

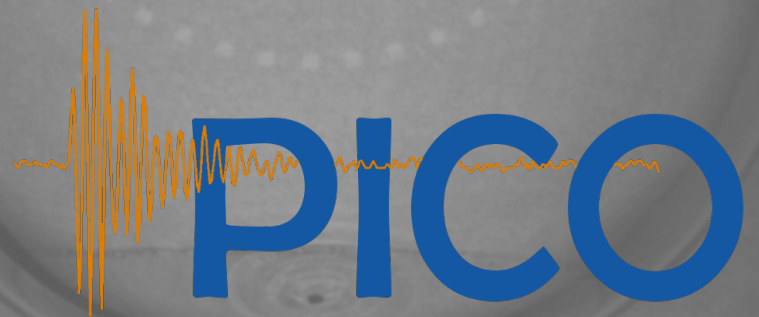
Status of the PICO-60 Experiment

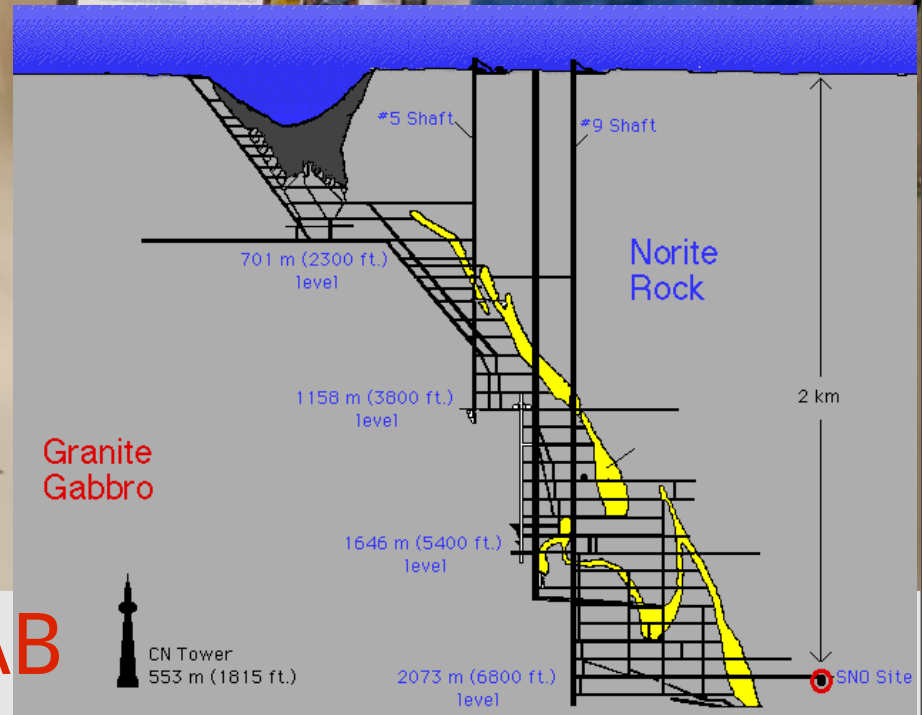
Pitam Mitra
University of Alberta

Edmonton, Alberta
Monday, 15th June, 2015



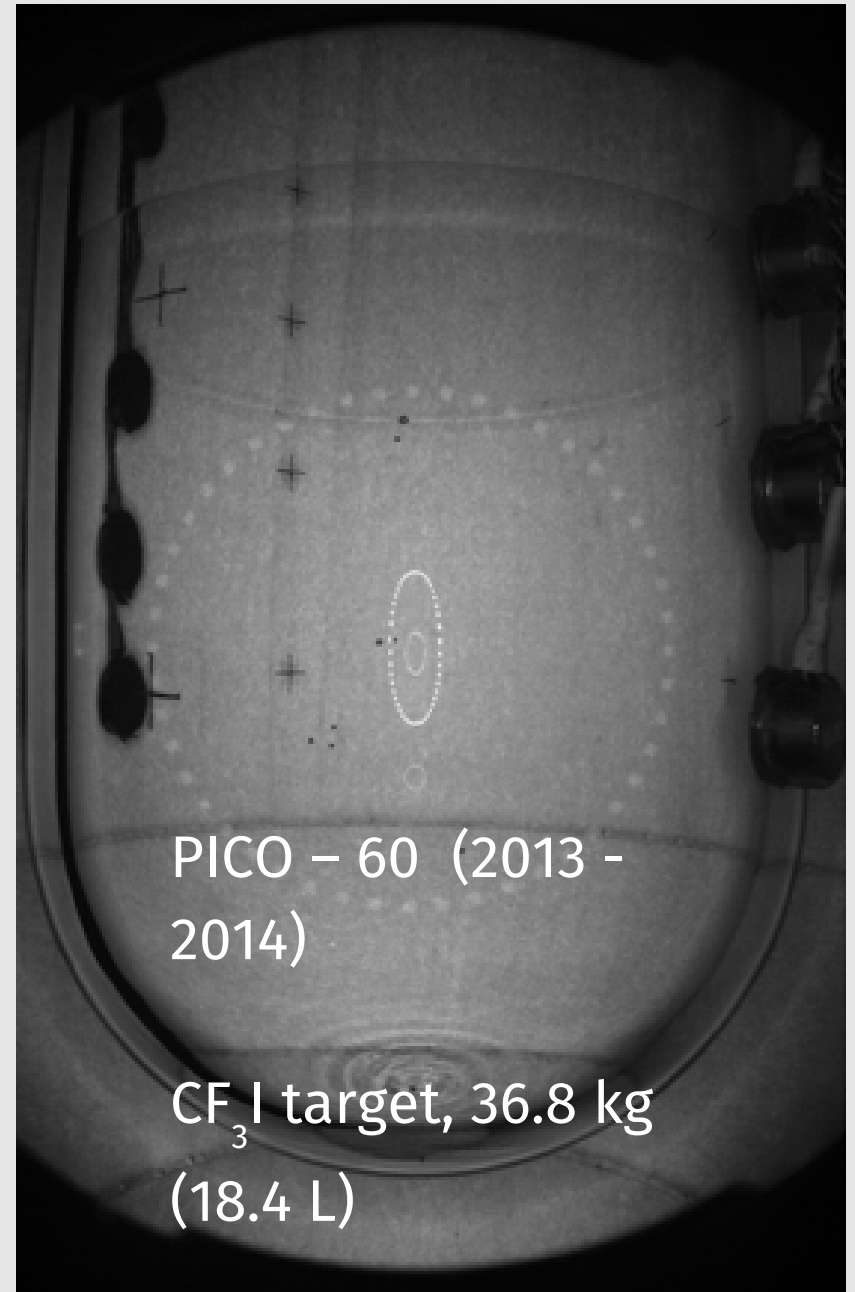
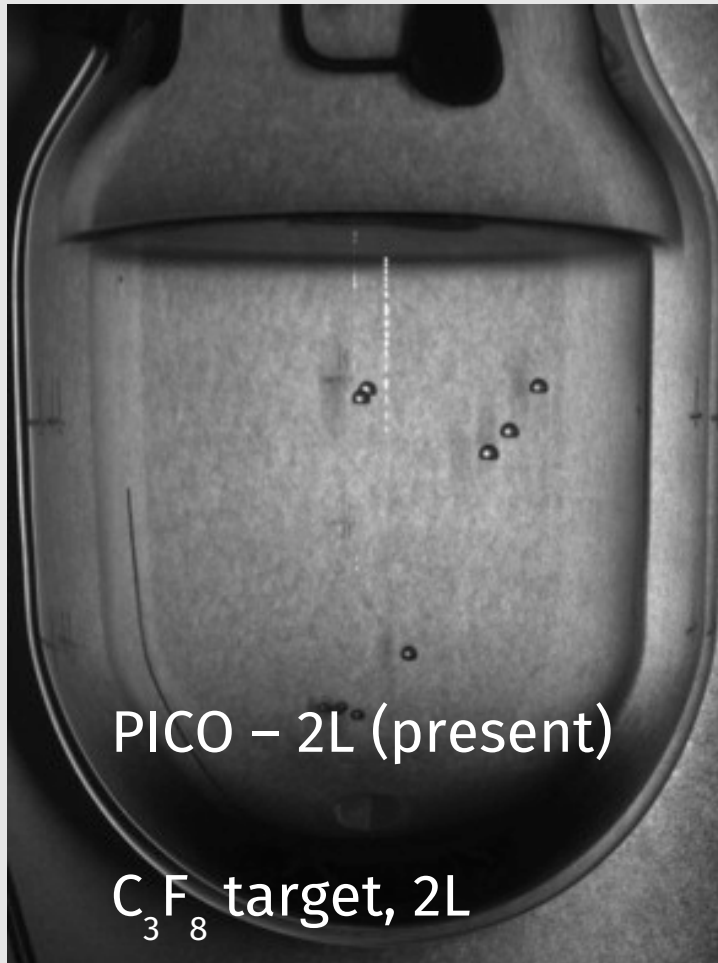
UNIVERSITY OF
ALBERTA

