

# First Bubbles from the Scintillating Bubble Chamber Experiment

Zhiheng Sheng  
Northwestern University  
On behalf of the SBC Collaboration

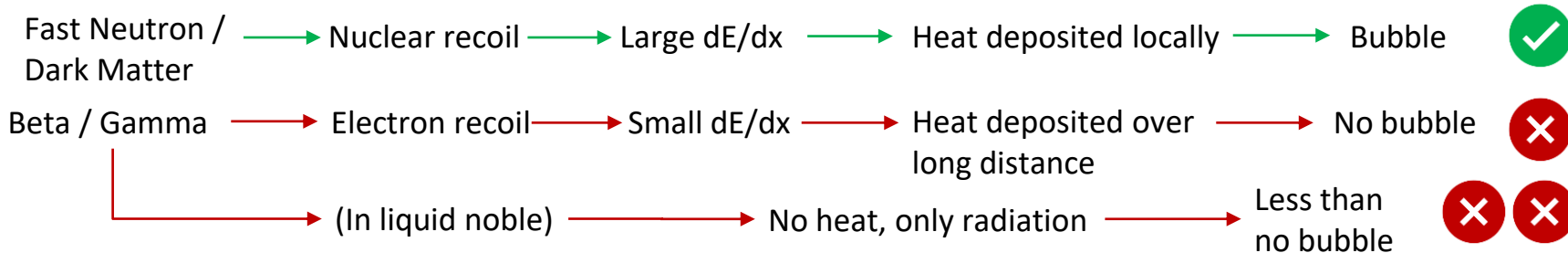
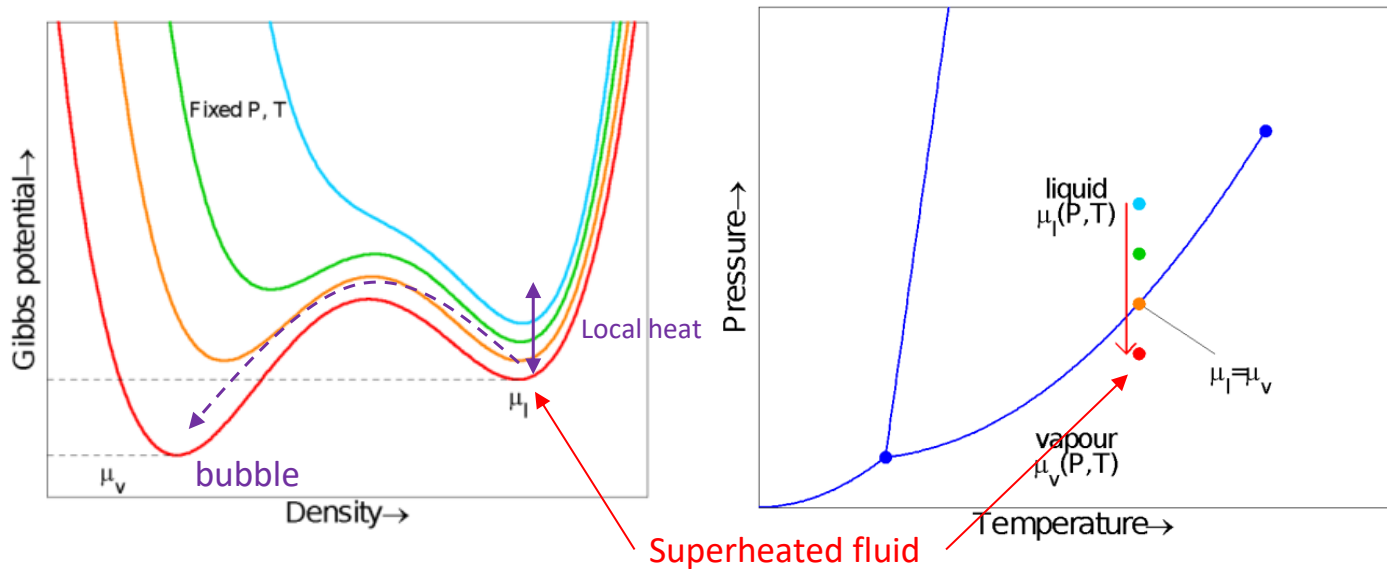
**Northwestern**

