The Scintillating Bubble Chamber

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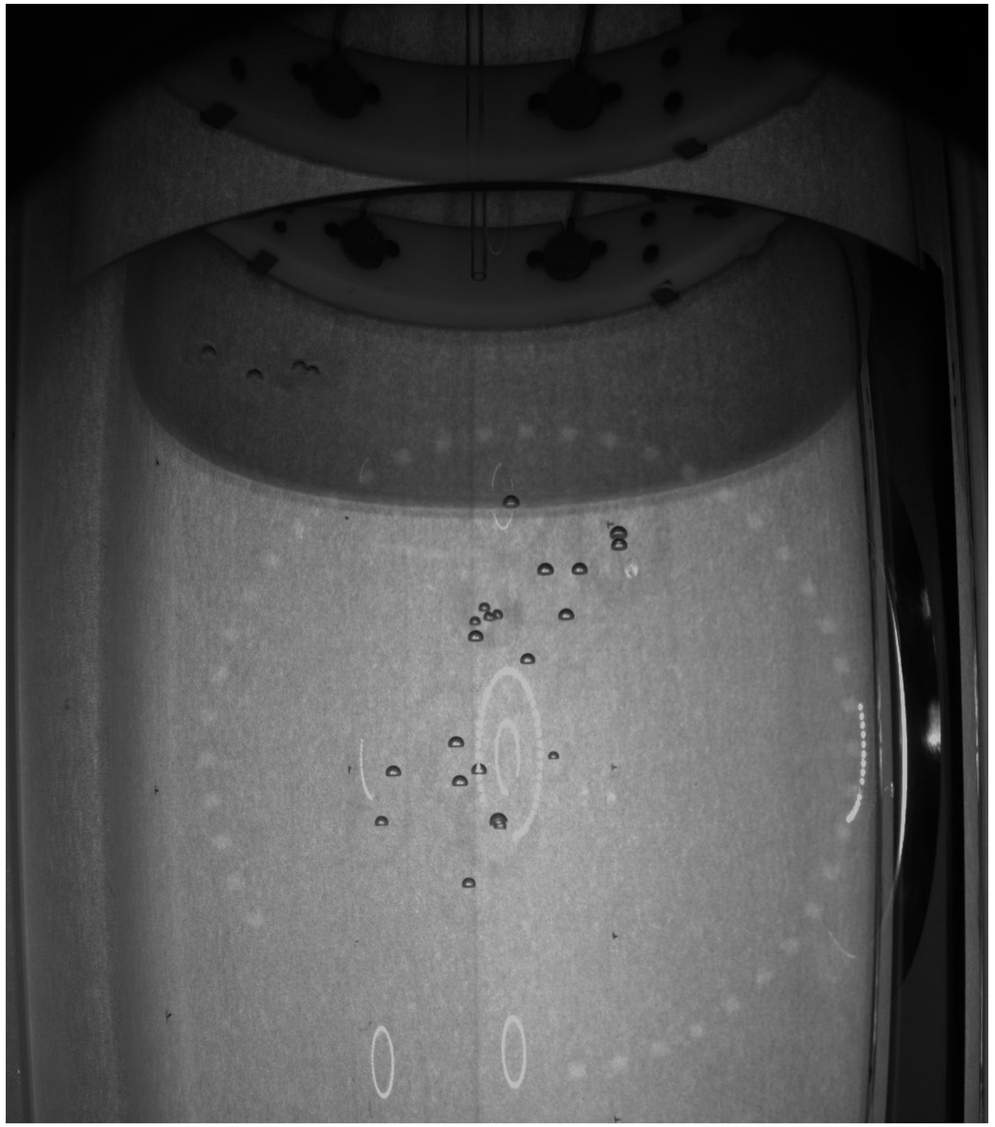
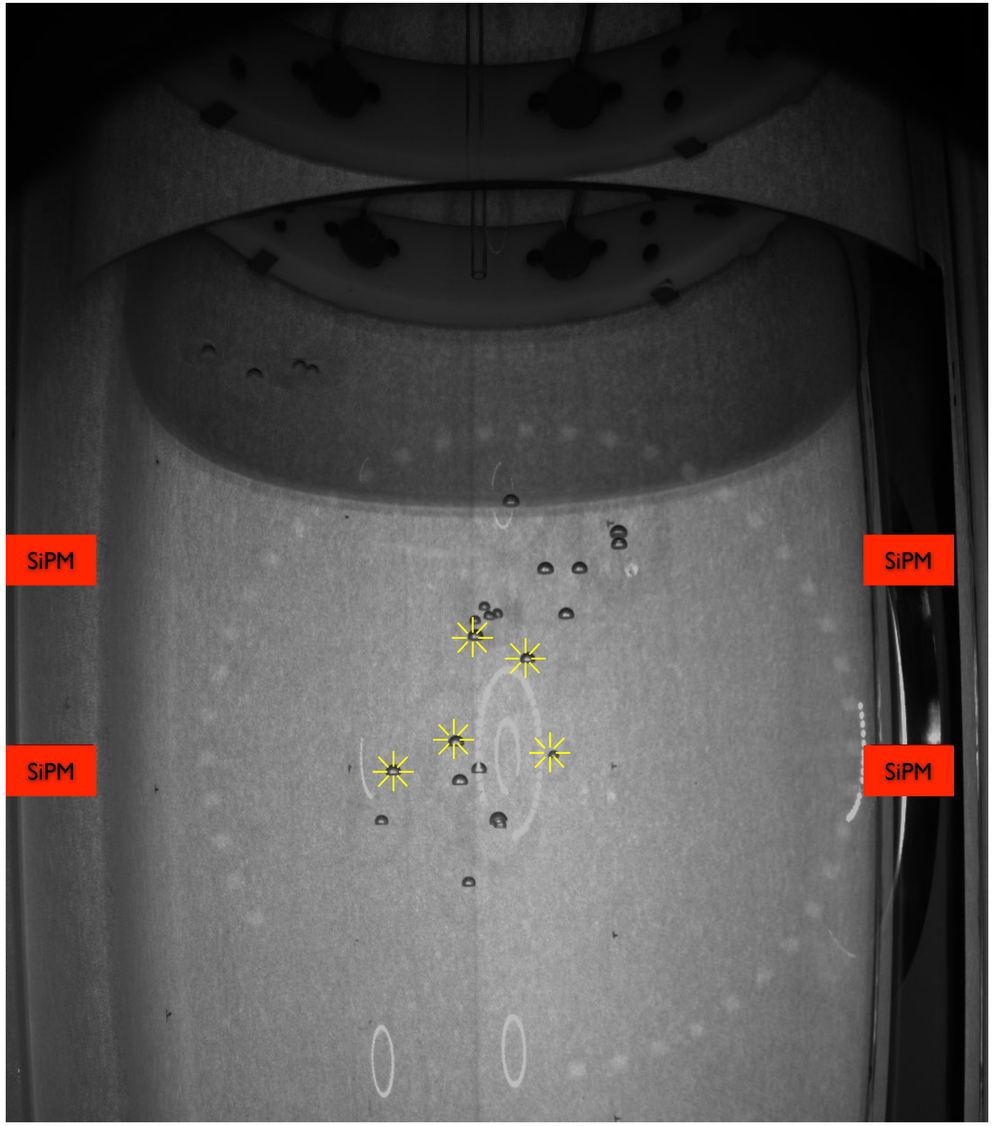
The “traditional” bubble chamber

