Future of NEWS-G at SNOLAB and LSM

GUILLAUME GIROUX

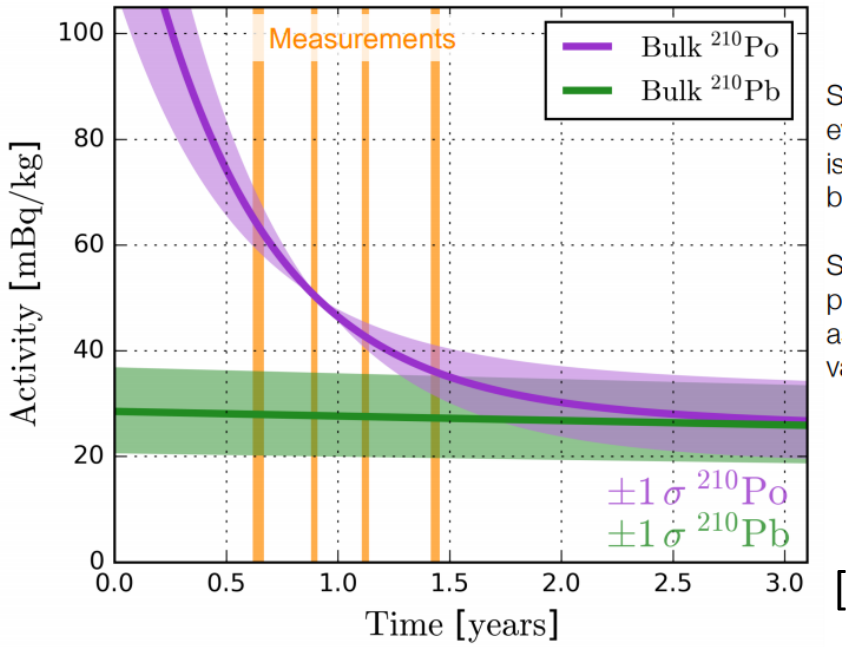
5TH NEWS-G COLLABORATION MEETING

LPSC GRENOBLE, JUNE 2019

Copper backgrounds

Current status: 140-cm sphere (C10100 Cu)

- Commercial copper, leading source of background is ^{210}Pb from the bulk copper. Recently measured with XIA by XMASS collaboration at 29 +/- 8 Bq/kg, ~5 times as much as all other backgrounds combined



