# The NEWS-G Experiment

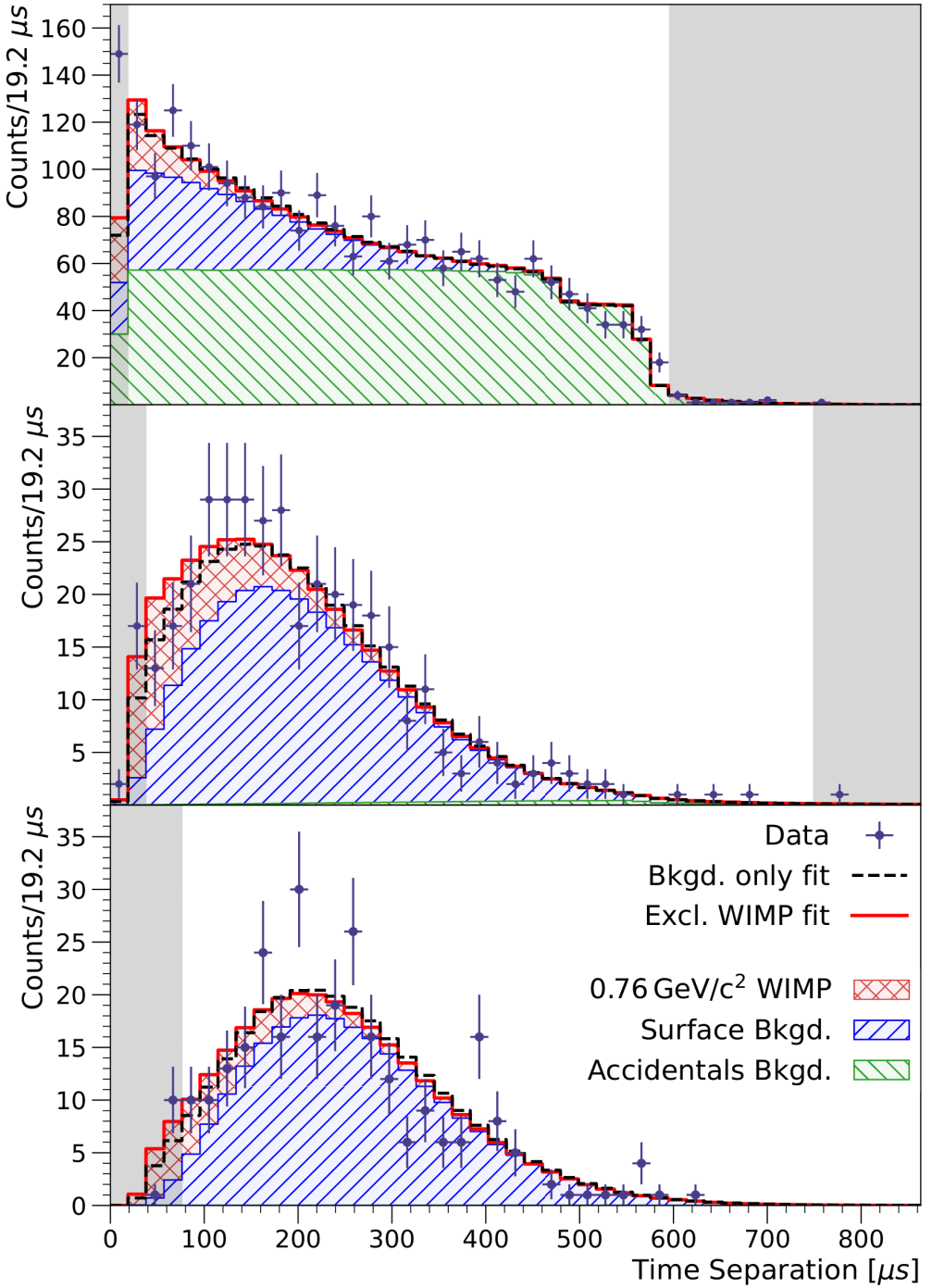
SEF 2025-02-04

Philippe Gros (Queen's U)
for the NEWS-G collaboration

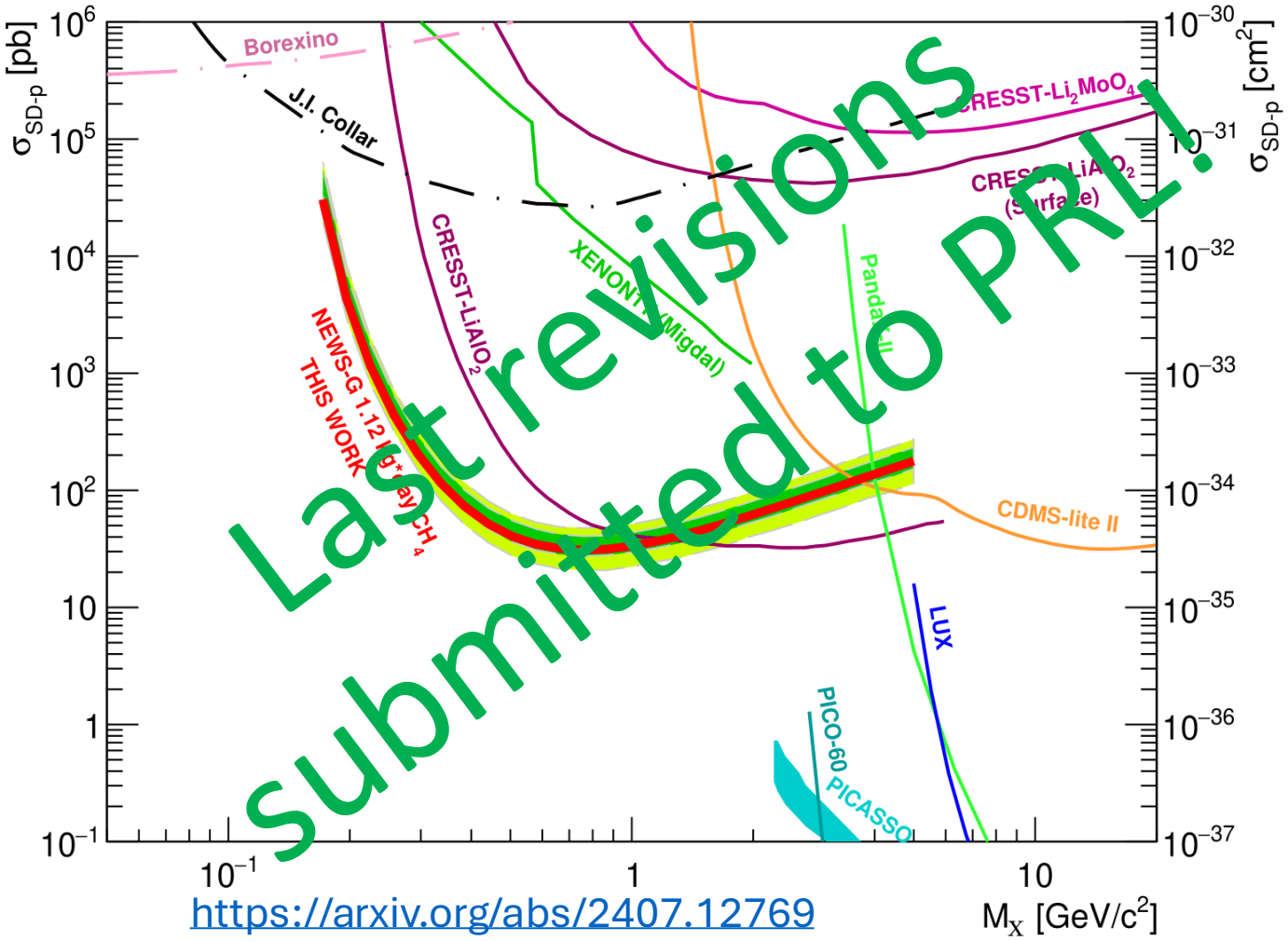
# Analysis results

# Analysis of LSM data 2019

- Data taken in fall 2019 with temporary shield at LSM
- Gas: 135mbar pure CH4
- Electron counting possible
- Negative induced pulses of 2nd channel allows rejection of electronics noise
- Time separation between electrons allows surface noise rejection
- 30% of test data, 70% blinded