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



The PICO Experiment at SNOLAB

The PICO program



PICO -60

CF_3I



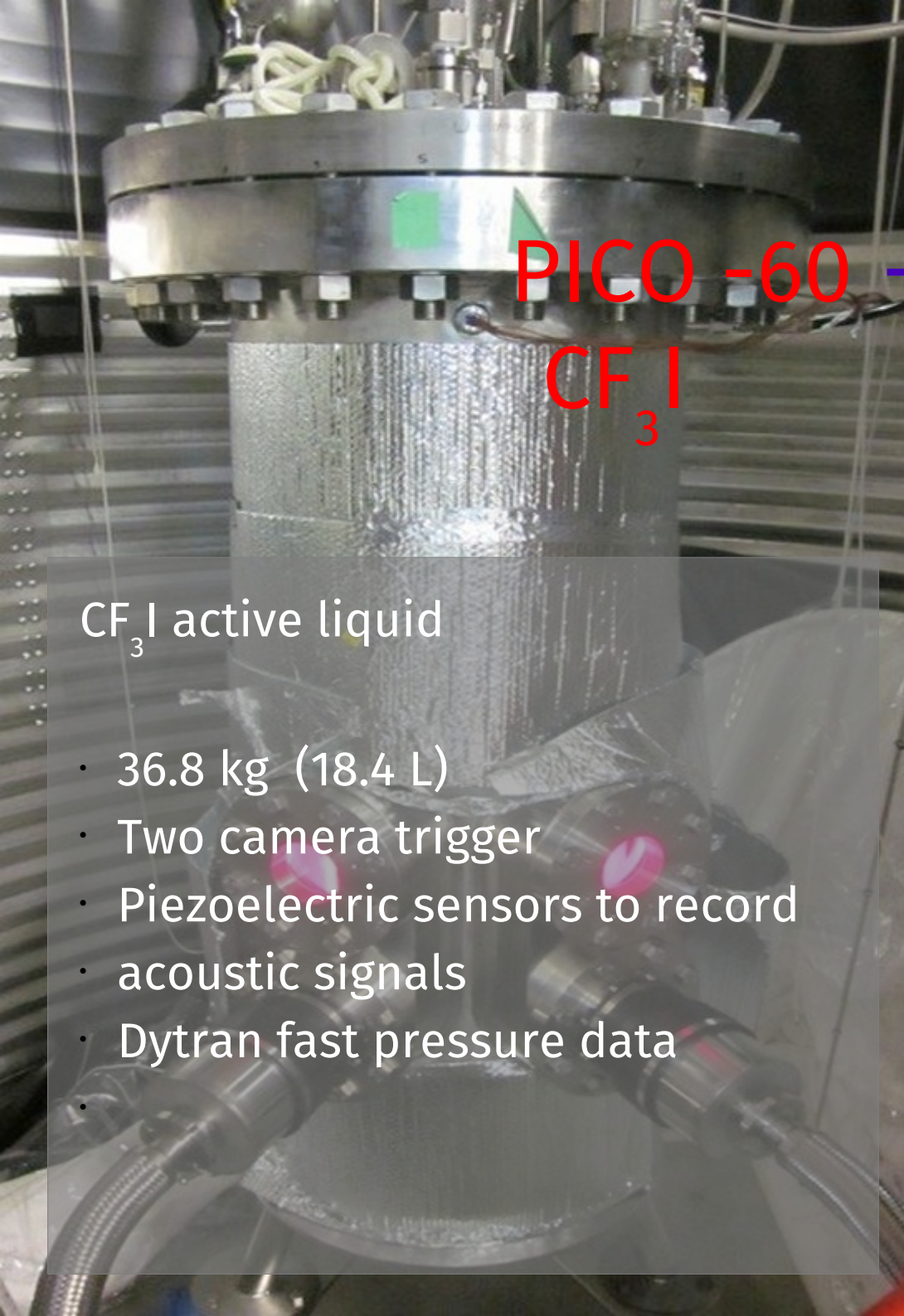
PICO-60

C_3F_8

CF_3I 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