Department of  
Physics and Astronomy

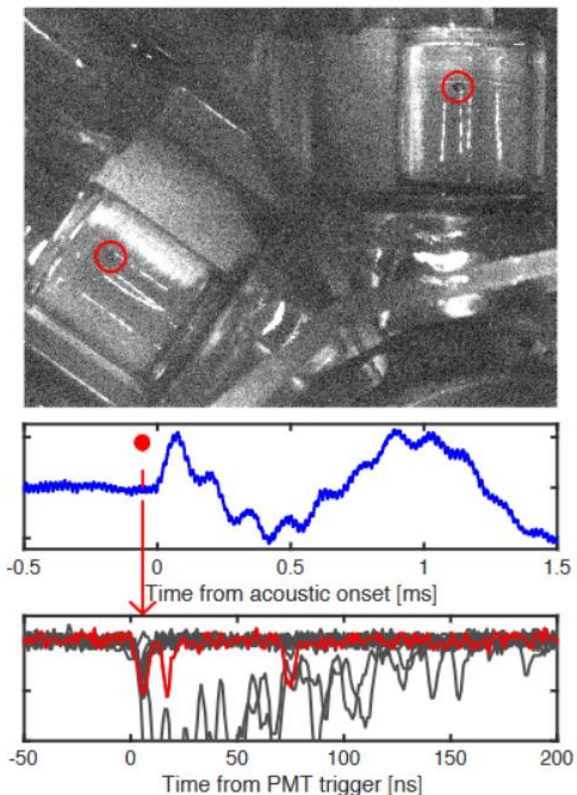
APS Global Summit  
2026-03-17



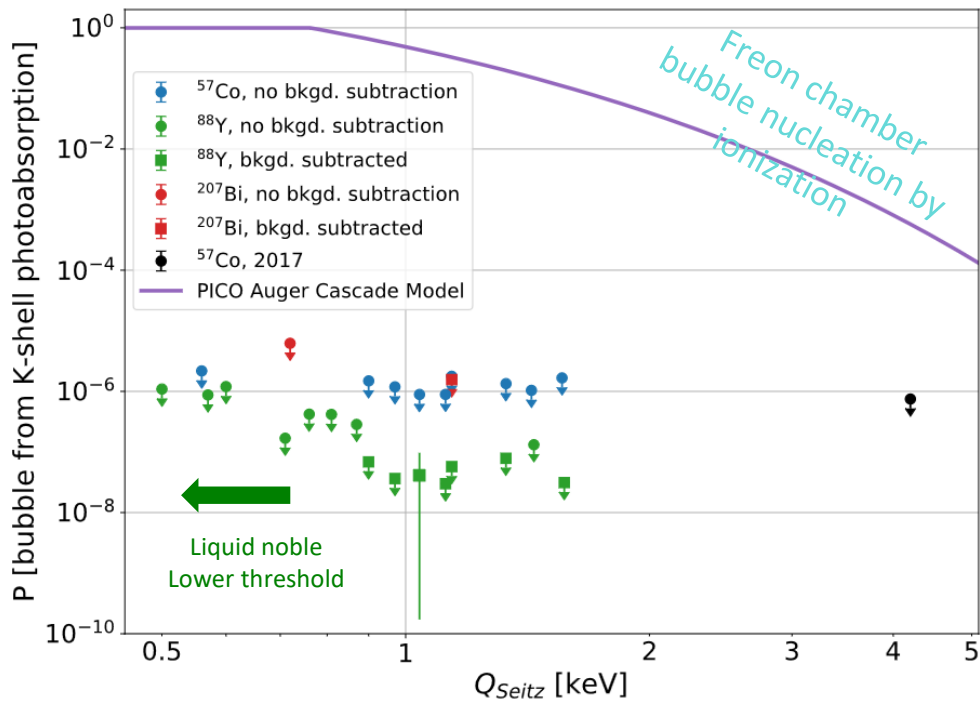
# Superheated Fluid and Bubble Chambers



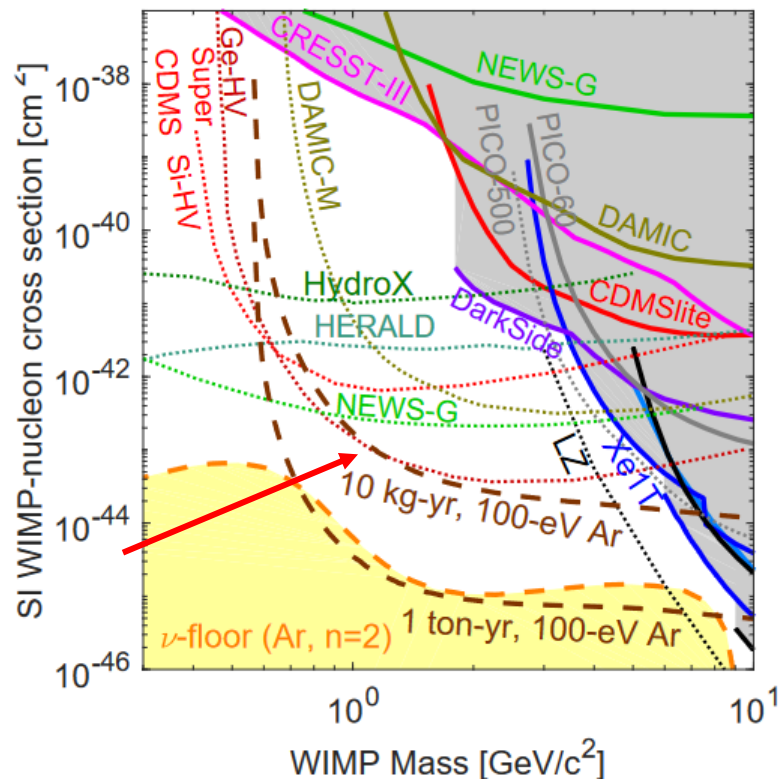
# Electron Recoil Discrimination



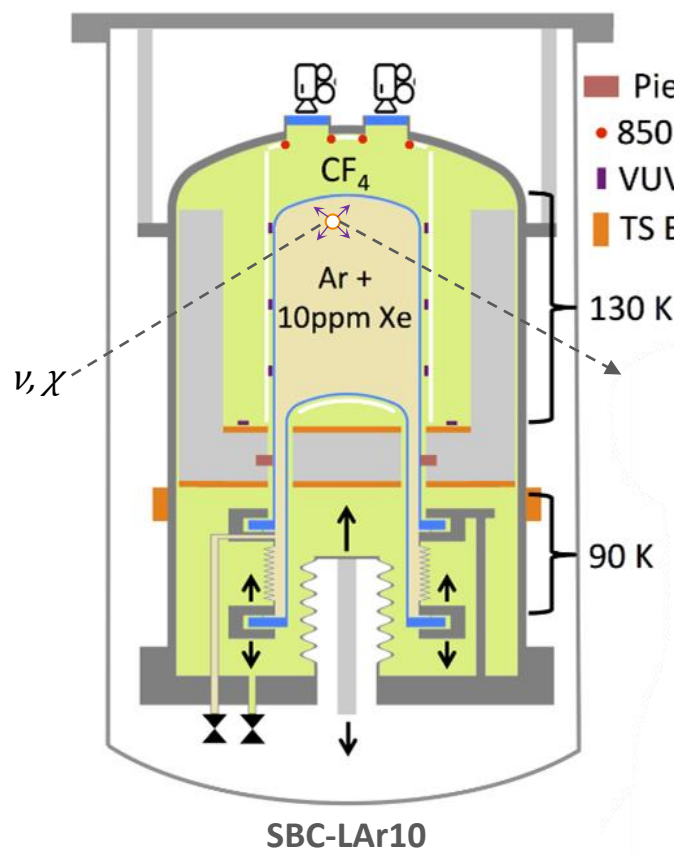
Prototype Xenon bubble chamber



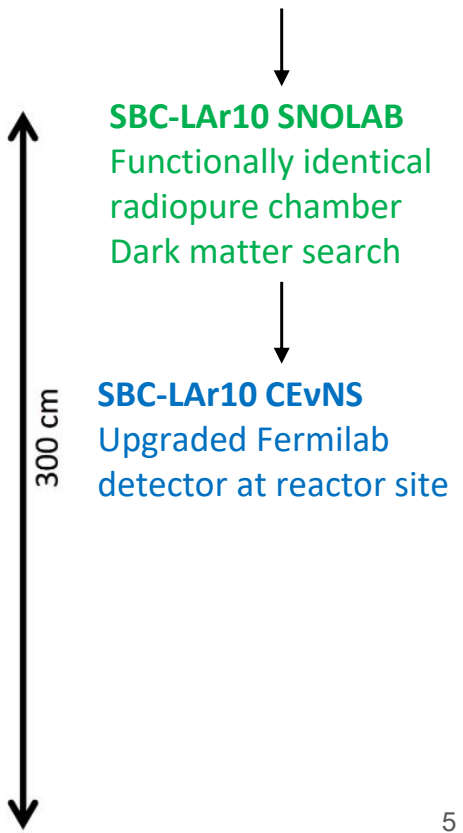
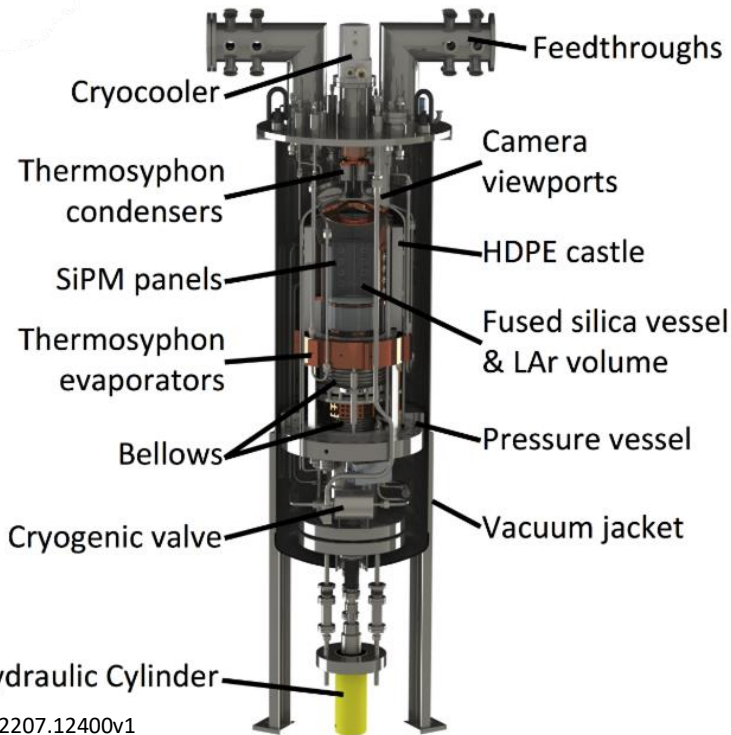
# Scintillating Bubble Chamber Technology



