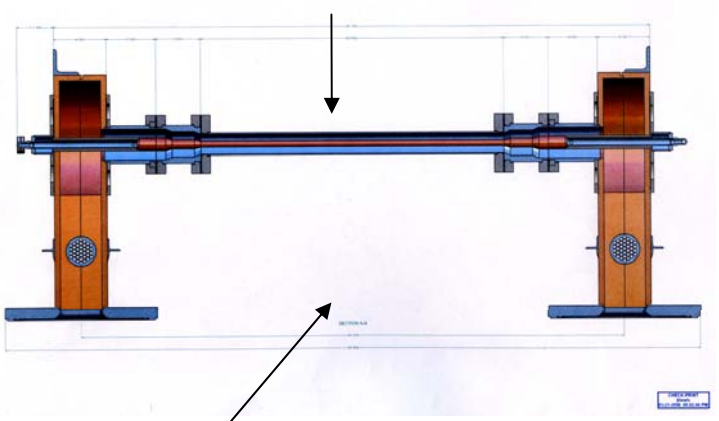
$$P(t) = \left\{ P_i - \left[1 + \frac{S_p}{C}\right] P_0 - \left[1 + \frac{S_p}{C}\right] \frac{Q_G}{S_t} \right\} e^{\left(\frac{-S_t t}{V\left[1 + \frac{S_p}{C}\right]} \right)} + \left[1 + \frac{S_p}{C}\right] P_0 + \left[1 + \frac{S_p}{C}\right] \frac{Q_G}{S_t}$$

$$Q_{DUT} = S_t \left(\frac{P_i}{1 + S_p / C} - P_0 \right) + V \frac{dP}{dt} - Q_{sys}$$

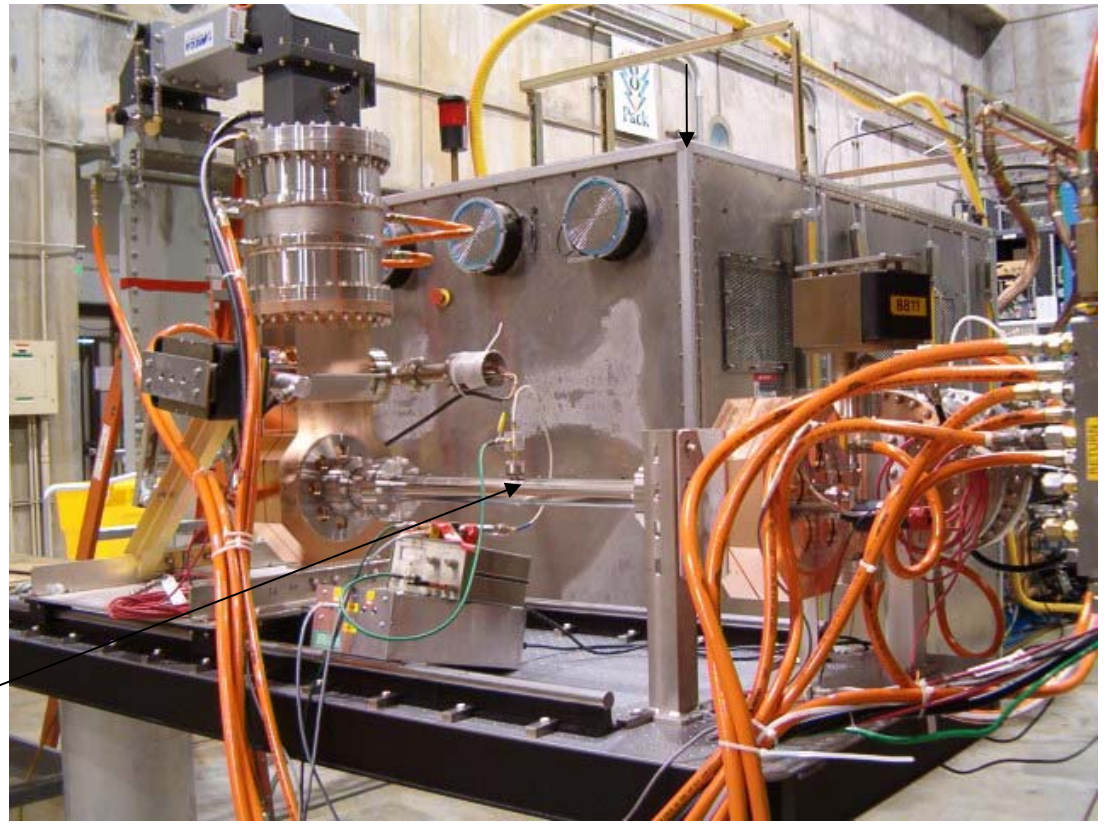
$$T_{DUT-RF} = \frac{1}{kT} \sum \left(\frac{P_i}{1 + S_p / C} - P_0 \right) S_{t_i} \Delta t + \frac{V}{kT} \sum \left(\frac{dP_i}{dt} \right) \Delta t - T_{SYS-RF}$$

To do these measurements, a novel L-band test stand was developed and installed at SLAC

Component Under Test



Concept and hardware of test set up for measuring components – first test component is a 40 mm straight tube



