

D. K. Mansfield & A. L. Roquemore



# Lithium Dropper Present Status

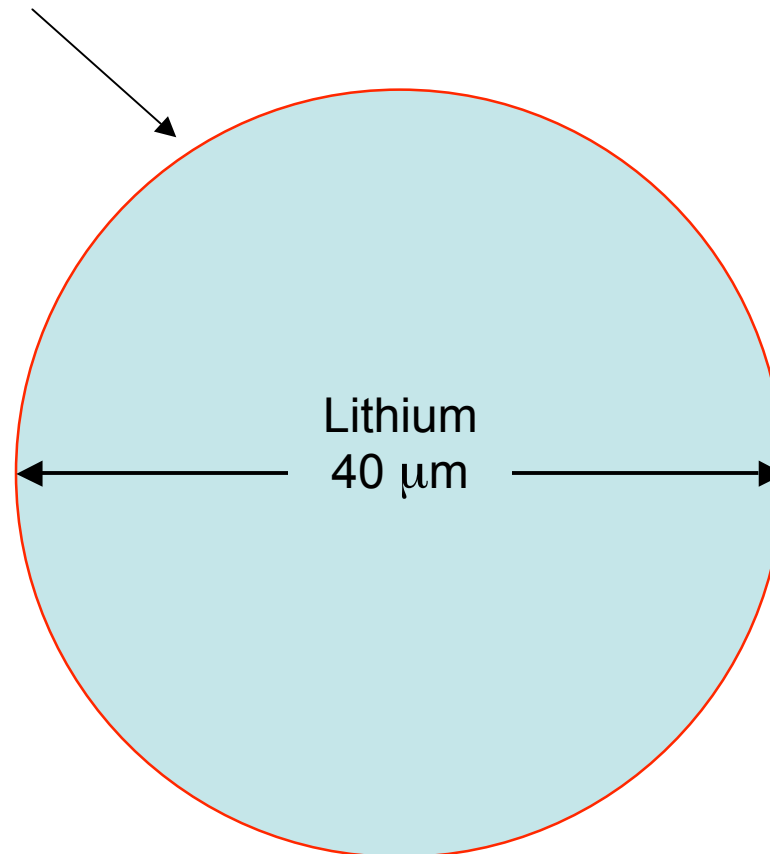
# Status of Raindrops



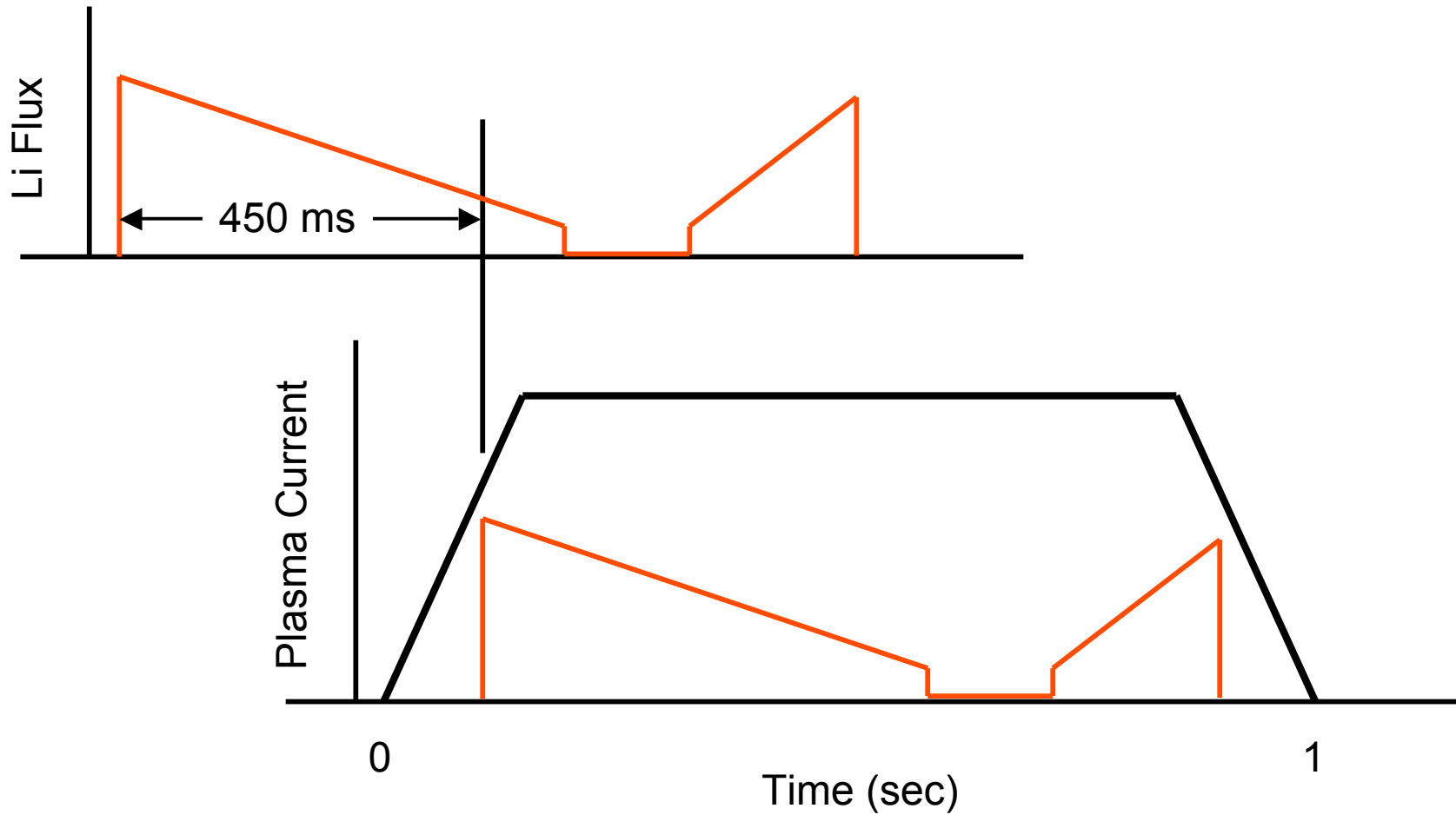
- Hardware complete and being assembled
- Final lab tests this week
- Installation next maintenance period (2 weeks)
- Paraffin-coated Li powder appears viable
  - Operation at  $2 \times 10^{-8}$  Torr for ~1 week
  - No out-gassing observed in RGA spectrum
  - Stable in  $D_2$ : ( $10^{-4}$  Torr for >10's of seconds)
  - Reacts with air in ~ 4 minutes
- Laboratory software virtually complete
- NSTX control software is pacing item