- Superheated target (C_3F_8, CF_3I…)
- Particle interactions nucleate bubbles
- Cameras and acoustic sensors capture signals
- Chamber recompresses after each event



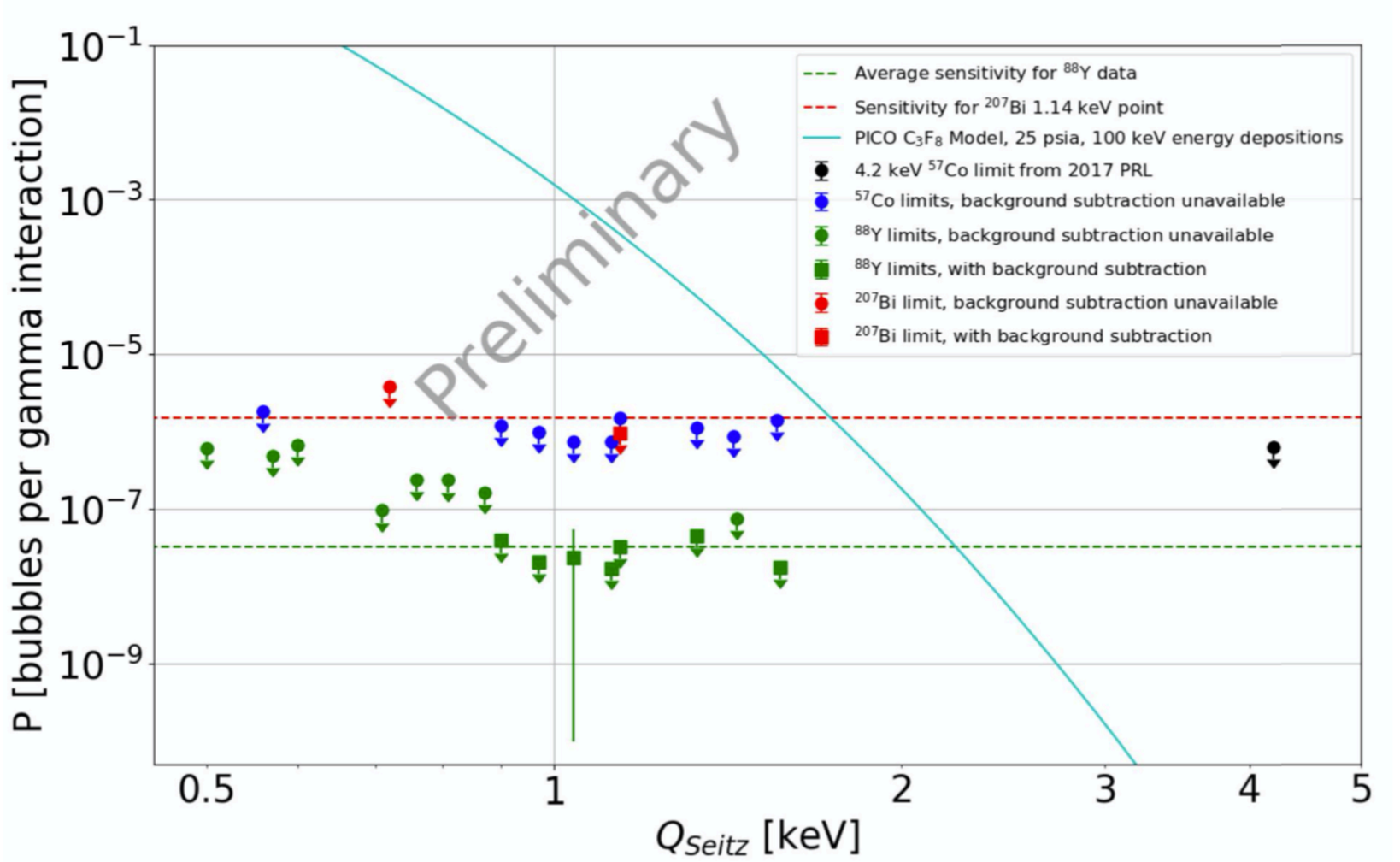
The *scintillating* bubble chamber

- Superheated scintillator (Xe, Ar…)
- Particle interactions nucleate bubbles and cause scintillation
- Cameras and acoustic sensors capture signals, photodetectors collect scintillation light
- Chamber recompresses after each event