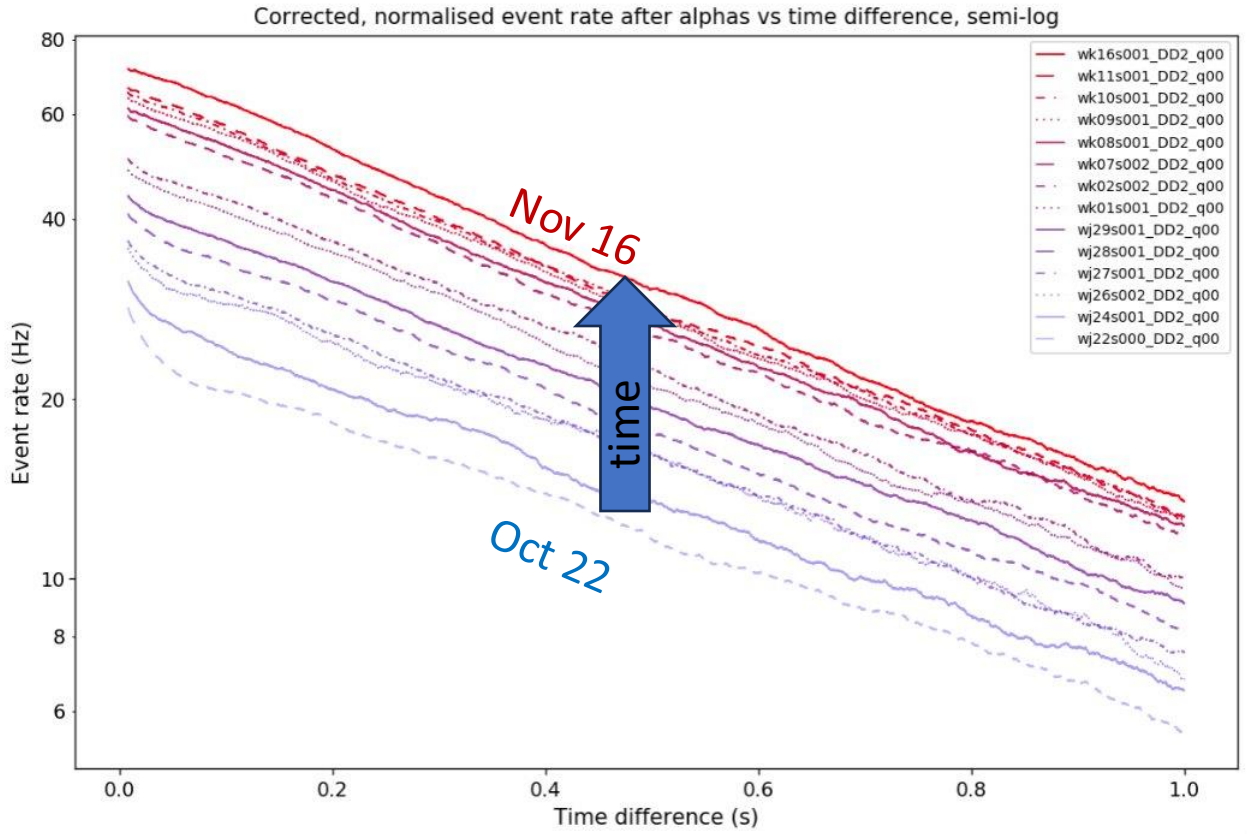
# Analysis of LSM data 2019



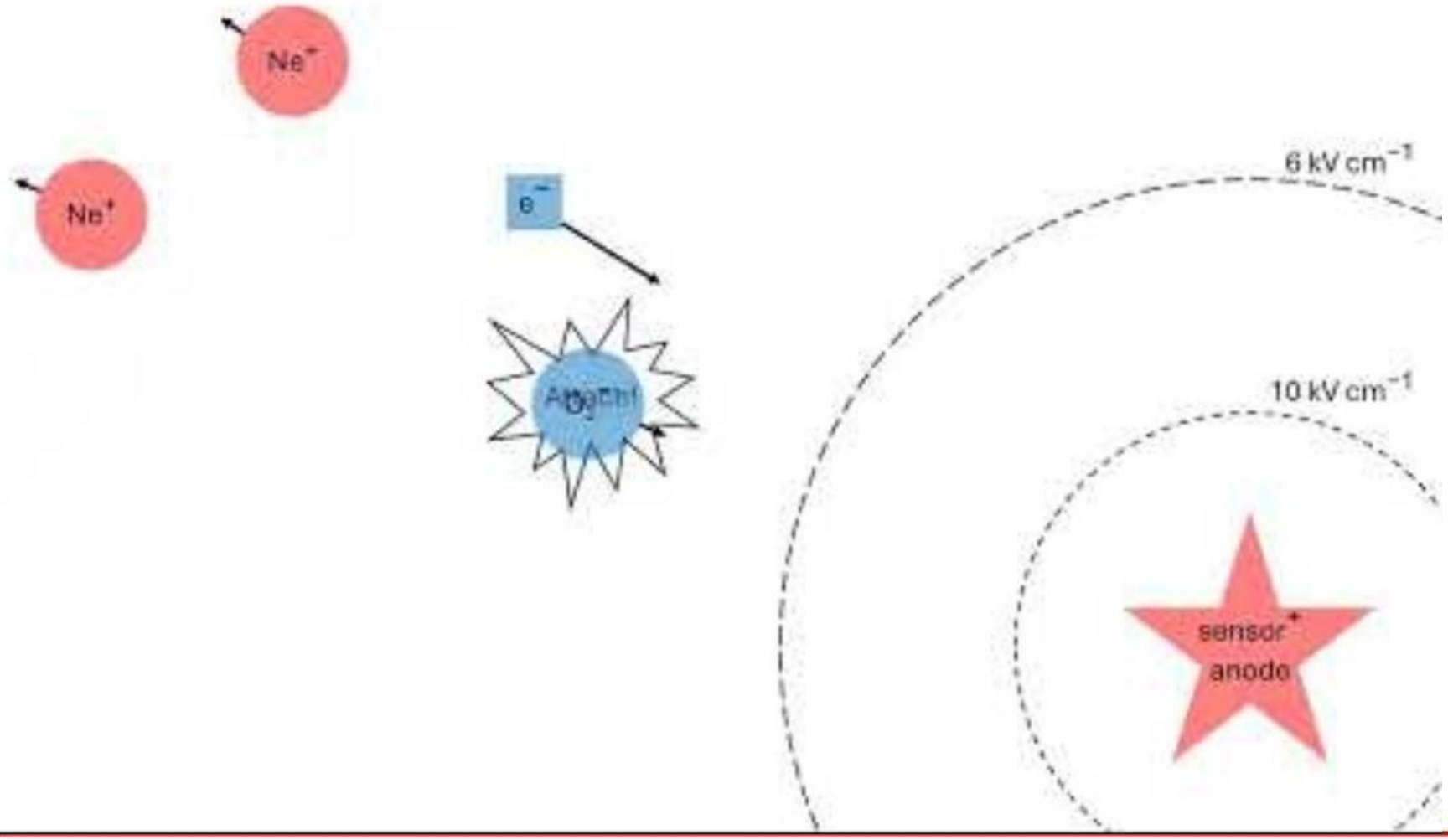

https://arxiv.org/abs/2407.12769

# Single electron background

- Single electron events follow high energy alpha events
  - Rate increase from a couple seconds
- The effect increases with gas degradation (using runs with small leak in detector)
- "Single electron events" are negative ions drifting slower



# Negative ions from capture



# Ongoing analysis in neon

- Physics data taken in 2022
- Neon + 2% CH4 at 1bar
- Better noise and BG conditions than LSM
- Better analysis focus now that LMS2019 data is submitted
- Will benefit from experience with previous dataset

