

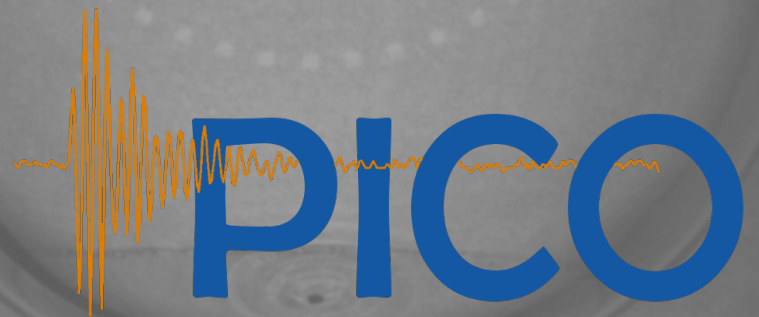
# Status of the PICO-60 Experiment

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University of Alberta

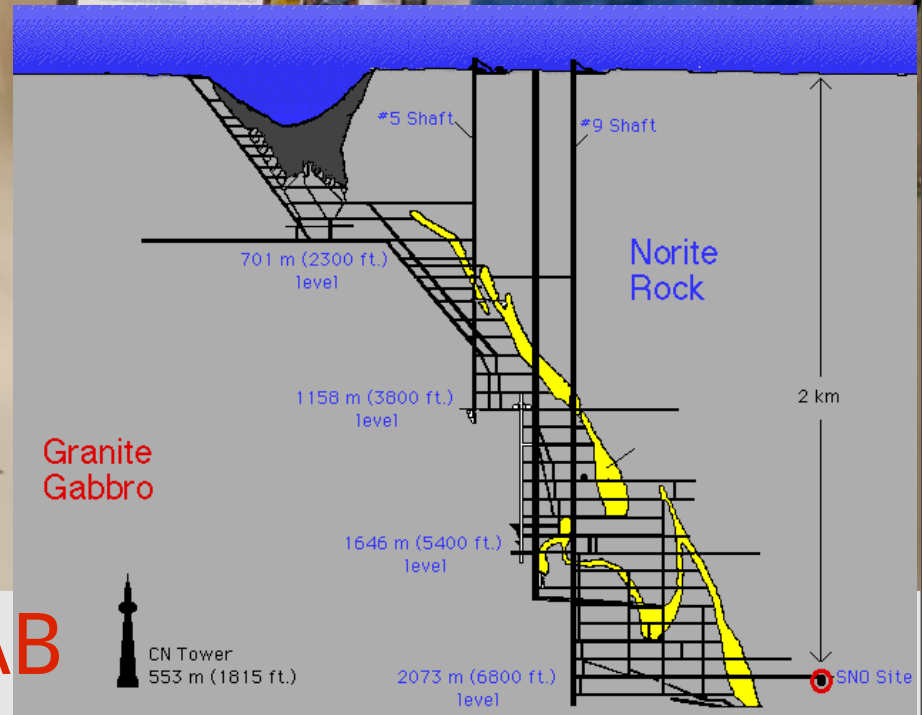
Edmonton, Alberta  
Monday, 15<sup>th</sup> June, 2014



UNIVERSITY OF  
ALBERTA

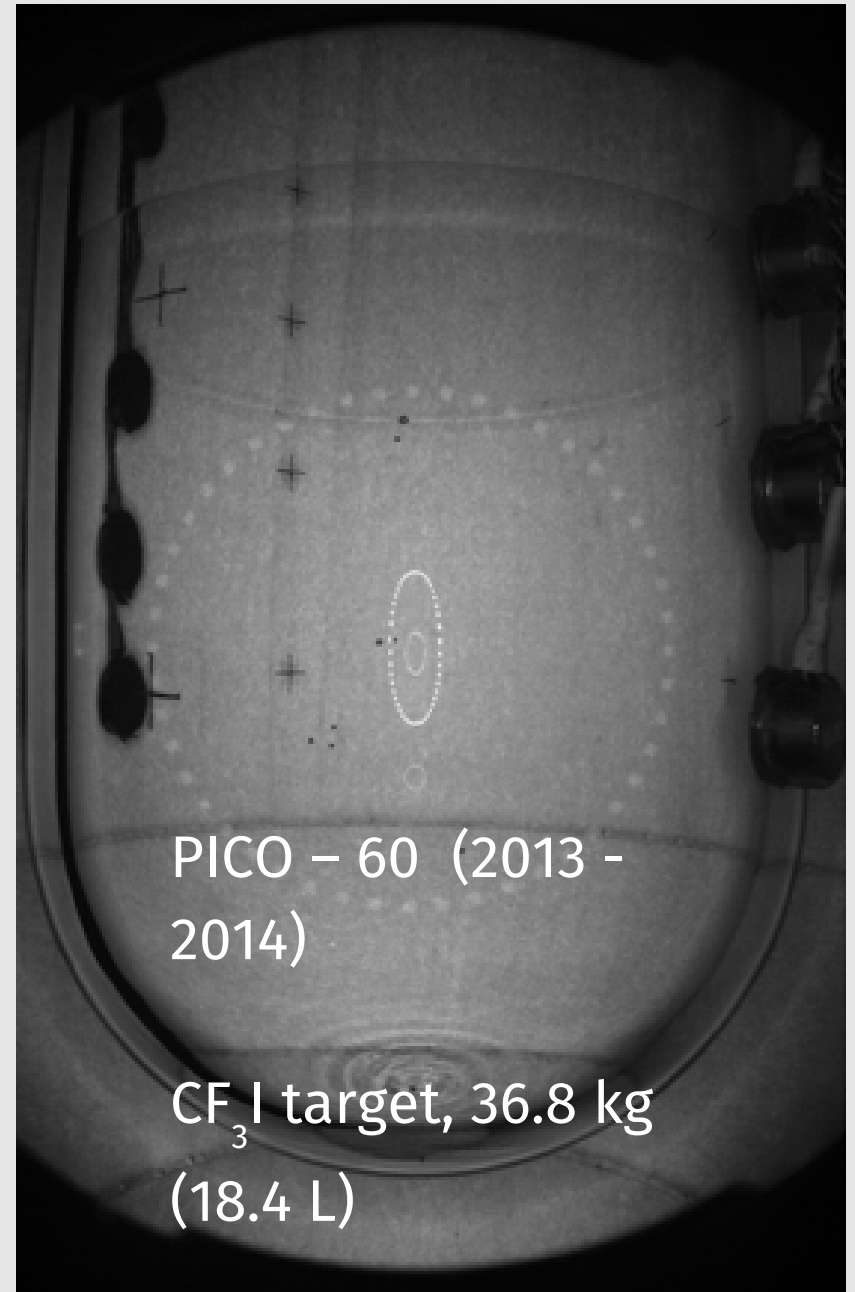
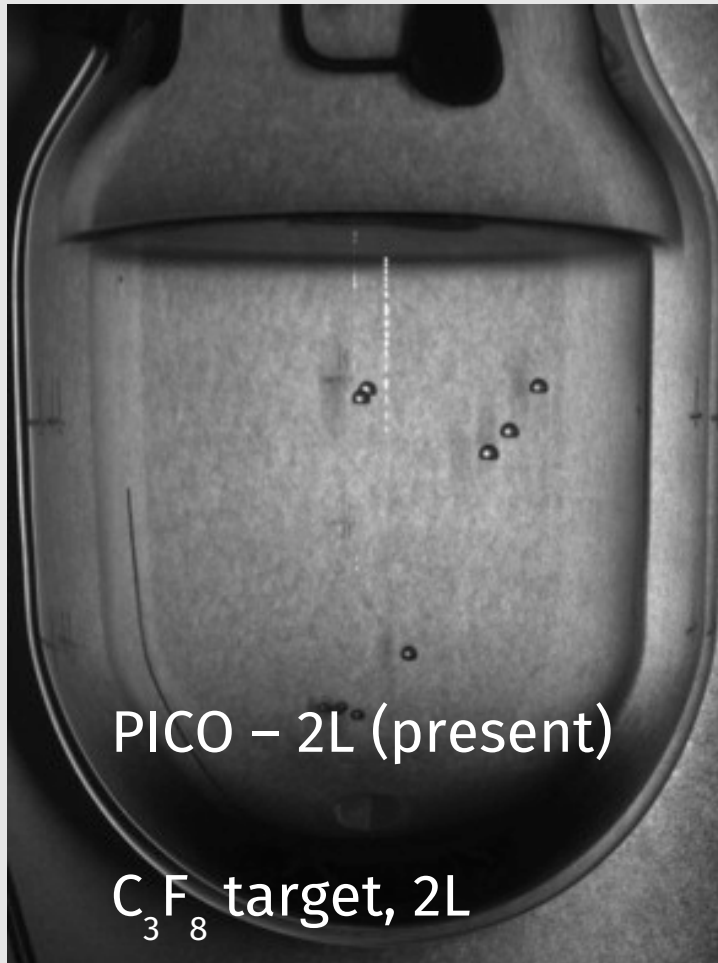
The word "PICO" in large blue letters, with an orange waveform graphic to its left.