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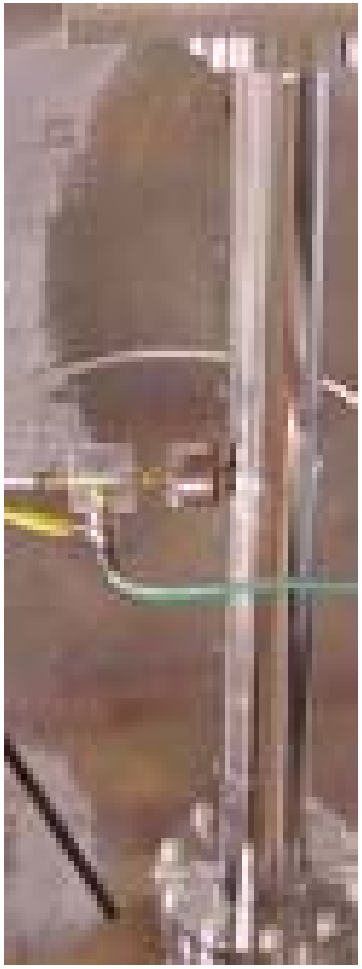
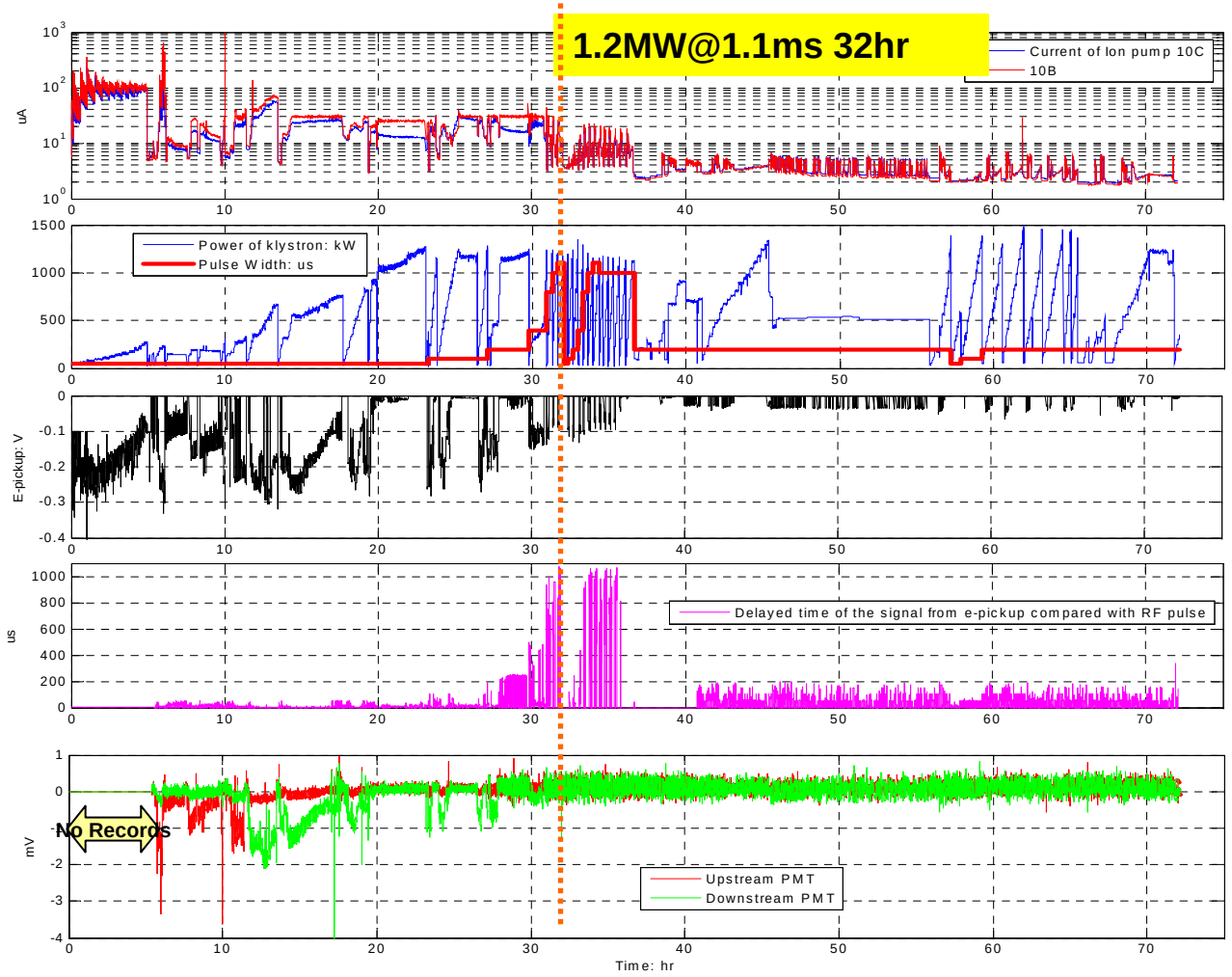
Initial results on a 40 mm diam 70 Ohm straight tube coax with an electron pickup have already proved interesting





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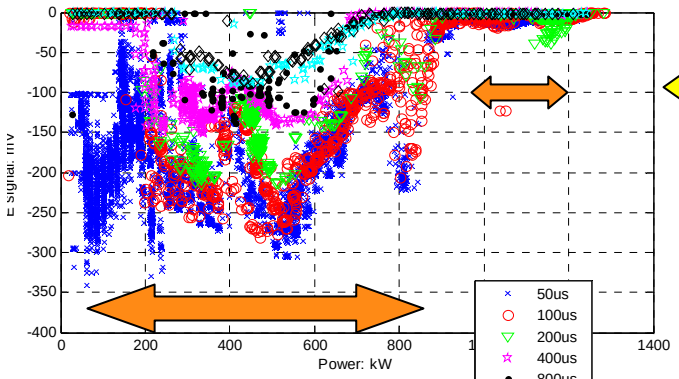
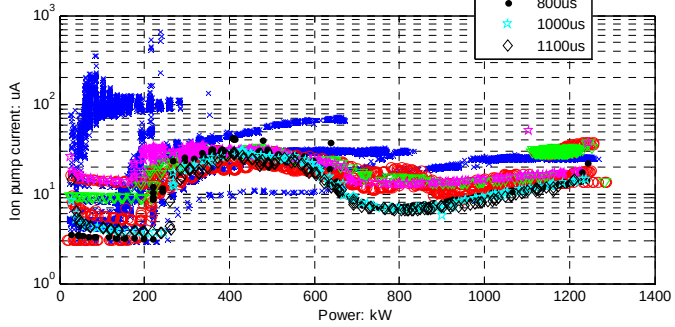
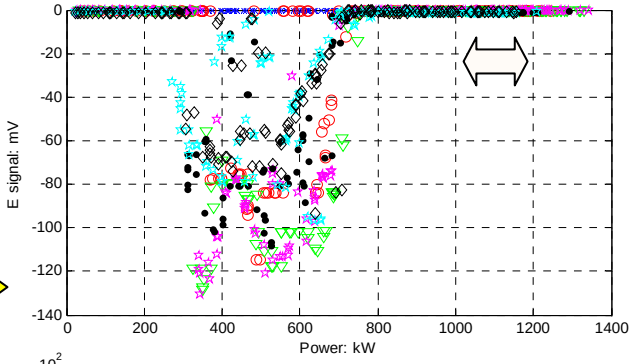
Significant conditioning activity was observed