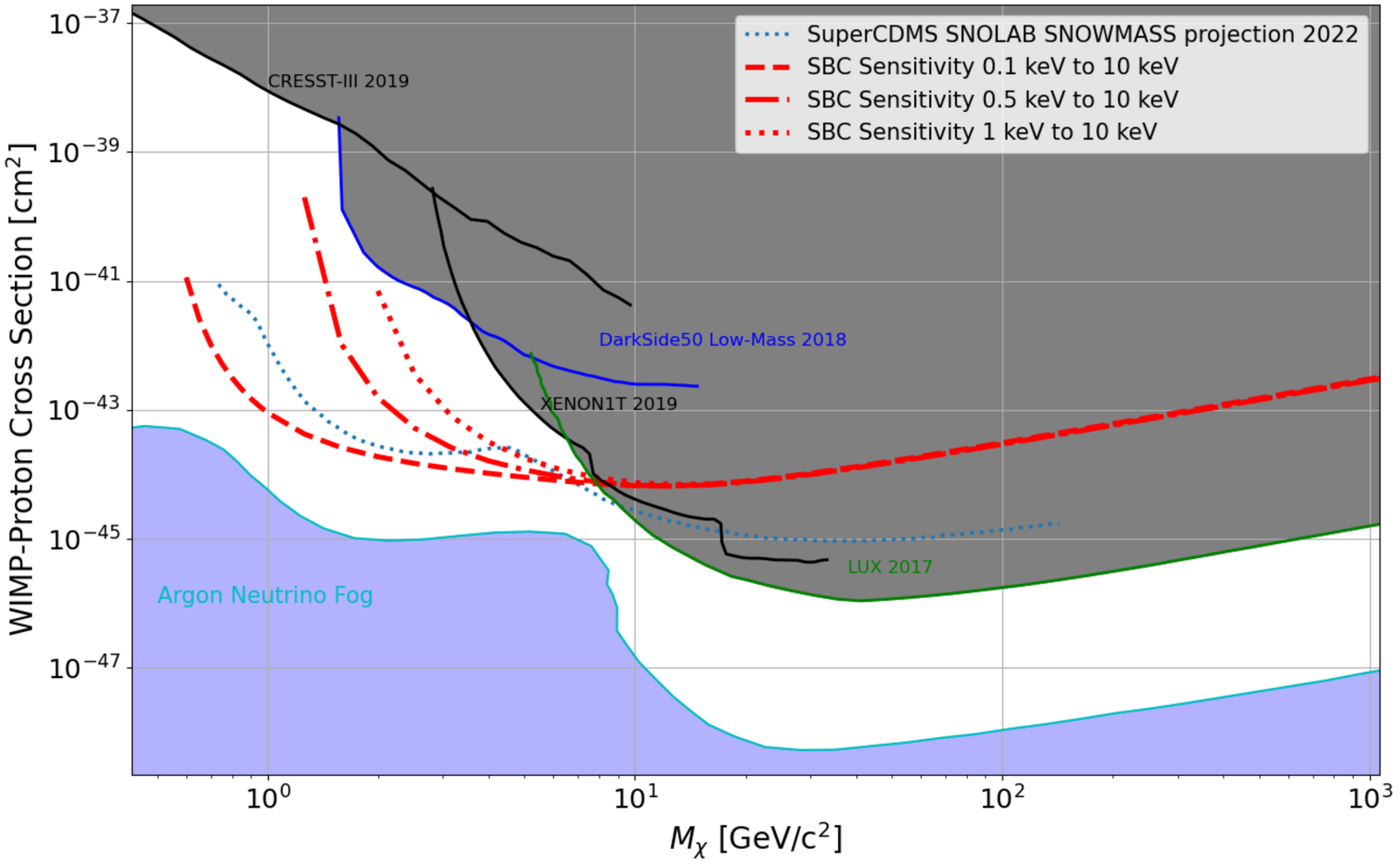


Why would we want to do this?

- This is a difficult thing to do
- Lower thresholds are not possible with a traditional chamber
- The superheated scintillator allows this to happen



What does this gain us?



- Lowering the threshold opens up significant area in the low mass search
- Note this assumes only CEvNS backgrounds and 10kg-year live time

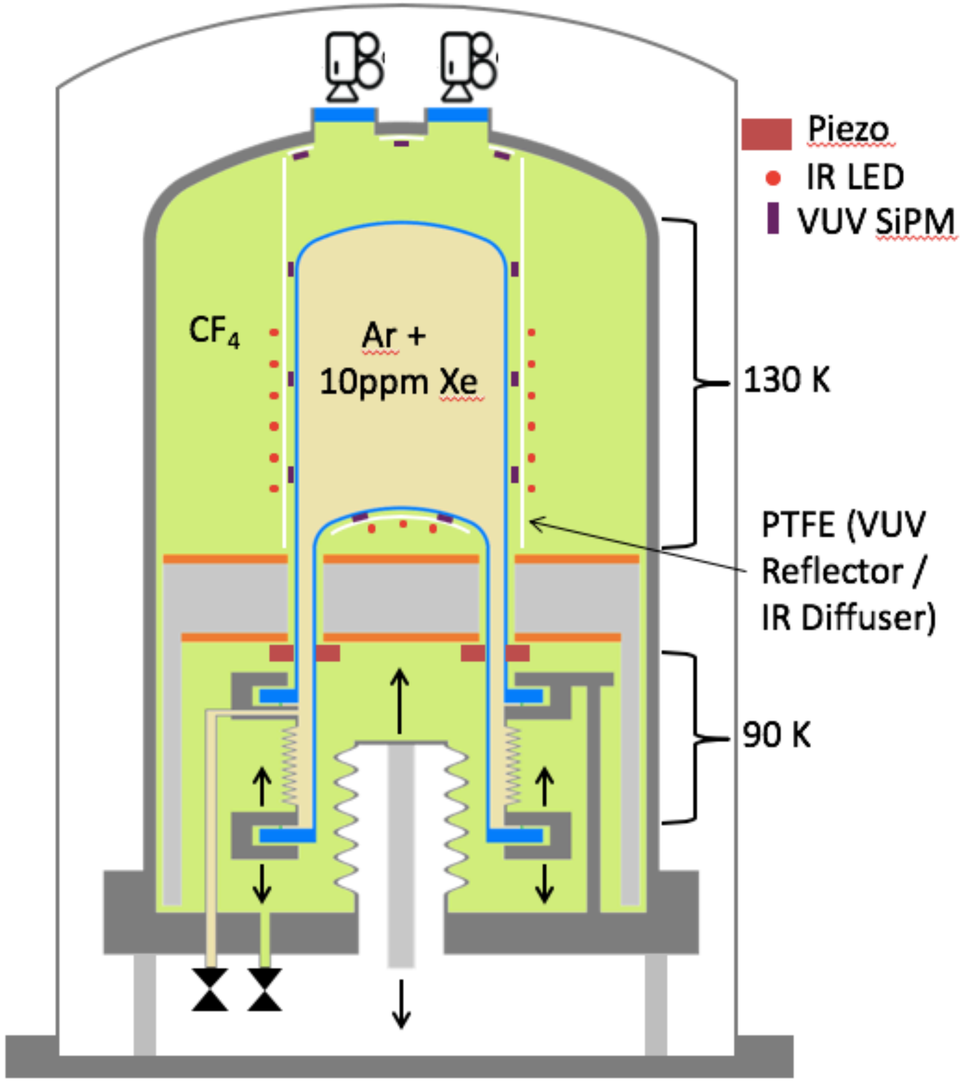
Collaboration Plan

2) Build and install detector at SNOLAB for DM search

1) Build and commission detector at Fermilab for threshold testing

3) Upgrade and install detector from 1) at a reactor for CEvNS studies

How are we doing this?