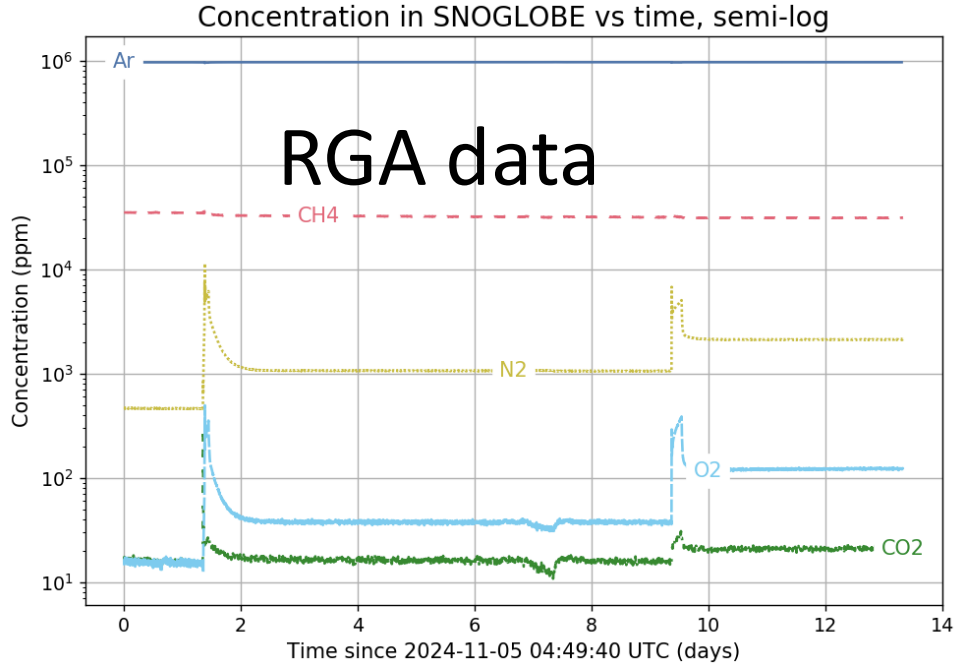
# Acitivities at SNOLAB

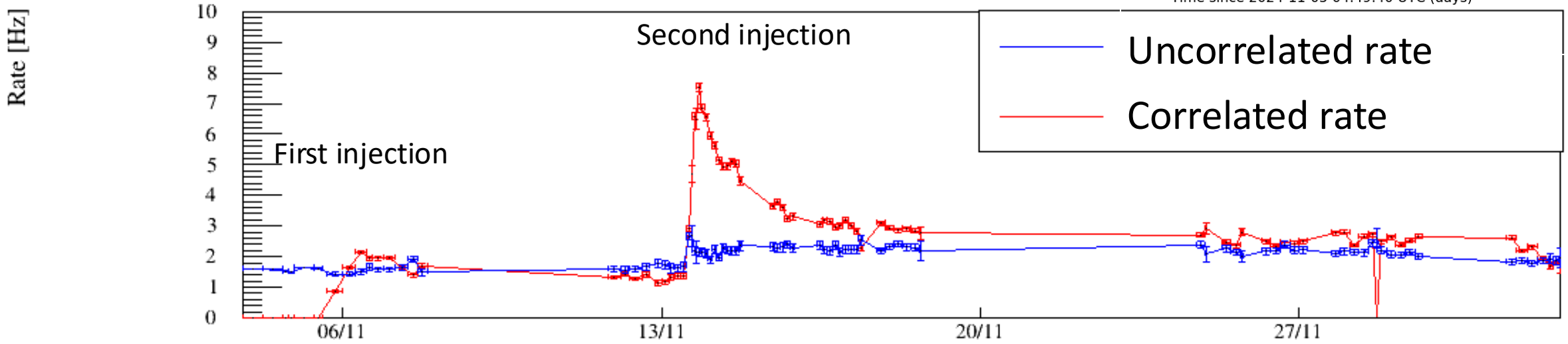
# Upgrade of circulation and purification

- More purification needed because of negative ion BG
- Circulation through purifier and radon trap
  - Small turbine for circulation -> 7 turbines in series
  - Flow ~0.5L/min, not sufficient -> 2.5 L/min (~2.5 sphere volume/day)
  - Temporary solution, not reliable
- Radon trap removes radon from purifier
  - Still not enough flow to fully remove radon from source inside sphere
- Still need better circulation pump
  - Pressure for flow in ¼" tubing
  - Clean
  - Operable at low and high pressure
  - ???

# Confirmation of oxygen effect in argon mix (cheap)

- Injection of a few mL of air (x2) -> few ppm O2
- Gas circulation without oxygen purifier
- Significant rate increase after each injection
- The extra events are correlated, and 1-2 electrons



# Helium operation

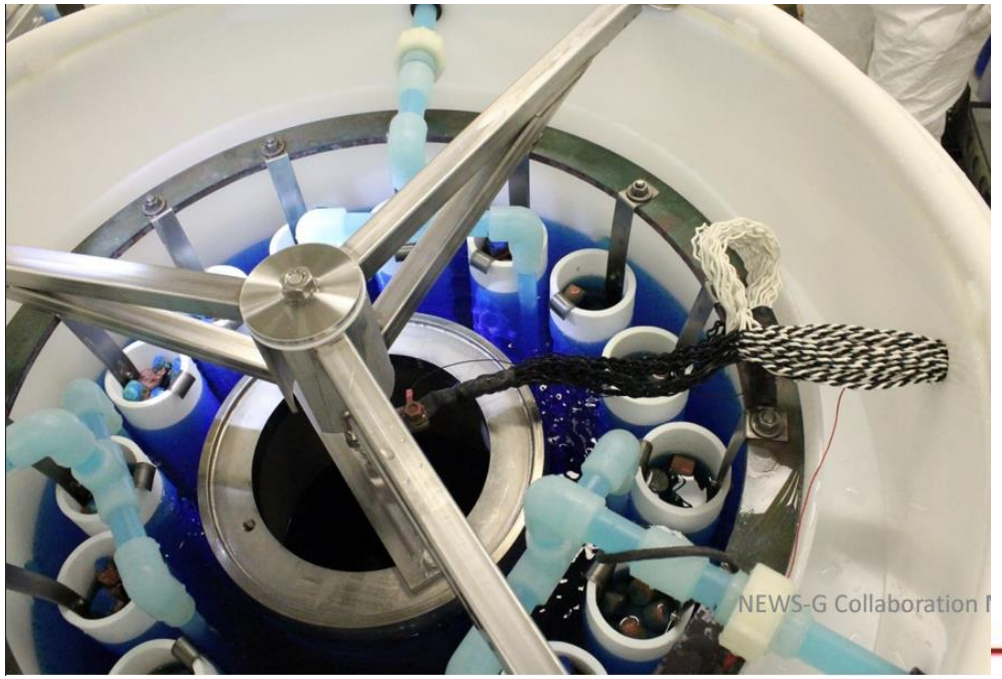
- Filled with 1bar He+10% CH4 in December 2024
- Stable operation over winter break
  - Failure of circulation system -> expected gas degradation
  - Slower drift (12ms vs ~3ms in neon), still manageable
  - Single electron sensitivity from calibration laser
- Repairs and upgrade of circulation system planned for Feb 17th