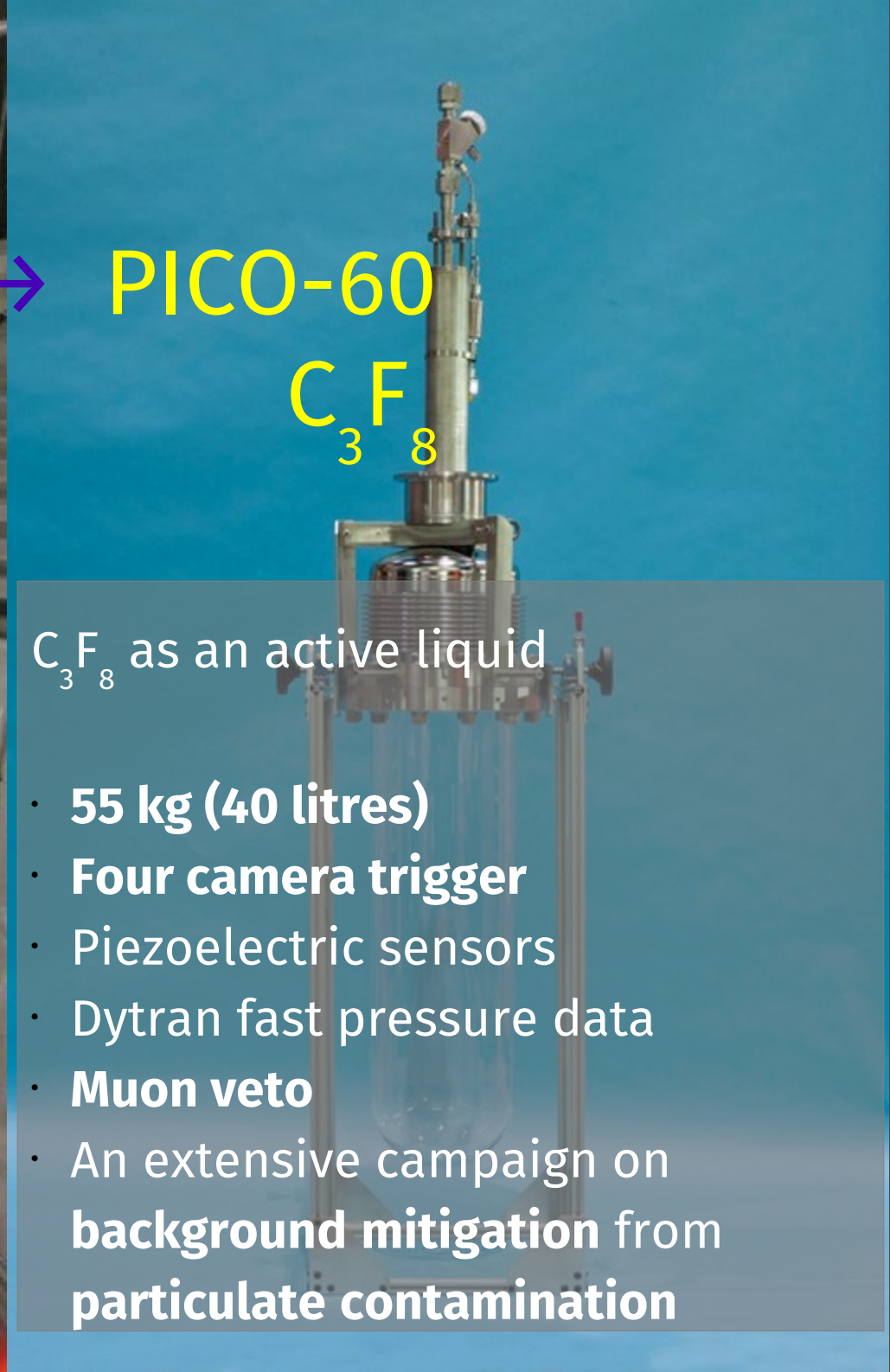


PICO-60



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



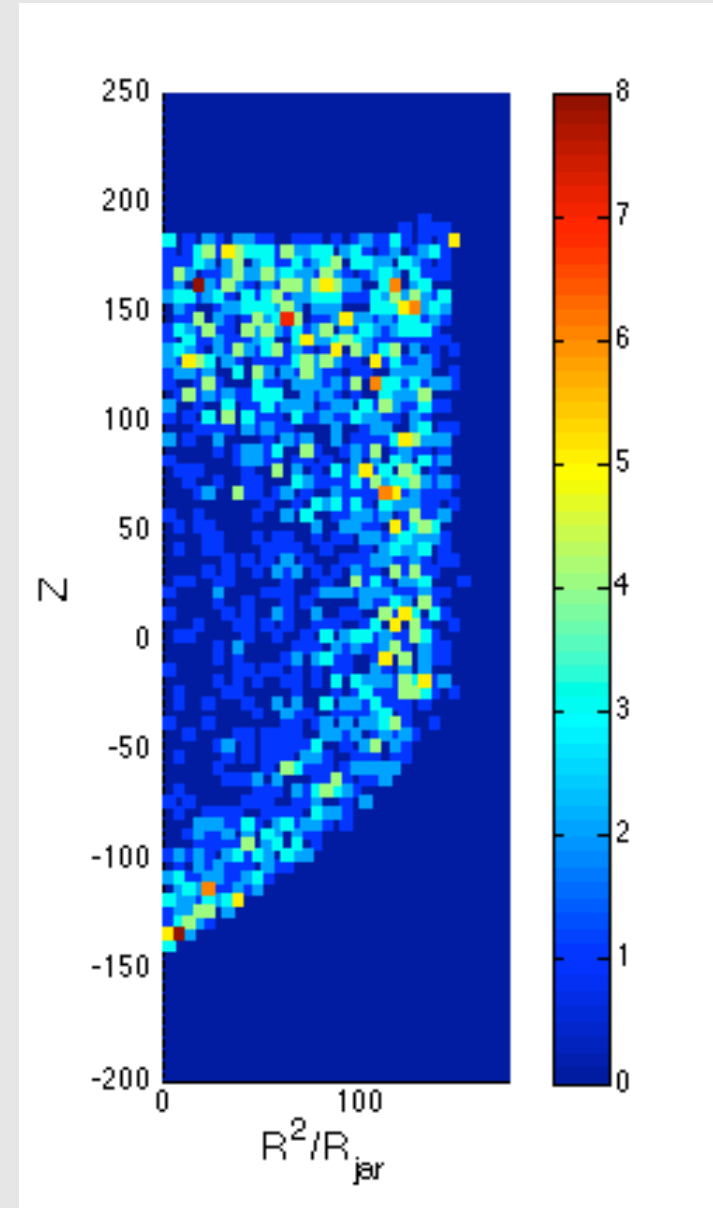
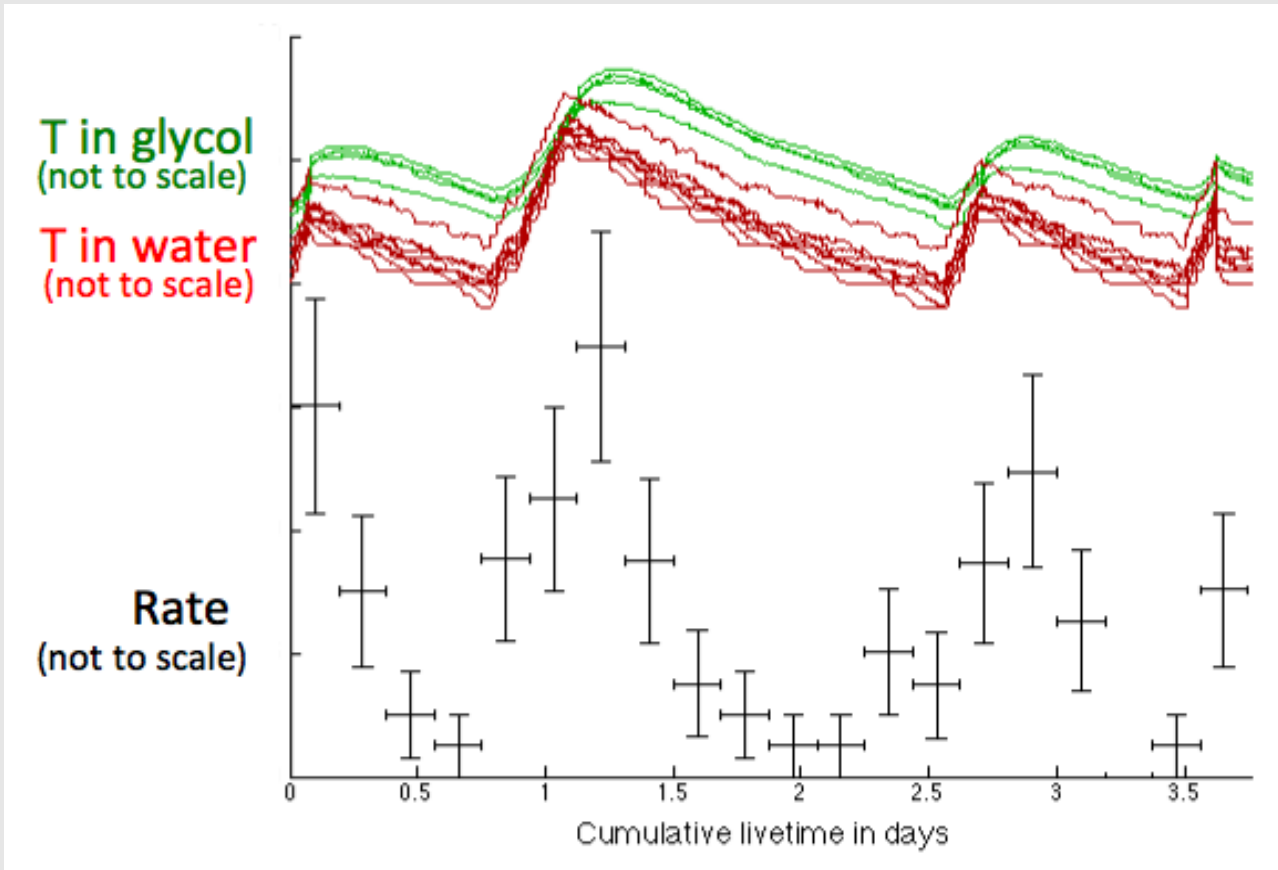
C_3F_8 as an active liquid