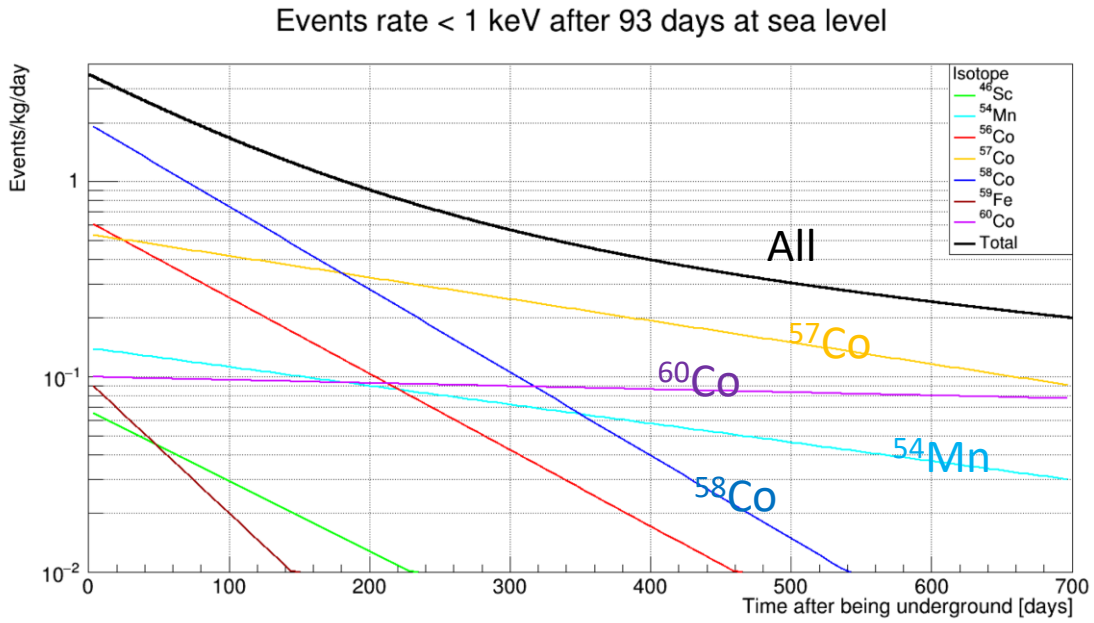
1.5 DRU

[Dan Durnford]

Copper backgrounds

Current status: 140-cm sphere (C10100 Cu)

- Spinning, welding, weld repair: ~93 days at the sea-level
- Cosmogenic activation: long lived ^{60}Co, but also shorter lived ^{58}Co, ^{57}Co, ^{54}Mn.



~4 DRU at t = 0

~0.4 DRU at t = 1 yr

[Alexis Brossard]

Future Mitigation of Copper Backgrounds

Ultimate solution:

- Electroforming of an monolithic copper shell in an underground environment (PNNL, or in situ at SNOLAB or LSM)
  - Perfect control on cosmogenic activation
  - Removes machining steps that may add backgrounds
  - No measurable ^{210}Po with XIA, < 4.1 mBq/kg, but expected to be << 4.1 mBq/kg
- Currently prohibited by costs
  - Large electroforming baths needed
  - Large amount of acid needed
- There is a need to establish a new underground facility for this art
  - LSM, SNOLAB or Boulby…

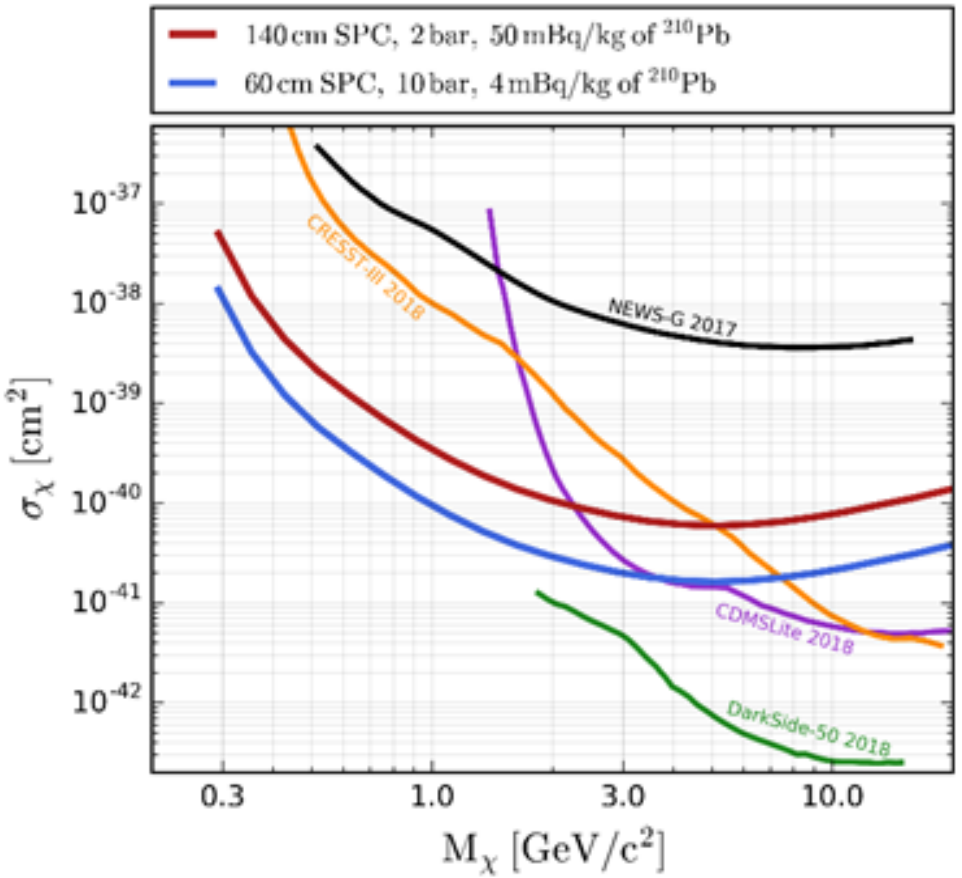
Future Mitigation of Copper Backgrounds

Intermediate solution:

- Cleanest commercially available copper sphere: Mitsubishi Material Corporation (MMC) 6N copper
  - 99.9999% Purity
  - No measurable ^{210}Pb with XIA (<4.1 mBq/kg)
- G. Giroux has requested funding from CFI for a 60-cm SPC to be certified for 10-bar pressure
  - Production of disks limit SPC size to 70 cm.
  - 60-cm chosen to leave option open to host in SEDINE shielding at LSM
  - Design piping to be able to fit in NEWS-G SNOLAB shielding
- Mitigation of cosmogenic activation
  - Dedication of a production line at MMC
    - Delivery 3 months after order
    - 1.5 months to prepare production line
    - 1.5 months to production from electrolization to disk form
  - Learning from previous experience and manage better shipping, machining, and transport between machining sites and LSM/SNOLAB

What we really pay for (55 kEur for 80 kg Cu) is the dedication of a production line. We could produce more disks for a second sphere, and we could replace SEDINE's innermost shielding with 6N Cu?

MMC 6N 60-cm (10-bar) SPC



Just accounting for ^{210}Pb reduction here

MMC 6N 60-cm (10-bar) SPC

Option 1:

Install at SNOLAB in NEWS-G shielding after the physics program of the 140-cm SPC becomes limited by backgrounds

Option 2:

Install at LSM in SEDINE's shielding

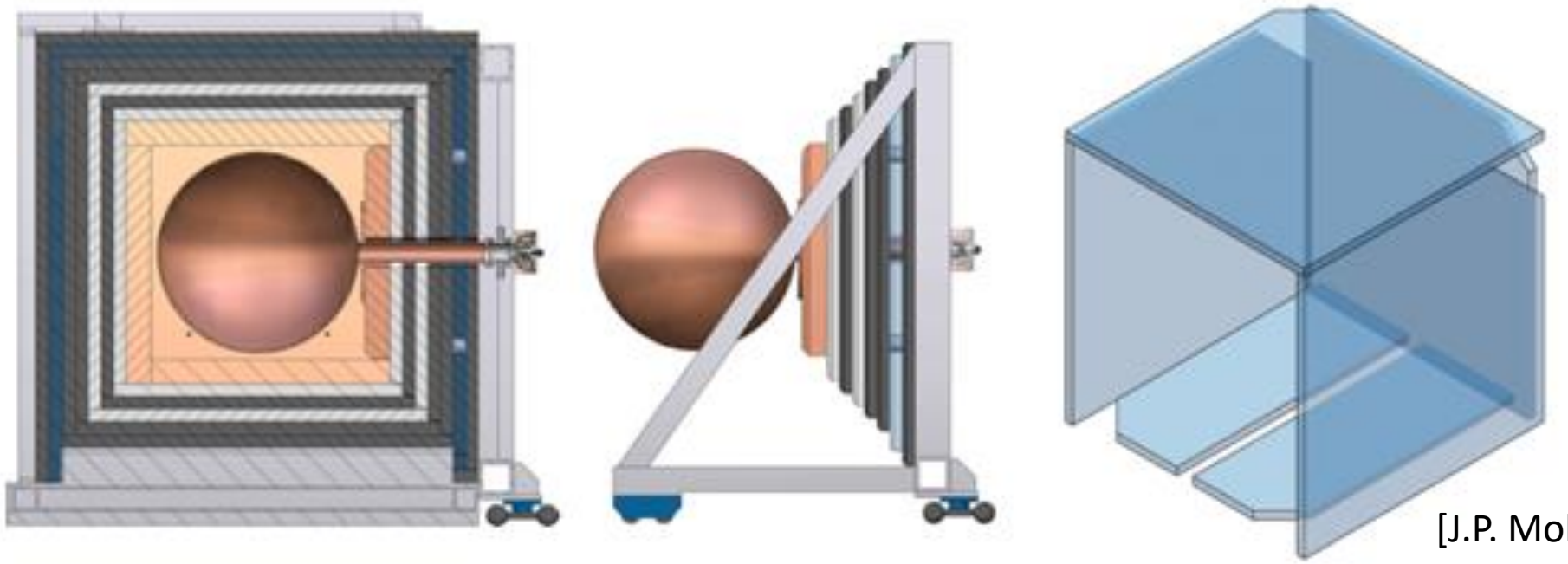
- This implies the shield at LSM would need to be modified to allow for a straight nozzle SPC, Pb plug to be manufactured.
- No glovebox at LSM: need to work in the radon free room.