# 2025 plans

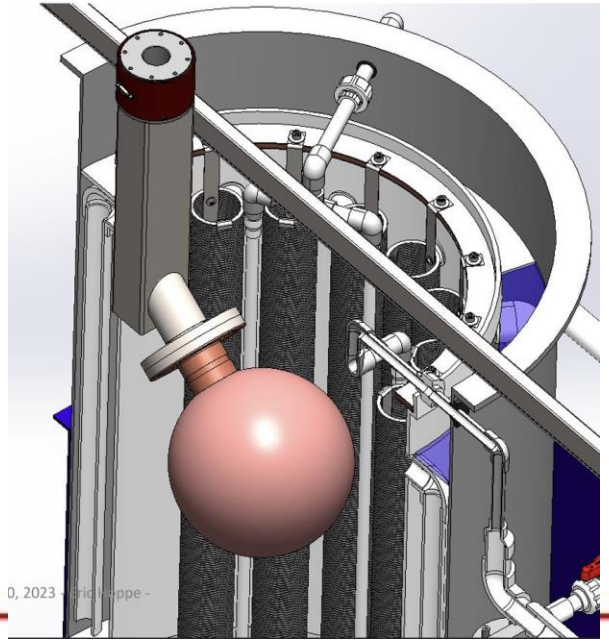
- At SNOLAB
  - Repairs on gas system
    - Upgrade of circulation if better pump can be found
  - Physics runs in Helium
  - Physics runs in pure CH4 (small upgrade to gas system needed)
- External calibration: Quenching factor
  - Neutron beam experiment at U de Montreal starting next week
  - If successful, QF measurements in neon, helium and methane

# MiniECuME: A 30-cm intact underground-electroformed SPC prototype

- Copper and acids samples from platting on a cylindrical mandrel reveal that lower-grade (10X cheaper) acid is viable option
- Mini-ECuME mandrel holder assembled, Spherical acrylic mandrel fabricated
- Plan to proceed in spite of defects in mandrel
- Stalled due to leaking slipring, waiting for replacement
- Electrical and leak tests planned when replacement arrives