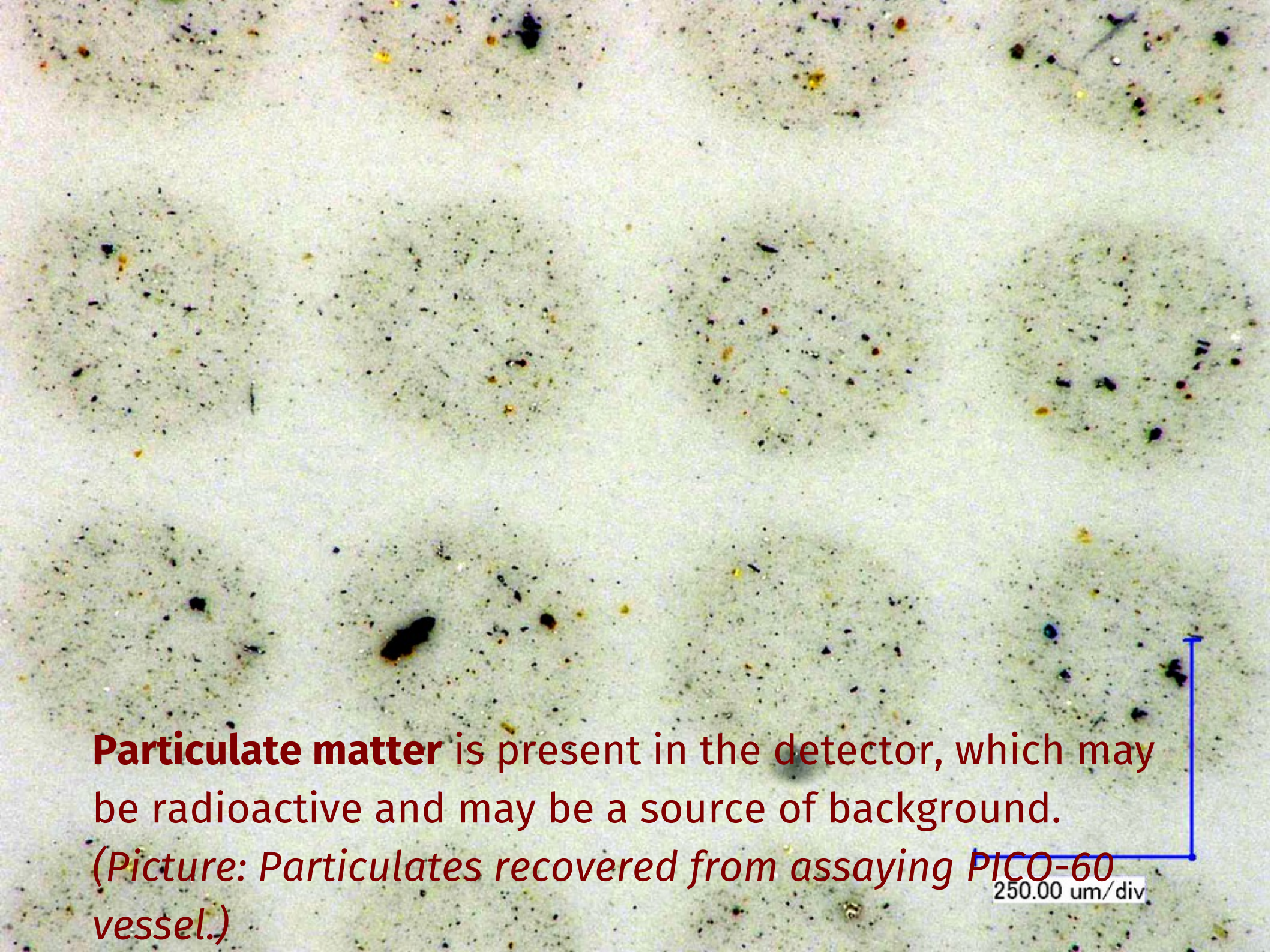
- **55 kg (40 litres)**
- **Four camera trigger**
- Piezoelectric sensors
- Dytran fast pressure data
- **Muon veto**
- An extensive campaign on **background mitigation** from **particulate contamination**

PICO-60 events were

Spatially clustered at top of active volume.

Correlated with temperature ramp



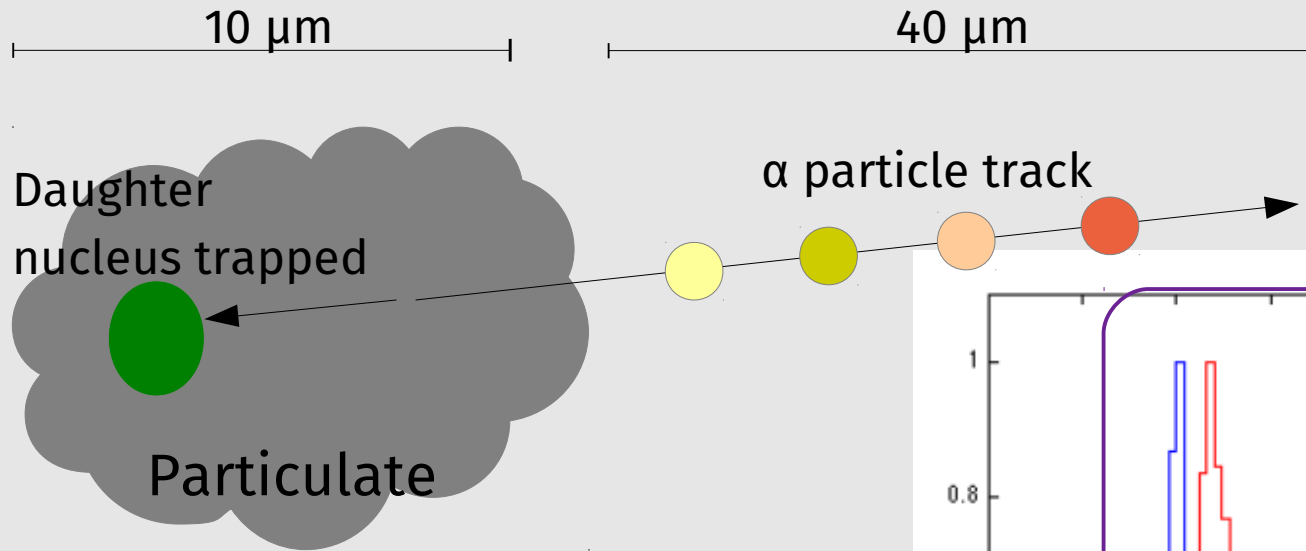
A microscopic image showing a light-colored, textured surface, likely a detector, covered with numerous small, dark, and multi-colored particles. The particles vary in size and shape, with some appearing as small dots and others as elongated, irregular shapes. The colors include black, dark grey, brown, yellow, and red. 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.)