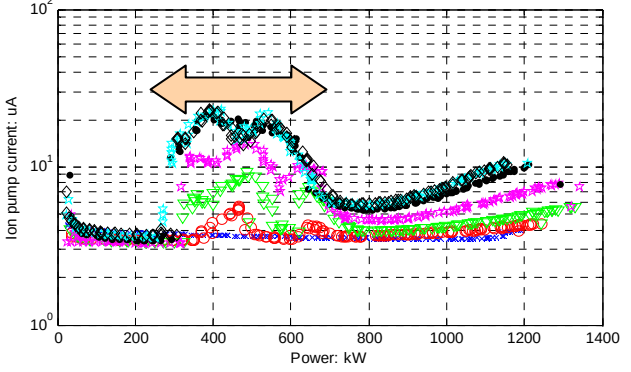


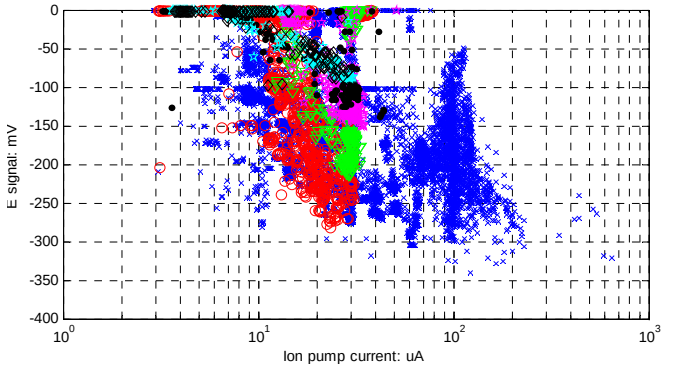
Before 32hrs

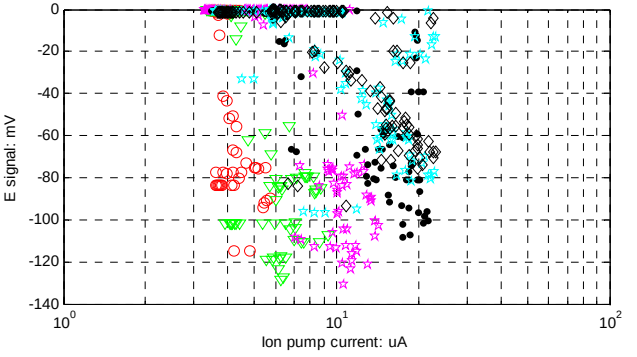


After 32hrs



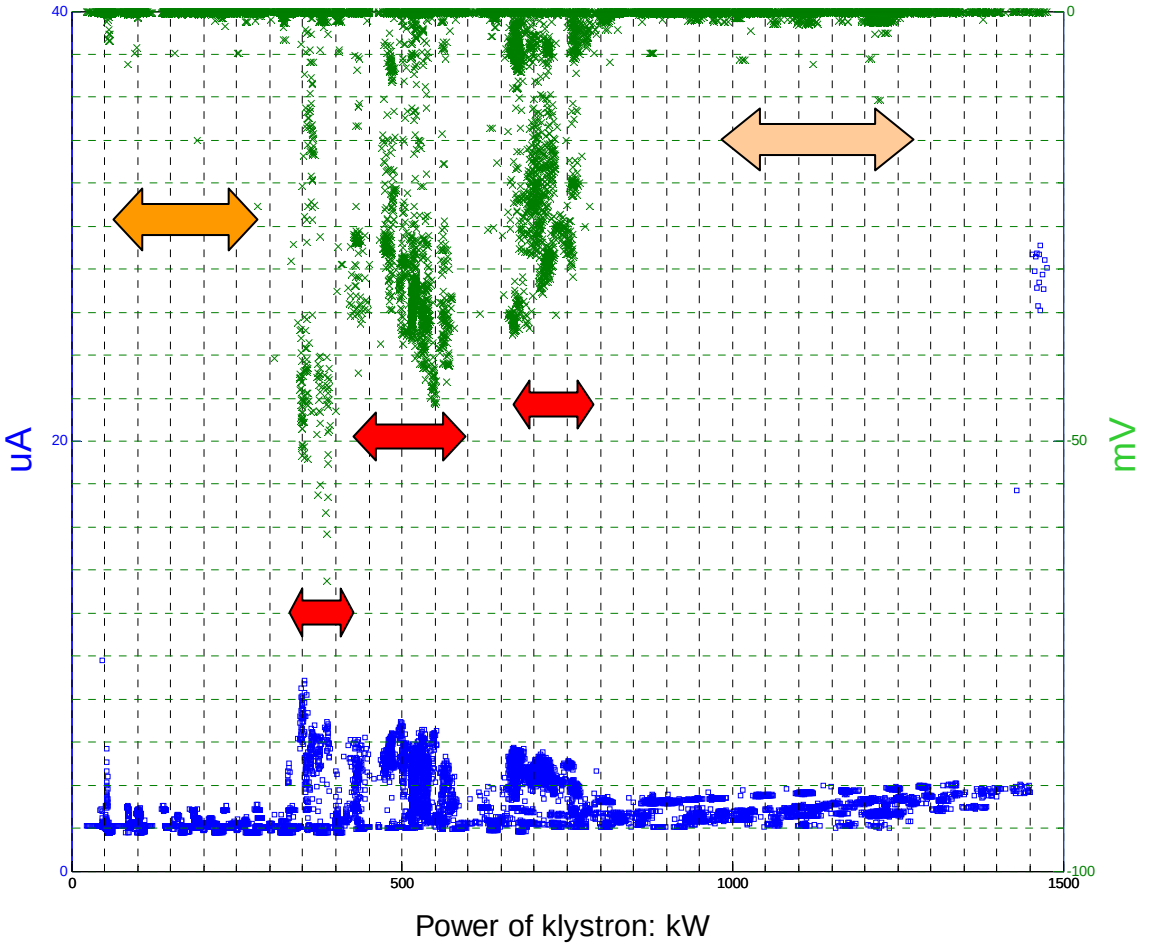






Multipacting bands were observed that agreed with simulations (next slides)