- Roughly 10kg of Argon
- SiPMs used for scintillation detection
- Much of the internal detail modelled on PICO 500
- “Only” added challenge is to keep it cold

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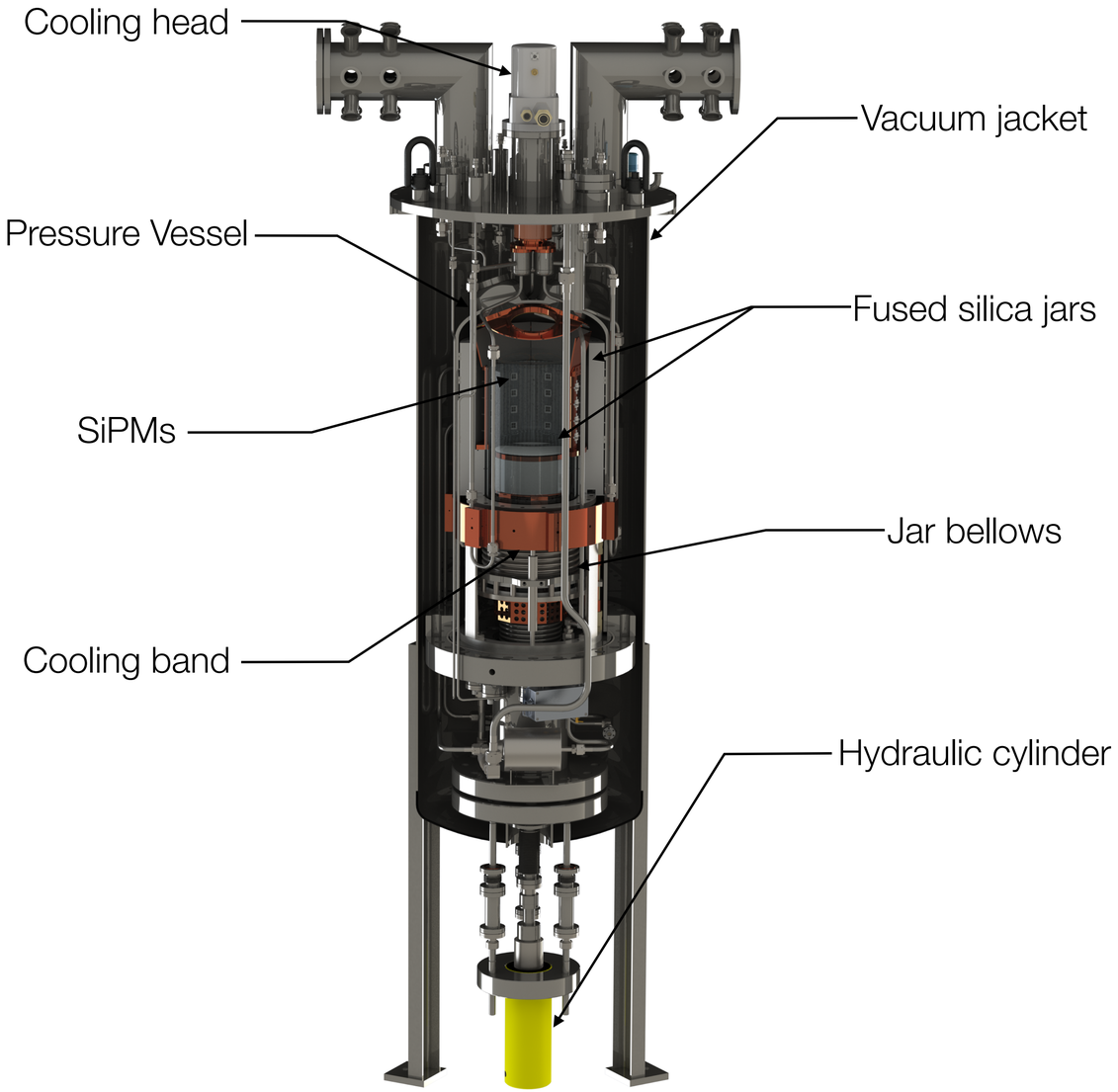

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What have we done?

