***TREND 2005***

# Measurements of Droplet Pinch-Off In Liquid Sodium


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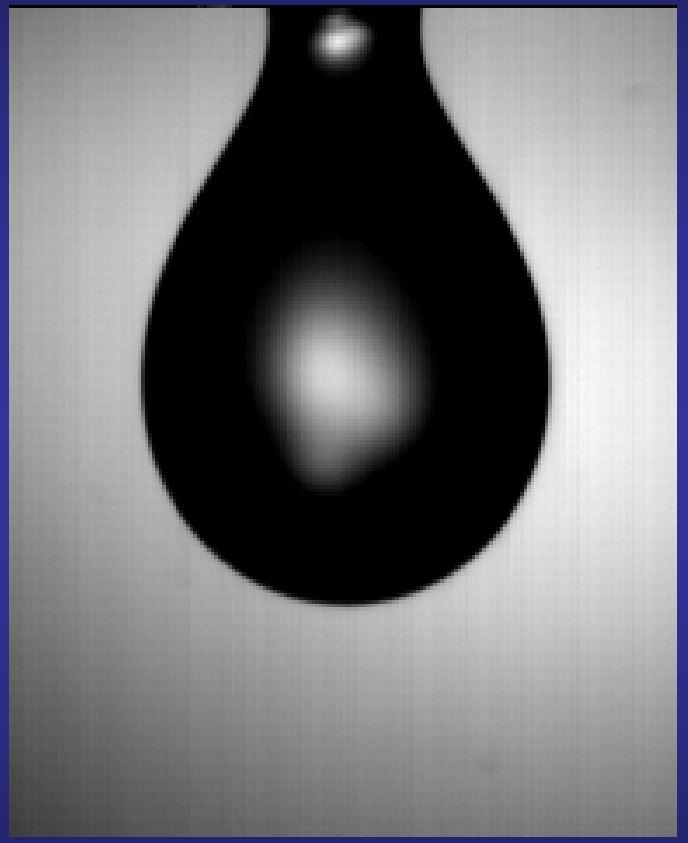
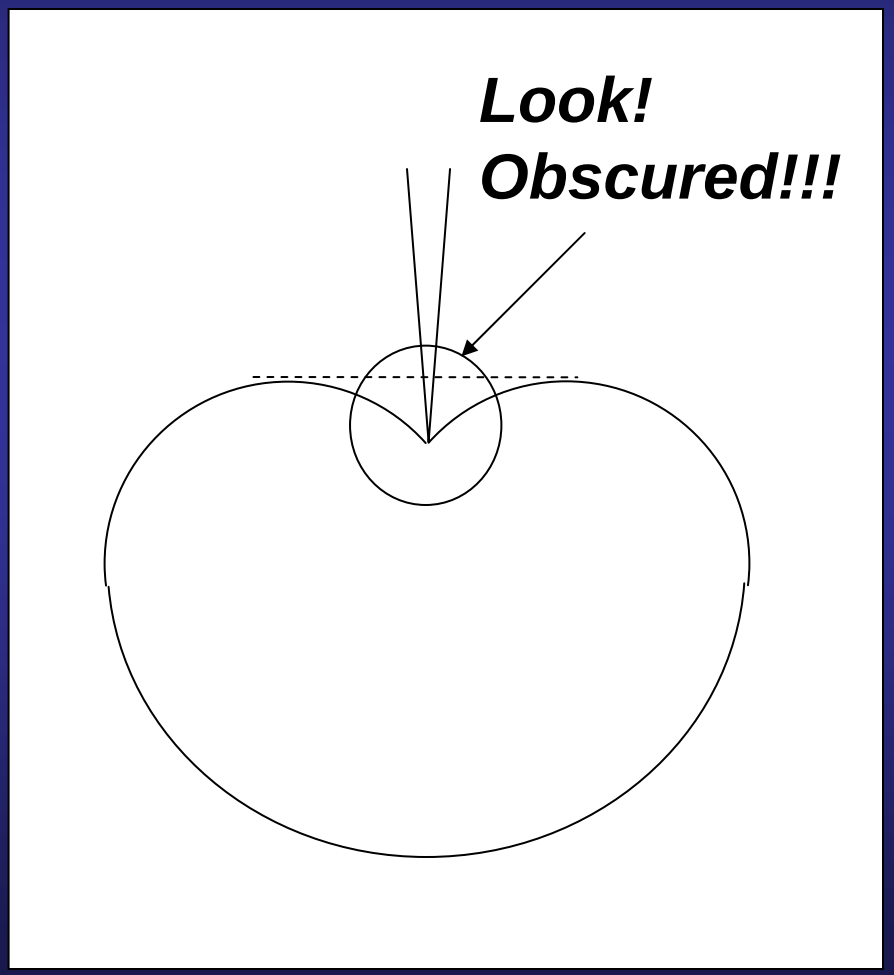
# Capillary Pinch-Off