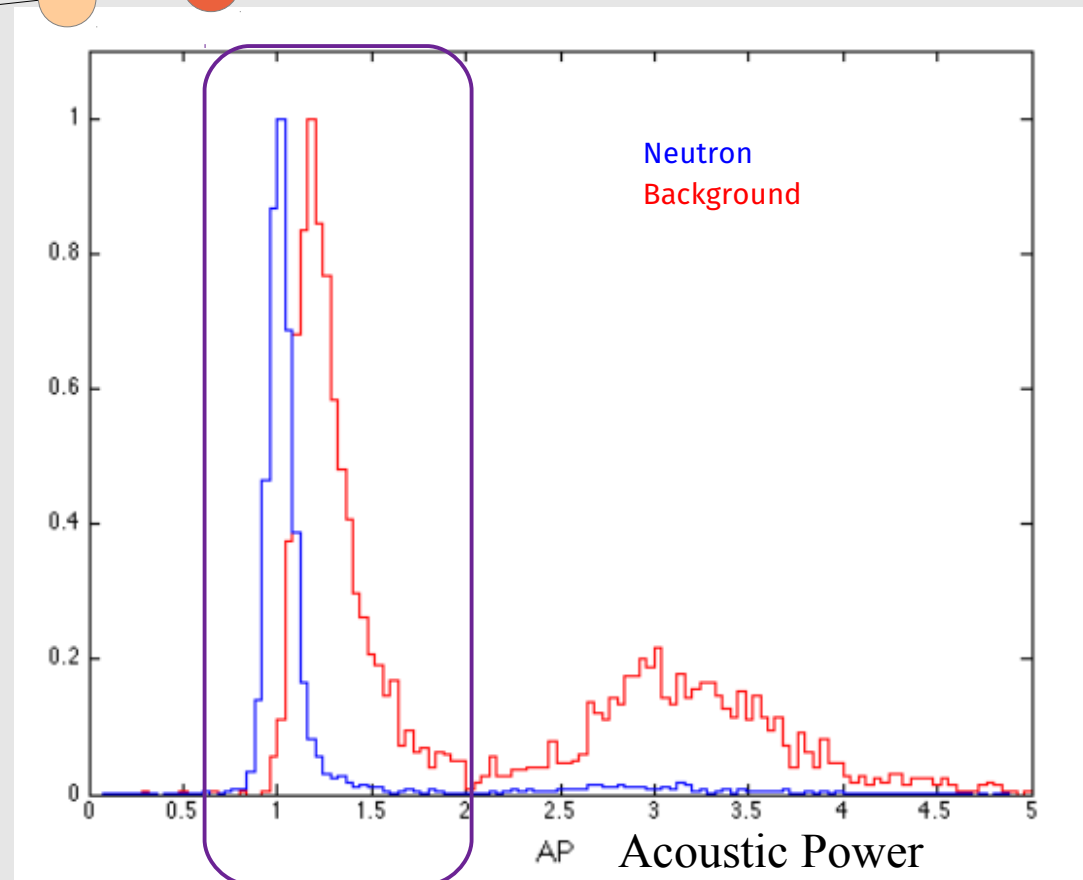
250.00 um/div

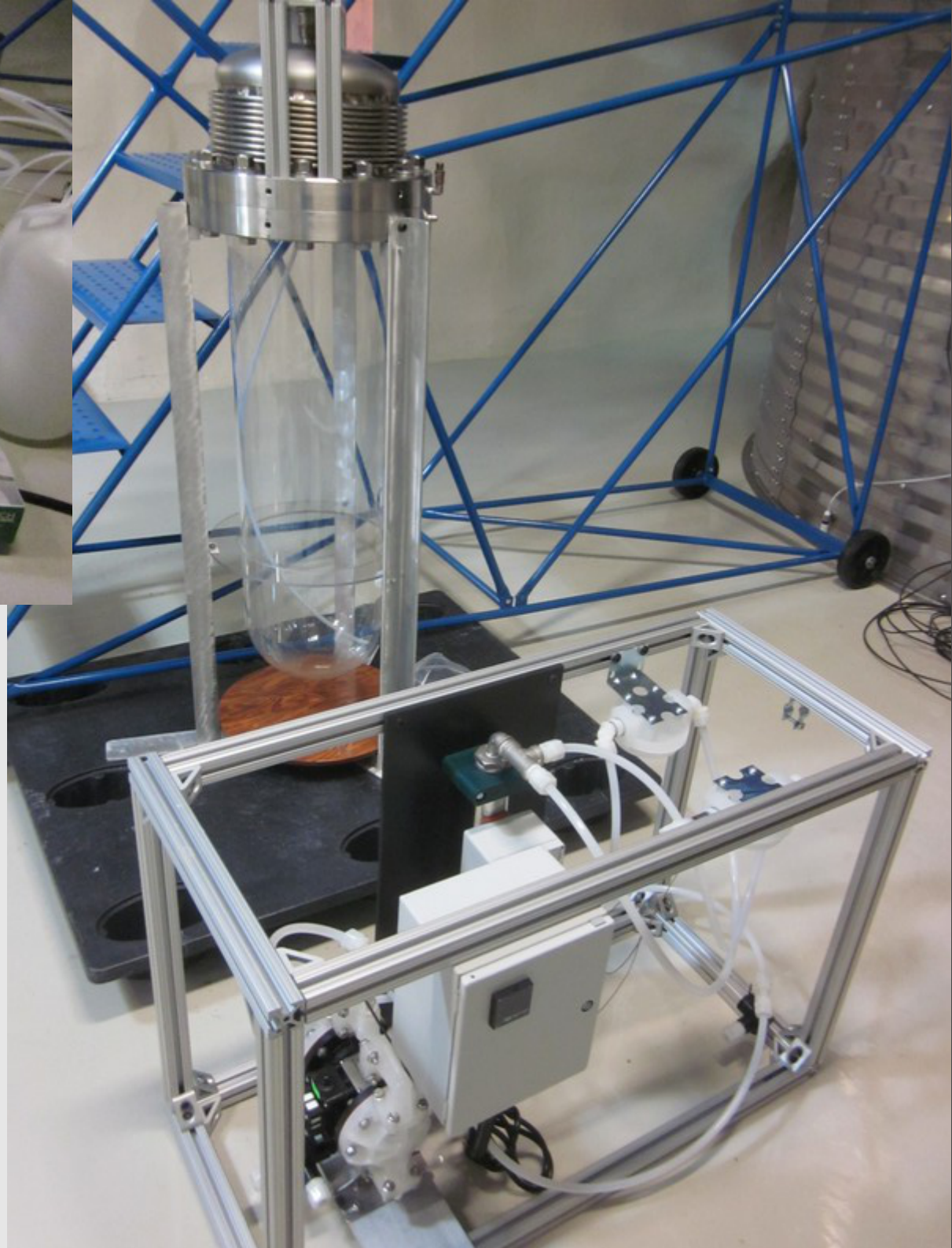
Anomalous acoustic power



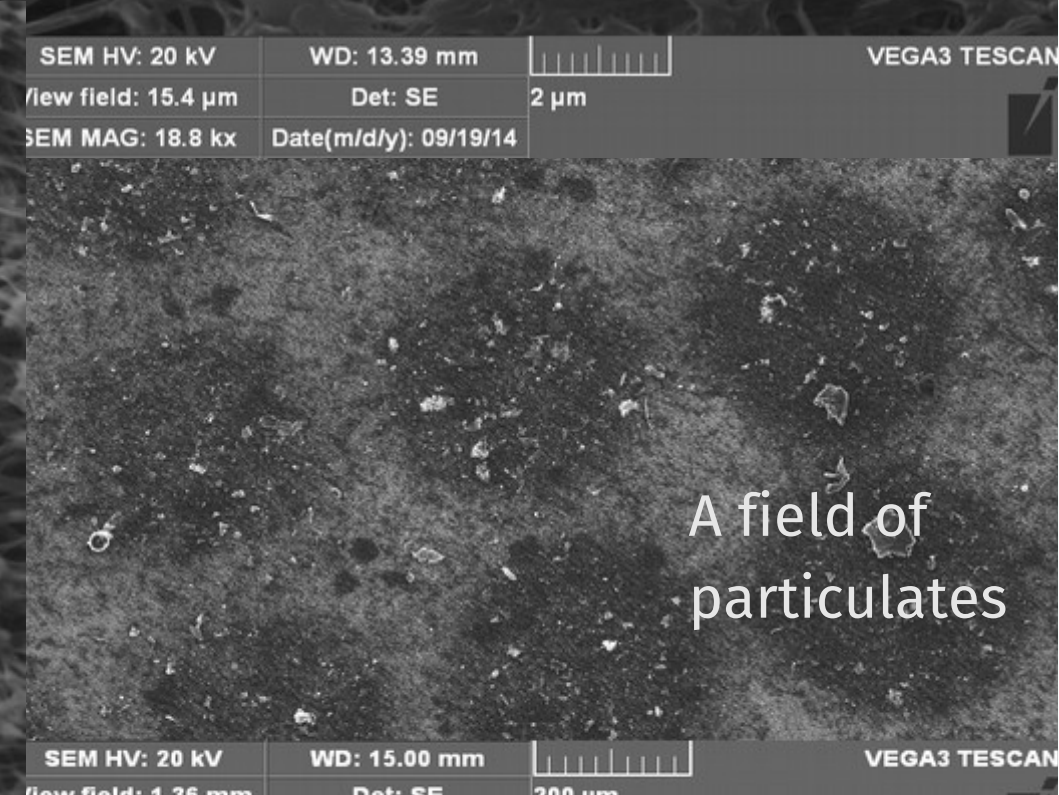