After proceeding, ramp power, step 10kW-300s



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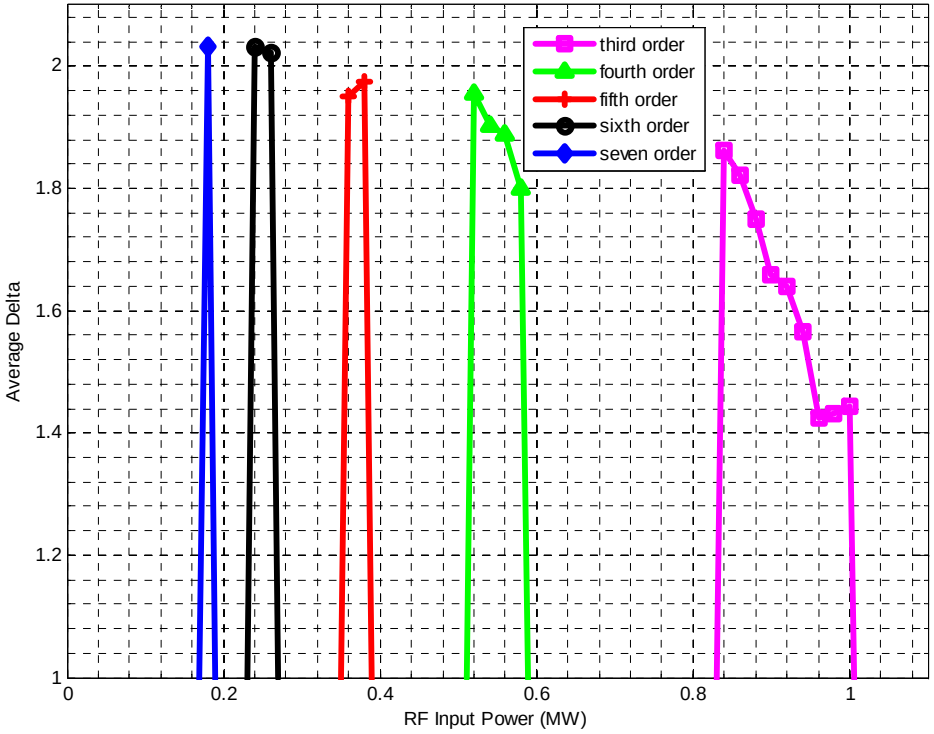
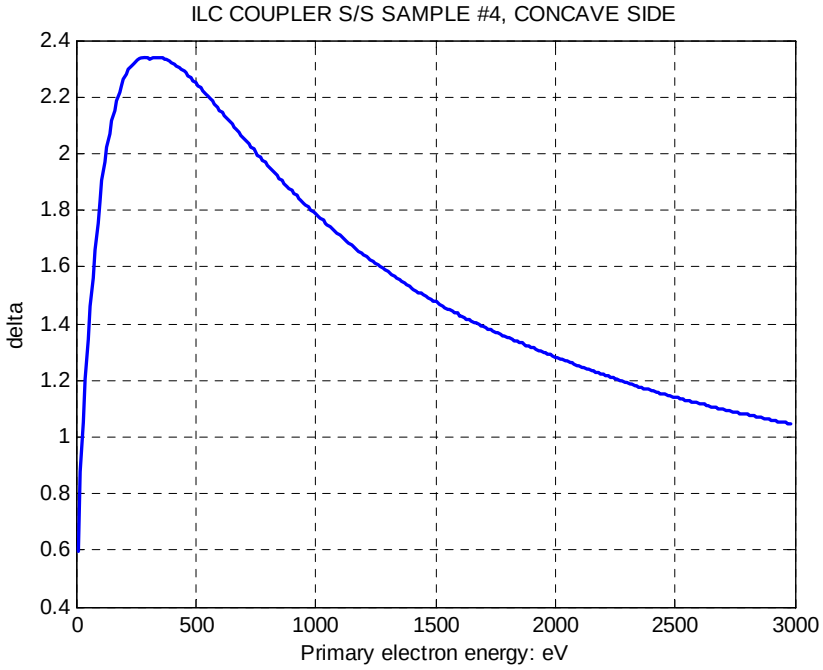
L. Ge, ACD, SLAC, 04/20/07

Robert Kirby, SMS, 04/05/07





Simulation	170~190	230~270	350~390	510 ~590	830~1000
Power in Coupler	43~170	280~340	340~490	530~ 660	850~1020
klystron power	50~200	330~400	400~580	620~780	1000~1200