- Application to fine-filament and inkjet production.
- Previously studied using strobe photography and high-speed video.



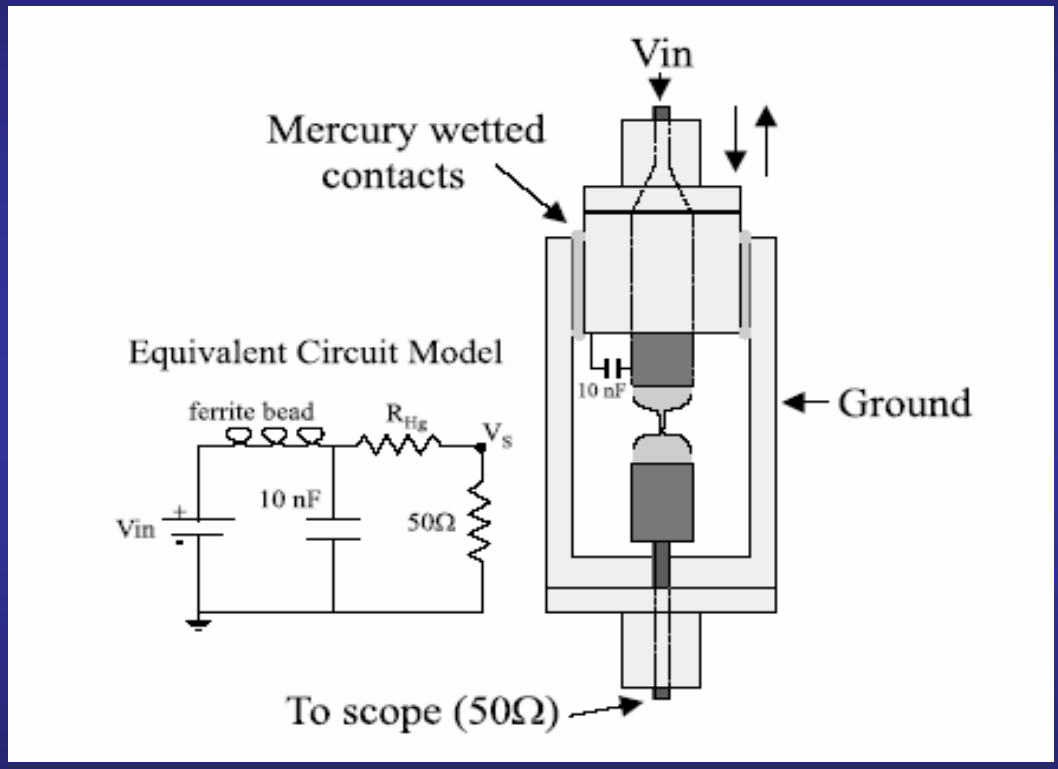
# Problem With Optical Studies

- **1) The optical constraints of measuring nanometer-length scales**
- **2) Geometry of pinch-off, which obscures the point of contact with the upper droplet.**



# A *New* Way to Look at It!

- In a 2004 study from the University of California, Irvine, physicists J.C. Burton, J.E. Rutledge, and P. Taborek tested the minimum diameter of the pinch-off by running an electric current through a drop of liquid mercury.