1. Scintillating Bubble Chamber (SBC) combines **powerful electron recoil (ER) discrimination** technique with **event-by-event energy resolution** of liquid-noble scintillators
2. DM masses down to  $\sim 1\text{GeV}$  ( $\sim 100\text{eV}$  nuclear recoil on argon nucleus)
3. SBC is the only technology that can achieve this that is also **easily scalable** to 1 ton or higher



**SBC-LAr10 Fermilab**  
 10kg calibration chamber currently  
 operating in MINOS underground tunnel



# SBC-LAr10-Fermilab Timeline



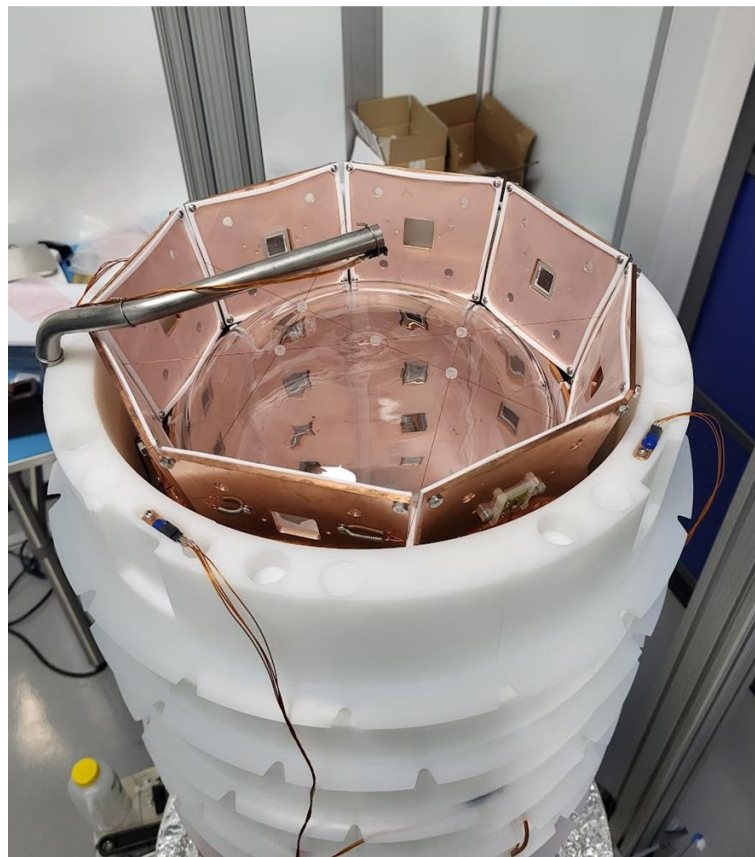
2024-05  
Moving to MINOS underground

2024-09  
First cryogenic operation  
- leak detected



2024-09  
First cryogenic operation  
- leak detected

Discovered cracked jar ...