# Scale Drawing of Lithium Powder Particle

40 nm mantle of  $C_{70}H_{142}$  : 30 ppm Carbon, 60 ppm Hydrogen

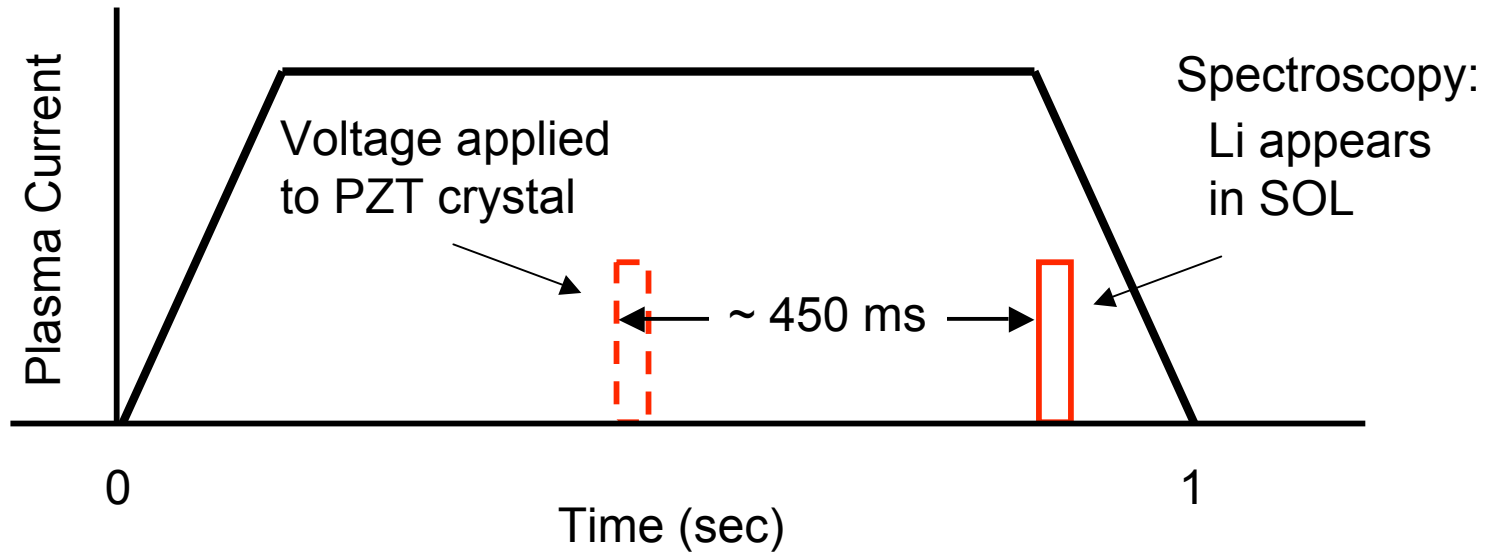


# Pre-programmed Flux Profile Must be Injected ~ 450 ms Before Plasma Breakdown

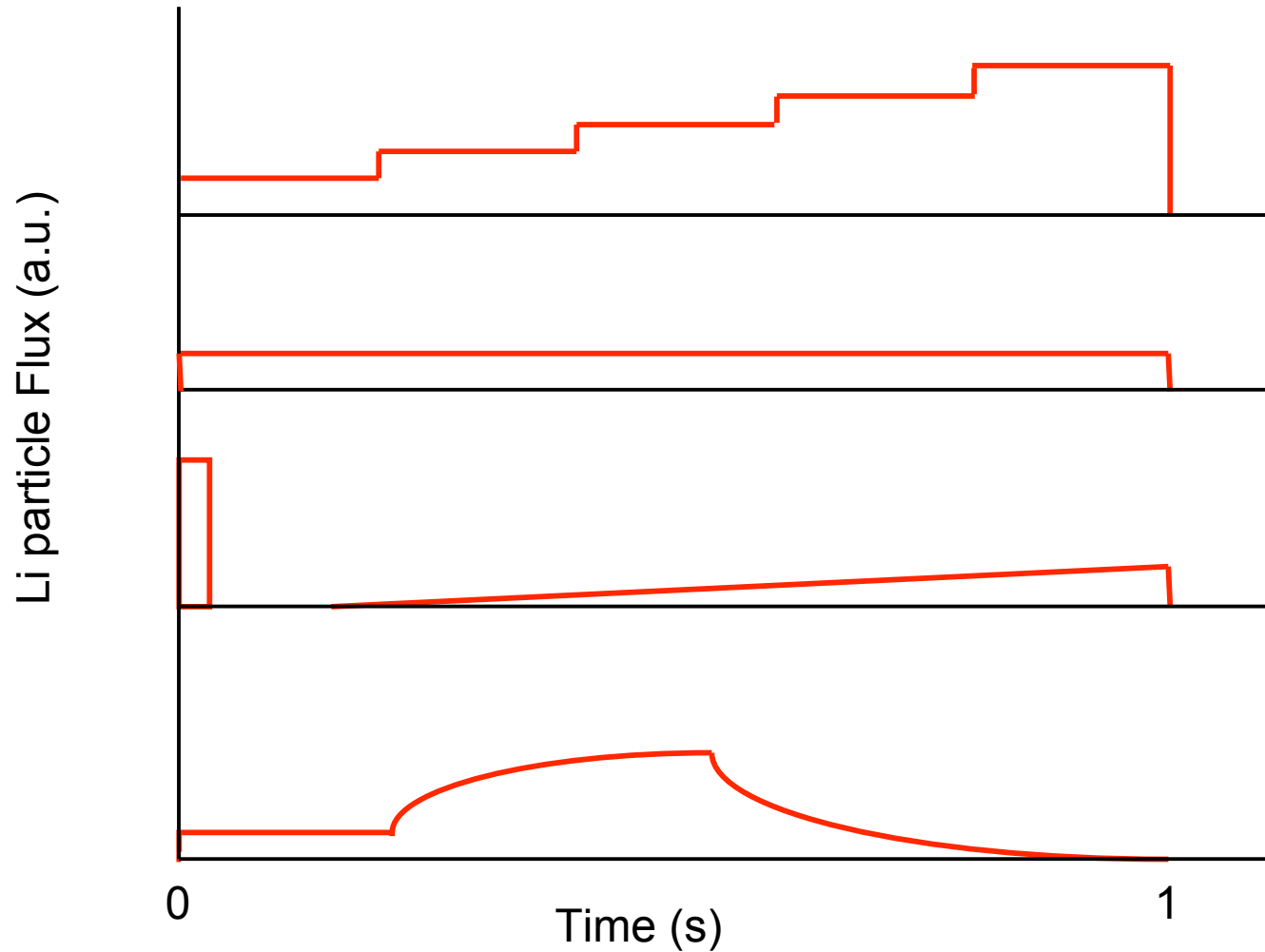




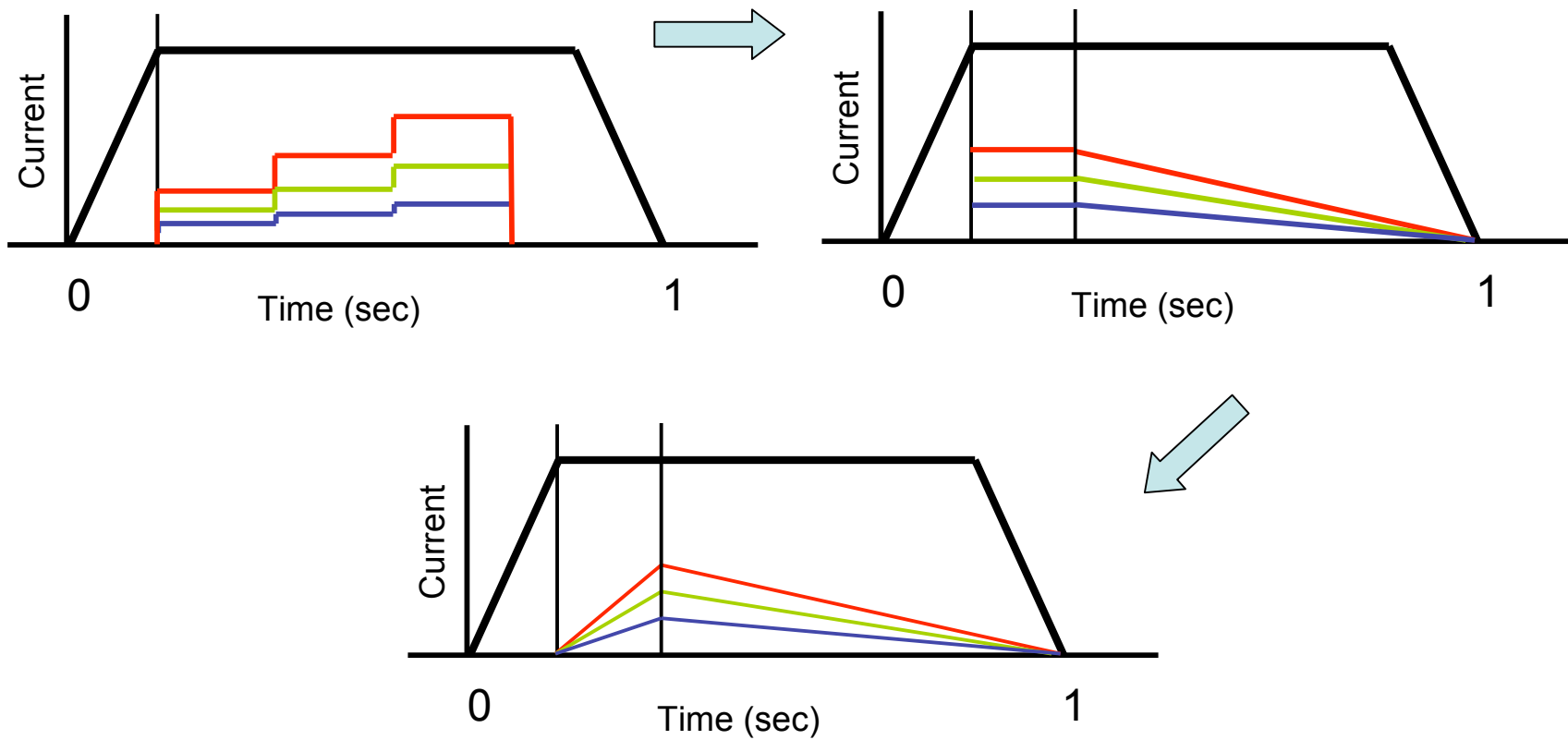
# Piggyback XMP: Measure “As-Built” Delay due to Gravity