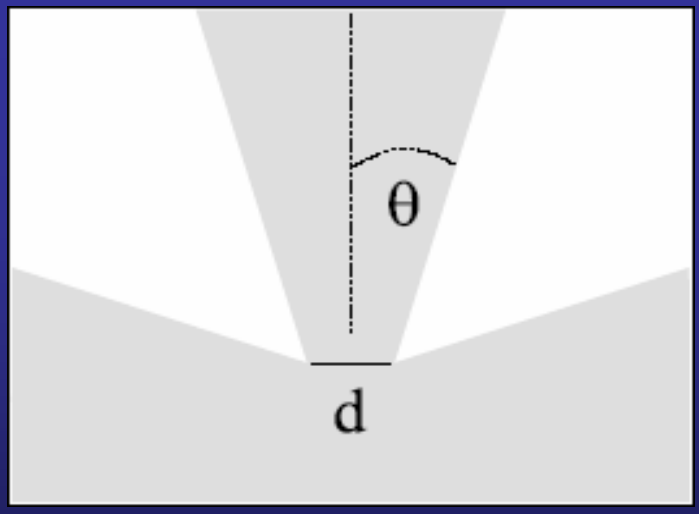



Burton, Rutledge, Taborek, *Phys. Rev. Lett.* **92**, 244505 (2004)

- By measuring the resistance across the droplet, they could find the minimum diameter d using the expression for resistance of a cone:
- The smallest neck diameter observed by Burton et al was about