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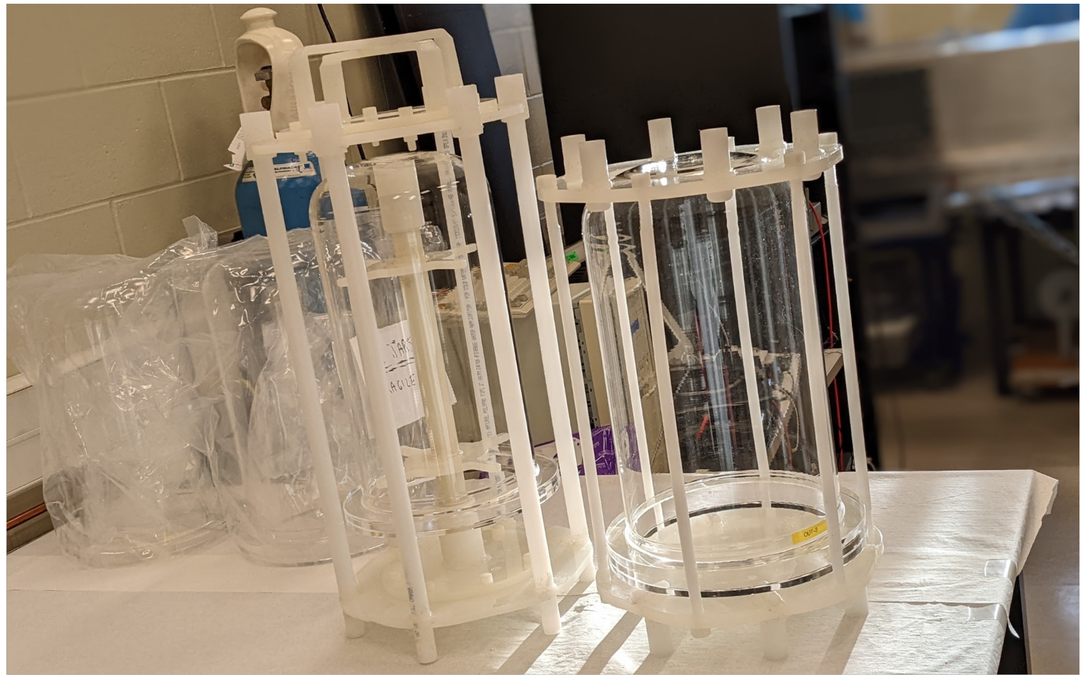
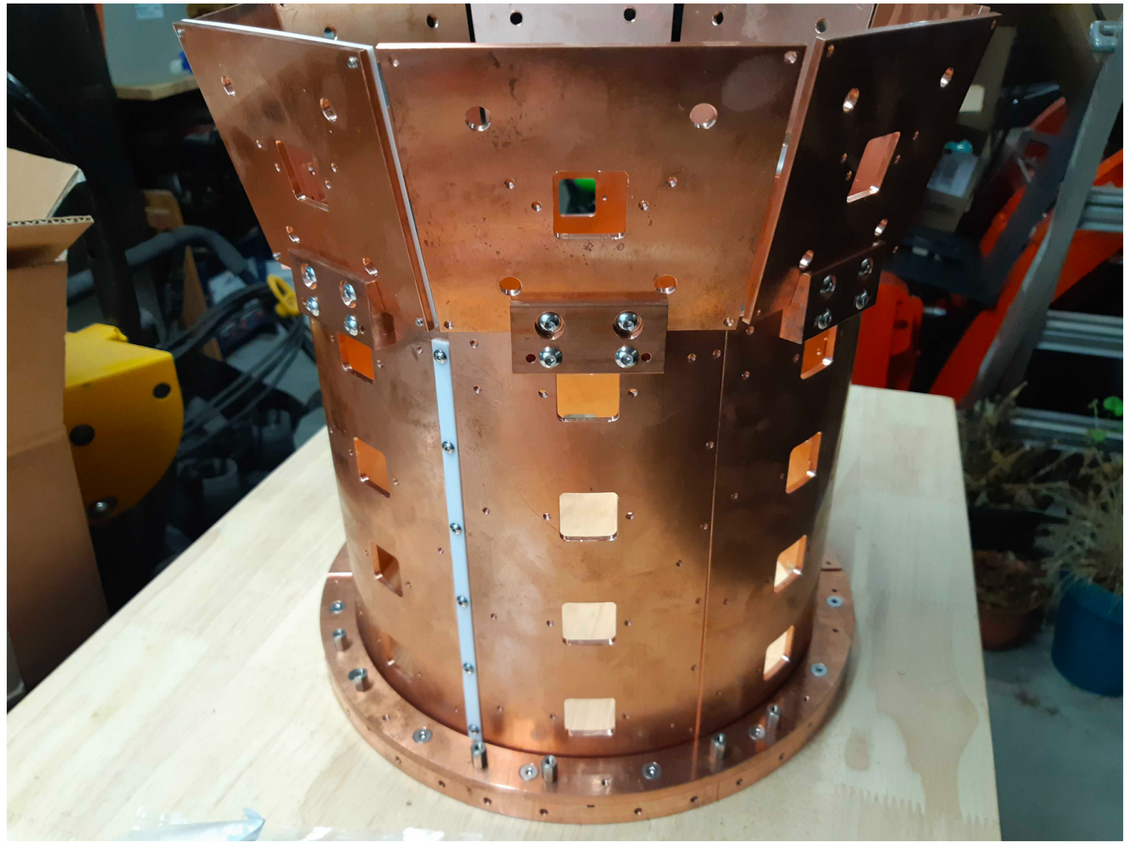
Inner assembly test assembly @ Queen's



HNO_3 leaching @ SNOLAB

What have we done?

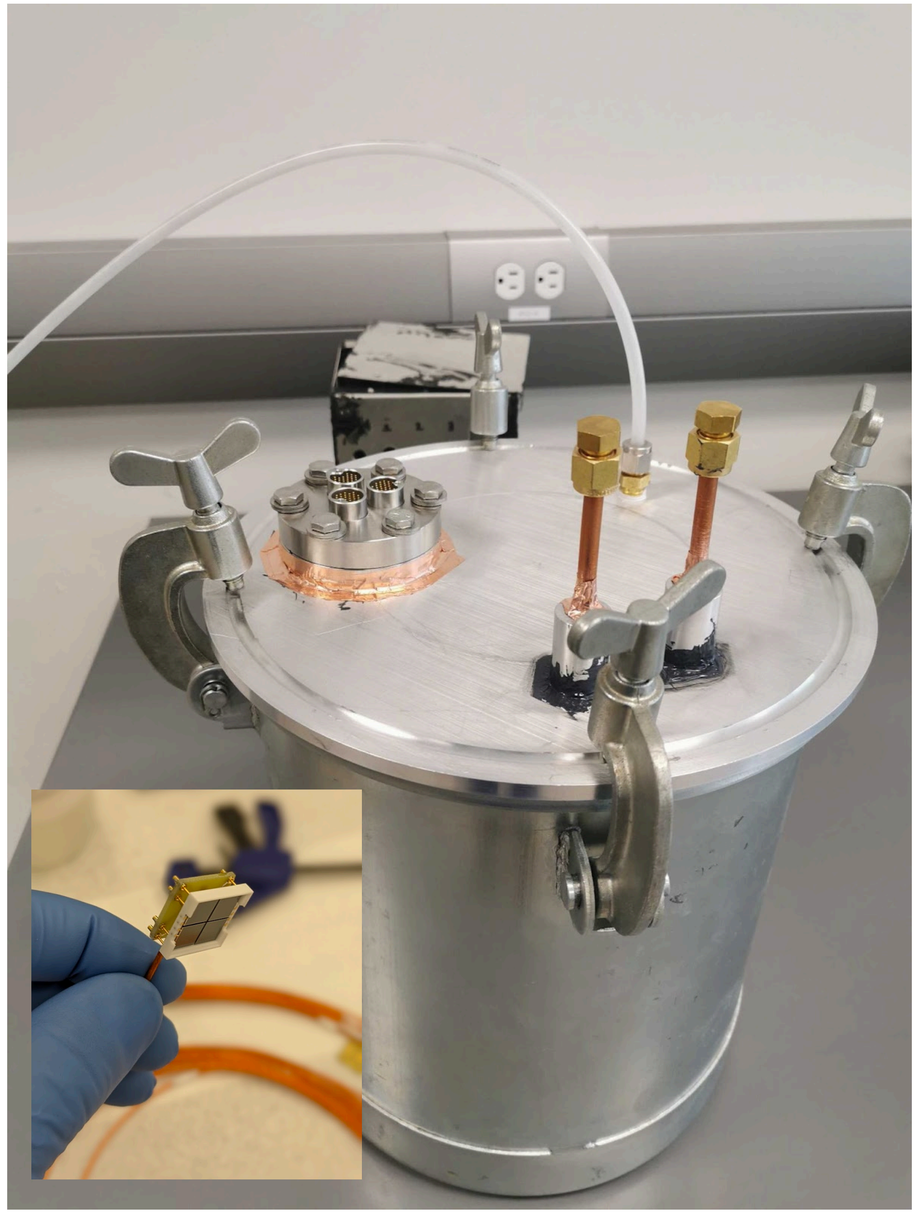
Hydraulic and Cryogenic tests @ Fermilab

