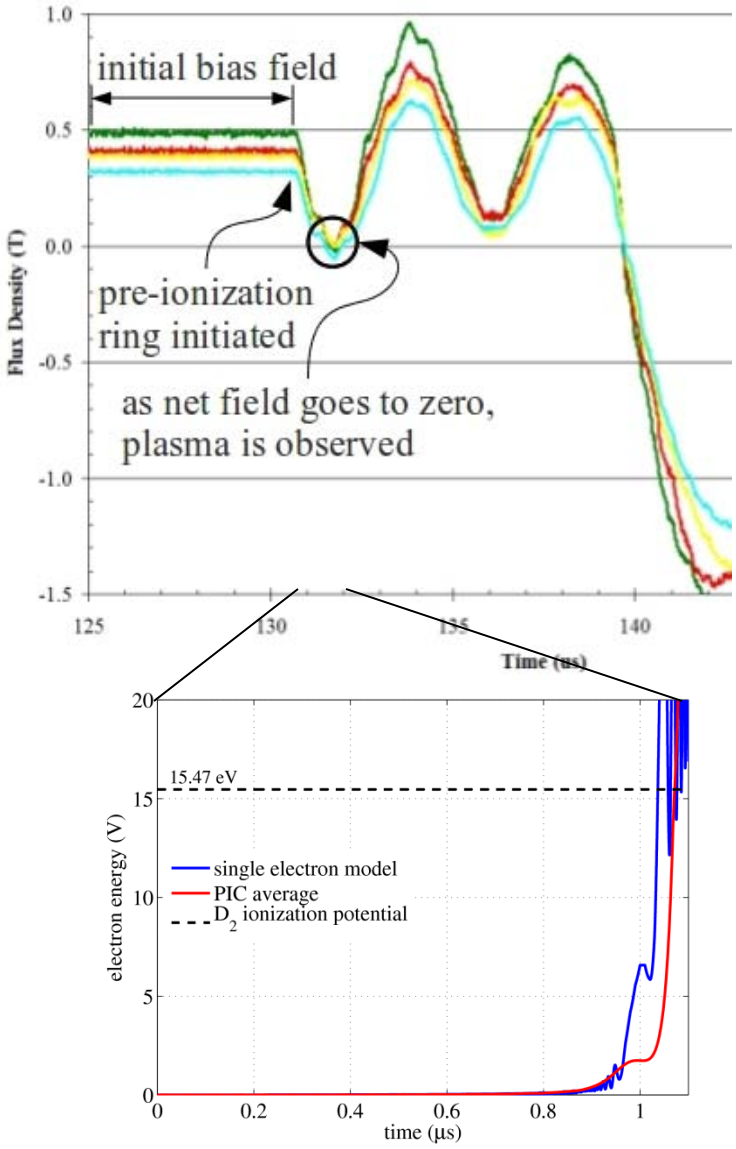
Explaining the Delay in Theta-Pinch Gas Breakdown

Questions with no clear answers;

- How is the pre-plasma gas evolving at early times?
- What is the most beneficial method of pulsed inductive PI?
- When is a bias magnetic field necessary?
- Why is a delay in gas breakdown seen in biased pulsed inductive devices?

Our numerical approach;

- ✓ model particle physics at early times in theta-pinch device
- ✓ show correlation with experiment
- ✓ elucidate how well the field energy is used during initial breakdown and provide explanation for ionization delay
- ✓ propose selection criteria when designing a bias and main discharge for pulsed inductive devices



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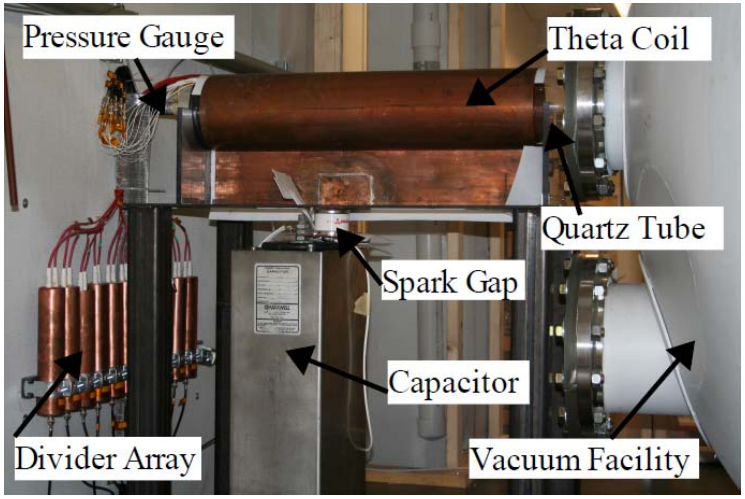
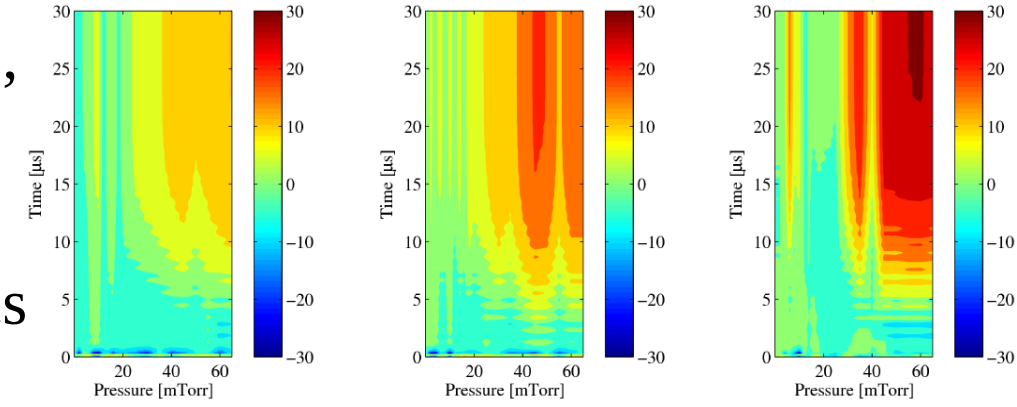
Pulsed Inductive Test Article