One year of repairs underground



Since then,  
Continuous operation and  
data-taking for ~6 months

2025-09  
First fill with LAr and LCF4



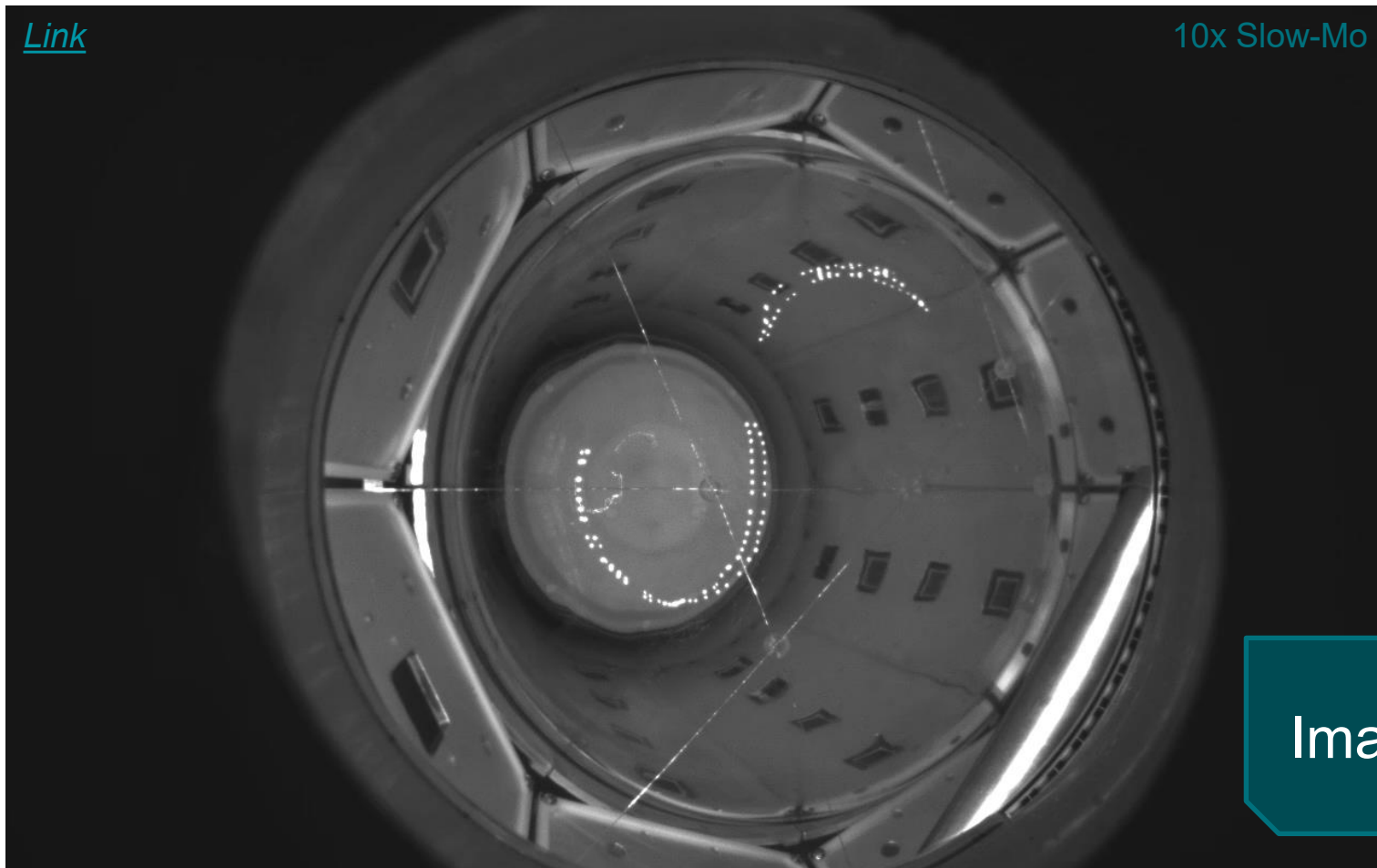
# Data streams and sample data

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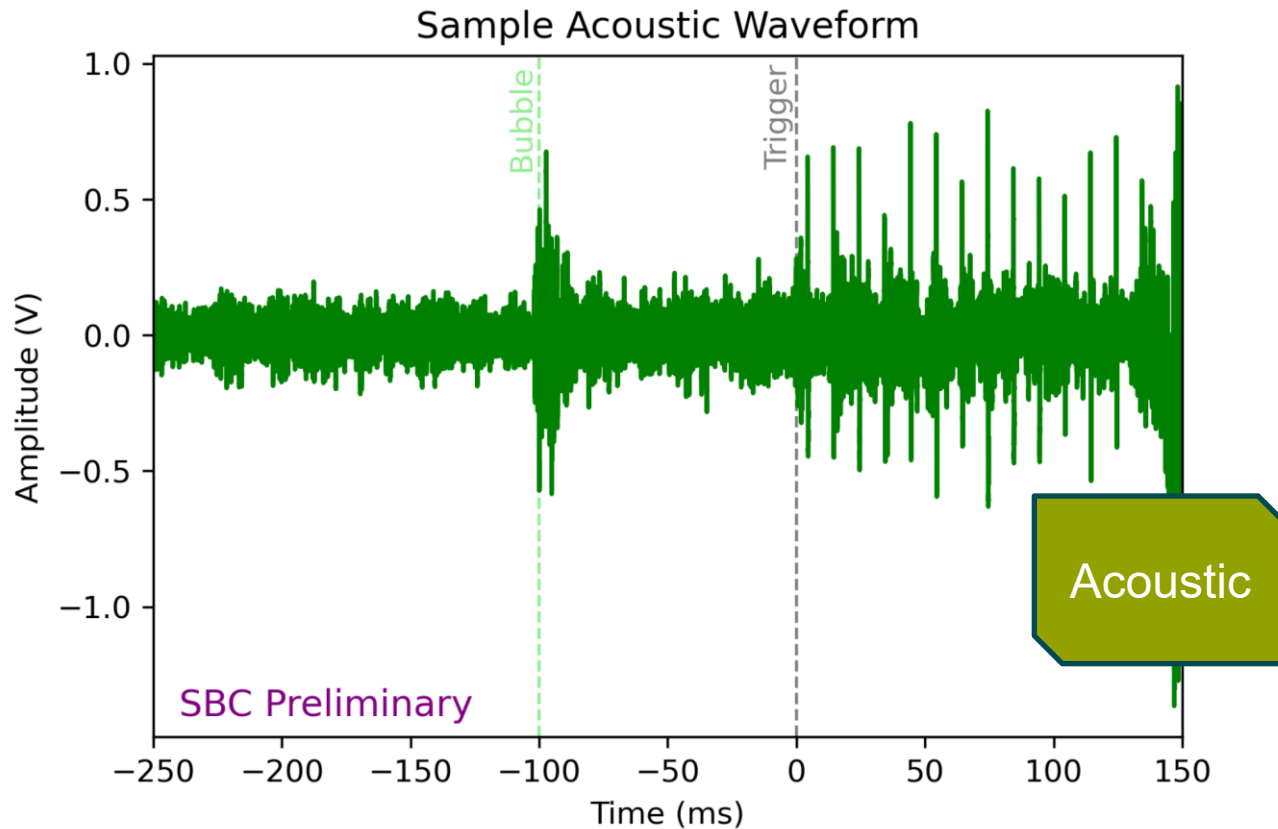
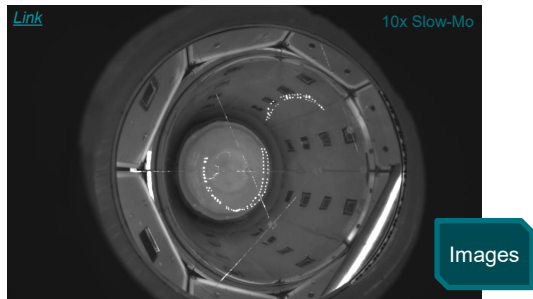
[Link](#)

10x Slow-Mo

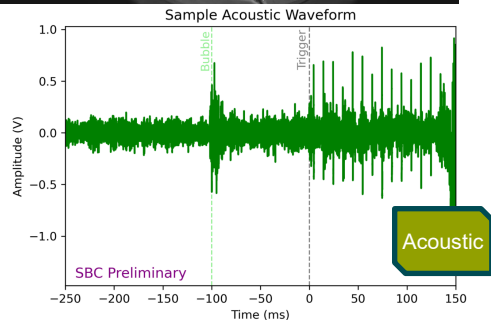
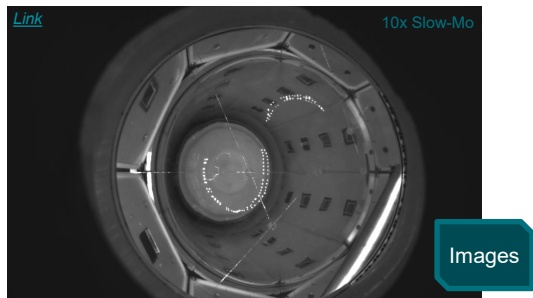


Images

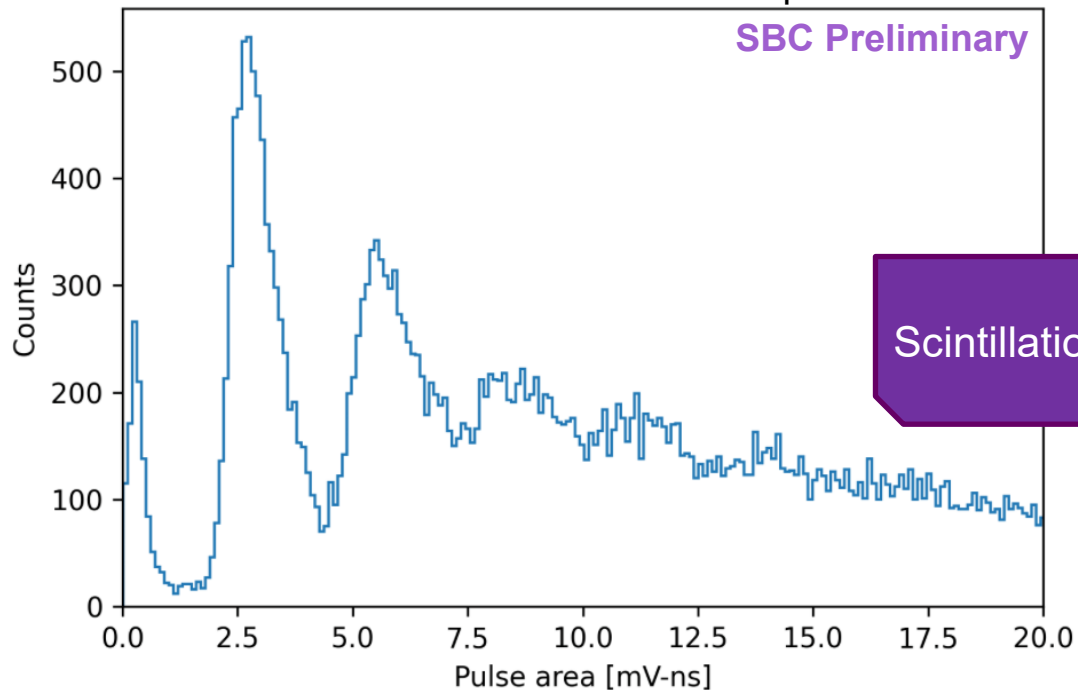
# Data streams and sample data



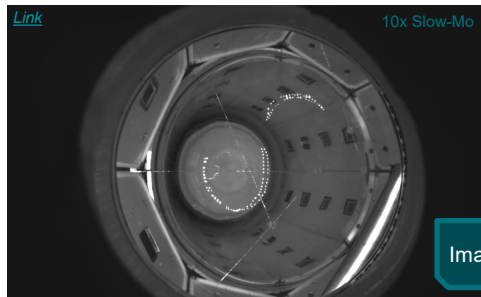
# Data streams and sample data



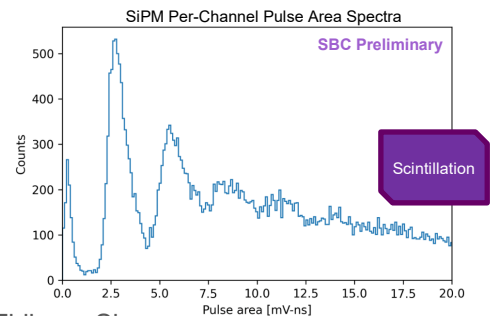
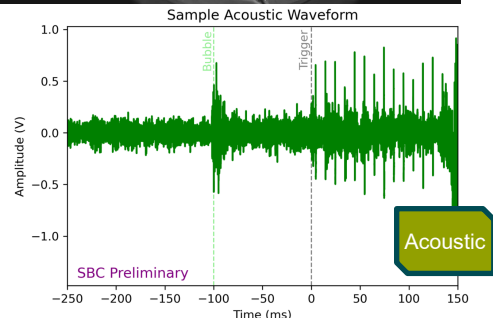
## SiPM Per-Channel Pulse Area Spectra



