

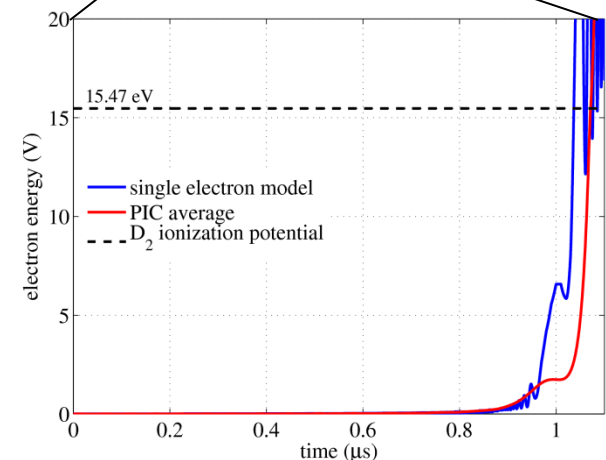
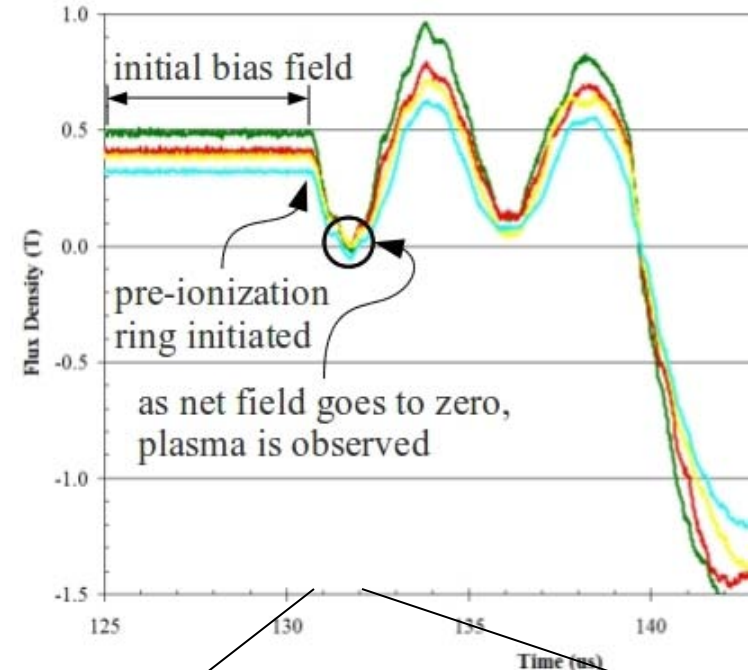
Explaining the Delay in Theta-Pinch Gas Breakdown

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?

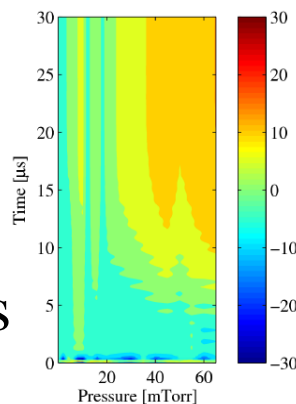
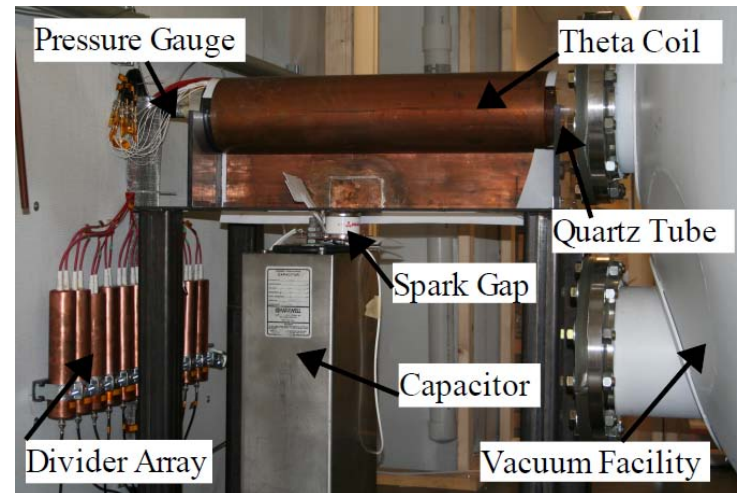
Our numerical approach;

- ✓ 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

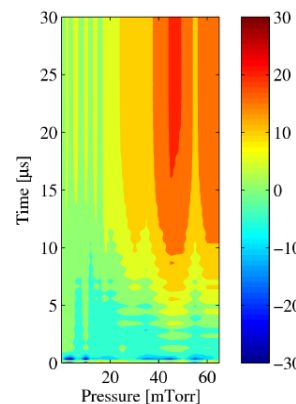


Pulsed Inductive Test Article

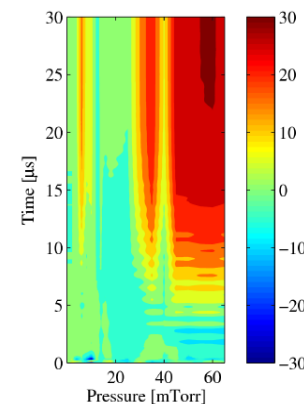
- **Missouri Plasmoid Experiment**
 - Pulsed inductive test article for studying fundamental plasma processes
 - Electric and magnetic probes diagnostics
 - Internal plasma probe diagnostics: shunted probe, ion saturation probe
 - Future: spectroscopy, fast framing camera diagnostics



Air, 15 kV



Argon, 15 kV



Air, 20 kV

Building MPX Internal Probe Diagnostics

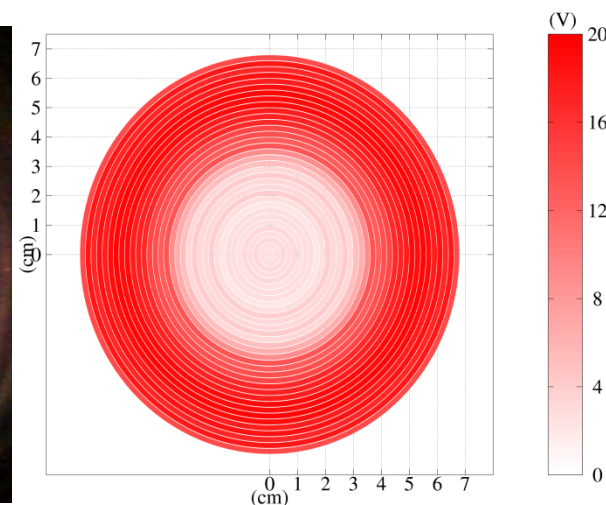
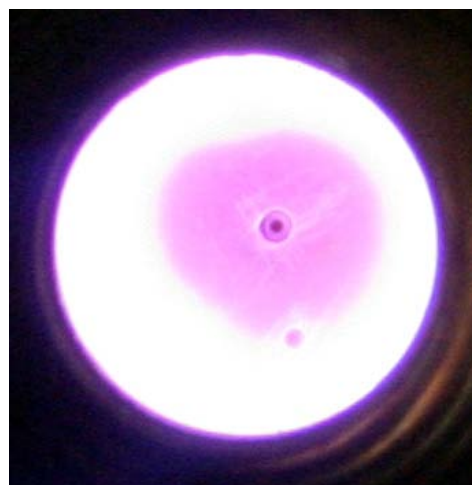
Goals for internal probes;

- ✓ 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



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

- 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 provide a full picture of the plasma evolution



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
 - $1.60 \times 10^5 \text{ T/V-s}$