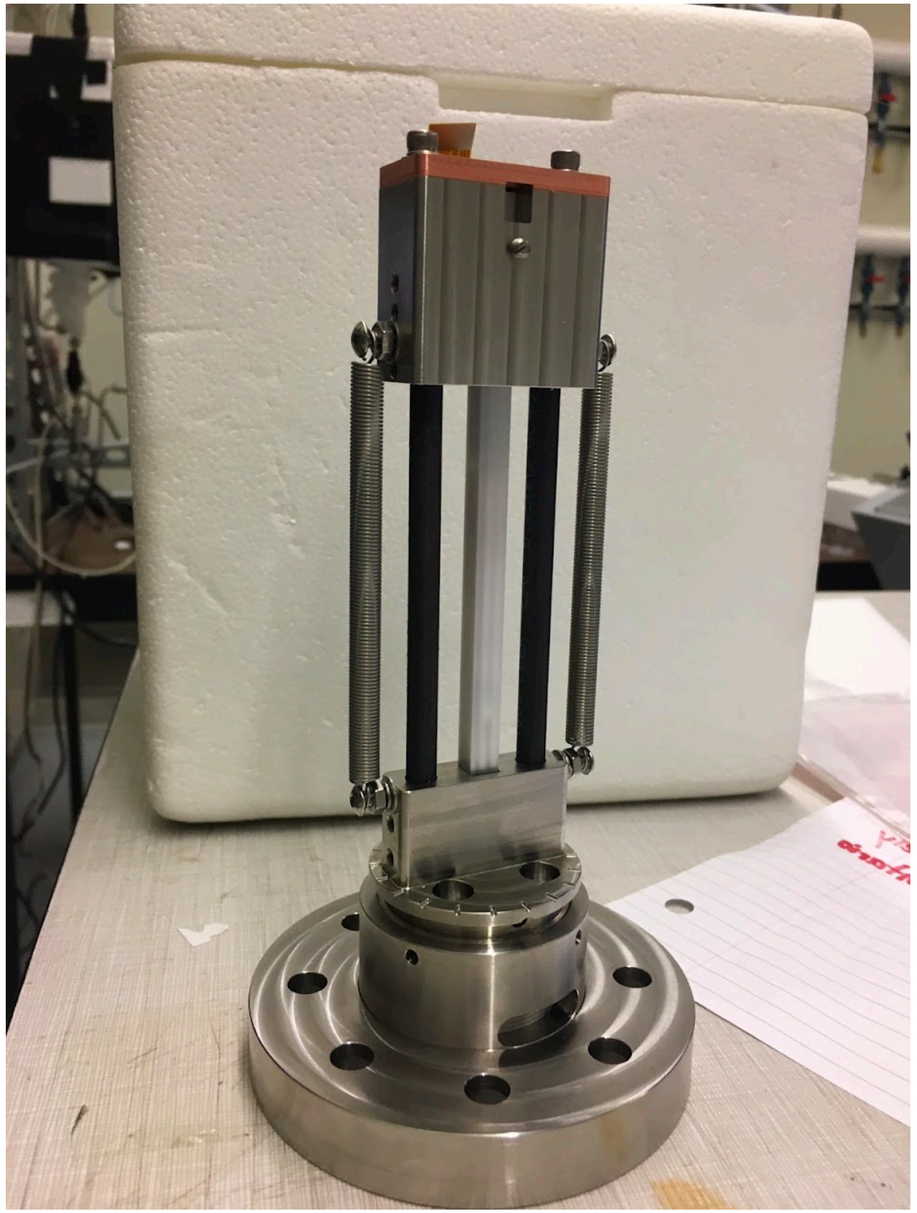


Precision machining @ U de Montréal

What have we done?

