Overview of NSTec Plasma Focus Tubes and Magnetohydrodynamic Modeling Capabilities

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• Brief Description of how DPFs work, in general what they are useful for.
• DPF devices that we have at NSTec
• Using MHD modeling software to optimize designs and predict performance
• Neutron Resonance Spectroscopy
• Early research into plasma focus tubes was carried out by Mather and Filippov in the 1970s.
• Their tube designs were topologically equivalent, and had similar operating characteristics.
• Interest in DPF has surged recently because of modern analysis and manufacturing techniques.
Utility of DPFs

Radiation Detection
- Detector Development
- Calibration
- System qualification
- Shielding/Collimation

Material/Component Response to Dose
- Fast Pulsed Assembly
- Fission Fusion spectrum

Neutron Resonance Spectroscopy
- EOS physics

Nuclear Physics experiments
- Cross section measurements
- Half-life measurements

Nuclear Forensics
- Irradiation of materials
- Damage studies
- Charged particle bombardment

Material Detection
- Homeland security
- DTRA

Vision • Service • Partnership
133 kJ Bank, D-T Source

- Our *second* D-T source
  - $3 \times 10^{12}$ neutrons per pulse
  - $< 50$ ns FWHM pulses
- Automatic D-T gas handling system
- Full support facility
1MJ Marx Bank (Gemini)

- Voltage increased to 70 kV
- Designed for $>10^{12}$ D-D neutron yield at full energy. As of February 2012, $1.76 \times 10^{12}$ at near full energy.
- Located in Las Vegas
Using MHD for Plasma Focus Design

• Anode/Cathode design
  Perturbations of Mather and Filippov designs
  You can change things that the DPF operator can’t...

• Prediction of experimentally observable quantities
  Pressure/Current relationships
  “rundown” time (how well it is electrically tuned)
  Pinch position (or repeatability of shot)
  Failure analysis
    • Magnetostriction of anode base
    • Snapped cathode bars
    • Mystery carbon residue
DPF-NRS setup

- Fissionable Material
- Mach2 Simulation of Filippov Tube
- Dense Plasma Focus Driver for Fast Pulsed Assembly
- Anode Source Tube
THANKS!