# Possible Lithium Input Flux Profiles using Arbitrary Waveform Generator

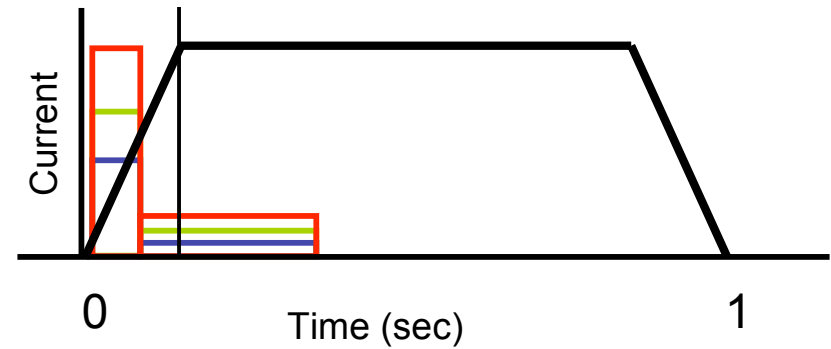
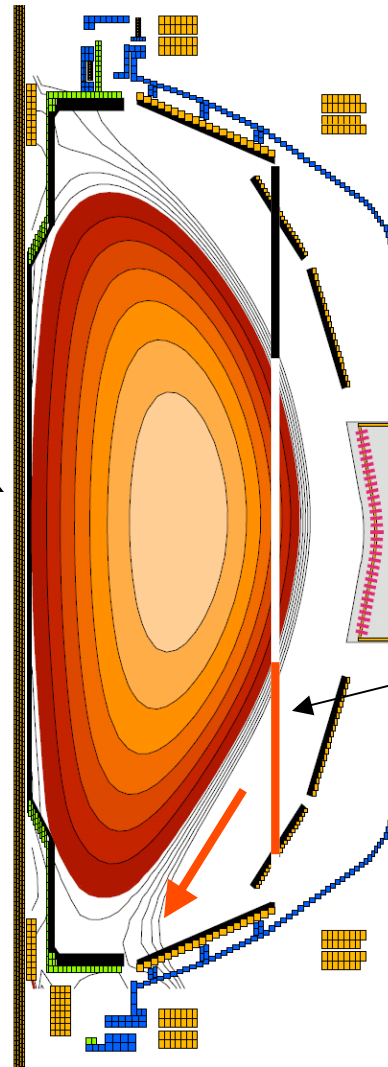


# Systematic Probing Profiles Designed for ½ Day Run



# “Early” Li Can be Preferentially Directed to Lower Divertor

Small Plasma  
Initiated  
on the CS  
Plot Shown  
Just  
After  
Breakdown



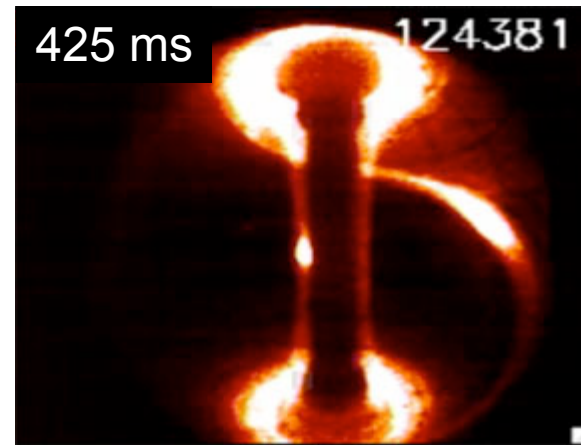
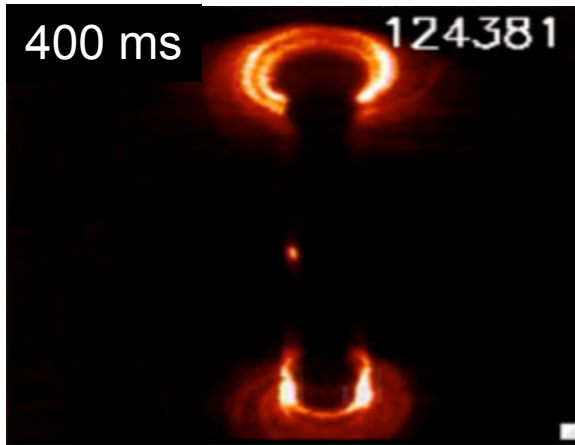
Pre-Pulse of  
Lithium for  
50 ms (850  
ms Before  
Breakdown)

EXTRA SLIDES

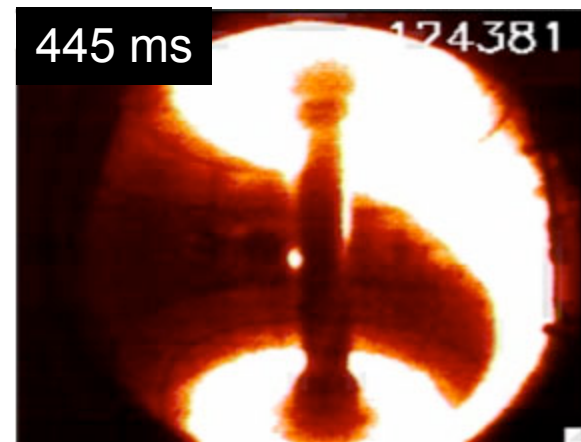
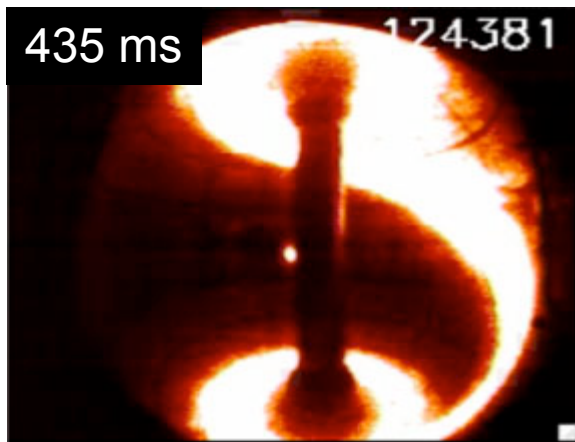
# White Light Movies Show Ablation of Li Powder in SOL. Li Ions Follow Open Field Lines to Divertor(s).



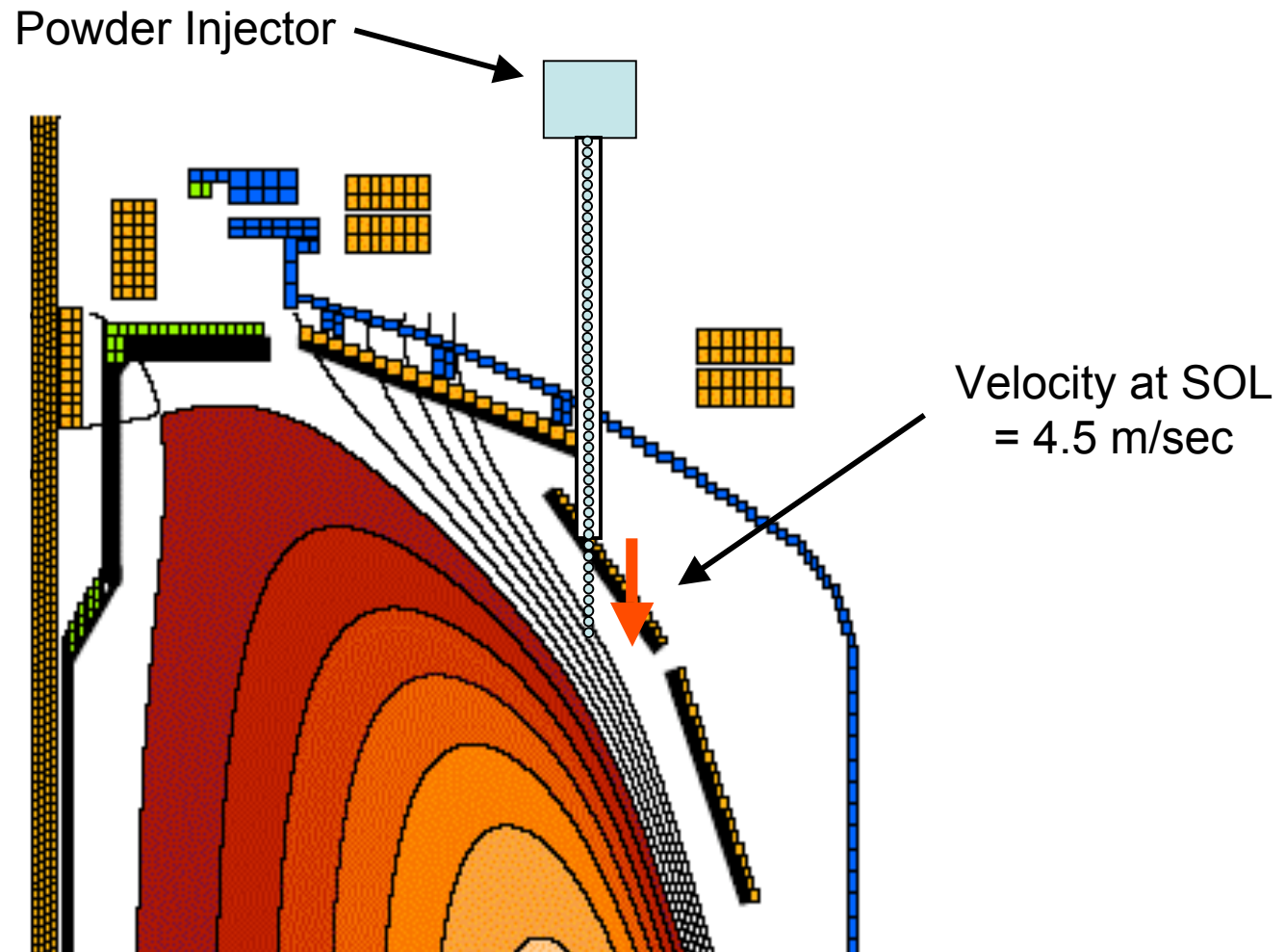
- Preferential drift toward upper x-point during LSN H mode