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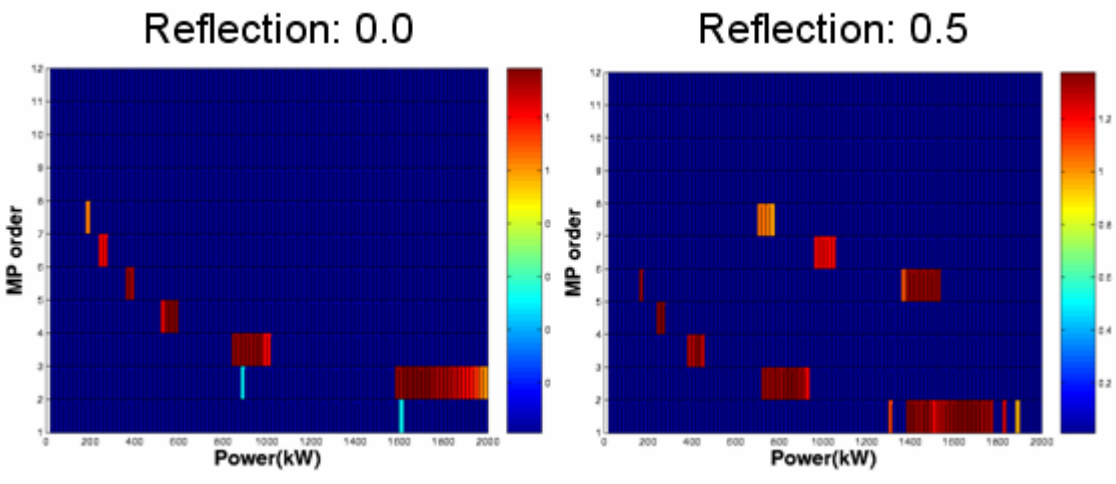
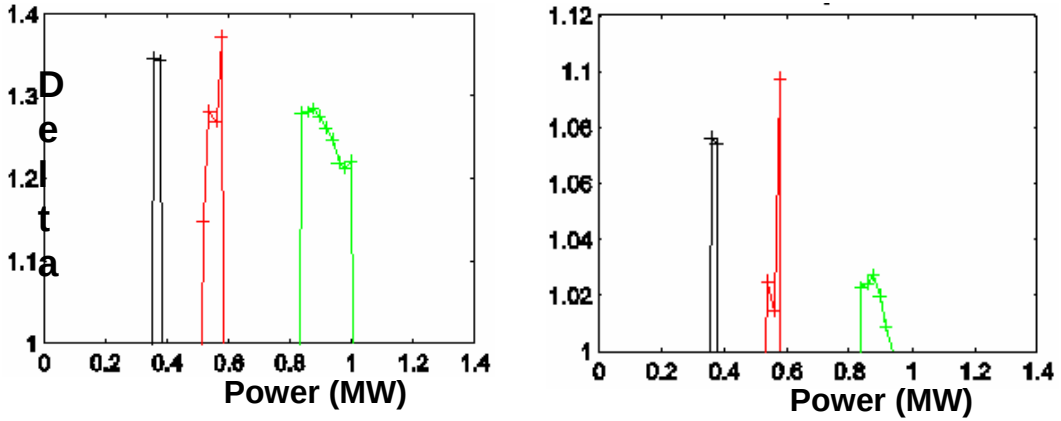
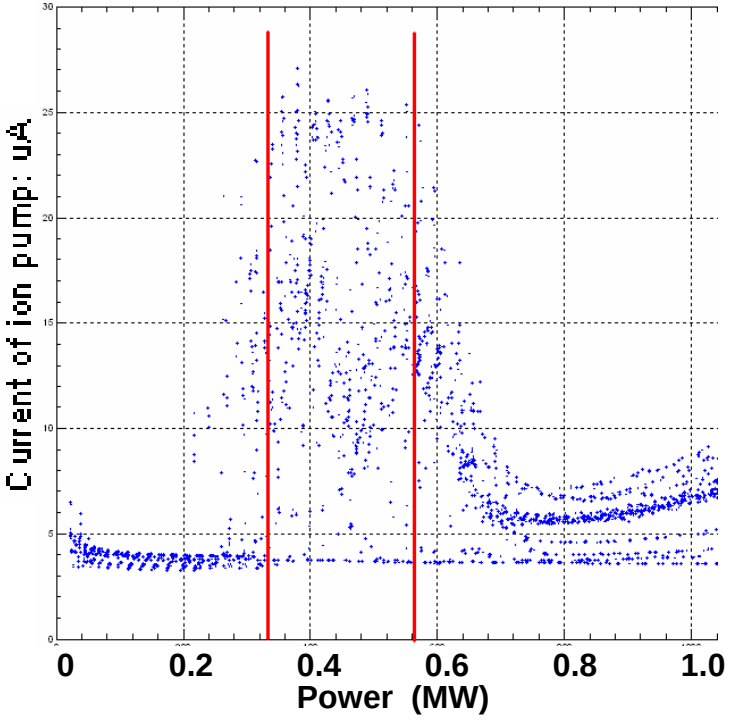
Cold Coax Multipacting Modeling (Work by Lixin Ge)





Simulation vs. Measurement



High power test (F. Wang, C.A., etc)

More components are being studied and will be compared with measurements.

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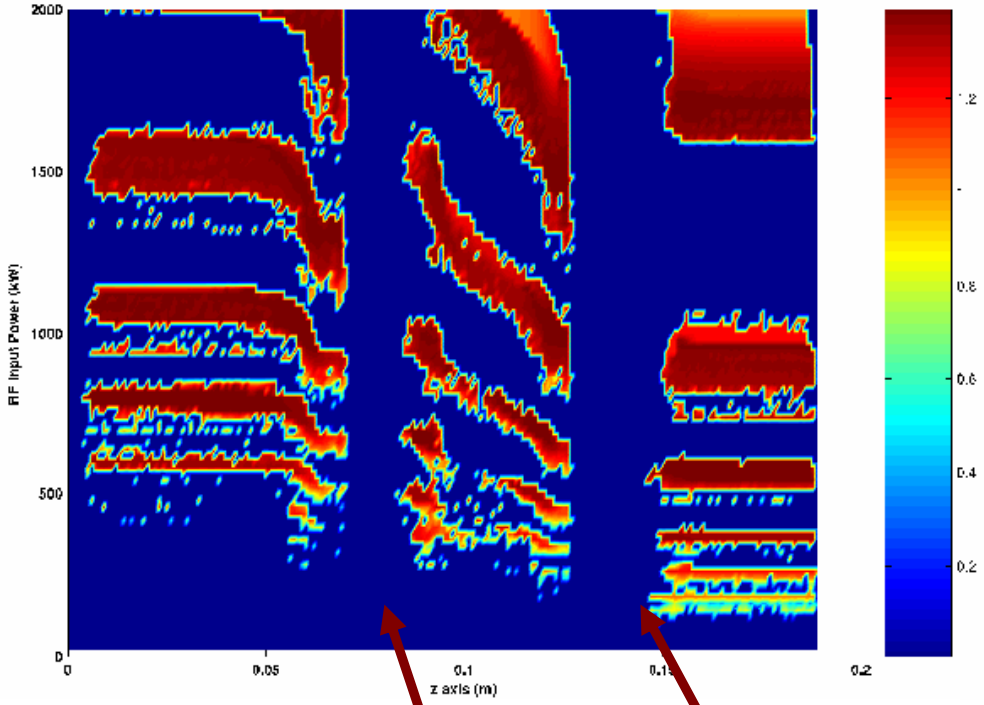
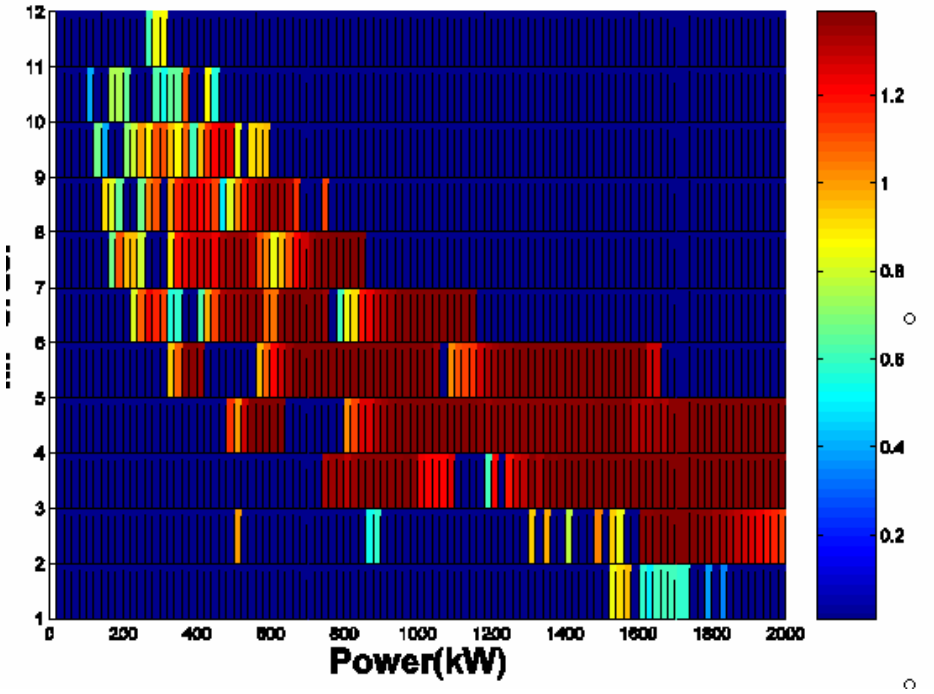
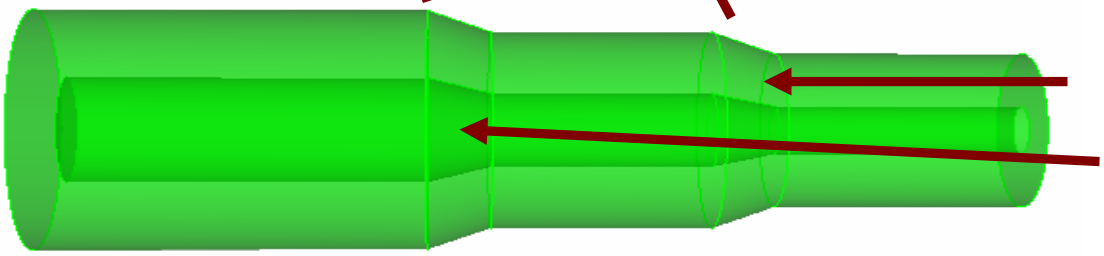
Taper Region Multipacting Modeling (Work by Lixin Ge)