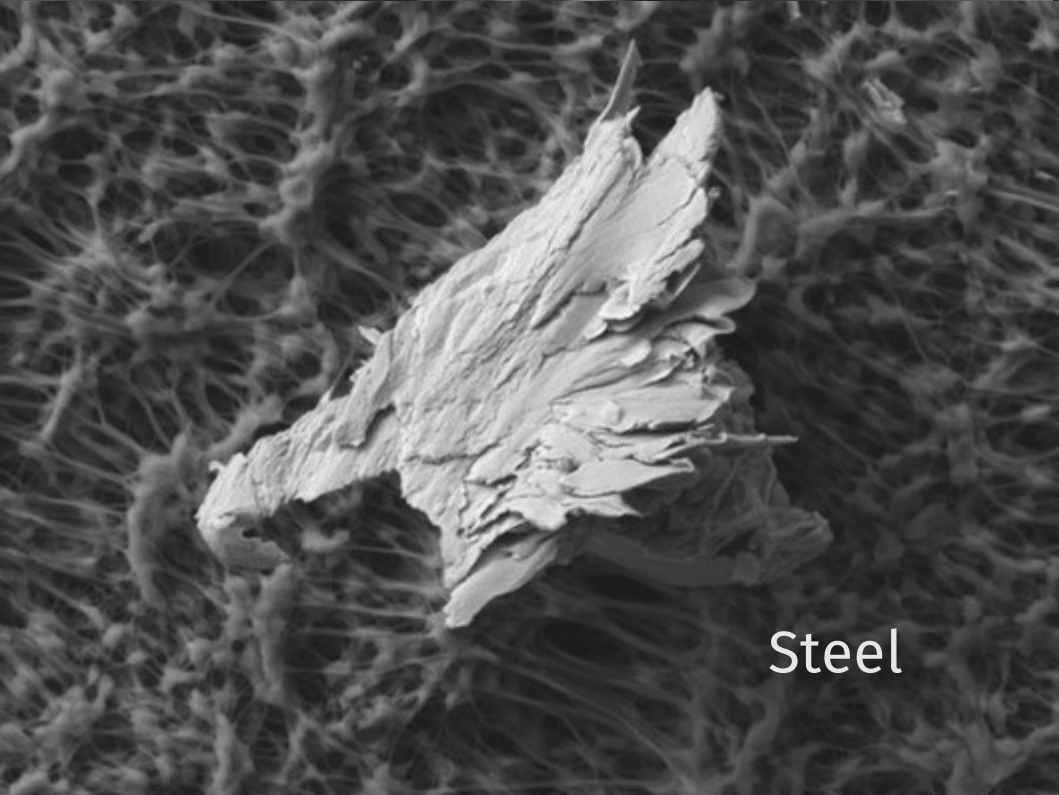
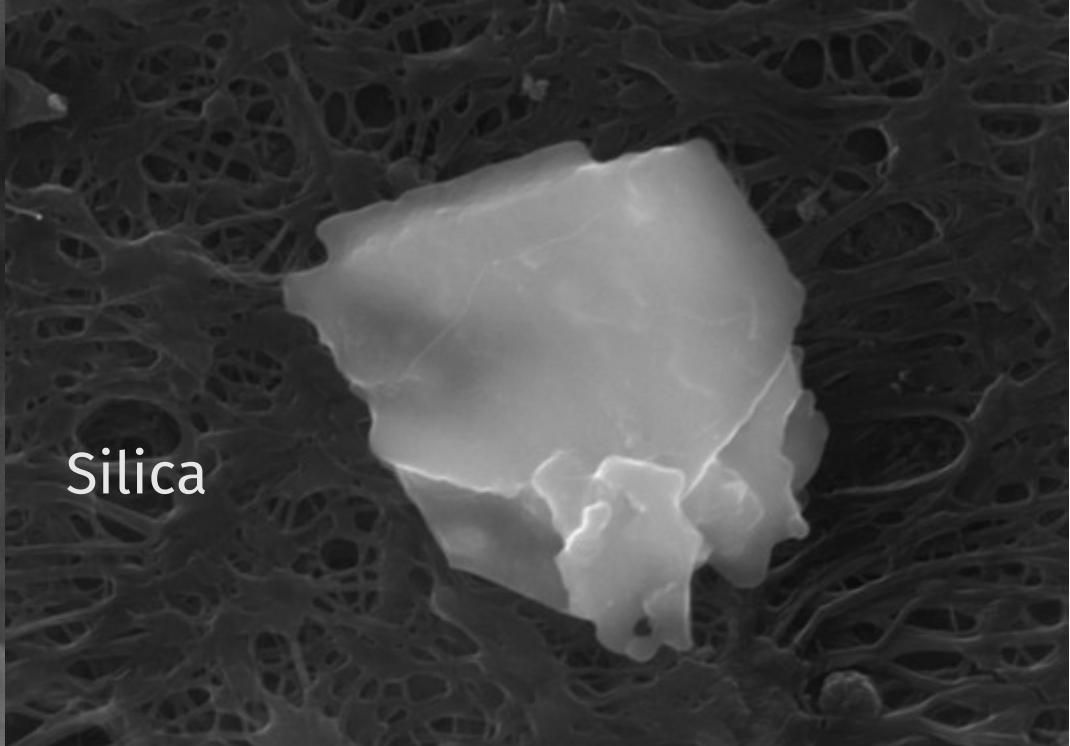
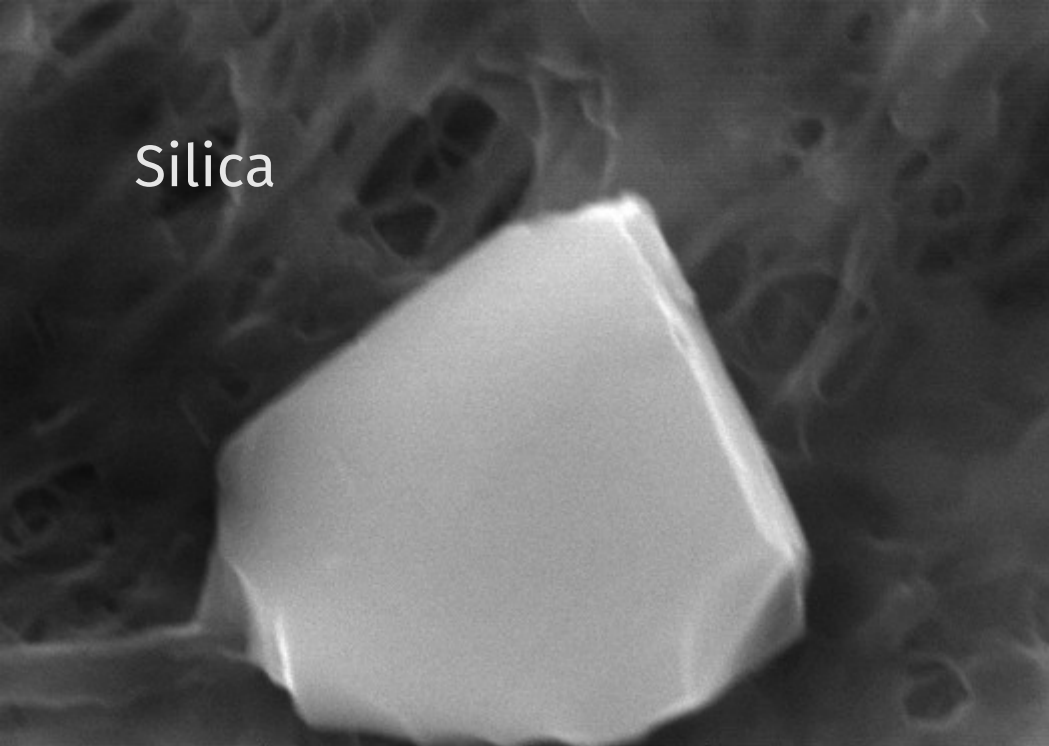
The alpha particle can escape,
but the daughter nucleus is trapped