PICO



# The PICO Experiment at SNOLAB

# The PICO program



PICO -60

$\text{CF}_3\text{I}$



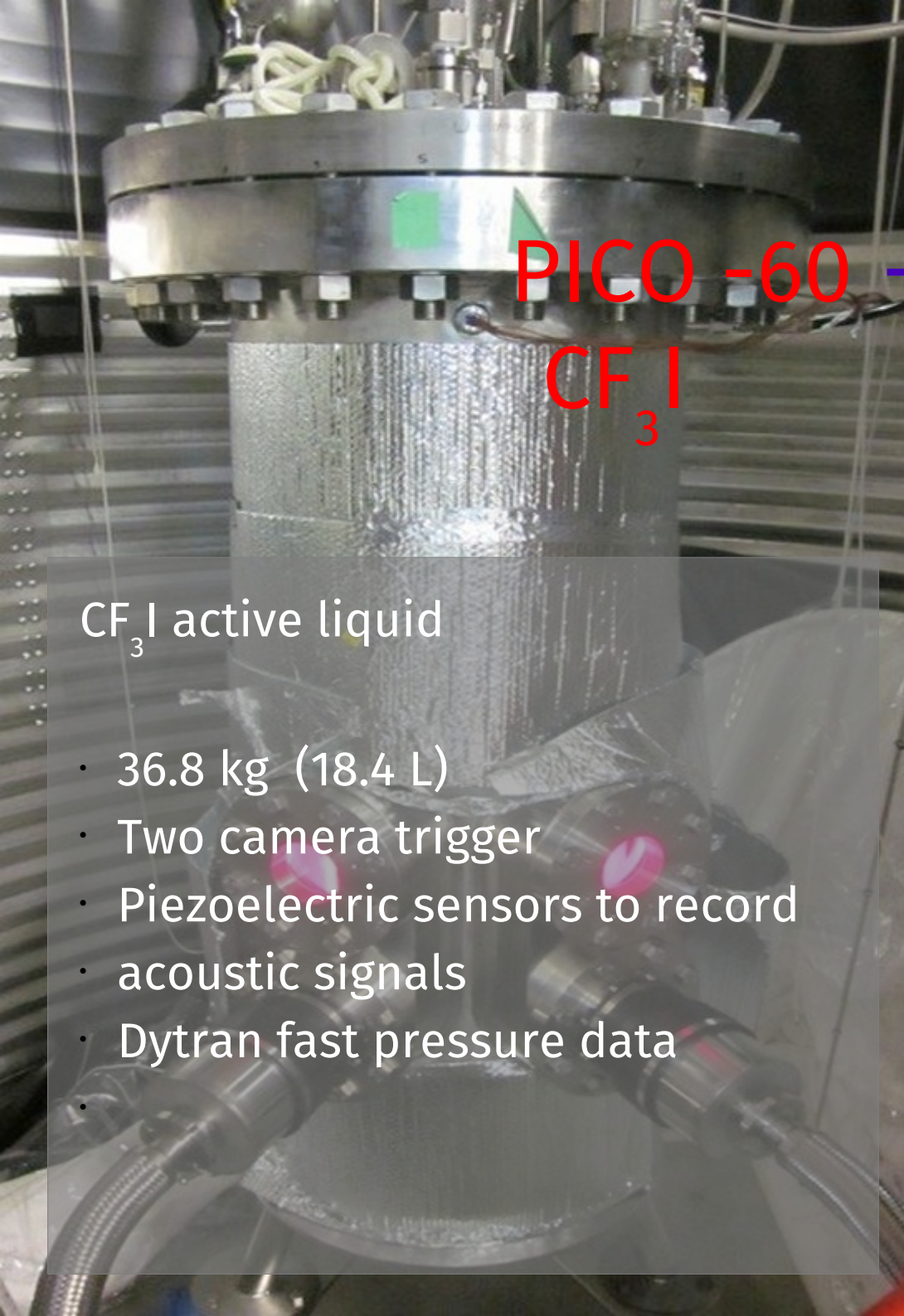
PICO-60

$\text{C}_3\text{F}_8$

$\text{CF}_3\text{I}$  Phase (ended April 2014)

- Collected >2700 kg-days of dark matter search data between 9 and 25 keV thresholds
- Collected >1500 neutron events from calibration runs
- Data analysis in progress



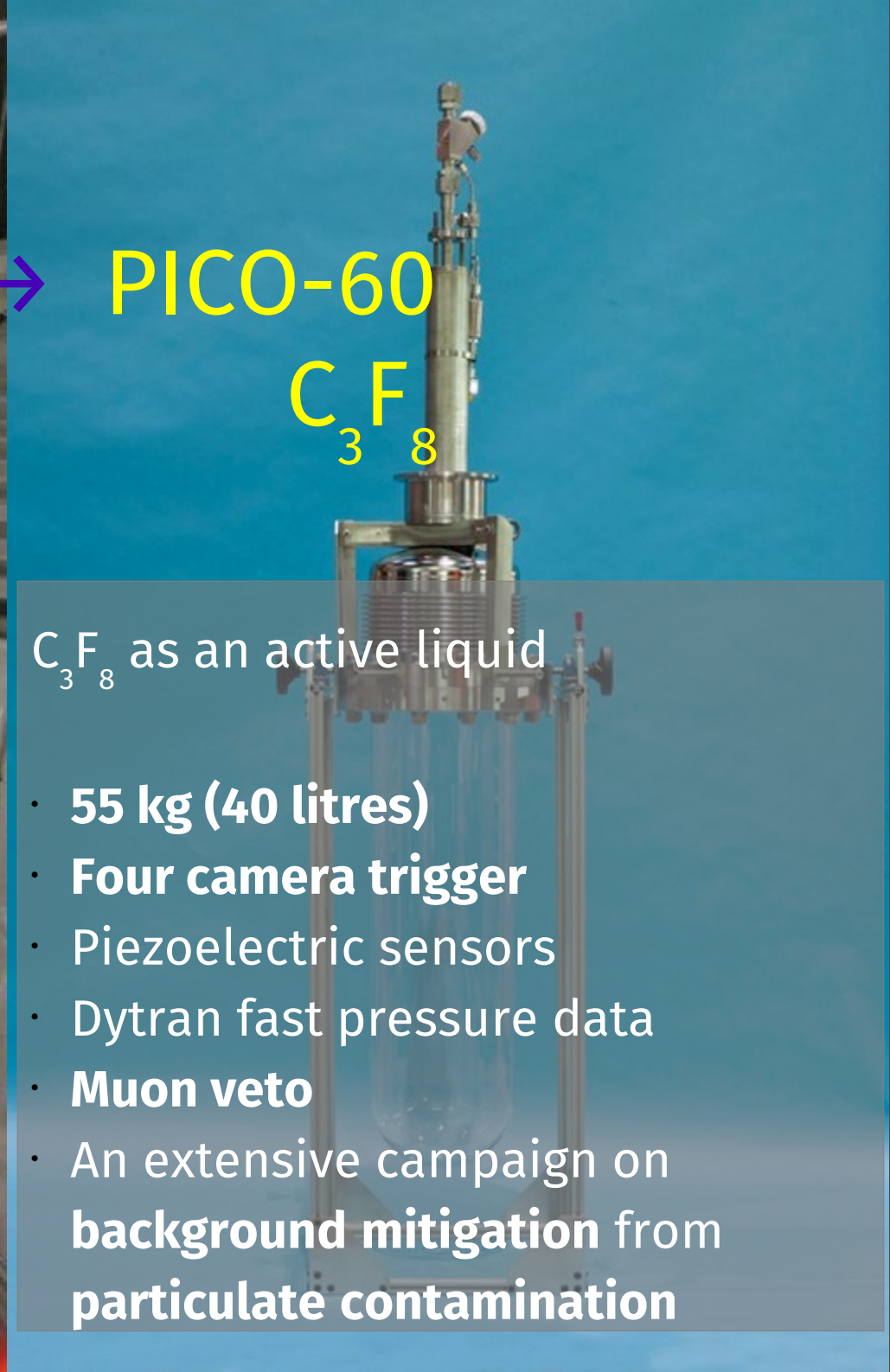


PICO-60



$CF_3I$  active liquid

- 36.8 kg (18.4 L)
- Two camera trigger
- Piezoelectric sensors to record acoustic signals
- Dytran fast pressure data