Delta as a function of RF input power and z axis locations



Delta as a function of RF input power and MP order.





No Multipacting activities between coax pipe

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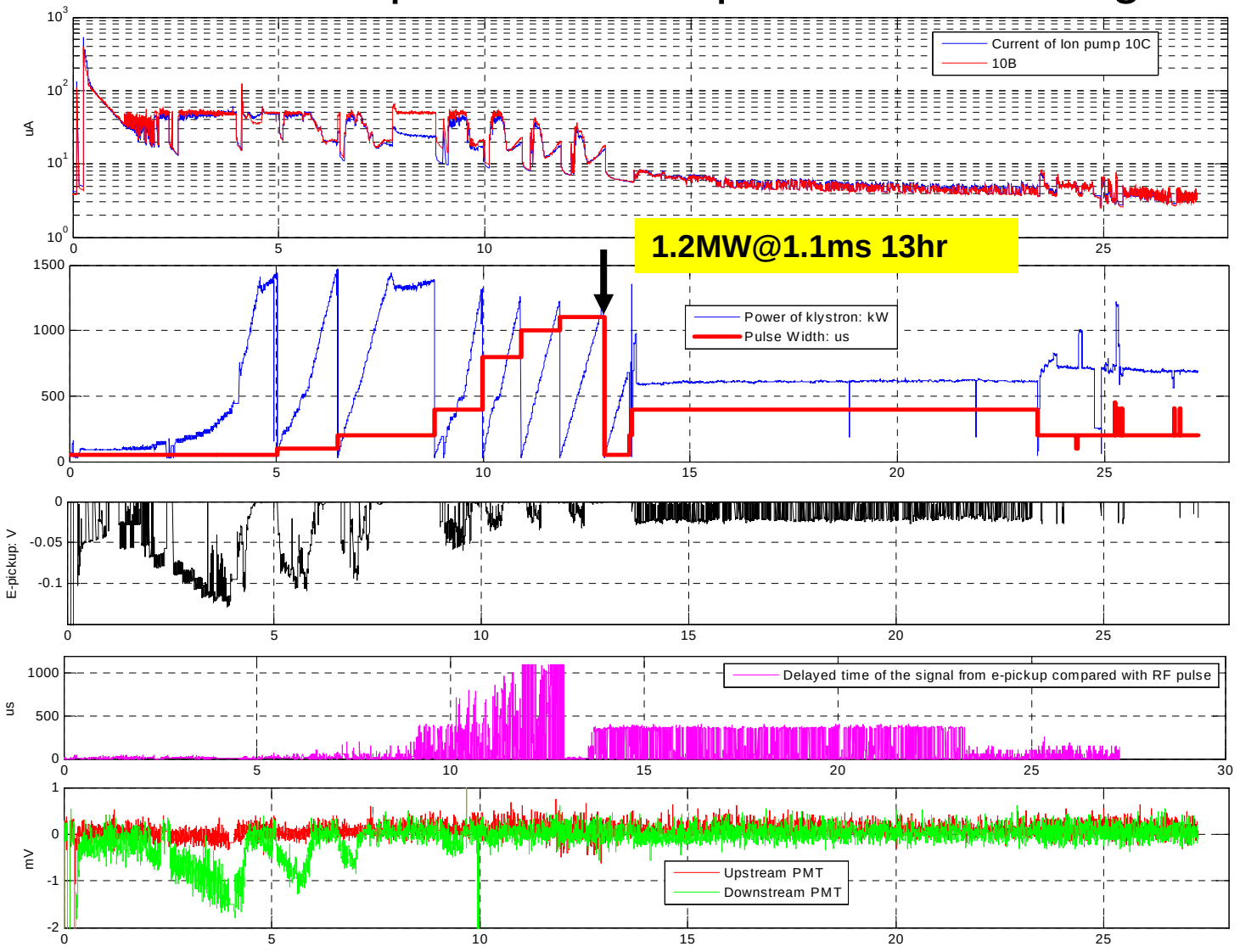
The 2nd processing run after venting to N_2 then air conditioned up in 13 h compared to 32 h originally