- Missouri Plasmoid Experiment
  - Pulsed inductive test article for studying fundamental plasma processes
  - Electric and magnetic probes diagnostics
  - Internal plasma probe diagnostics: shunted probe, ion saturation probe
  - Future: spectroscopy, fast framing camera diagnostics



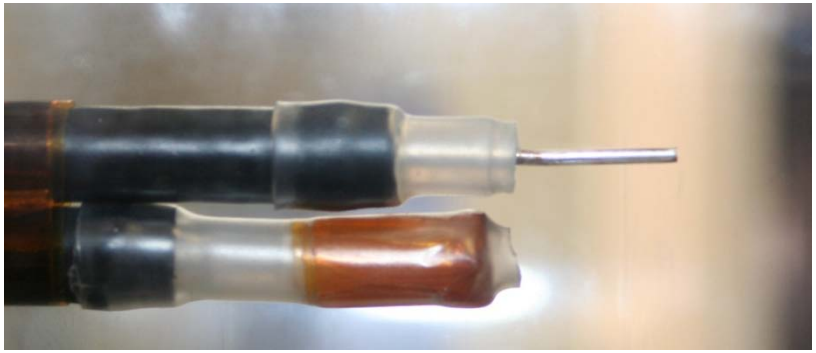


Building MPX Internal Probe Diagnostics

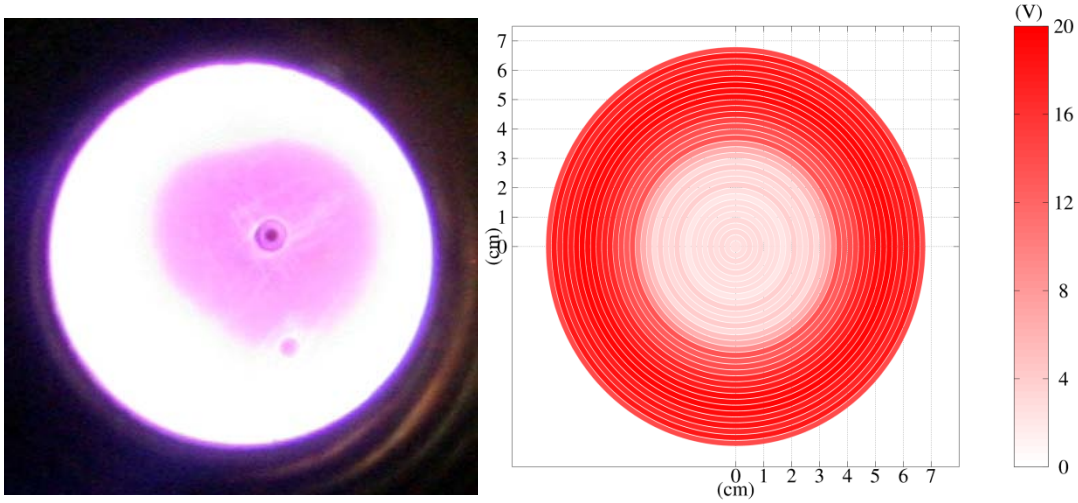
Goals for internal probes;

- ✓ design and fabricate Langmuir probe pair for use in the MPX pulsed power environment
- ✓ verify removal of noise to acceptable levels
- ✓ generate rough picture of plasma discharge activity

- ❑ verify azimuthal symmetry
- ❑ bias probe to ion saturation levels to quantify additional plasma characteristics
- ❑ refine picture with fine spatial resolution via the 2-D translation stage and couple with external measurements to proved a full picture of the plasma evolution



Dual probes used for MPX test article consisting of an exposed probe (top) and a dielectrically shielded null probe (bottom).



Time-lapsed exposure of MPX operation at 30 mTorr along side shunted probe voltage data taken at 14 mTorr.

B-dot Probes

I. Differential probe design
- Removes common mode (capacitive coupling, electrostatic) noise from probe signal
- Constructed on Printed Circuit Board (PCB)
  - Ensures consistency between probes
- Calibrated using pulsed-power Helmholtz coil
  - 1.60 x 10^5 T/V-s