  **2.7 nm.**

$$d = \frac{2\rho_r \cot(\theta)}{\pi R}$$



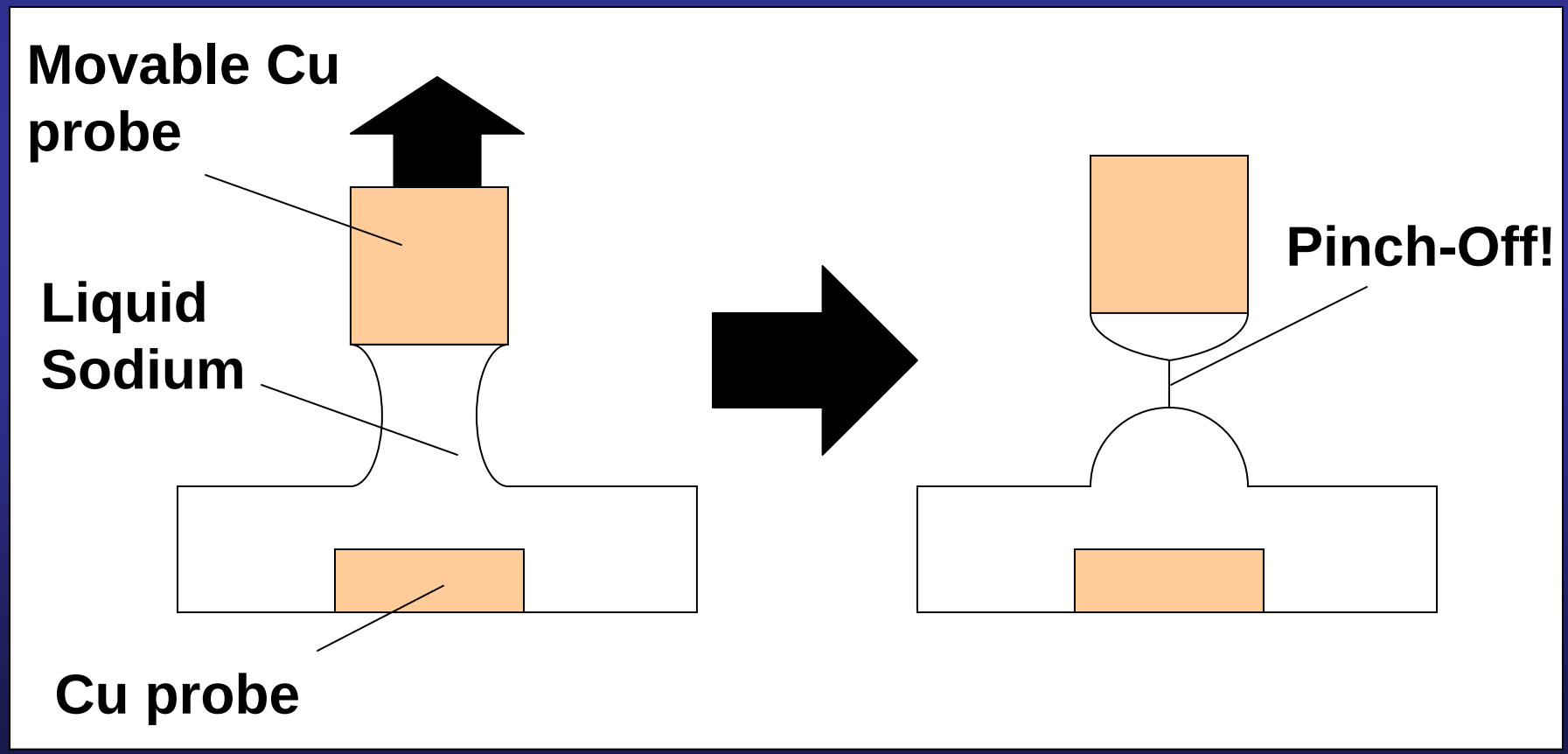

Burton, Rutledge, Taborek, *Phys. Rev. Lett.* **92**, 244505 (2004)

# But *Why* Sodium?

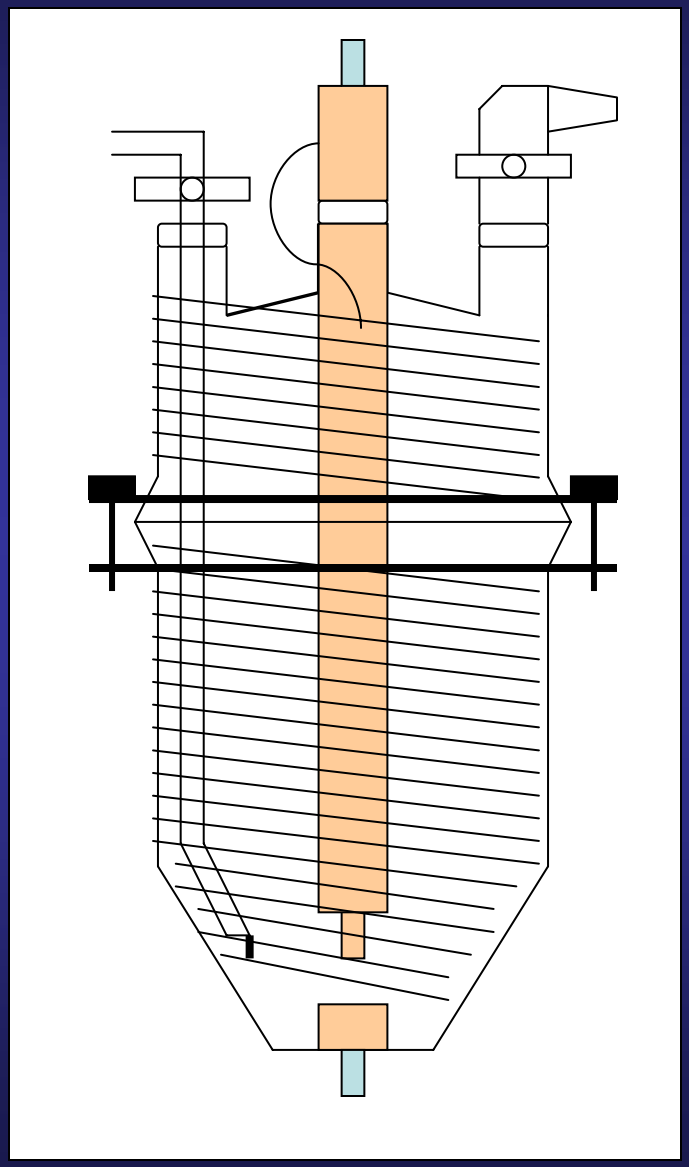
- 10X More Conductive than Mercury
  - 10X BETTER RESOLUTION
- Study Effect of Magnetic Fields