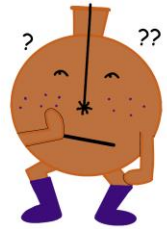



The ECA electroforming bath at PNNL

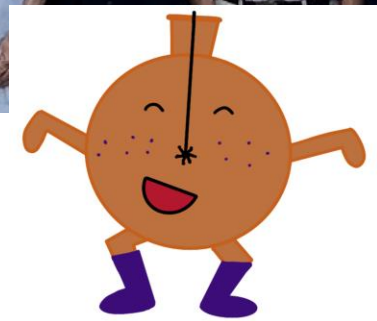


MiniECuME mandrel holder

MiniECuME acrylic mandrel




# Questions?

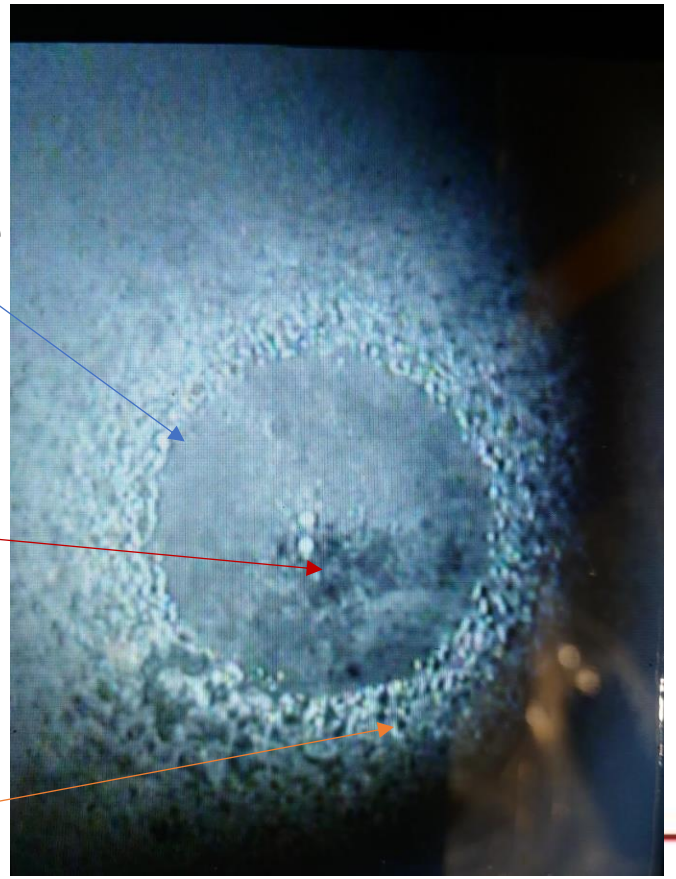


# In Situ Etching

- January 2024
- In situ etching
  - Spray inner surface with etchant (3% peroxide, 2% sulfuric)
  - ~10L circulated with diaphragm pump
  - Solution extracted from sphere bottom using nitrogen pressure (~500mbarg)
- Visual inspection of sphere using fish cam
  - Fishing camera borrowed from SNOLAB
  - Taking advantage of open confirguration