PICO-60



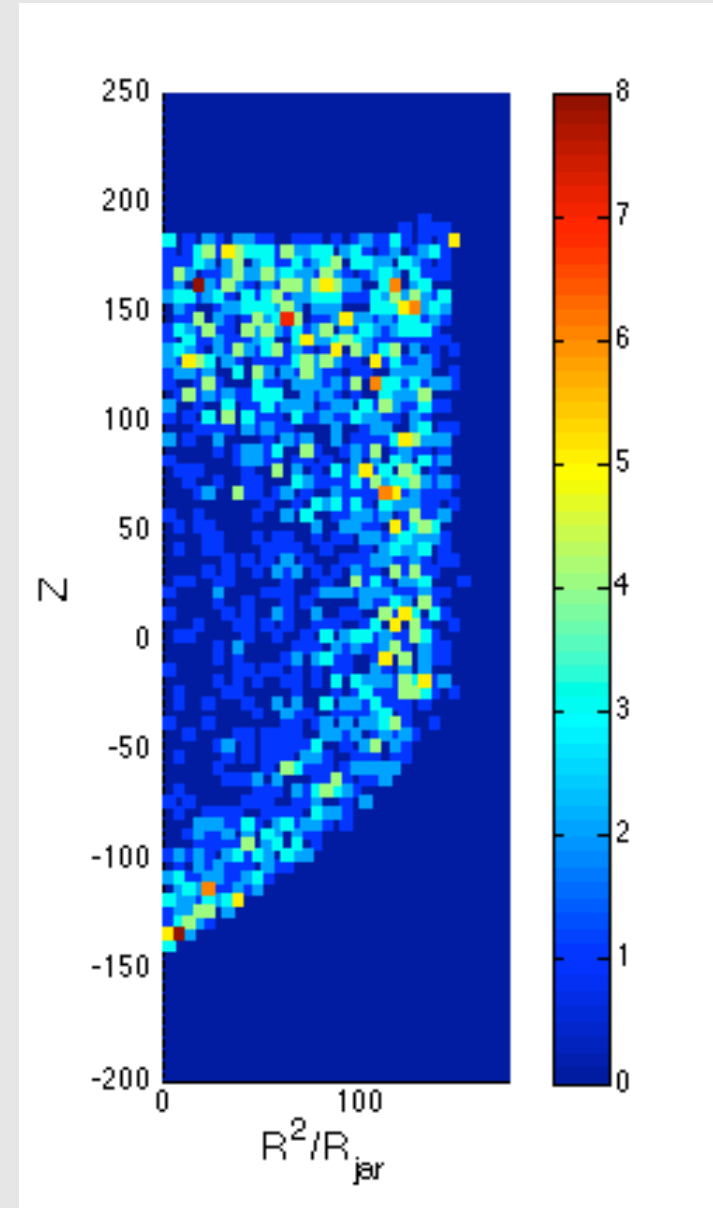
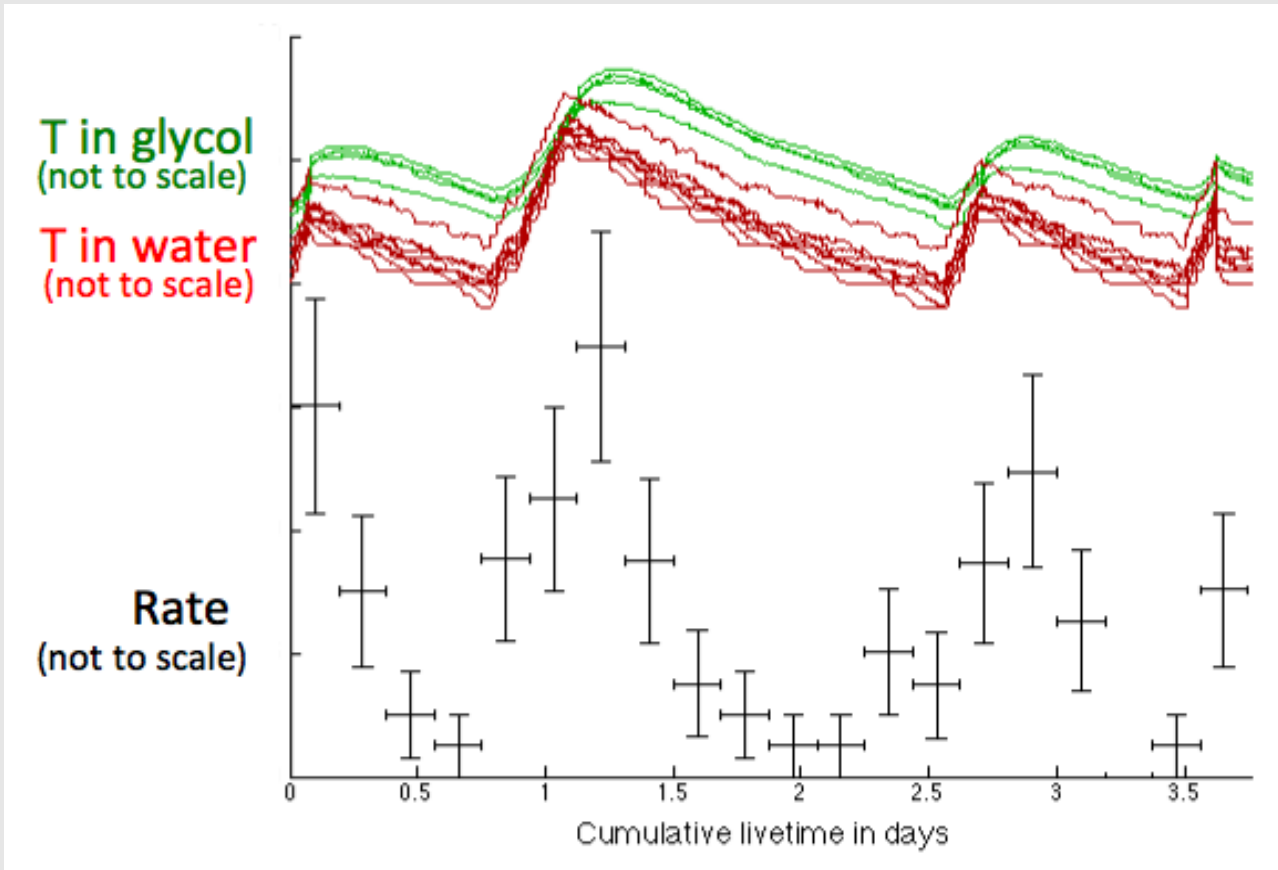
$C_3F_8$  as an active liquid