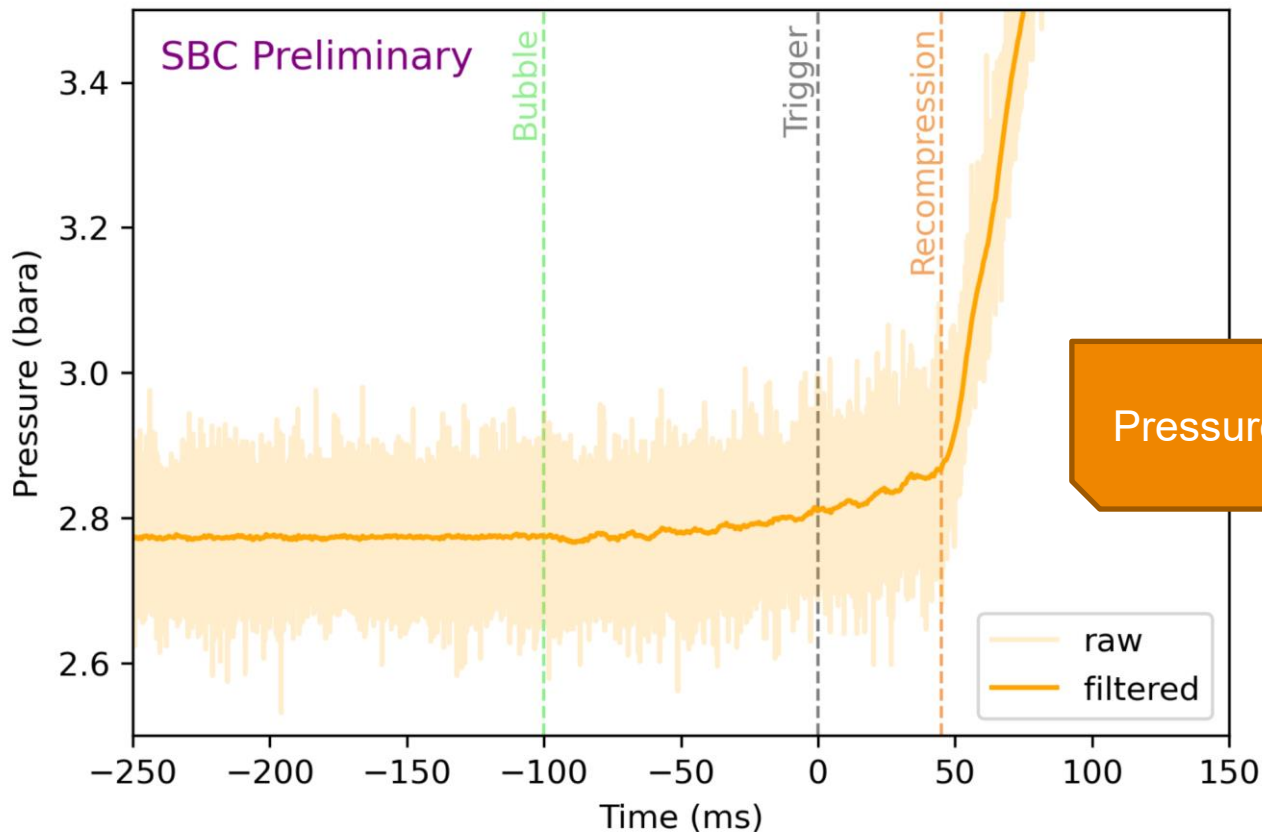
# Data streams and sample data



Images



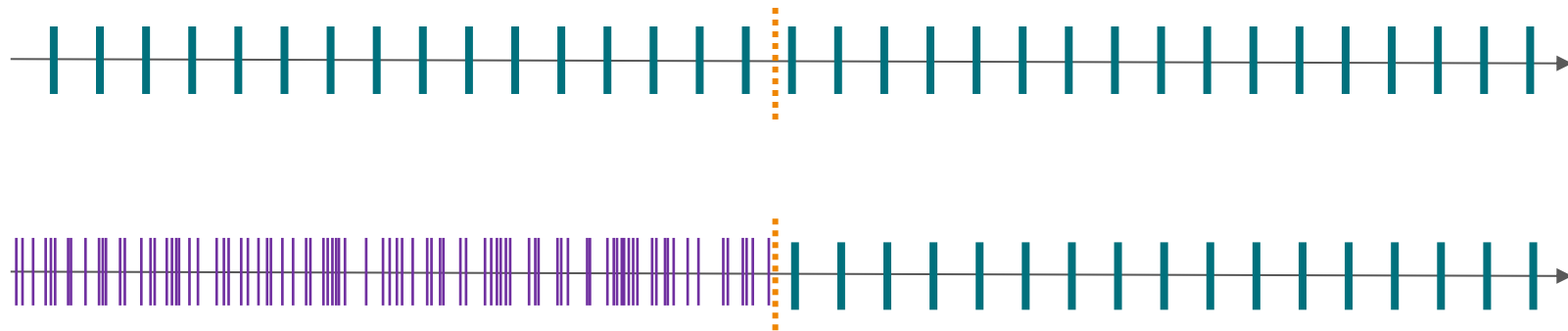
## Sample Pressure Trace



# Two DAQ modes – Imaging and scintillation

Camera images only  
(pre- and post- trigger)

Trigger  
(Pressure-based)