# In situ etching

# Sphere inspection



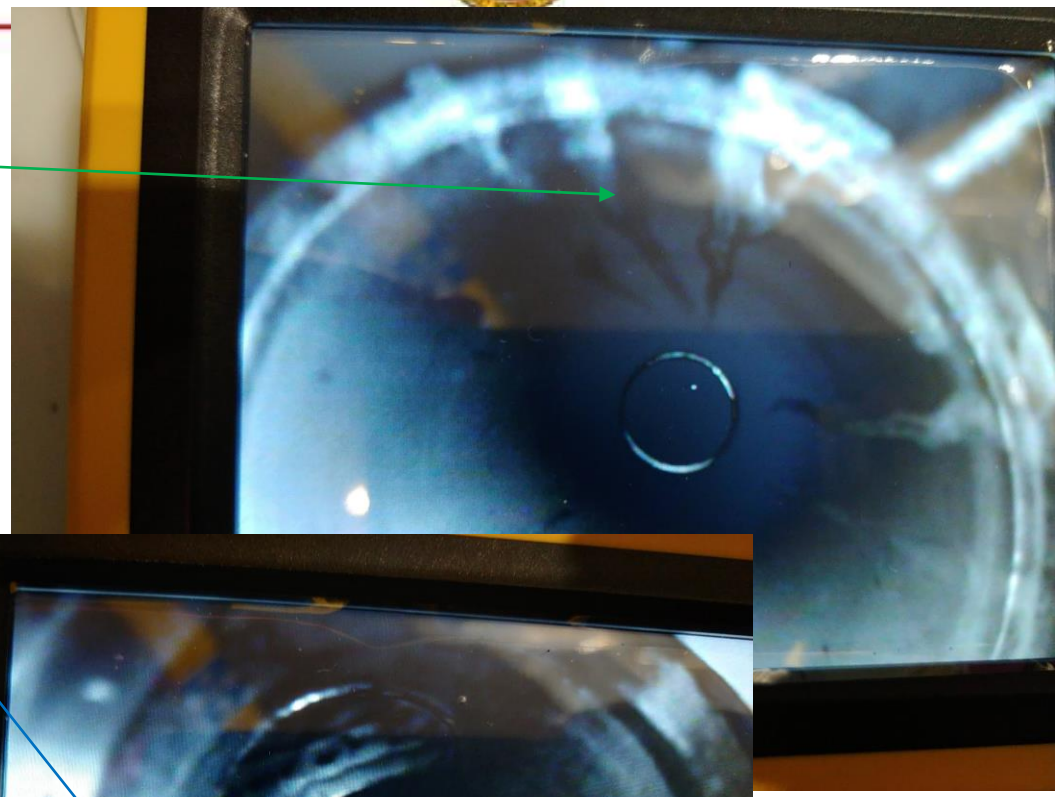
Water puddle

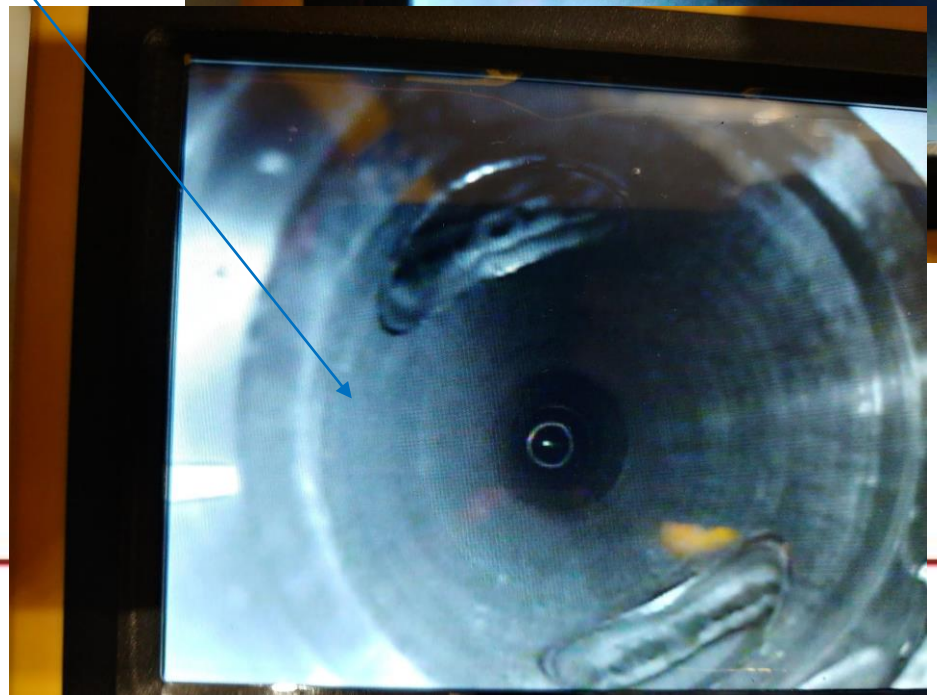
Unknown dark residue

Rough copper surface

Dripping along copper nozzle, unknown origin

No visible in stainless section



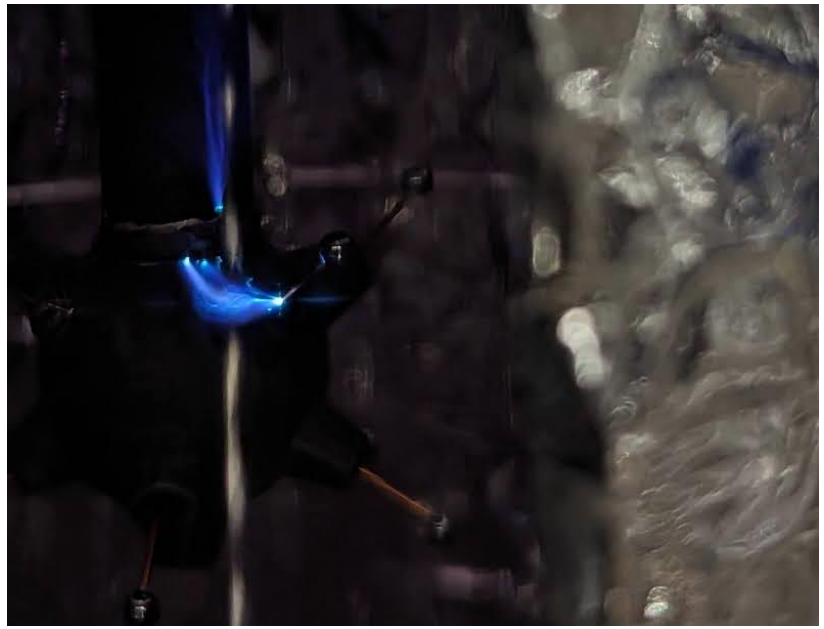


# Sensor replacement

- Sensor replacement
  - Previous sensor unstable at high voltage
  - Problem from poorly insulated wire soldering
  - Sensors tested in transparent tube
- Better preformance
  - Noise appeared after a couple months, unexplained
  - Good for alpha, cannot reach high gain
  - Possible issue with HV feedthroughs
- Alpha rate measurements
  - No significant reduction from etching
  - Dominated by radon (with surface components from daughters)

# Sensor test

- Old sensor
  - High current from ~2000V
  - Discharge from base of north wire to DLC



- New sensor
  - Ramp to 5000V
  - Discharges start at ~5000V
  - From ball to DLC, along wire
  - Extra cleaning after test