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

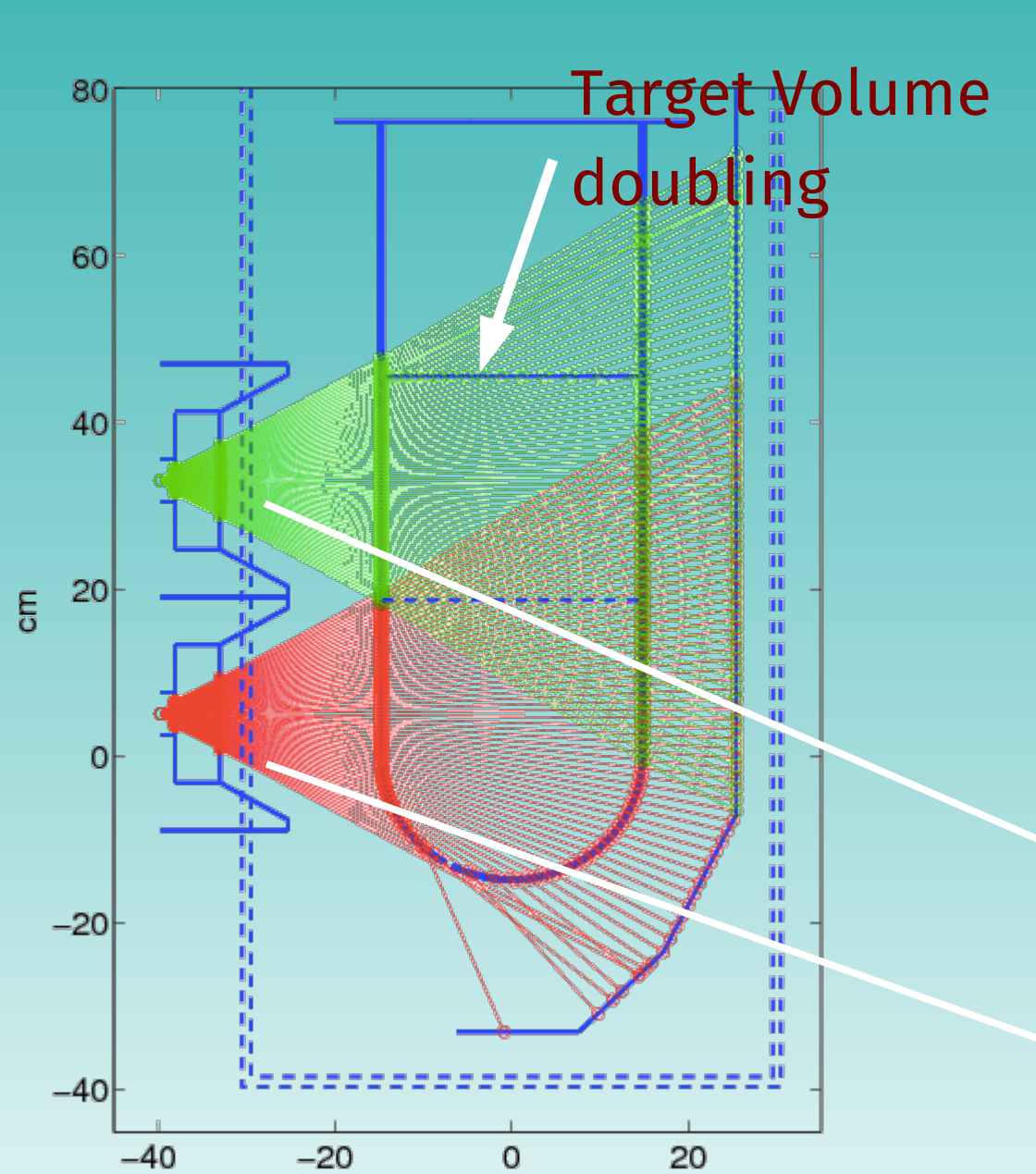
Sample	Th-232 (fg/g)	Th Activity (counts/day)	U-238 (fg/g)	U-238 Activity (cts/day)	Total (cts/day)
PICO-60 Buffer	1010±113	169±19	304±131	209±90	379±109
PICO-60 Particulates		In	Progress		

Assumption: The impurities are evenly spread across both fluids.

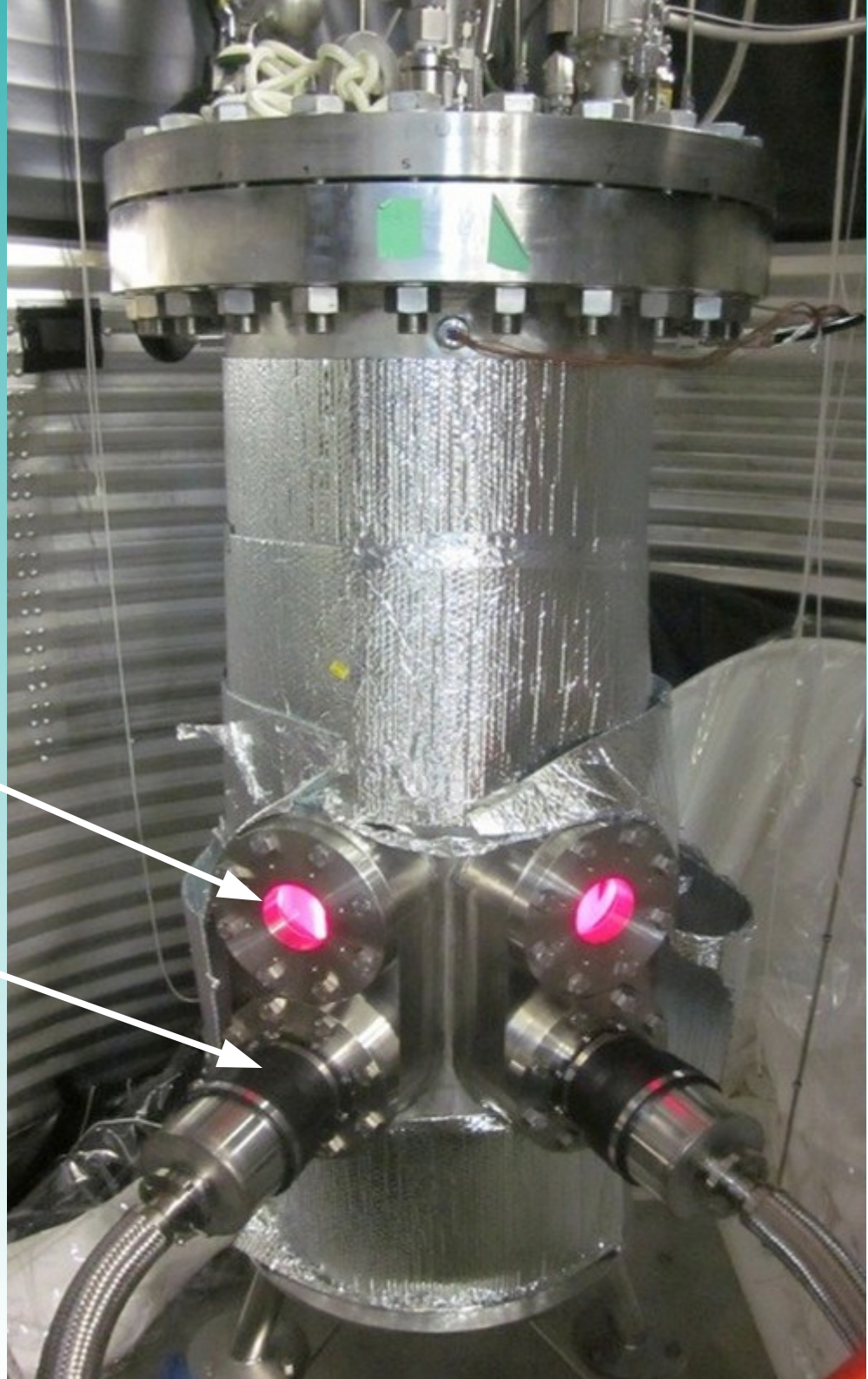
Reality: Buffer is a polar solvent. CF3I is non-polar. *A density gradient is likely.*