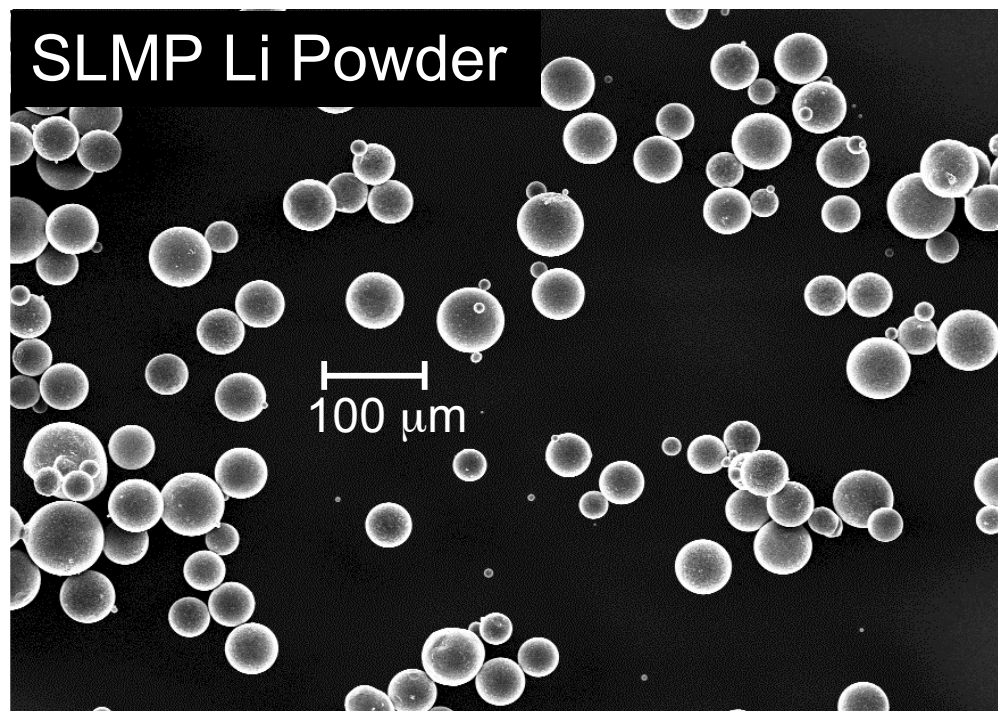
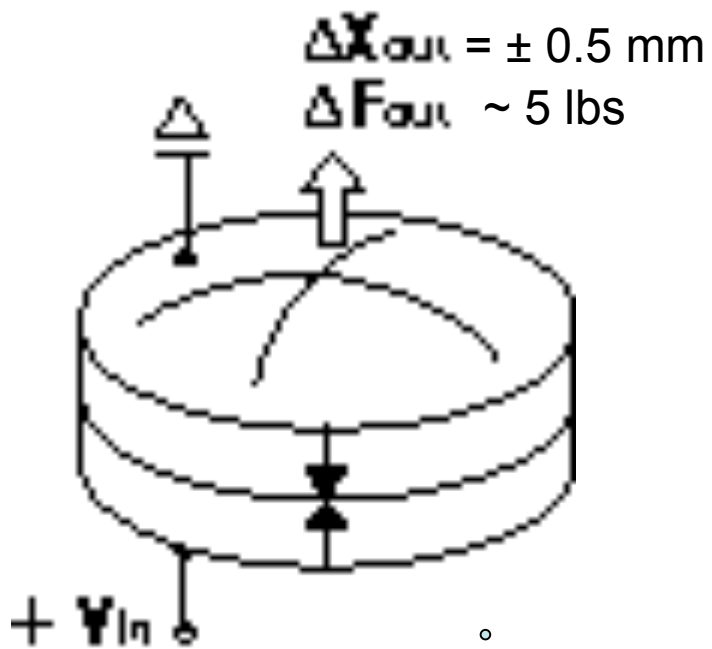


Initial Injection  
Li Powder

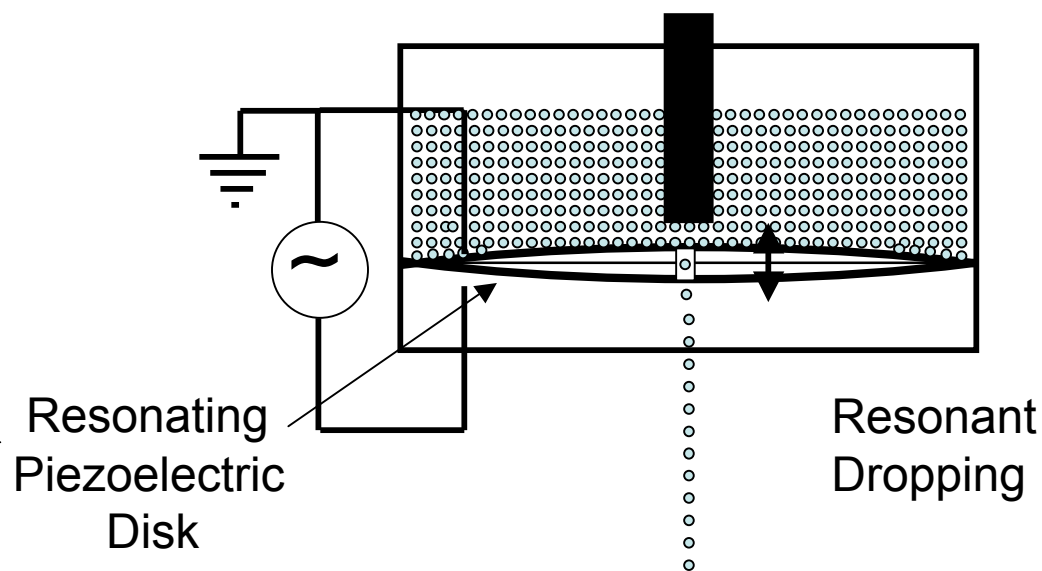
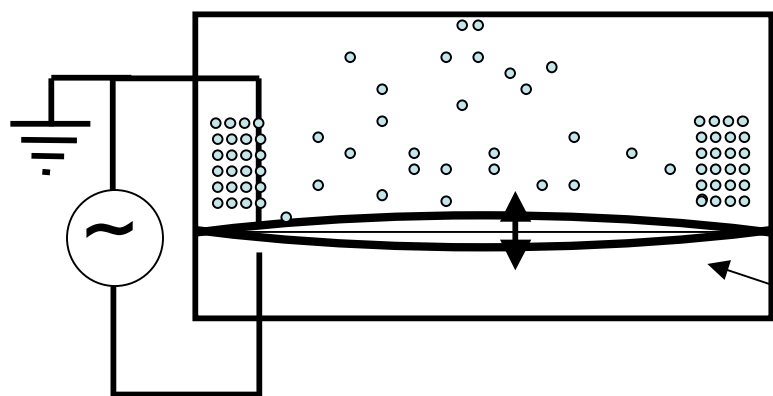