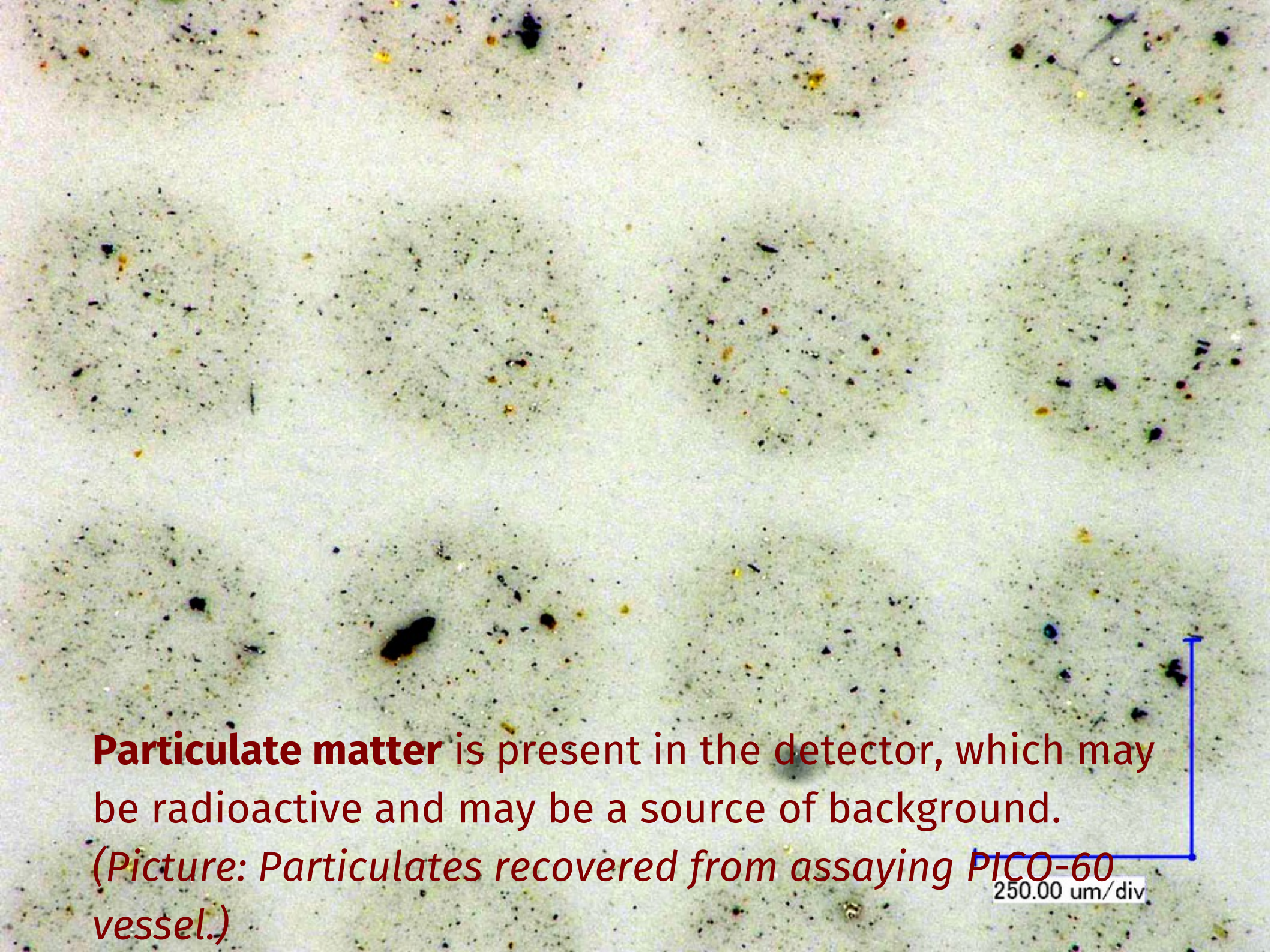
- **55 kg (40 litres)**
- **Four camera trigger**
- Piezoelectric sensors
- Dytran fast pressure data
- **Muon veto**
- An extensive campaign on **background mitigation** from **particulate contamination**

# PICO-60 events were

Spatially clustered at top of active volume.

Correlated with temperature ramp



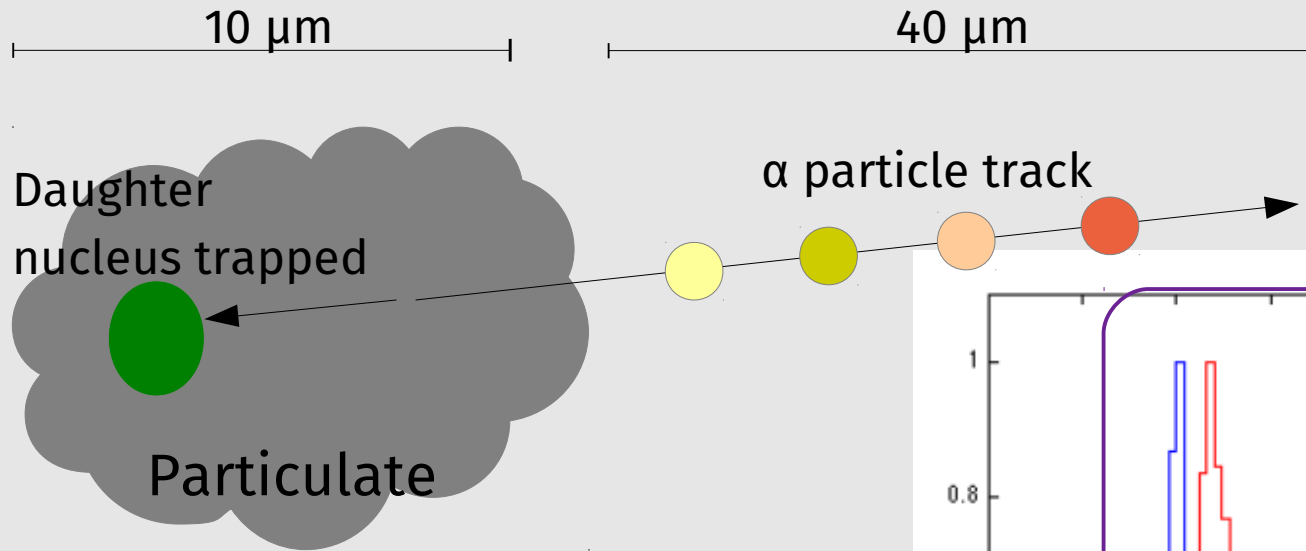
A microscopic image showing a light-colored, textured surface, likely a detector, covered with numerous small, dark, and multi-colored (black, brown, yellow, red) particulate matter. The particles vary in size and shape, with some appearing as small dots and others as elongated fibers or clumps. A blue L-shaped scale bar is located in the bottom right corner, with the text '250.00 um/div' printed below it.