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

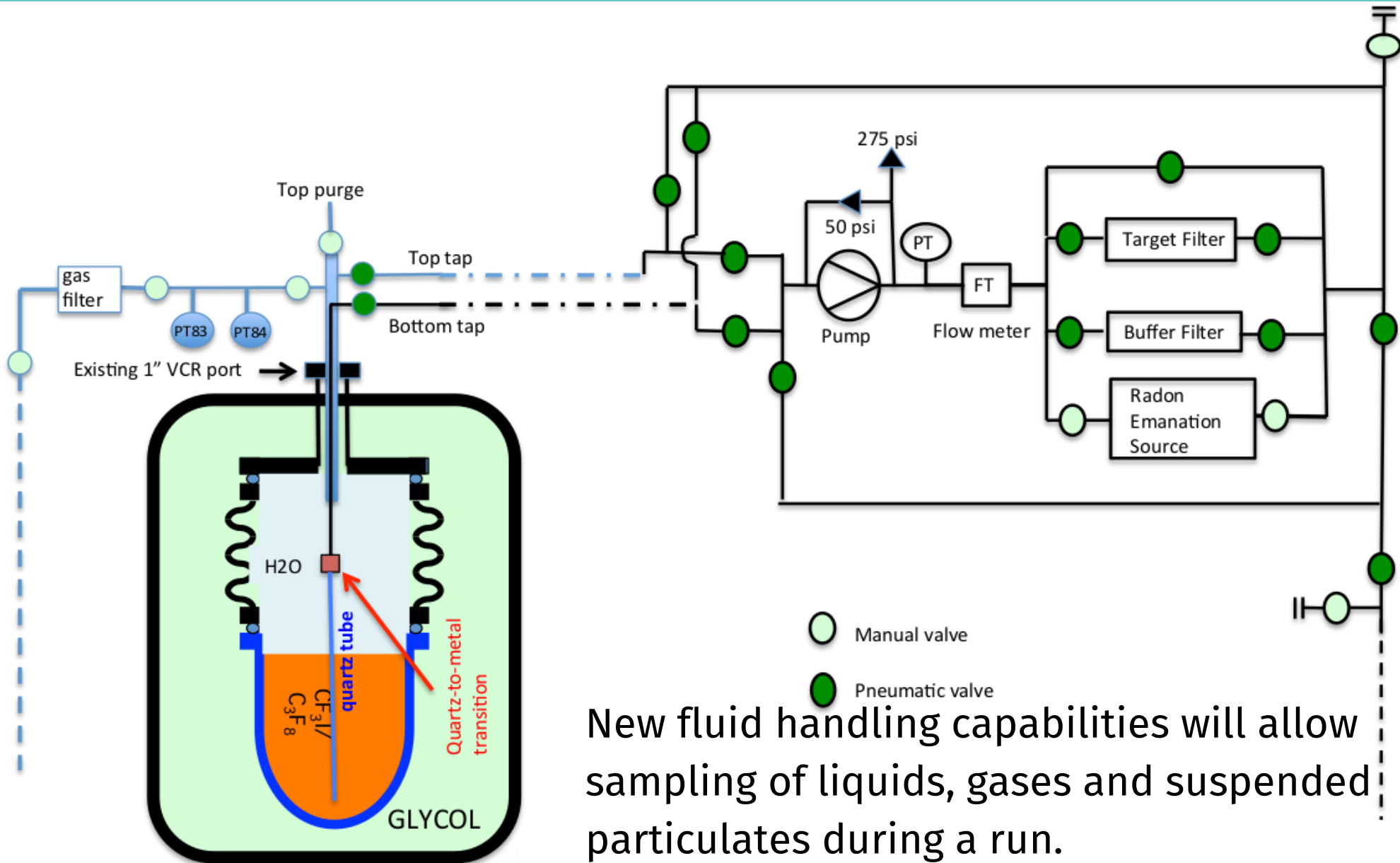
Observed: 81 cts/day



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



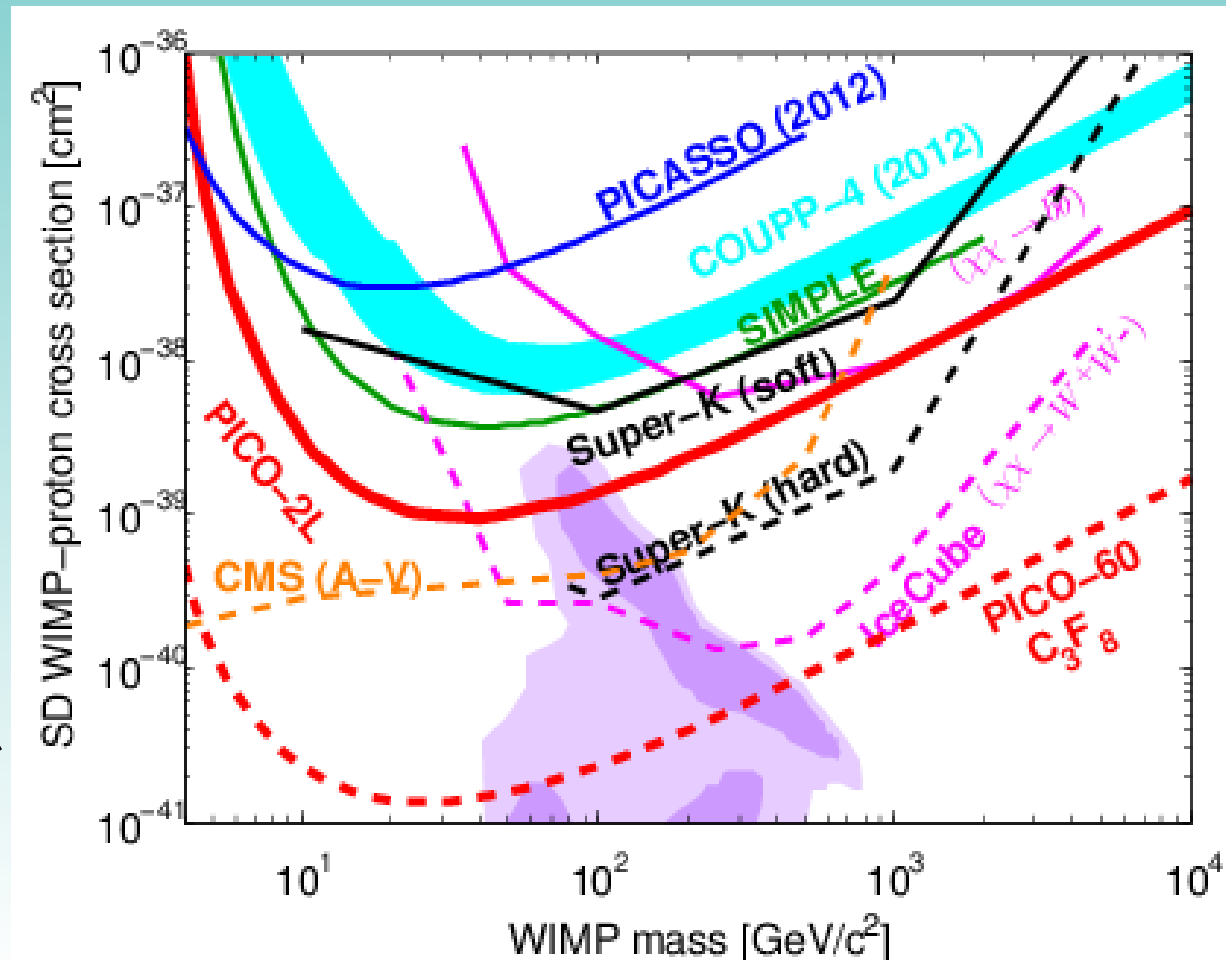
In-line filtration system



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!