# Prototype Acoustic Resonance Dropper Can Drop from 0.3 mg up to Much-Too-Much Powder (Li Surrogate)

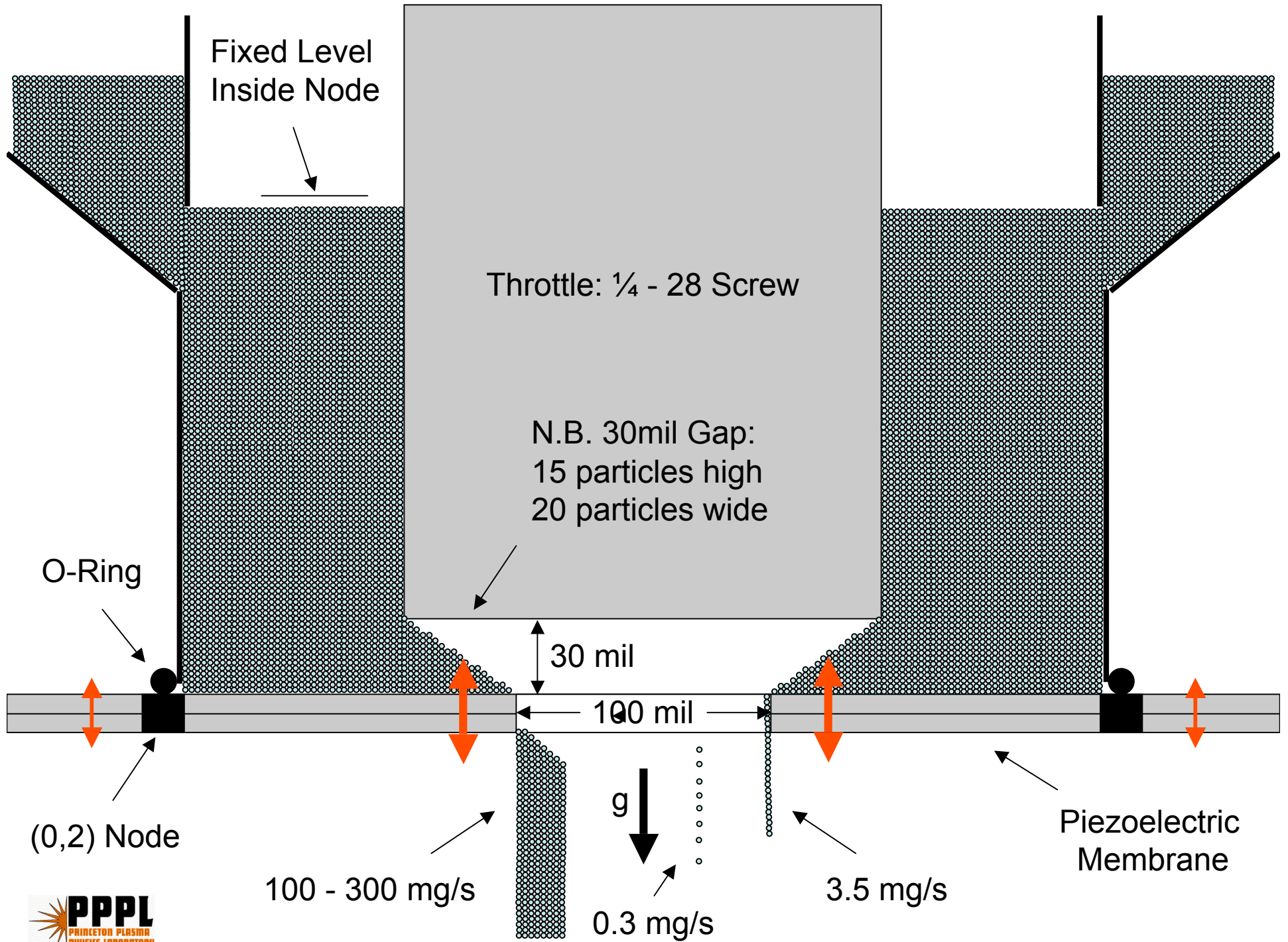




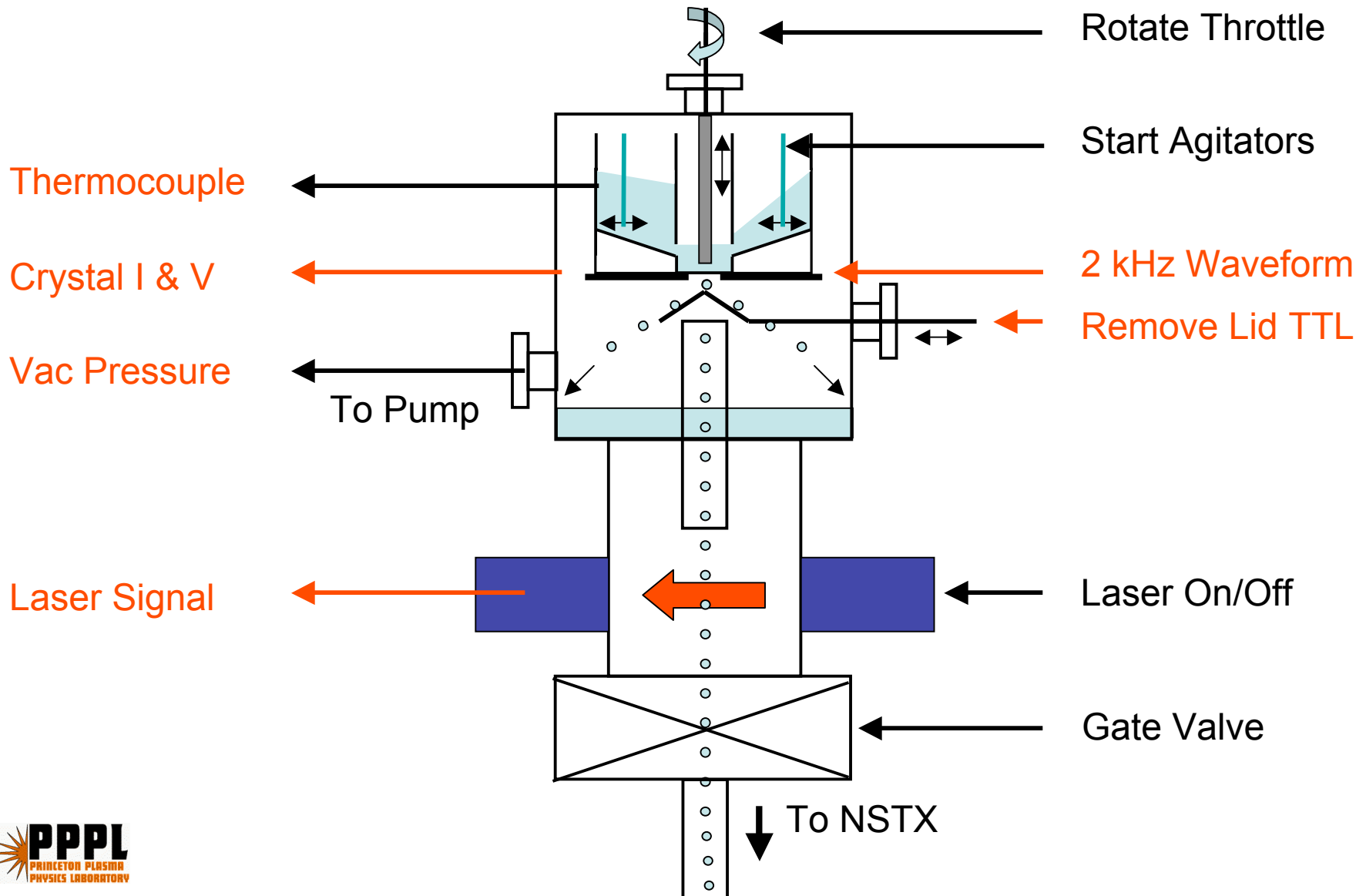
Resonant  
Levitation