**Particulate matter** is present in the detector, which may be radioactive and may be a source of background.

*(Picture: Particulates recovered from assaying PICO-60 vessel.)*

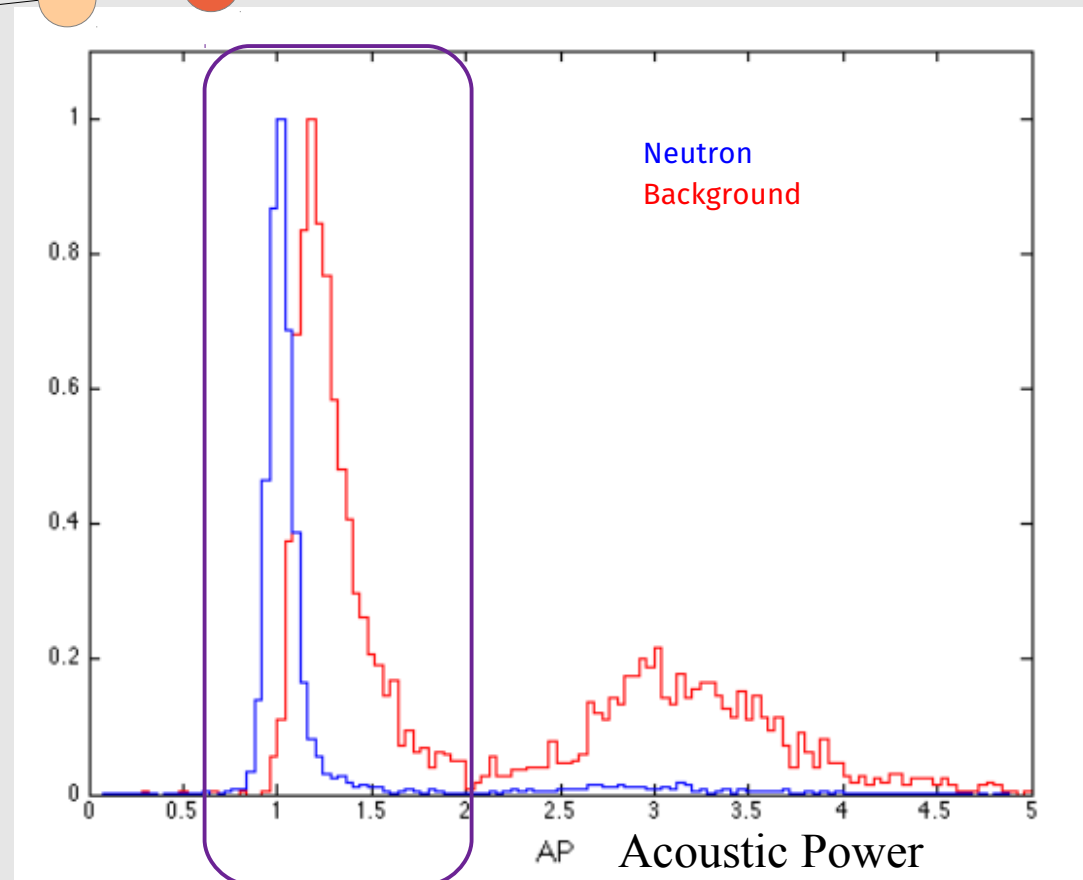
250.00 um/div

# Anomalous acoustic power

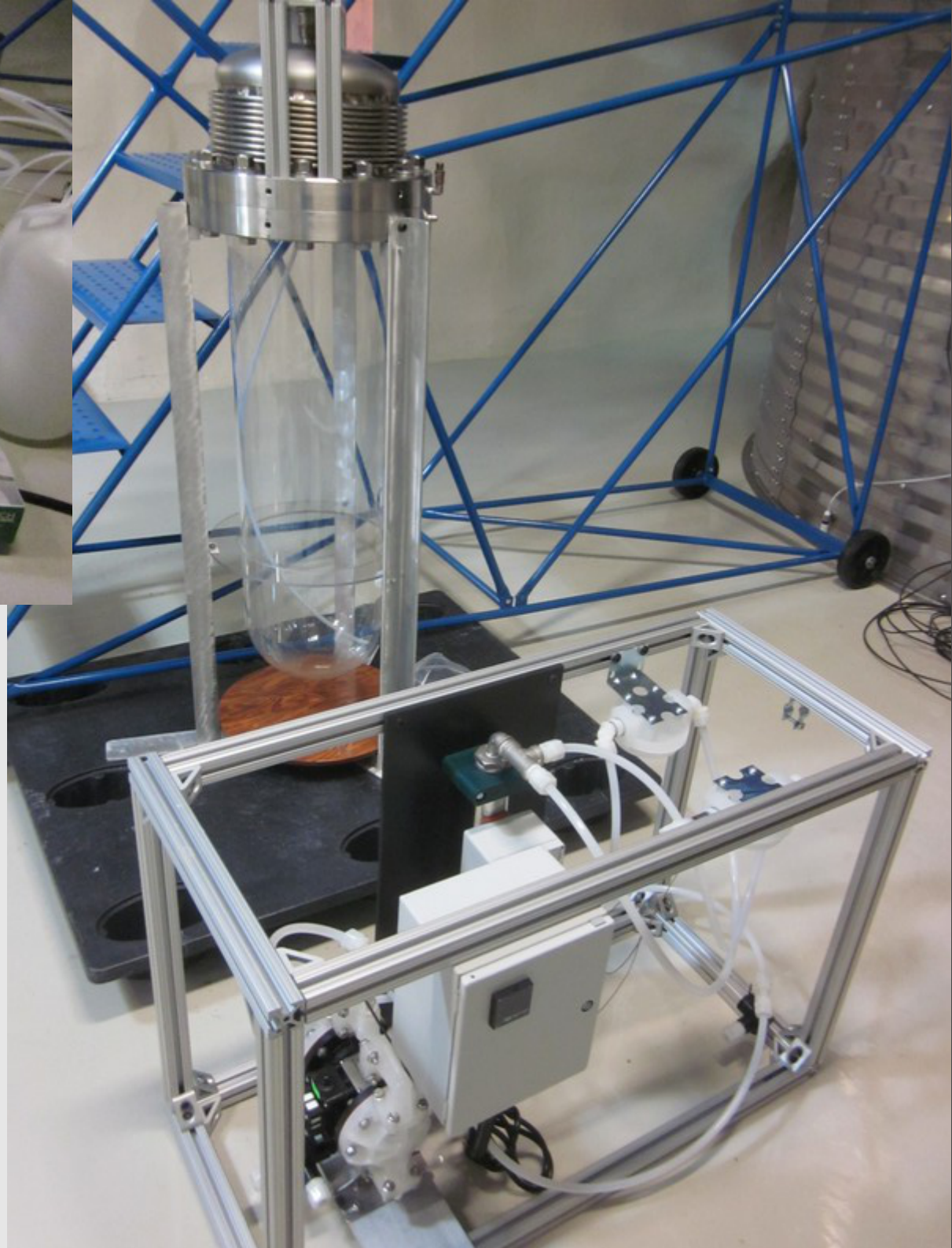