# Experimental Design

- THE SODIUM BRIDGE



- THE VESSEL



- THE COPPER SHIELDING

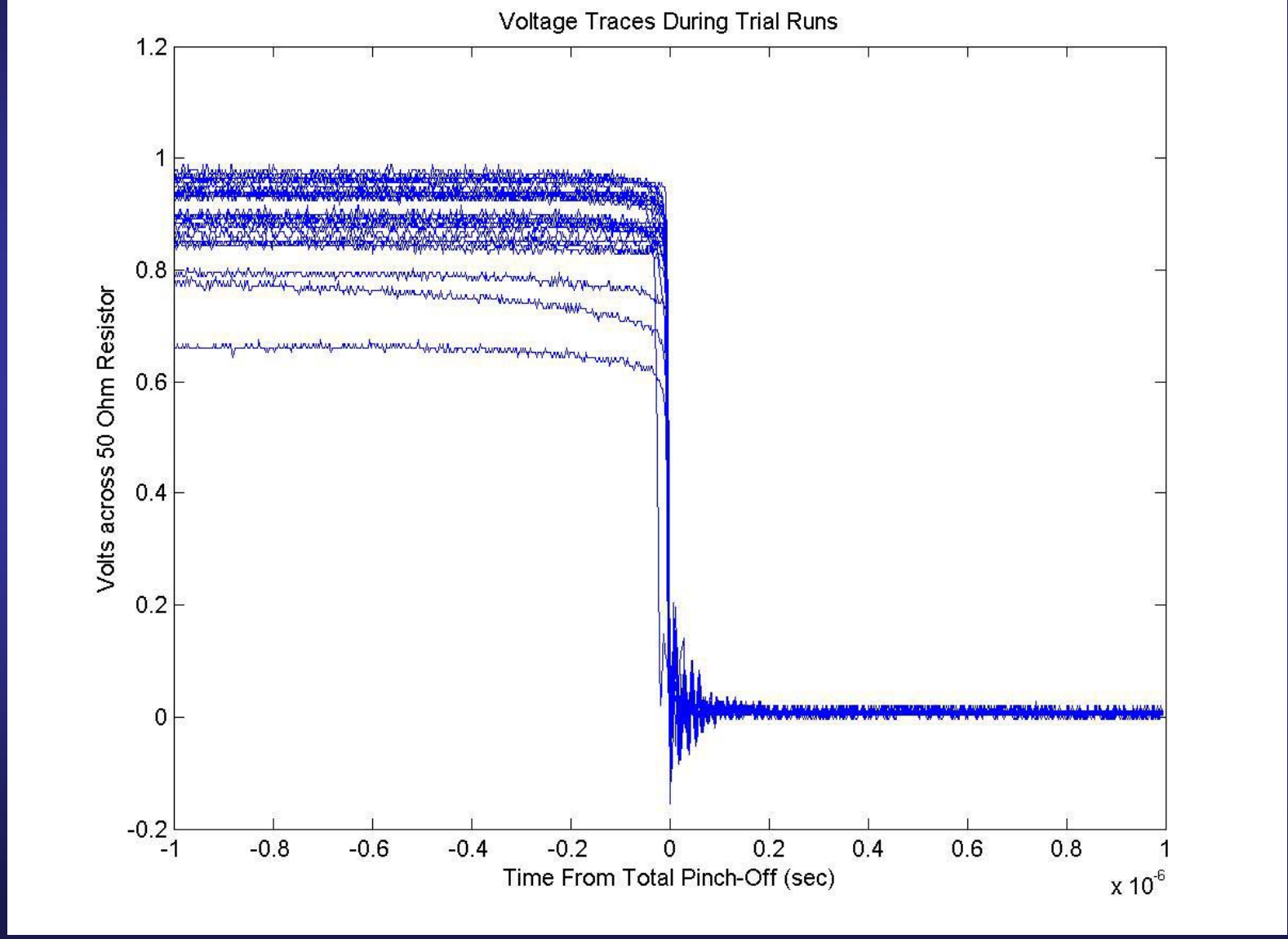
- Reduces Electrical Noise
- Coaxial Ground
- Distributes Heat
- Containment/ Structural Support