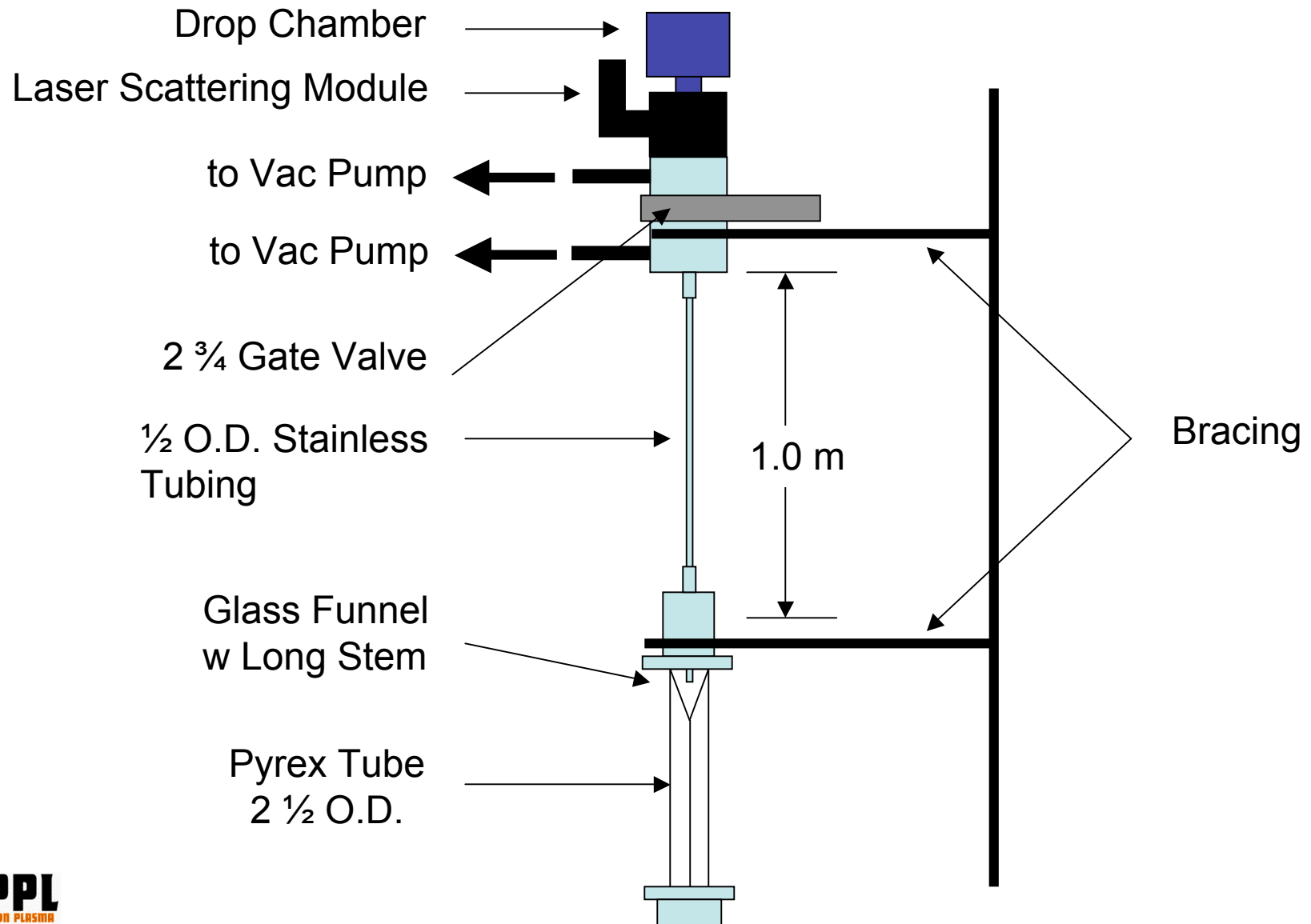




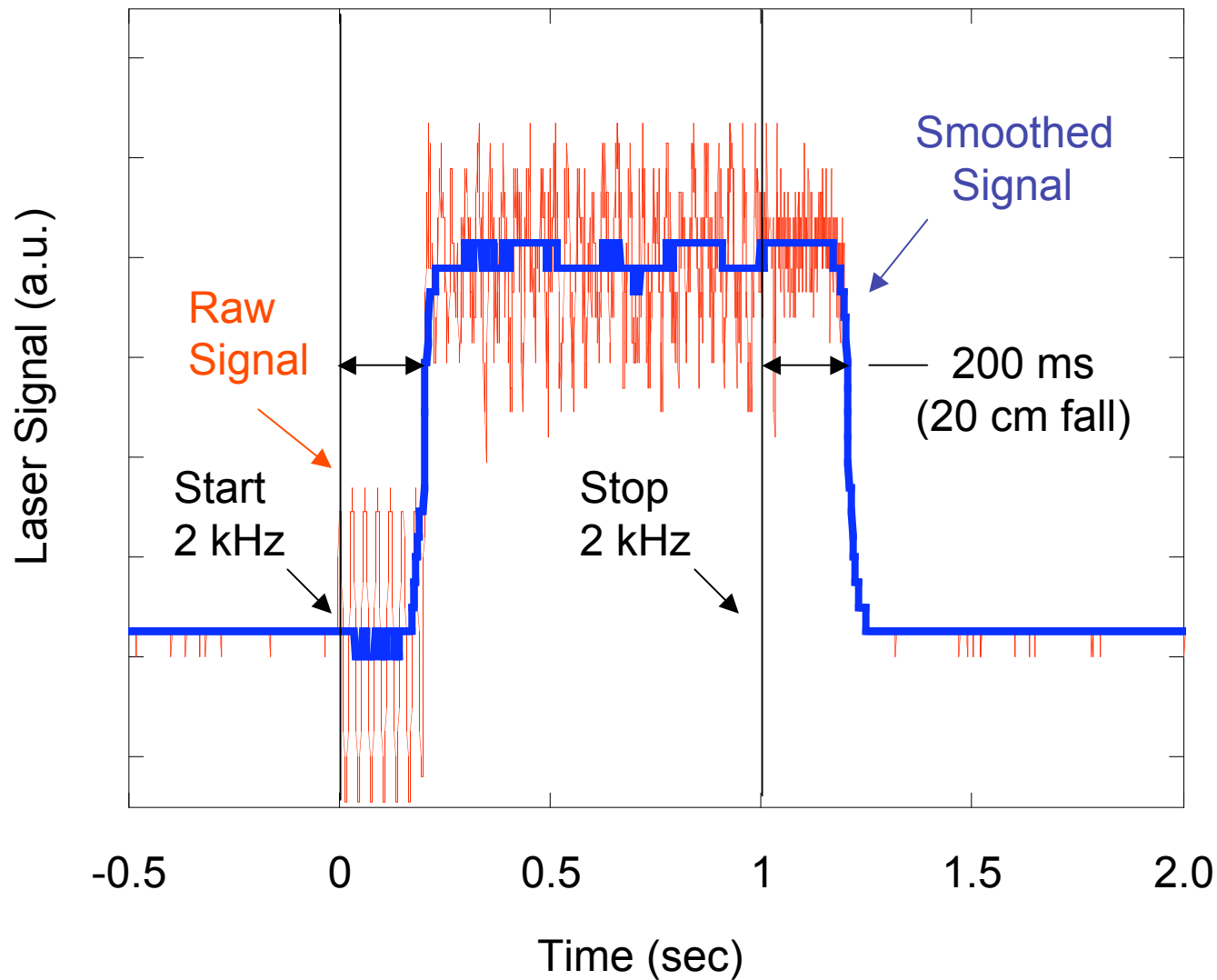
# Output and Input Signals: Necessary During Shot and Optional



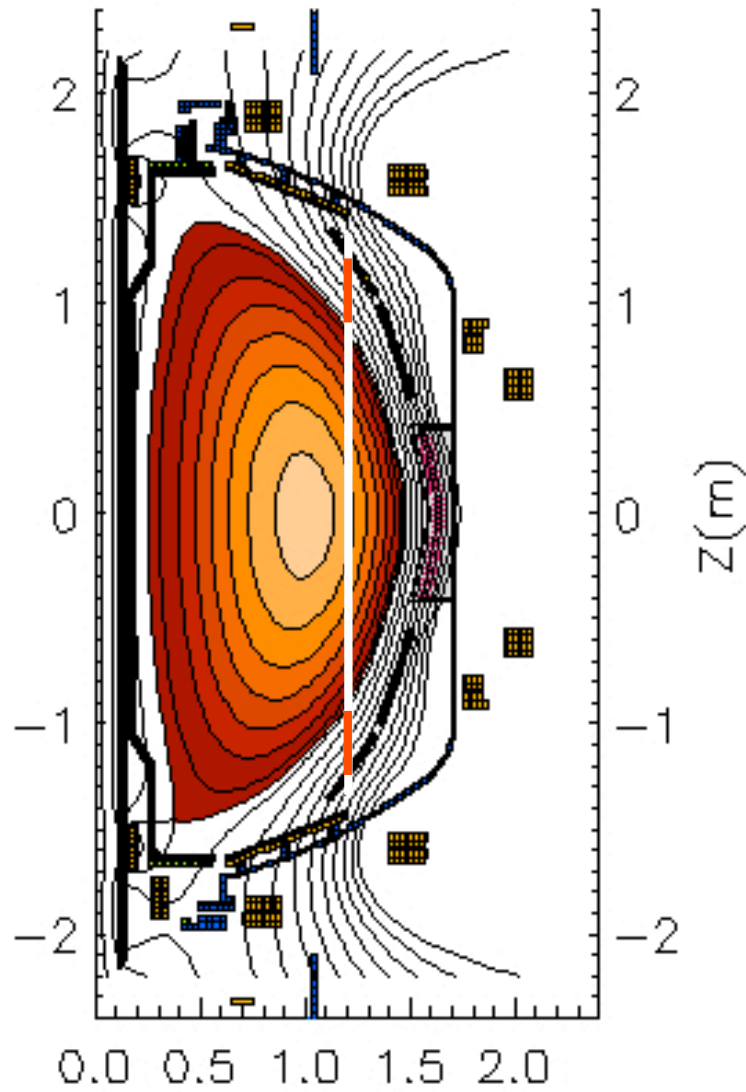
# Existing Computerized Laboratory Test Facility