The alpha particle can escape,  
but the daughter nucleus is trapped

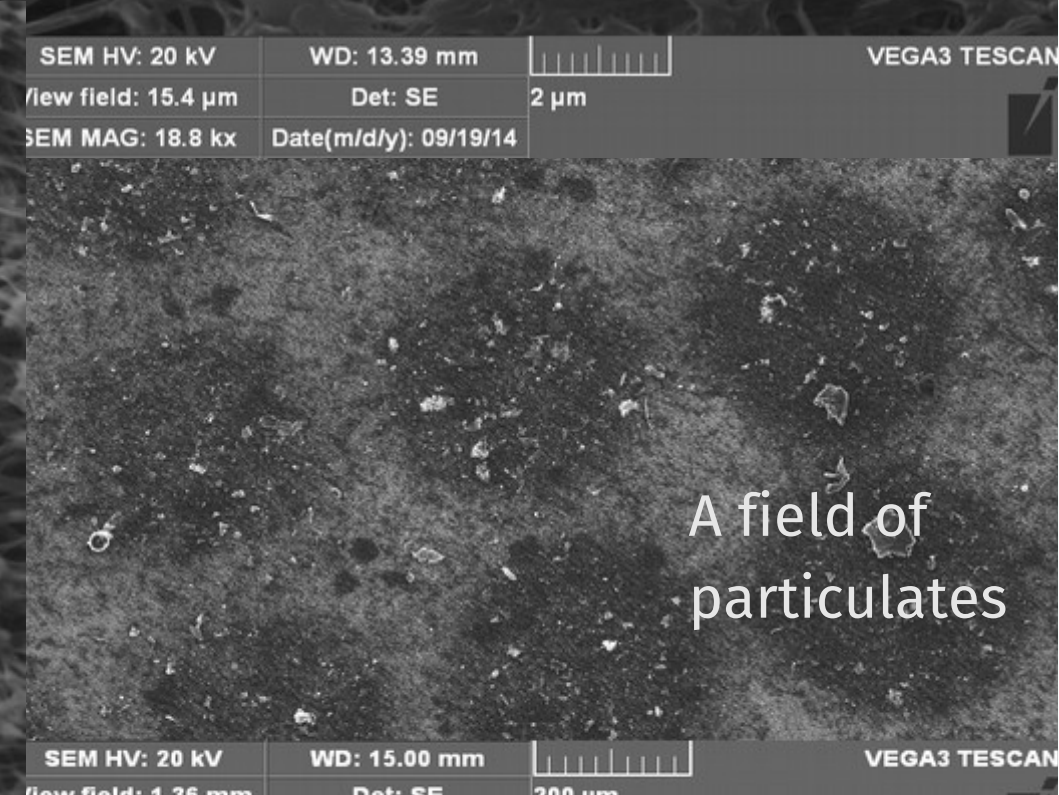
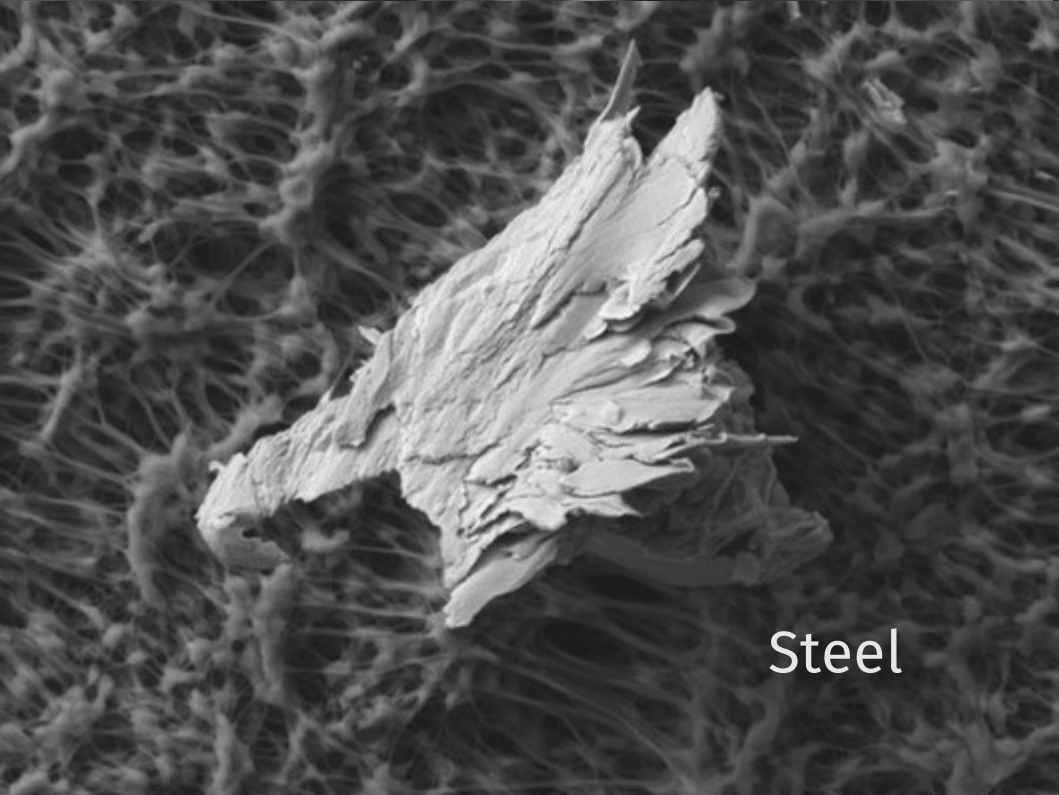
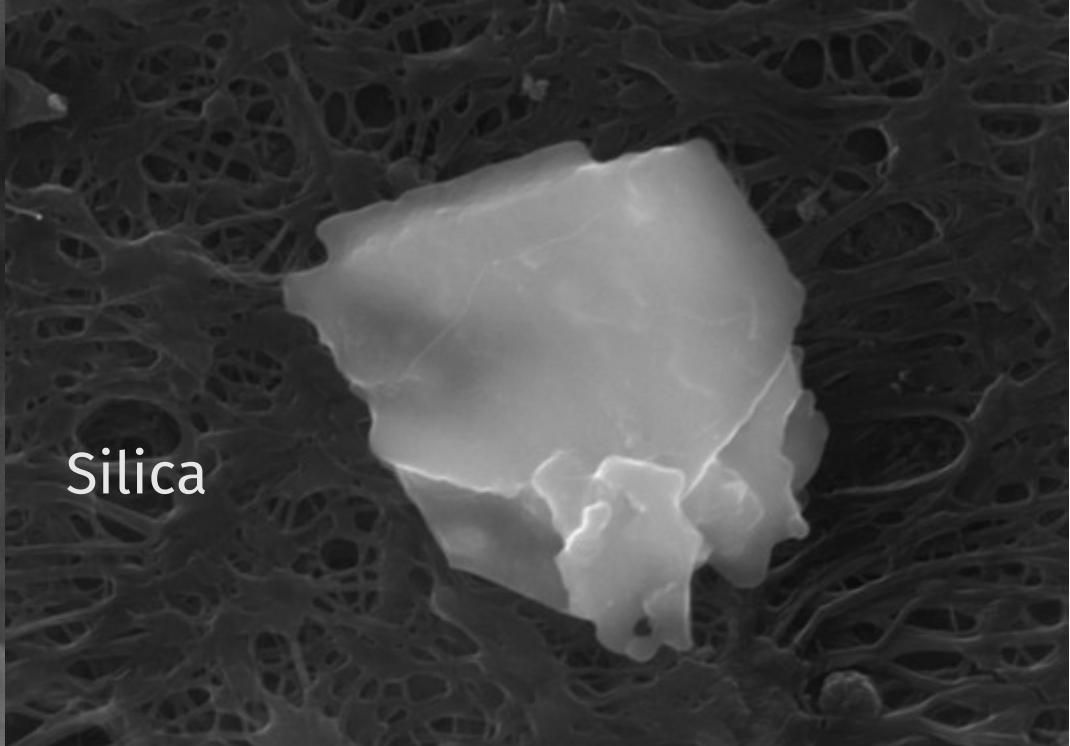
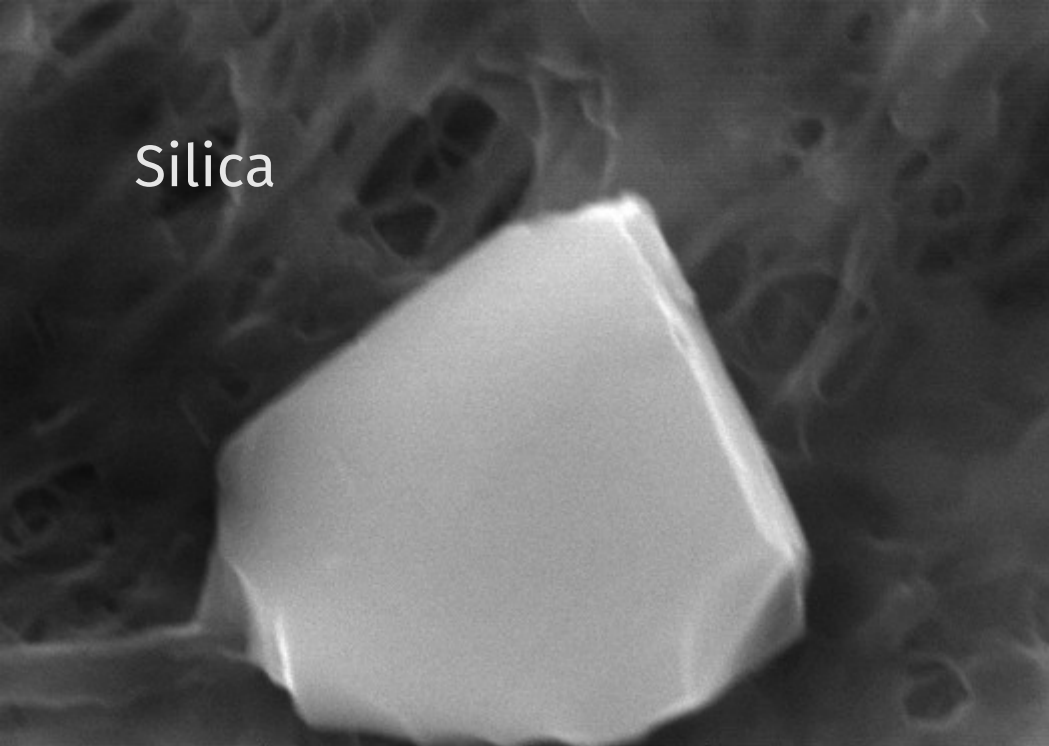
Acoustically this mimics a nuclear  
recoil.