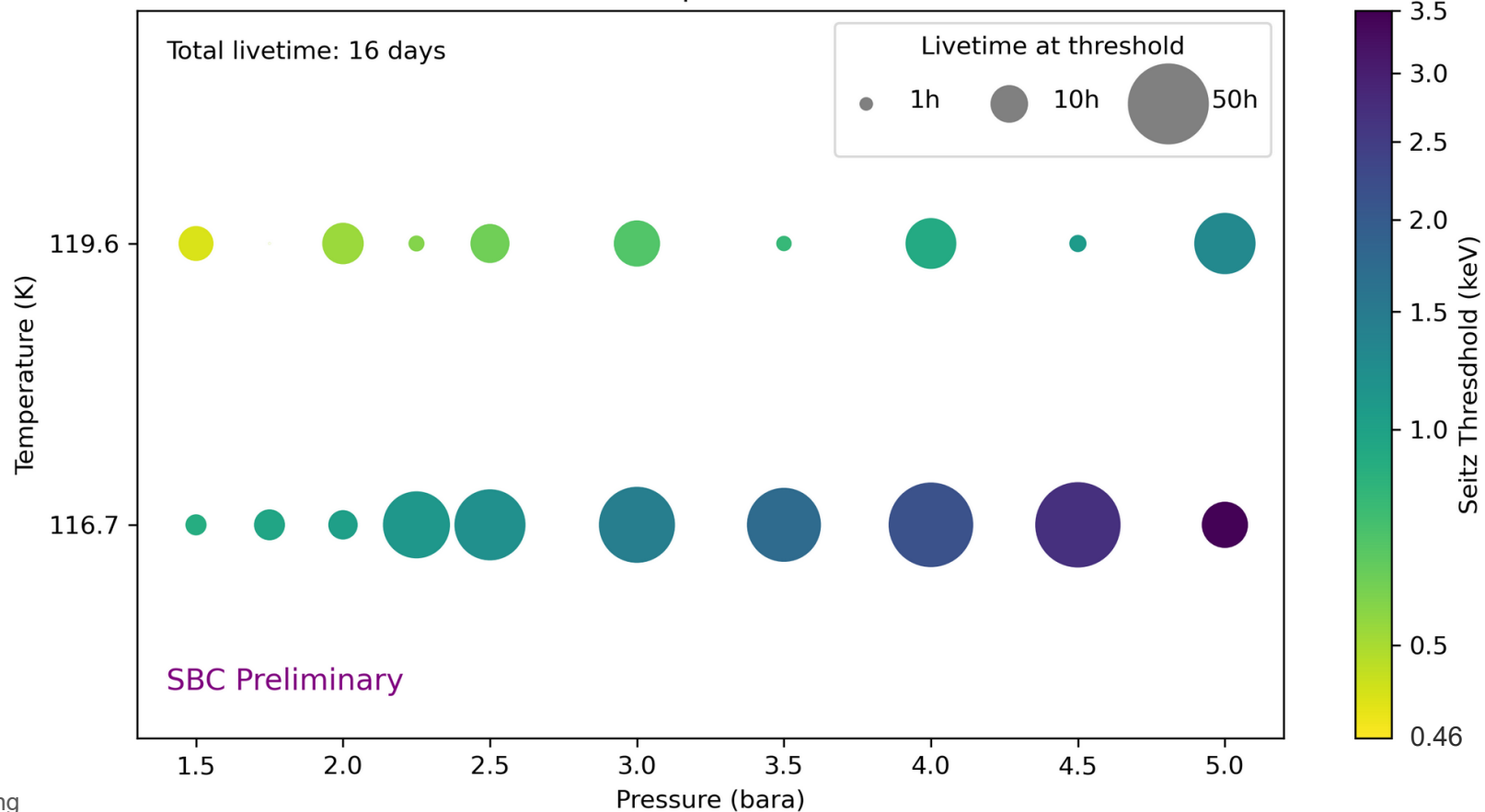


Pre-trigger scintillation +

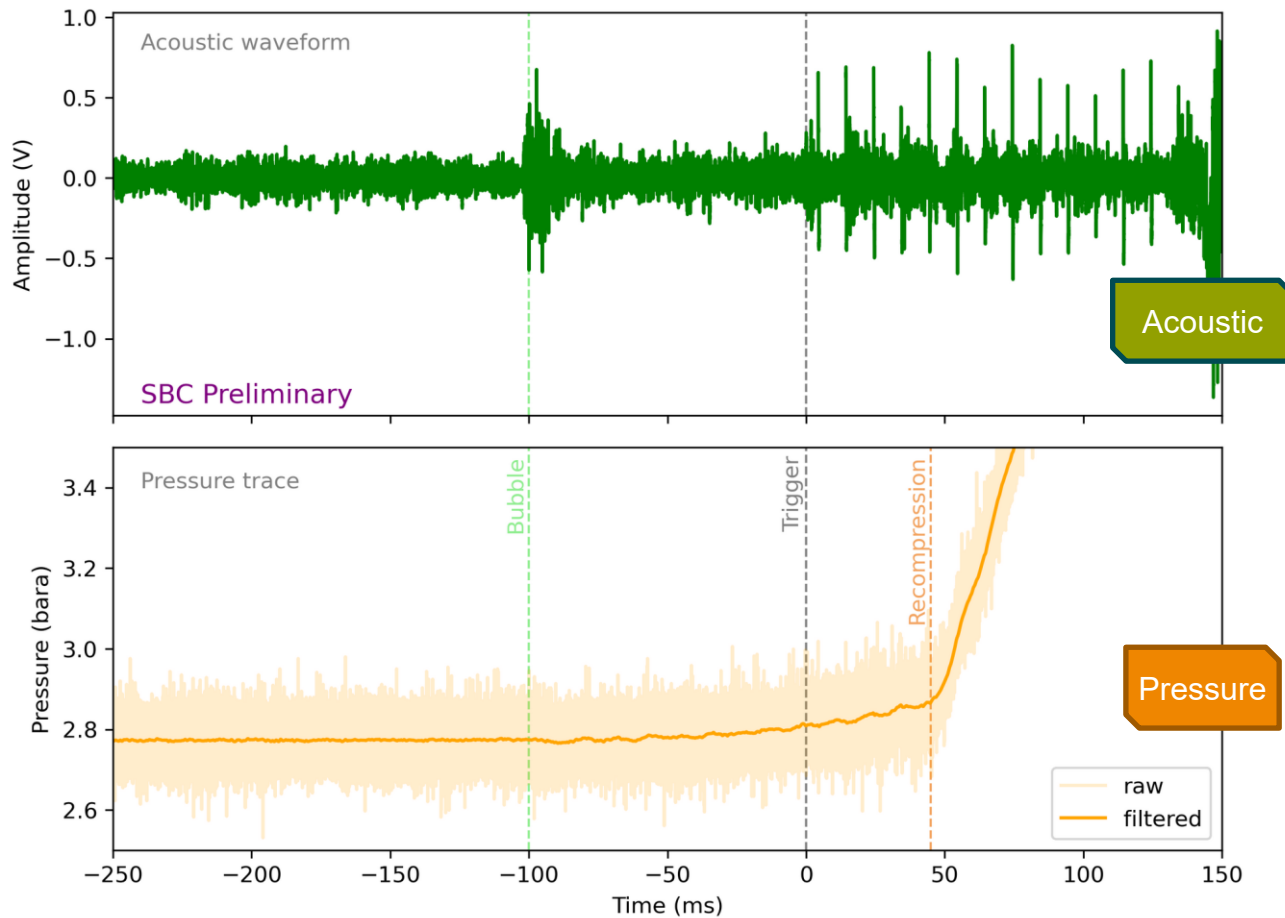
Post-trigger camera

# Temperature and pressure range explored

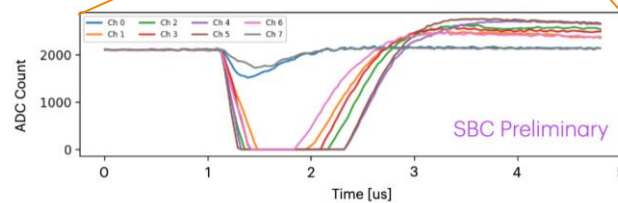
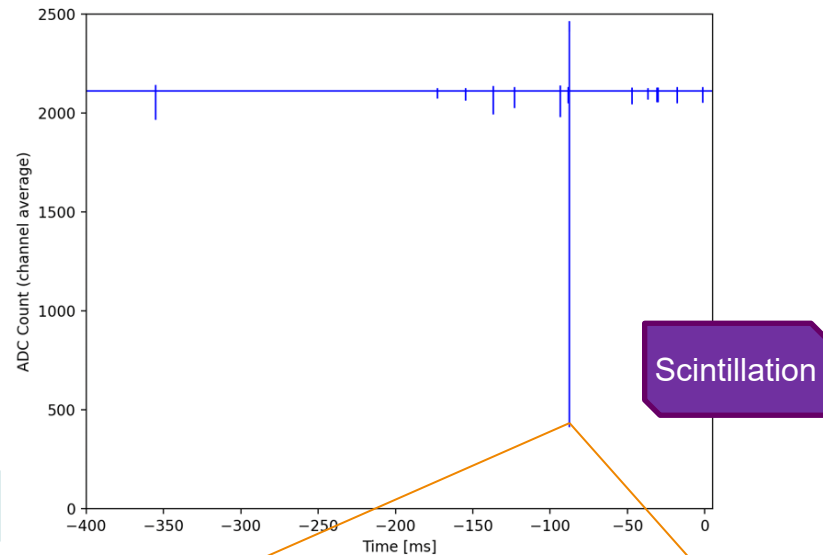
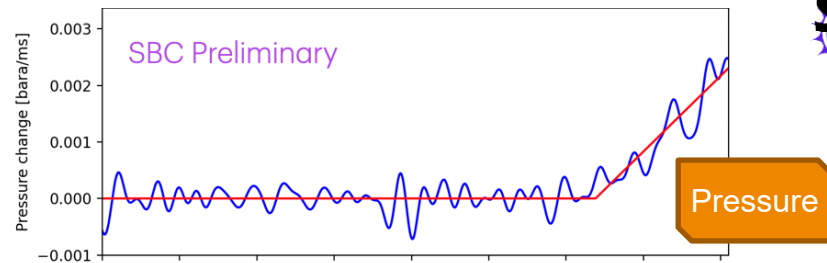