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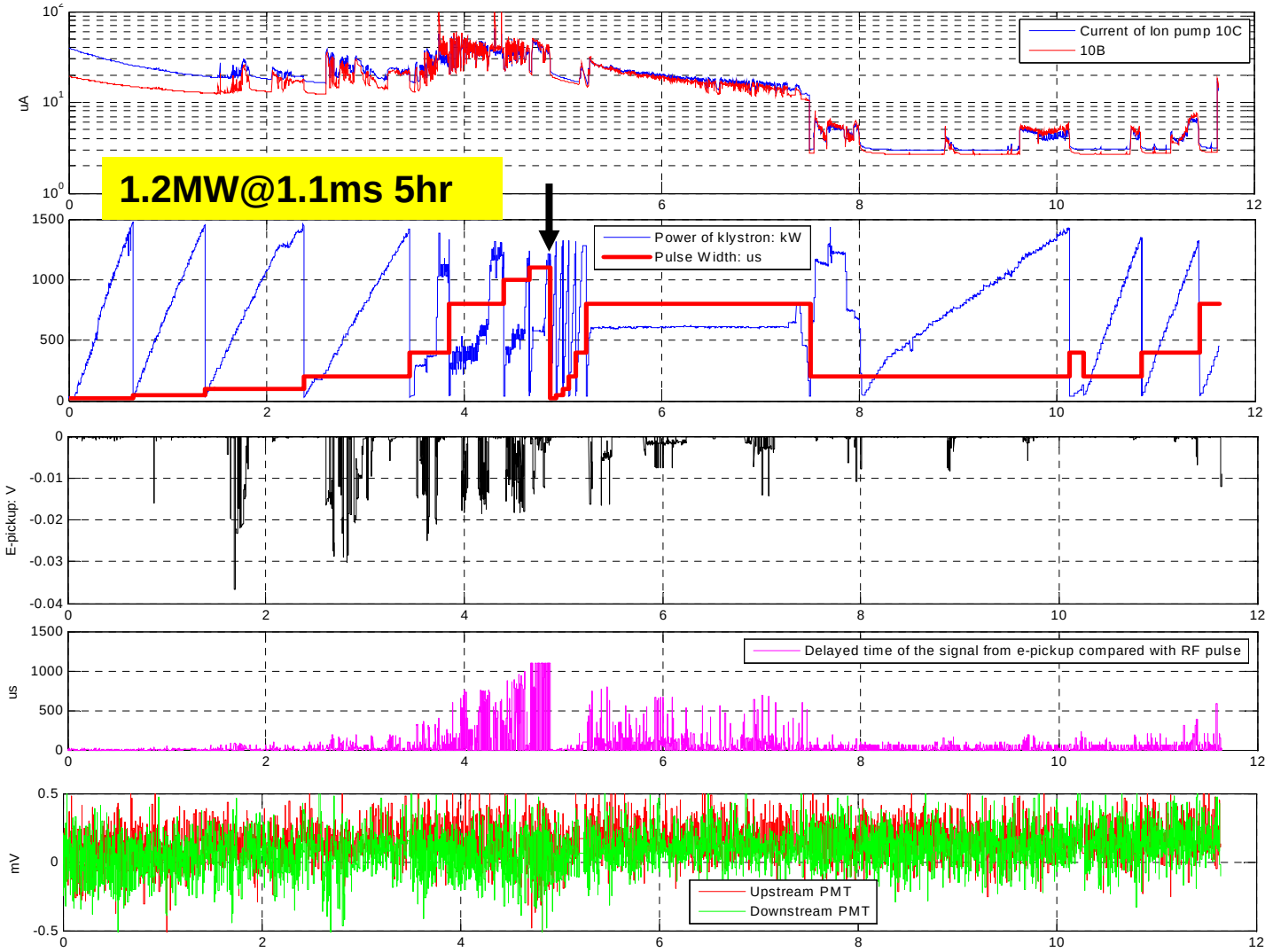
The 3rd run after N_2 vent and a shorter e-probe conditioned up in 5 h



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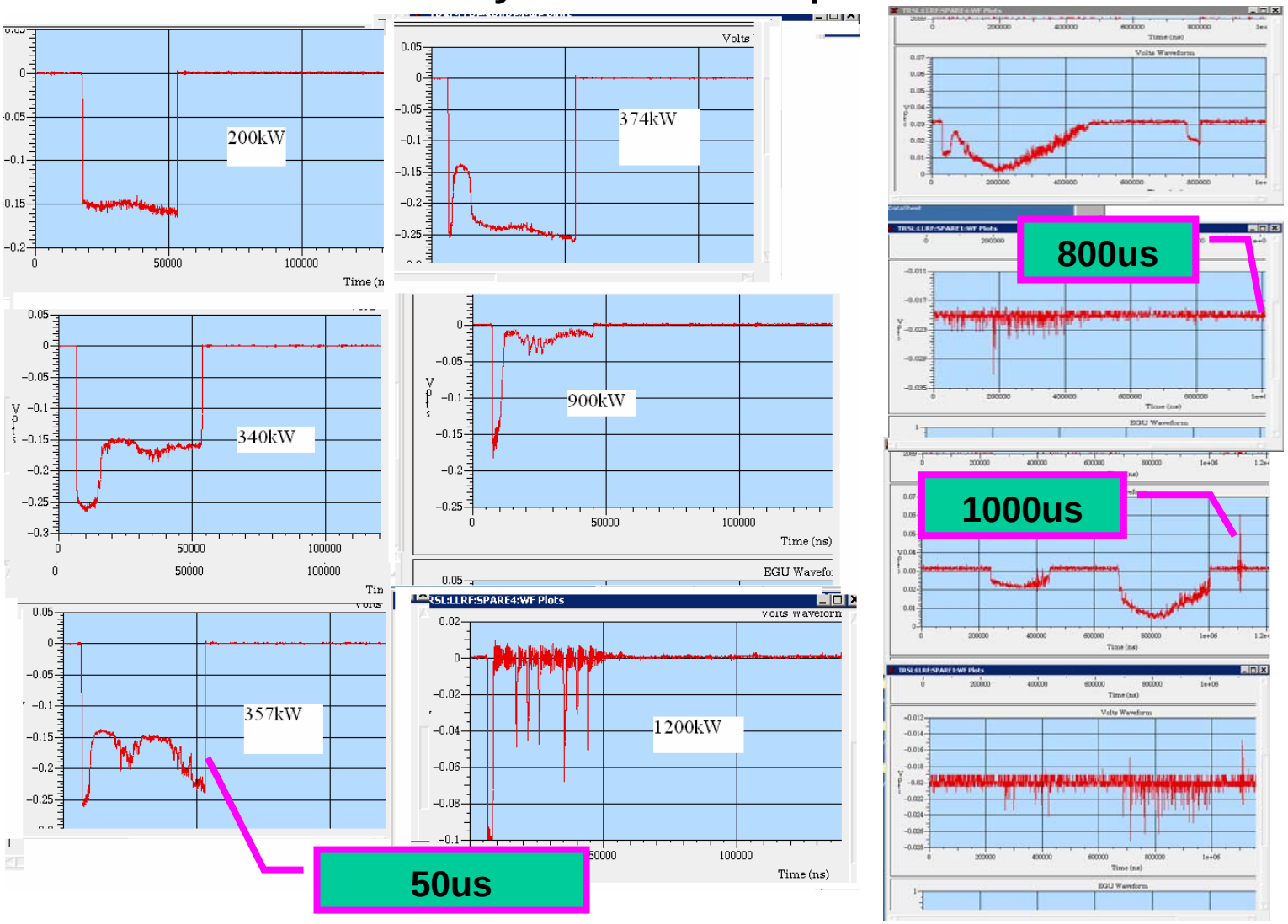
Electron probe signals indicated copious electronic activity around the probe