A spray system was designed to extract residual particulates



SEM HV: 20 kV	WD: 13.39 mm		VEGA3 TESCAN
View field: 15.4 μm	Det: SE	2 μm	
SEM MAG: 18.8 kx	Date(m/d/y): 09/19/14		

SEM HV: 20 kV	WD: 15.00 mm		VEGA3 TESCAN
View field: 1.36 mm	Det: SE	200 μm	
SEM MAG: 159 x	Date(m/d/y): 04/14/15		

X 4.500 5.0kV LEI SEM 1 μm 9/11/2014 WD 15.4mm

# PICO-60

## Inductively Coupled Plasma-Mass Spectrometry Trace Element Analysis

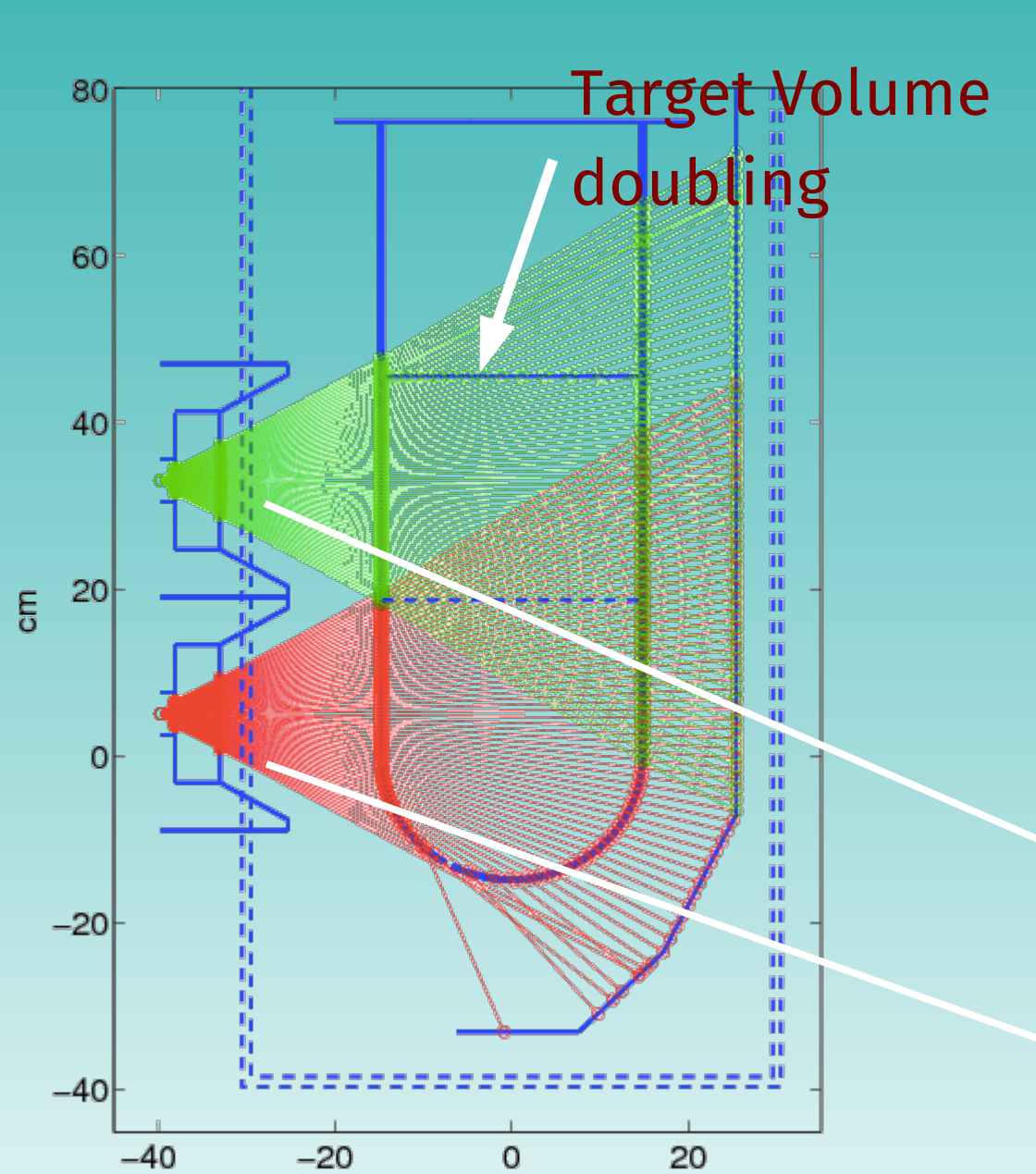
Sample	Th-232 (fg/g)	Th Activity (counts/day)	U-238 (fg/g)	U-238 Activity (cts/day)	Total (cts/day)
PICO-60 Buffer	1010±113	169±19	304±131	209±90	379±109
PICO-60 Particulates		In	Progress		

Assumption: The impurities are evenly spread across both fluids.

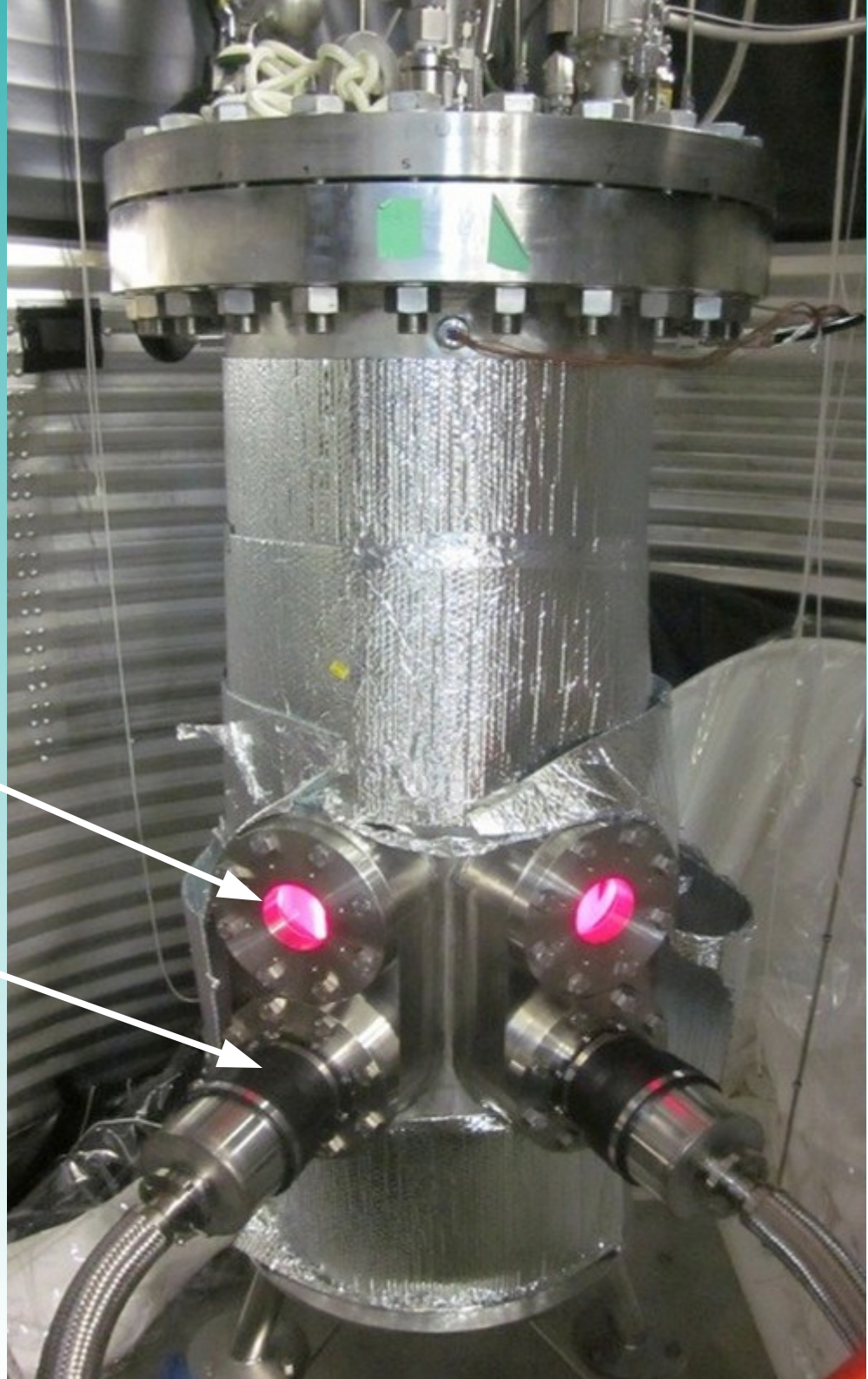
Reality: Buffer is a polar solvent. CF3I is non-polar. *A density gradient is likely.*

Assumption 2: This is an estimate of the maximal equivalent concentration – assuming that all the particulate matter is in the active liquid It is an upper bound and is an extreme case