# Running the Experiment

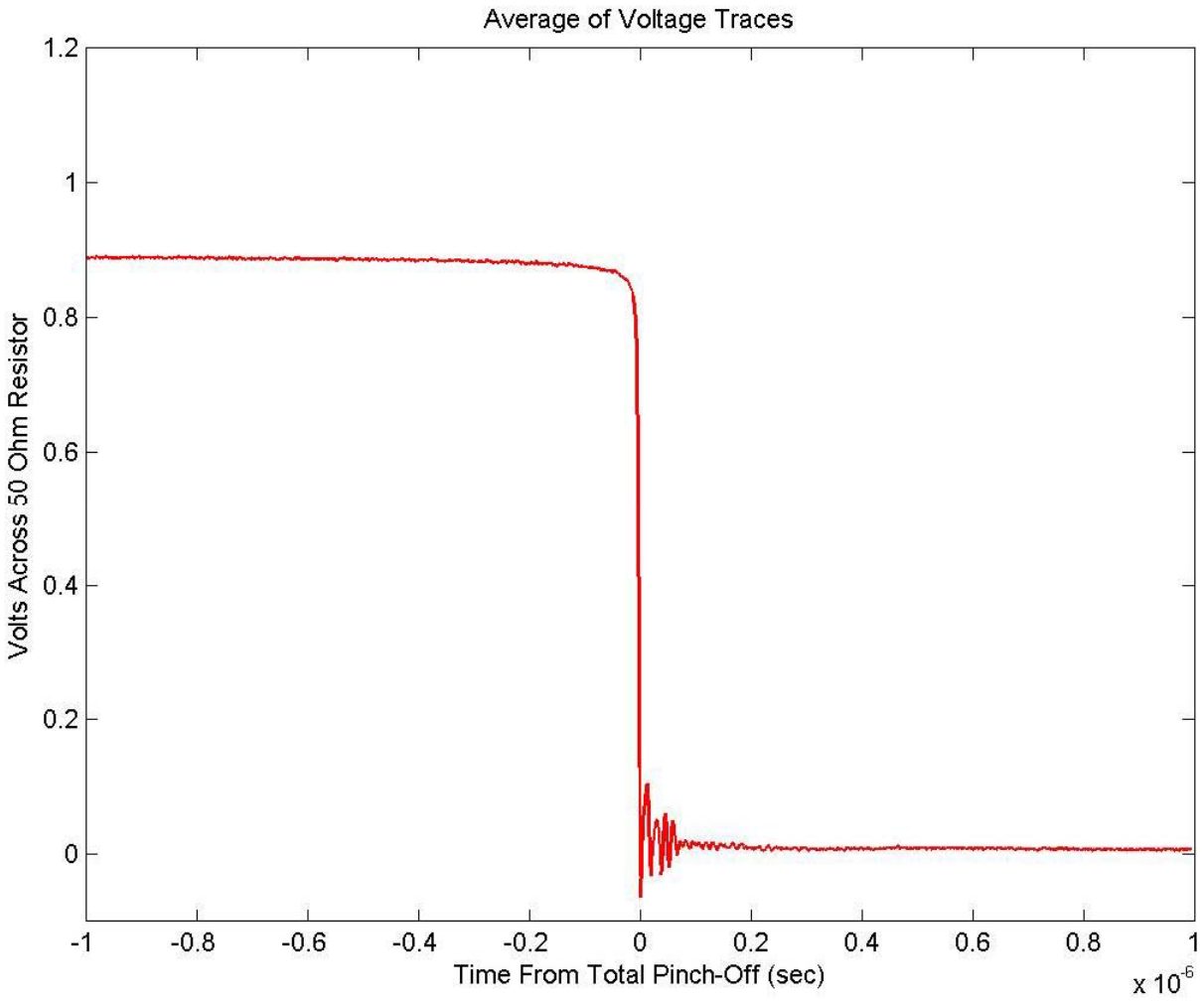
**Gah!**
**Problems!**

- Sodium Melting?
- Sodium Purity
- Contact Wetting
- Sampling Rate

# Data?


Voltage Traces During Trial Runs
Volts across 50 Ohm Resistor
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
Time From Total Pinch-Off (sec)
x 10^-6

# At Least It's Not *Lohr**




***BAD STAR TREK PUN, © DON MARTIN**