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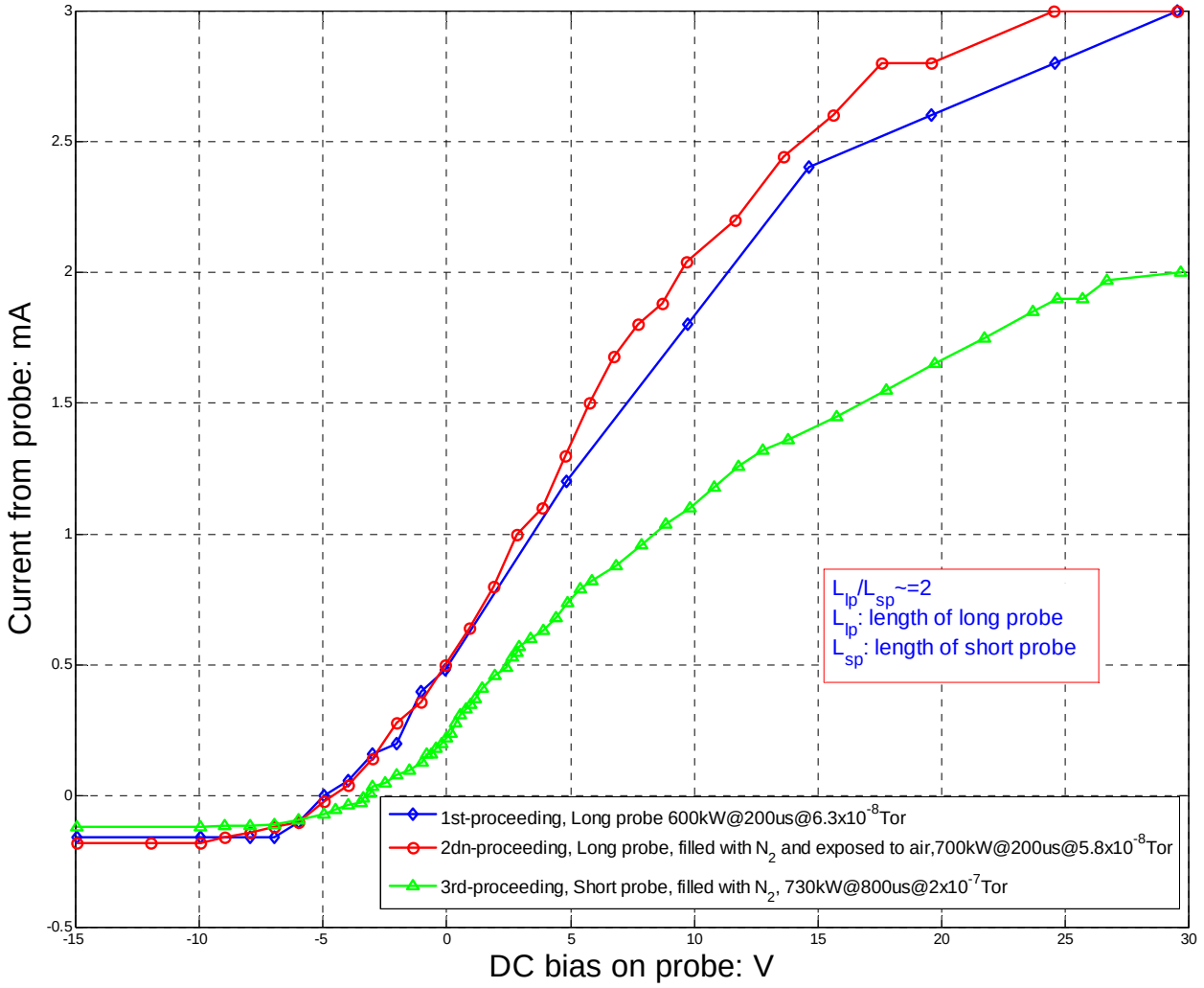
Plotting the electron signal at different DC biases suggests some plasma phenomena present



Summary

- The coupler component test stand at SLAC is now operational
- Initial runs on a simple SST coax show ample conditioning behavior
- The electron pickup probe is providing some interesting phenomena in terms of delayed turn-on times and half-wave time structure
- Component geometries to be tested in the coming months:
  - 40 mm straight coaxial line SST wall (includes taper transition to 60 mm)
  - 40 mm straight coaxial line with DESY/CPI-recipe Cu plating
  - 40 mm straight coaxial with cold bellows and Cu plating
  - TTFIII window assembly with and without ceramic window

- **For those interested in further discussion and presenting additional information, an supplemental coupler meeting is scheduled for Wednesday 11:00-12:15 in One East covering coupler conditioning experiences and multipacting modeling**