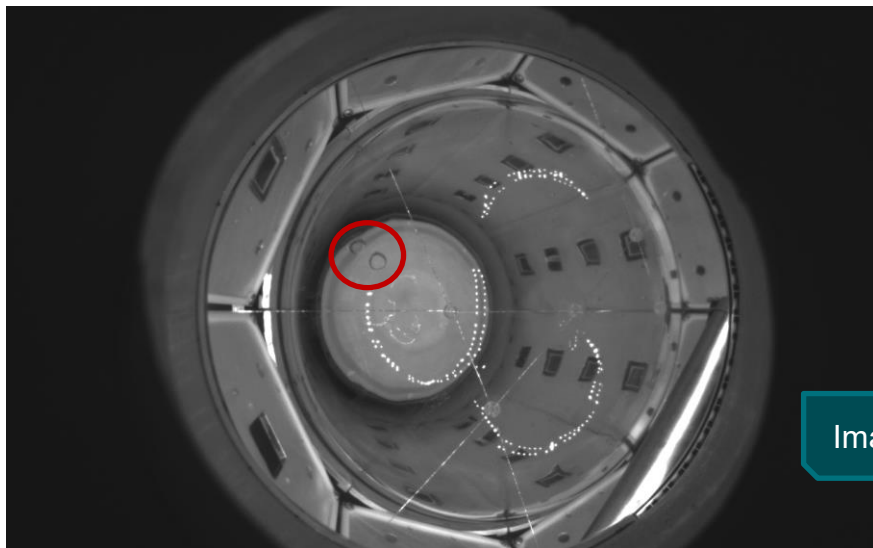
## SBC LAr10 explored thresholds



# $T_0$ Coincidence - Pressure + Acoustic



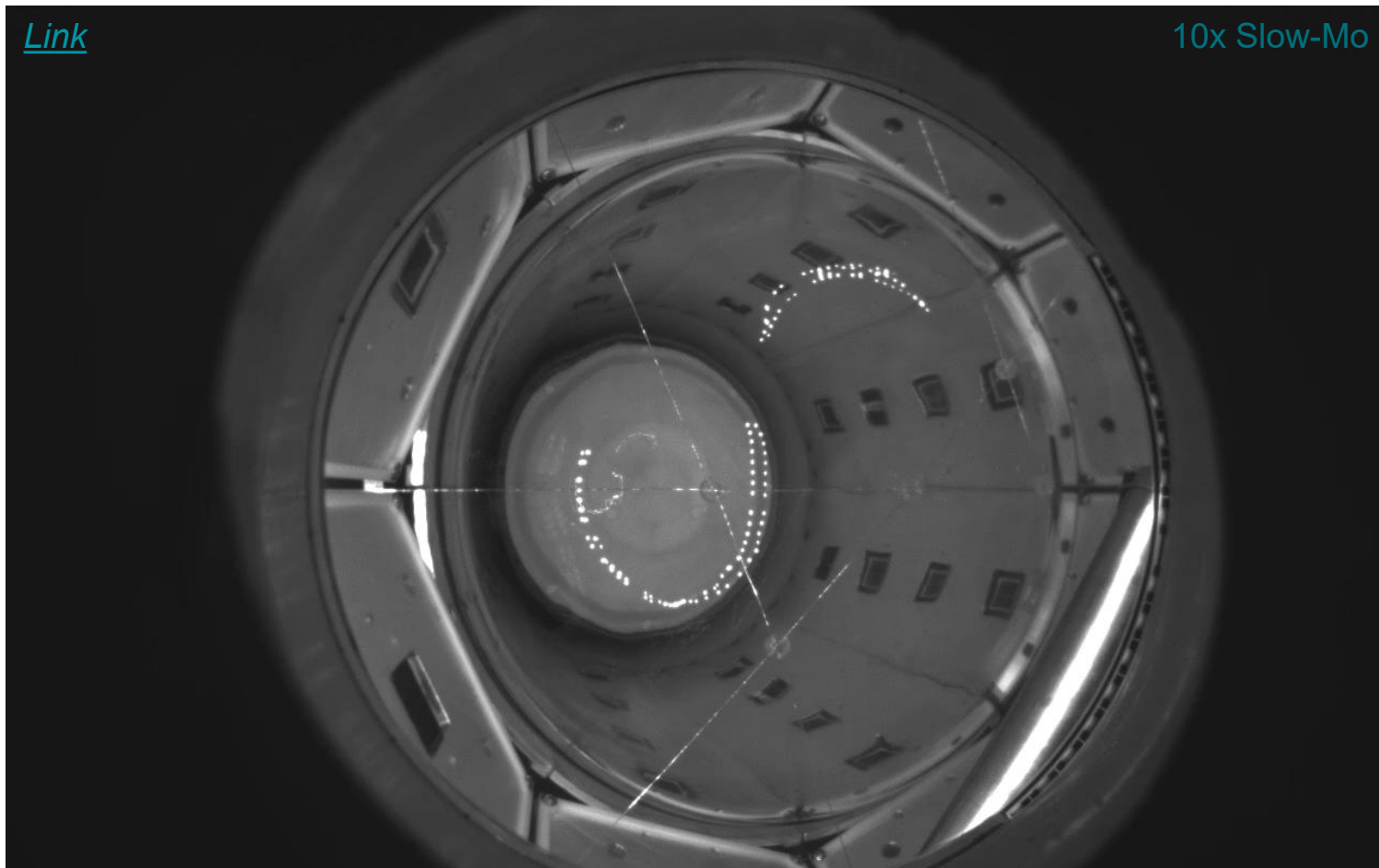
# T<sub>0</sub> Coincidence - Pressure + Scintillation



# Multi-bubble events from neutrons

[Link](#)