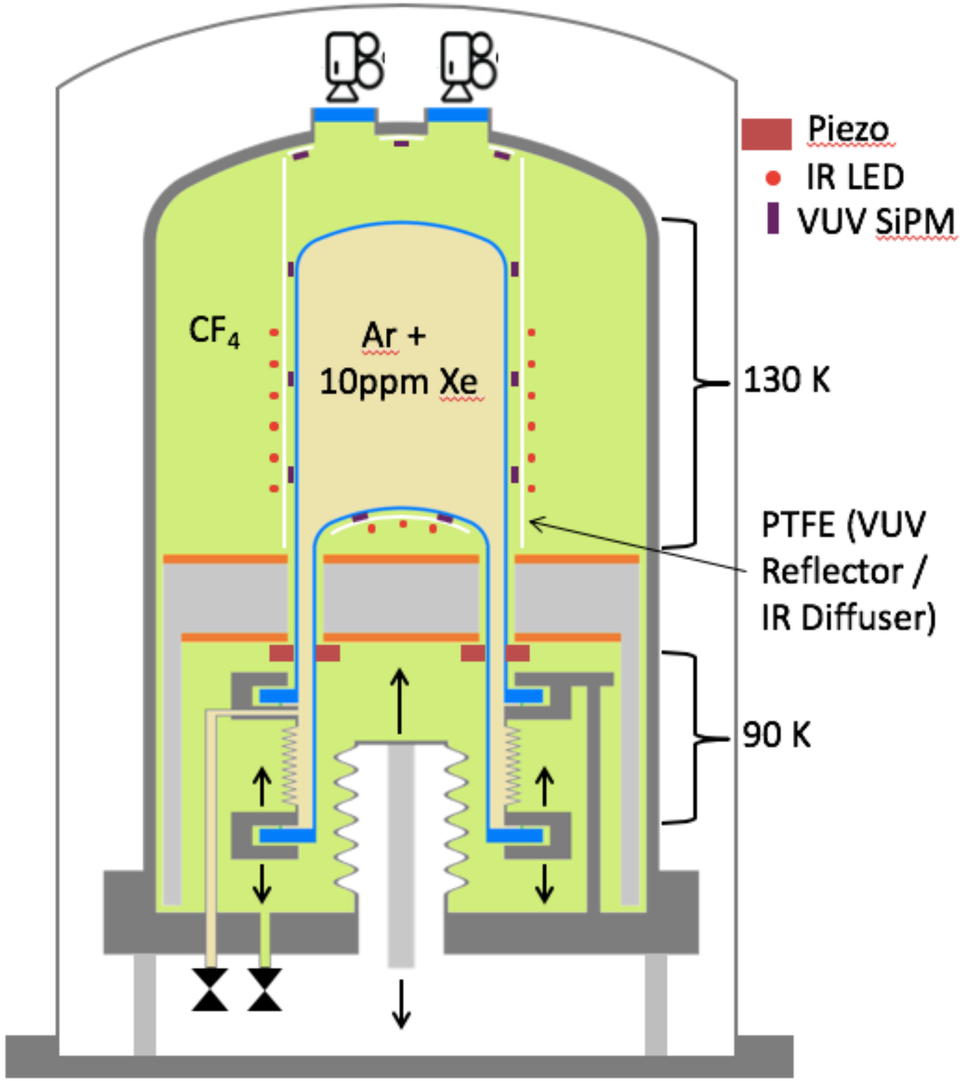
SiPM tests @ Queen's





Camera optics tests @ U Alberta

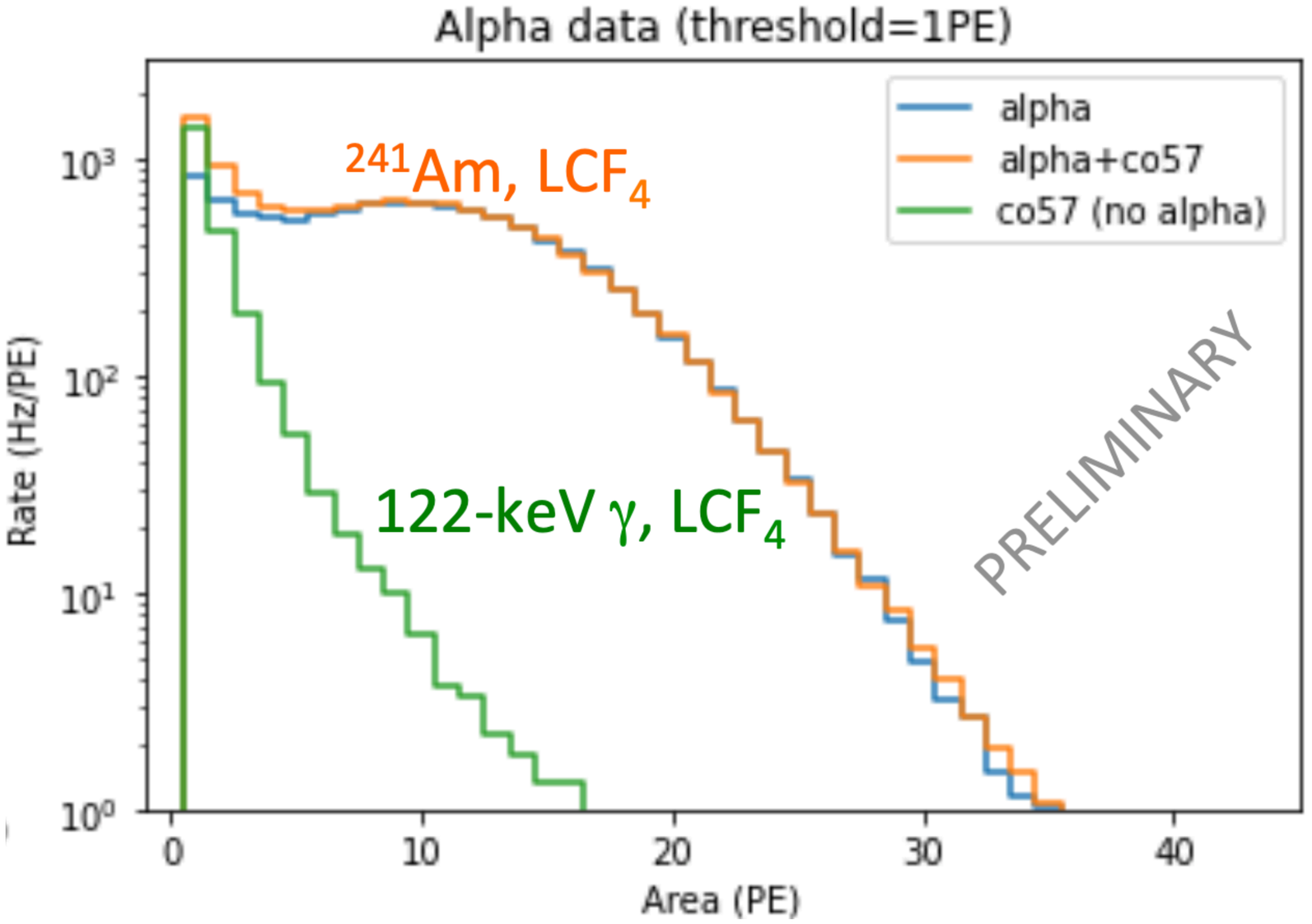
“Bonus” physics!