# Raw Laser Signal Using Surrogate Powder Shows Rapid Start and Stop of Particle Flux



# Lithium Particle Trajectory



# The Budget Estimates



Task	Engineer man-hrs	k\$ Ld	Tech man-hrs	k\$ Ld	M. Shop man-hrs	k\$ Ld	M&S k\$	k\$ Ld
Dropper & Housing	32	5.8	16	2.1	32	4.3	1.5	2.0
Laser Scat. Module			16	2.1			0.5	0.7
Diagnostics							1.0	1.3
Software	24	4.3					5	6.5
Li Powder							4	5.2
Power Supply							7	9.1
Piezo Actuators							1	1.3
Assemble System			24	3.2				
Lab Measurements			3.2	4.2				
Install System			24	3.2				
Sub-Total k\$		10.1		14.8		4.3		26.1

<b>Labor = \$ 29.2 k</b>	<b>M&amp;S = \$ 26.1 k</b>	<b>Total (Loaded) = \$ 55.3 k</b>
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# The Schedule



Task / Week	1	2	3	4	5	6	7	8
Drafting Dropper & Housing	█							
Machine Dropper & Housing		█	█	█				
Software & Controls	█	█	█	█	█	█	█	█
Cabling					█	█	█	
Assemble Hardware				█				
Final Lab Measurements					█	█		
Installation							█	
ISTP								█

## An Acronym or Two



Resonant Acoustic Injection for Decreased Recycling  
Outside the Plasma Separatrix :

**RAINDROPS**

If this too cute by half ....

**RAIN**



- ▼ Signal Generators**
- ▼ Arbitrary Waveform Generators
  - ▶ 16-Bit, 200 MS/s, Single-Channel
  - ▶ 16-Bit, 100 MS/s, Single-Channel
  - ▶ 16-Bit, 100 MS/s, Single-Channel, with OSP
  - ▼ 14-Bit, 100 MS/s, Single-Channel
    - NI PXI-5412
    - ◆ NI PCI-5412
- ▶ Function Generators
- ▶ RF Signal Generators
- ▶ Cables for Signal Generators
- ▶ Software for Signal Generators

[NI Home](#) > [Products & Services](#) > [Modular Instruments](#) > [Signal Generators](#) > [Arbitrary Waveform Generators](#) > [14-Bit, 100 MS/s, Single-Channel](#) > [NI PCI-5412](#) **United States**

## NI PCI-5412

### 100 MS/s, 14-Bit Arbitrary Waveform Generator



[\[+\] Enlarge Picture](#)

- 14-bit resolution, 100 MS/s sampling rate
- Function generator emulation mode
- 8, 32, or 256 MB of shared waveform data and sequence instruction memory
- Multimodule synchronization with <20 ps skew
- 20 MHz analog bandwidth
- [Data Sheet](#) | [Select Accessories](#)

[Overview](#) | [Specifications](#) | **[Pricing](#)** | [Services](#) | [Resources](#)

#### Step 1: Verify Device and Quantity Selection

Part Number	Description	Est Ship Days	US Dollars (change)	Qty
	NI PCI-5412			
779177-01	8 MB <span style="color: green;">NI Recommended</span>	5 - 10	\$ 3,599.00	<input type="text" value="1"/>
779177-02	32 MB	5 - 10	\$ 4,999.00	<input type="text" value="0"/>
779177-03	256 MB	5 - 10	\$ 7,499.00	<input type="text" value="0"/>

Each NI PCI-5412/8MB requires: 1 Cable

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**Total Items:** 0  
**Subtotal:** \$ 0

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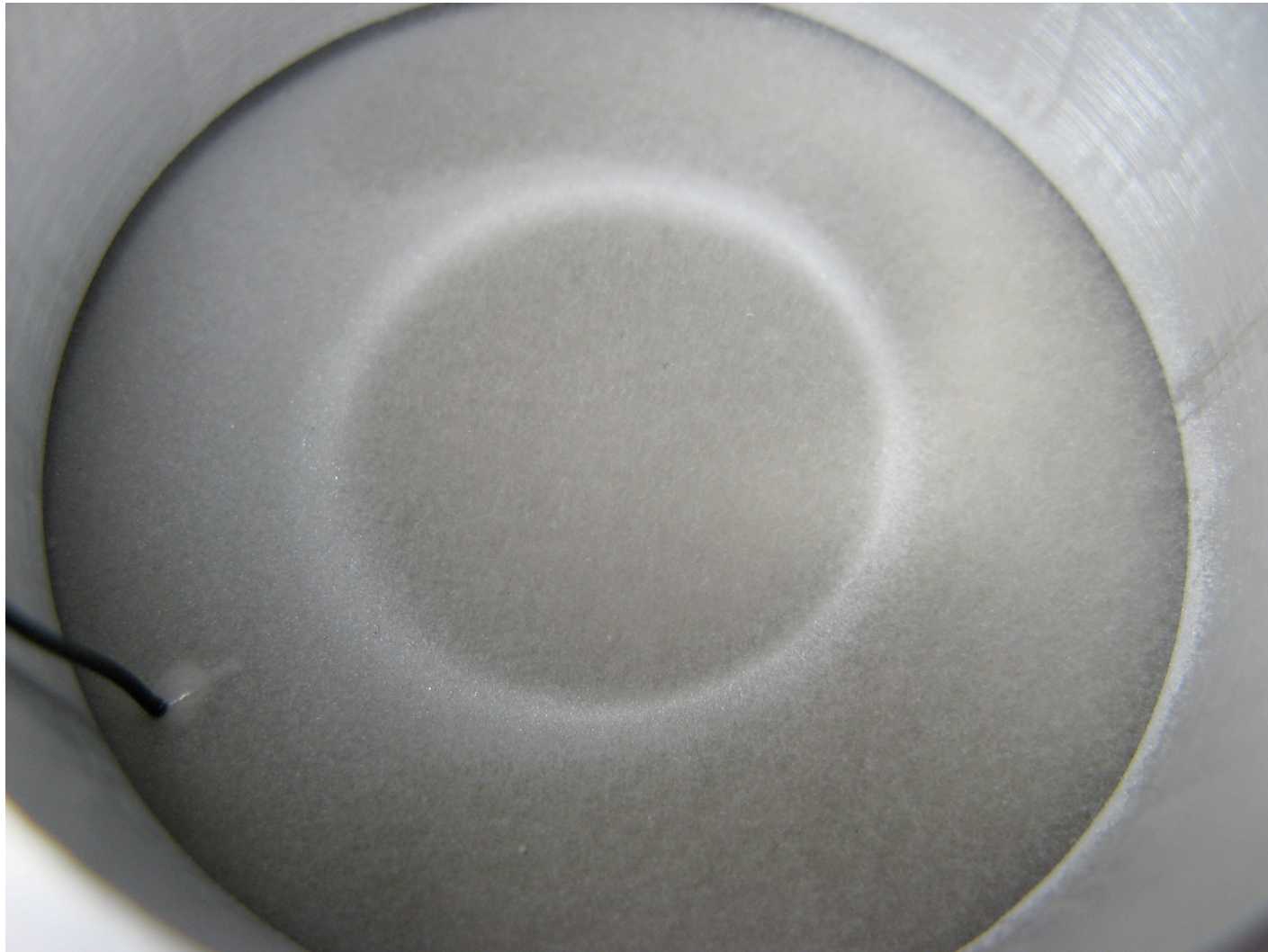
#### My Parts List