10x Slow-Mo

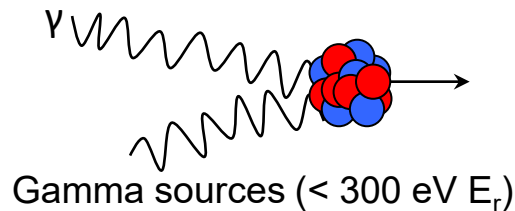
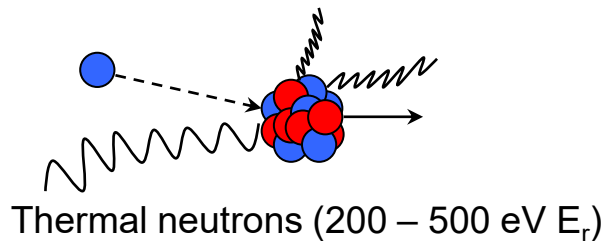
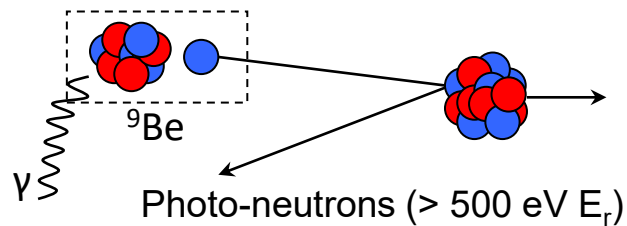


# Calibration Plan

## ER Calibration

- Continuing operation at multiple thermodynamic thresholds
- Exploring limits of ER blindness with multiple gamma sources
- ER light yield study with scintillation data

## NR Calibration



See Dan Pyda's talk tomorrow:  
 Wednesday, **Mar 18, 4:06 PM**. Hyatt Regency **Mineral B**.  
[The SBC Dark Matter Experiment and Calibration Plan.](#)

See our new calibration paper:  
[E. Alfonso-Pita et al 2026 JINST 21 P03020](#)



Northwestern University

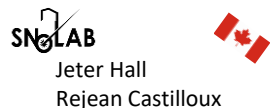
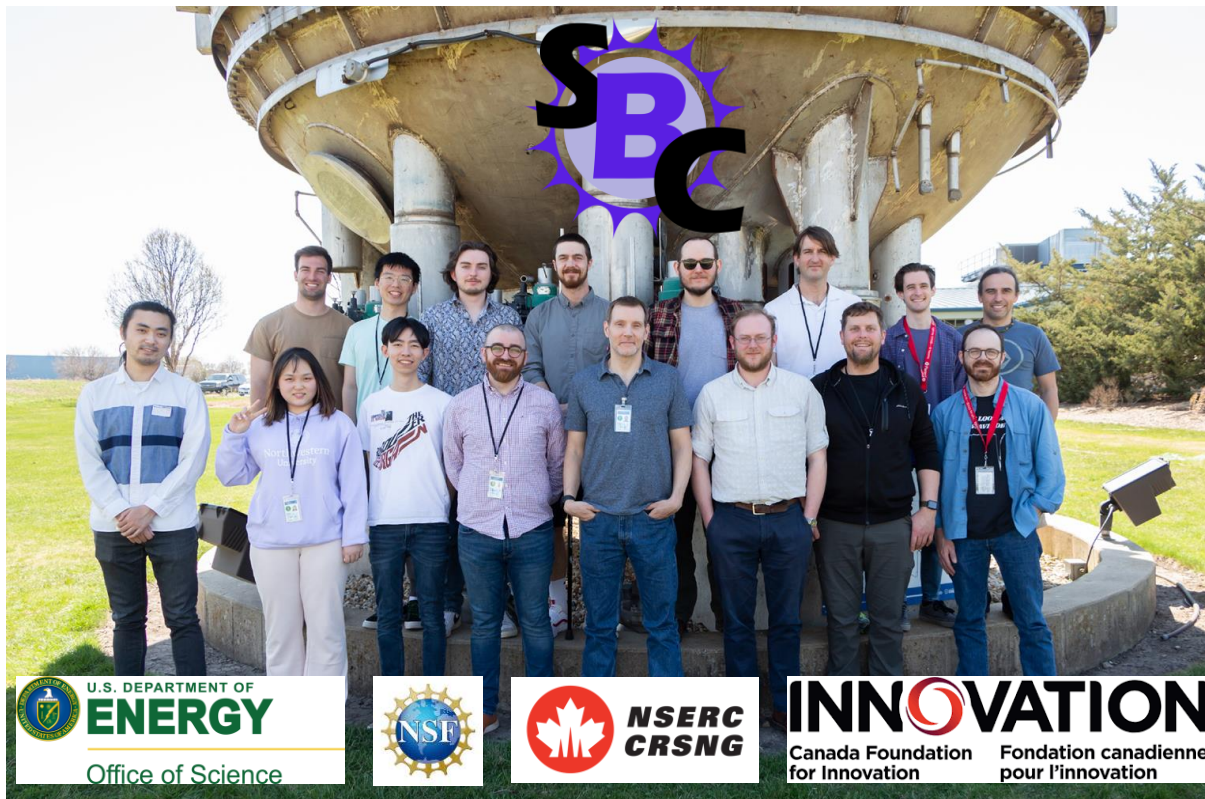
**Eric Dahl**  
Crystal Coulson  
Al Kucich  
Baisakhi Mitra  
Otto Nicholson  
Zhiheng Sheng



**Ken Clark**  
Ben Broerman  
Jonathan Corbett  
Austin de St Croix  
Koby Dering  
Carter Garrah  
Nicholas Moss  
Gary Sweeney  
Alex Wright  
Ezri Wyman



**UNIVERSITY OF ALBERTA**  
Marie-Cécile Piro  
Carsten Krauss  
Mitchel Baker  
Youngtak Ko



Eric Vázquez-Jáuregui  
Ernesto Alfonso-Pita



Russell Neilson  
Julian Fritz-Littman  
Noah Lamb  
Daniel Pyda



Ilan Levine  
Ed Behnke



Hugh Lippincott  
Logan Joseph  
TJ Whitis  
Ryan Zhang

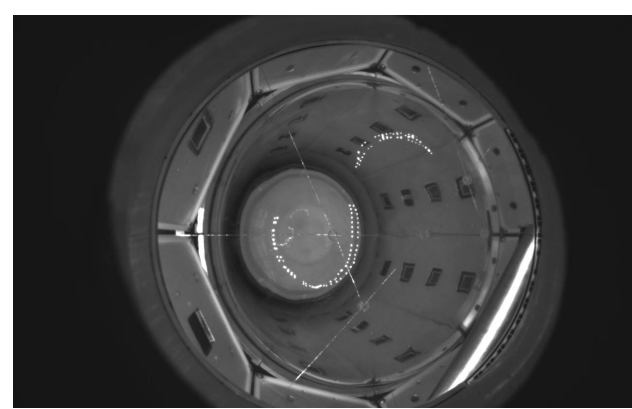


Gray Putnam  
Vrushank Patel



Shawn Westerdale

# Conclusions



- SBC-LAr10 is operational!
  - Six months of data in-hand
  - Simultaneous scintillation + bubble nucleation observed
  - Applying lessons learned to SBC-SNOLAB
- Explored thermodynamic thresholds down to 460 eV so far
  - Calibrations with gamma and neutron sources in progress
- Stay tuned for calibration results, lower-threshold operations, and SBC-SNOLAB



Slides and links

See Dan Pyda's talk tomorrow:  
Wednesday, **Mar 18, 4:06 PM**. Hyatt Regency **Mineral B**.  
[The SBC Dark Matter Experiment and Calibration Plan.](#)

See our new calibration paper:  
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