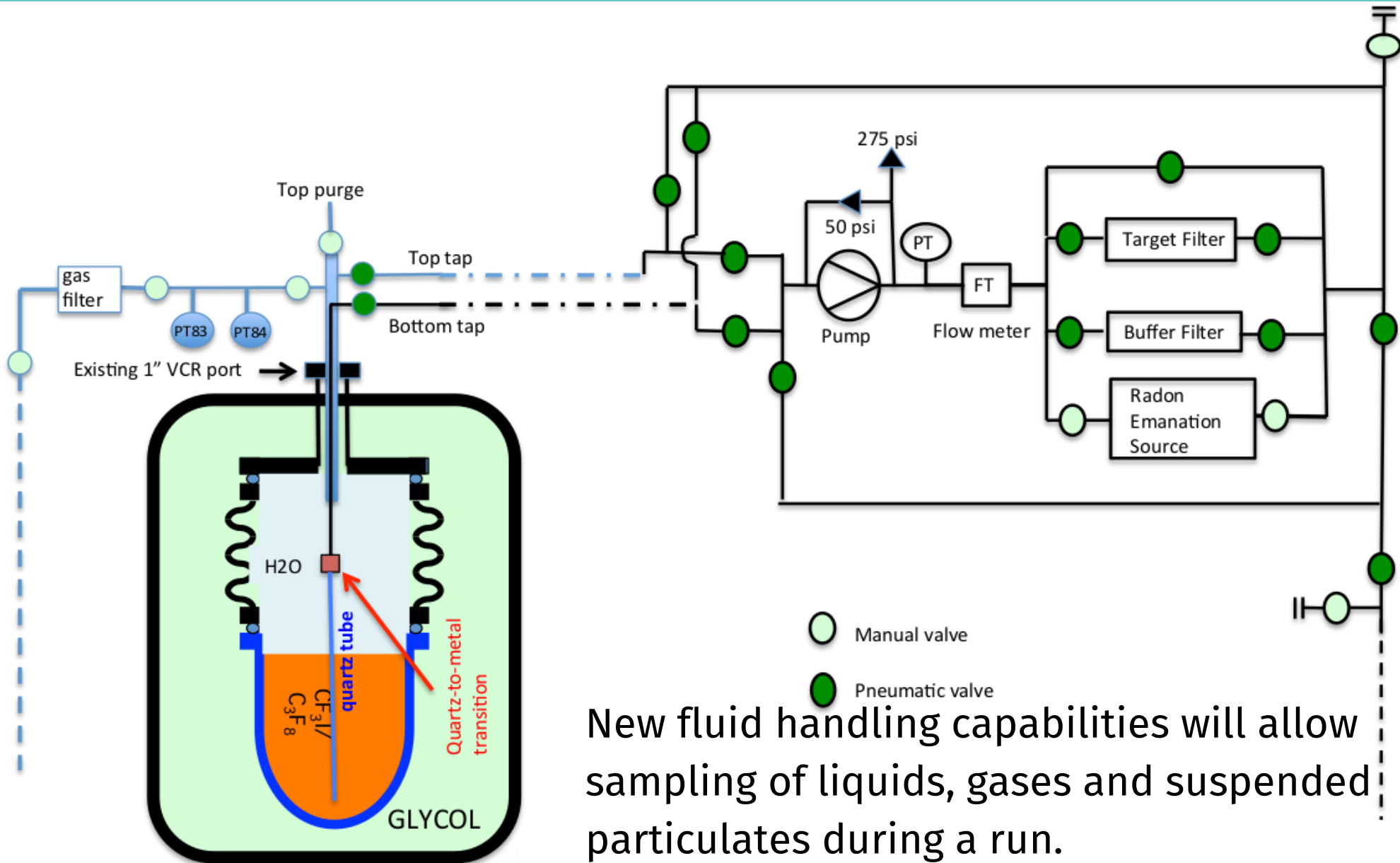
Observed: 71 cts/day



- 4x cameras instead of 2x
- New DAQ (more CPUs) + new software being developed.
- 50 fps  $\rightarrow$  350 fps



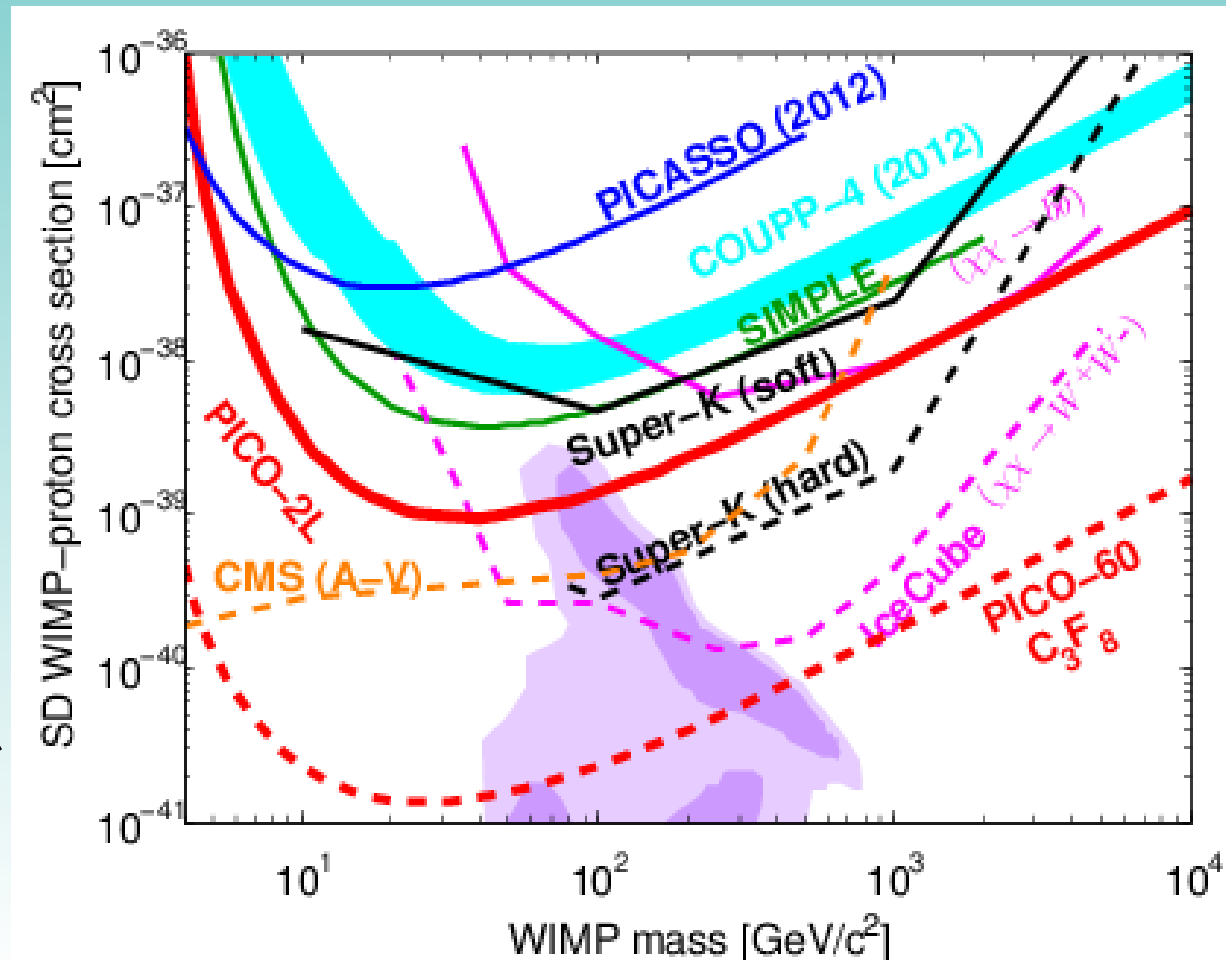
# In-line filtration system



New fluid handling capabilities will allow sampling of liquids, gases and suspended particulates during a run.

# Summary

- PICO-60 will focus on spin dependent dark matter search for the next two years.
- A new strict cleaning regime will be put in place – and tested with existing methods for particulates
- New active liquid:  $C_3F_8$
- More cameras and a new video acquisition system
- On-line filtration of particulate matter
- The last PICO-60 data is being analyzed and a result will be published shortly



Thank You!