Create a Parts List to store products while you browse

# 0,2 Mode of Piezoelectric Disk with Glass Beads – 2 KHz



# 0,2 Node of Piezoelectric Disk with Glass Beads – 2 KHz

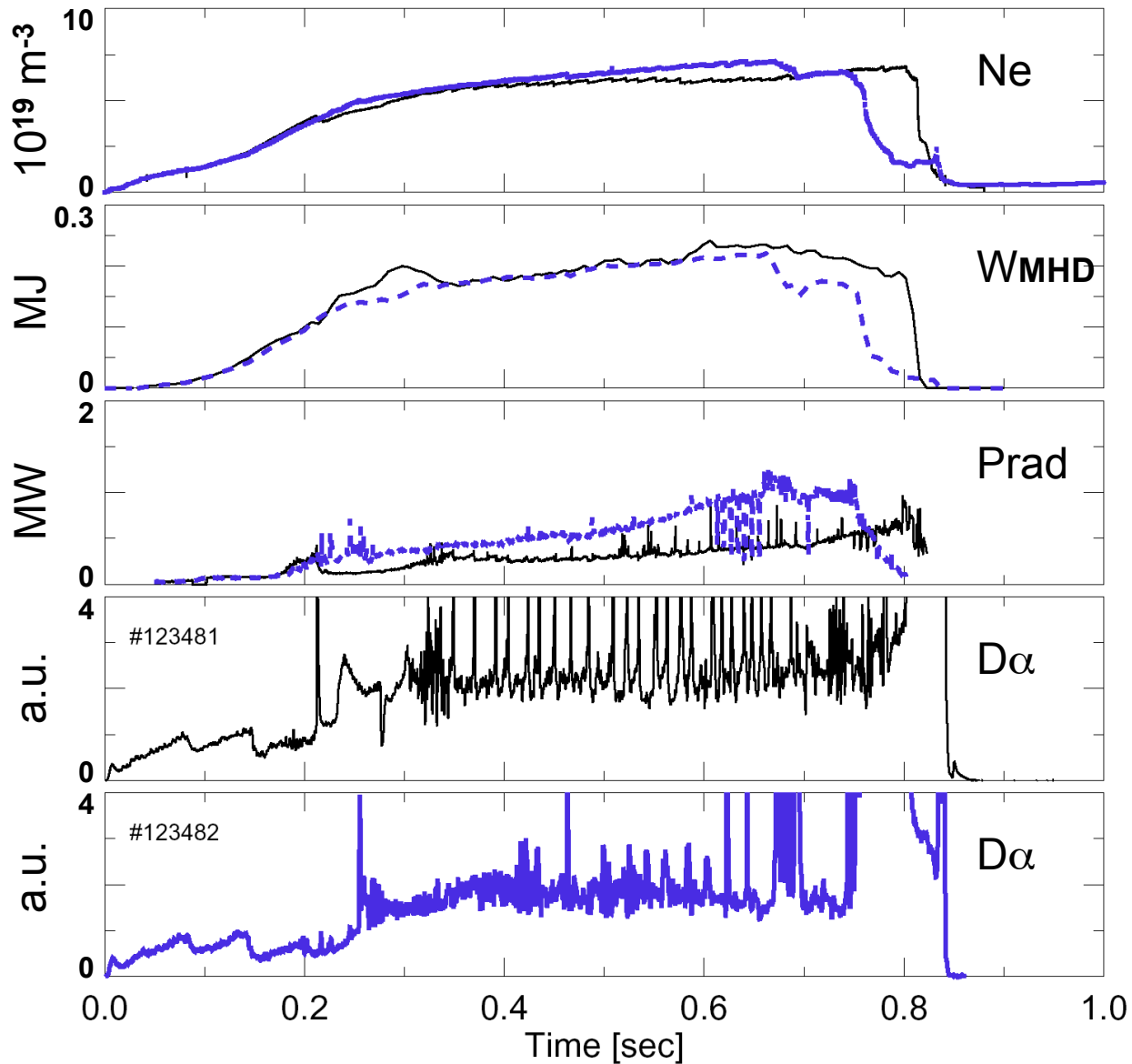




# 1/2 inch OD Injection Tube Has Been Installed in Bay I



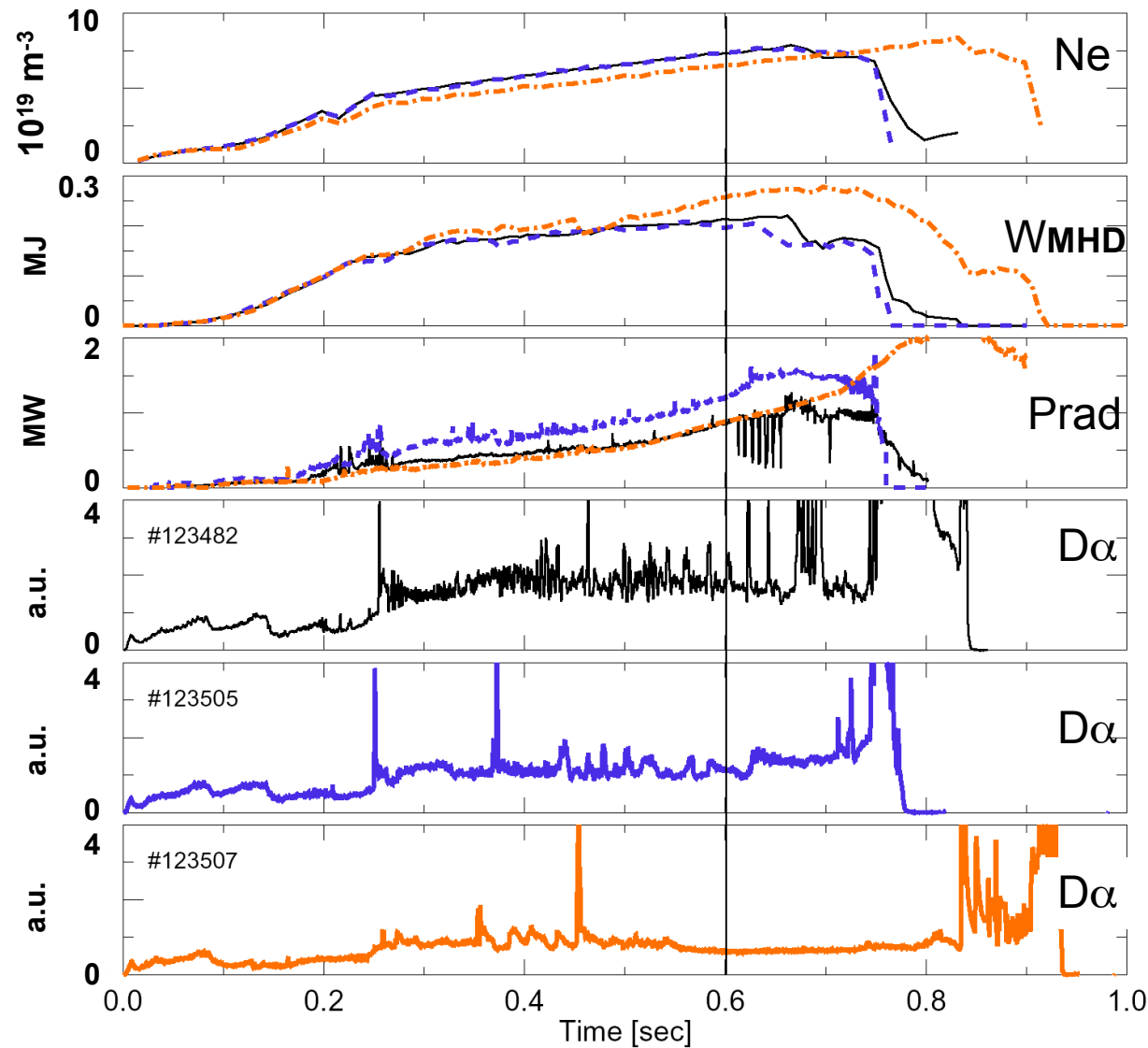
# ELMS $\rightarrow$ Faint Elms $\rightarrow$ No ELMS Transition (I)



330 mg Total  
5.6 mg/min

522 mg Total  
9.6 mg/min

# ELMS → Faint Elms → No ELMS Transition (II)



522 mg Total  
9.6 mg/min

2200 mg Total  
0.0 mg/min

2636 mg Total  
13.7 mg/min

# 2007 Transitional Profiles @ 0.6 sec

123505 No Li, Faint ELMS

123507 With Li, No ELMS