- SBC uses CF_4 as a hydraulic fluid
- Testing has progressed with validating components in liquid CF_4, including SiPMs
- At this point, there was a bit of a surprise

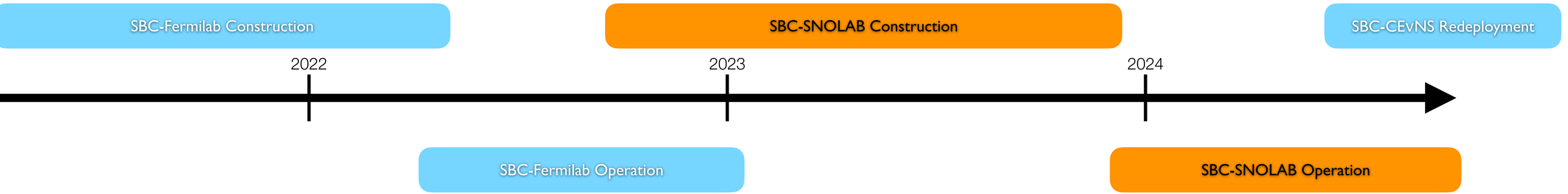
“Bonus” physics!

- Evidence that alphas can be seen in the hydraulic fluid
- Redesigned the SiPMs to have a few looking outward
- Joint effort between Northwestern and Queen’s

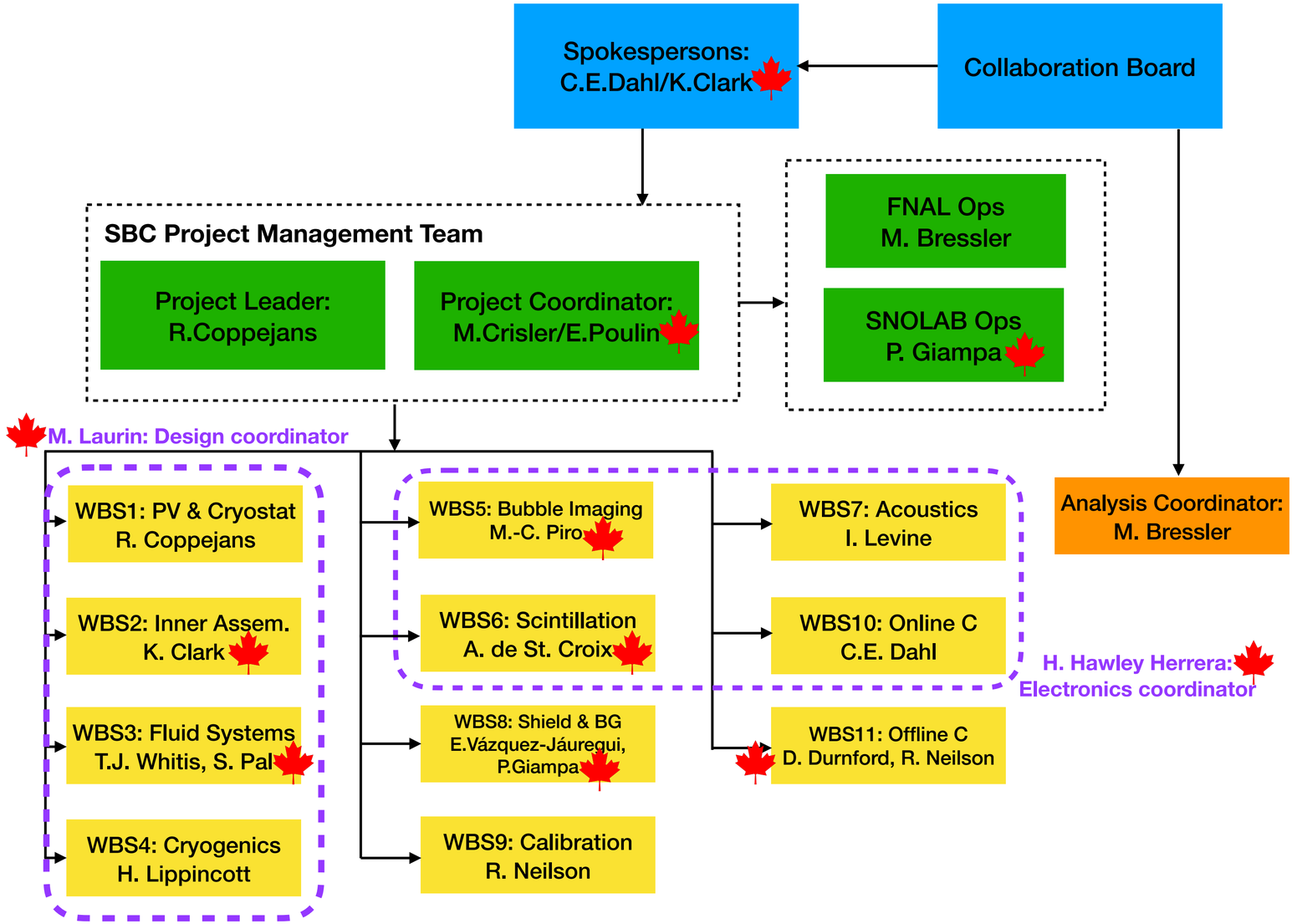


Timeline

- SBC-Fermilab mechanical/cryo commissioning complete [Summer 2022]
- SNOLAB on-site preparation begins [Fall 2022]
- SBC-SNOLAB construction on surface and UG [throughout 2023]
- Data taking [2024]



Canadian & HQP Leadership



- Canadians hold many leadership positions
- Of particular note, Canadian HQP (non-faculty) lead 5 of the WBS areas

The SBC Collaboration

Northwestern University

- **Eric Dahl**
- Rocco Coppejans
- Zhiheng Sheng
- Aaron Brandon
- David Velasco

Queen's University

- **Ken Clark**
- Austin De St Croix
- Hector Hawley
- Kaden Foy
- Jonathan Corbett
- Patrick Hatch

University of Alberta

- Marie-Cécile Piro
- Carsten Krauss
- Daniel Durnford
- Sumanta Pal
- Youngtak Ko
- Mitchel Baker

SNOLAB

- Pietro Giampa
- Jeter Hall
- Eric Poulin

Université de Montréal

- Mathieu Laurin

Northeastern Illinois University

- Orin Harris

Pacific Northwest National Laboratory

- Chris Jackson

Universidad Nacional Autónoma de México

- Eric Vázquez-Jáuregui
- Ernesto Alfonso-Pita
- Ariel Zuniga-Reyes

Drexel University

- Russell Neilson
- Matt Bressler
- Noah Lamb
- Stephen Windle

Indiana University South Bend

- Ilan Levine
- Ed Behnke
- Cody Cripe

UC Santa Barbara

- Hugh Lippincott
- TJ Whitis
- Runze Zhang

Fermilab

- Mike Crisler