Looks like we're headed for option 2

Fate of SEDINE 60-cm NOSV copper SPC

In the case of option 2, SEDINE becomes available.

We propose to run it in the future Queen's compact shield (funding requested to CFI)



[J.P. Mols]

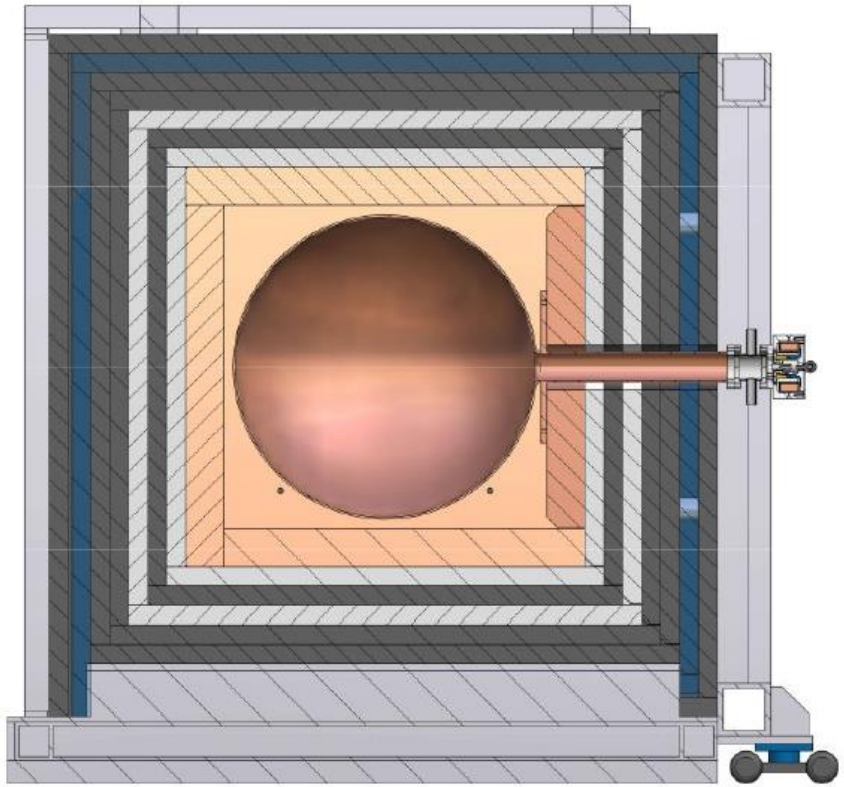
Fate of SEDINE 60-cm NOSV copper SPC

SEDINE in the Queen's compact shield

- Characterization of detector and sensors in low background conditions
- Measurement of attainable background indicates the feasibility of coherent neutrino-nucleus (CNNS) scattering experiment at nuclear reactor

CNNS at nuclear reactor

- Rich physics program: sterile neutrinos, neutrino magnetic moment, non-standard interactions, probe of nuclear structure, weak nuclear charge
- Technological applications: Monitoring of nuclear reactor, nuclear safeguarding



Current issues

Electroformed sphere:

- Funding
- Partnerships

6N Sphere

- High pressure certification in France and Canada
- High pressure certification with CH4 ?
- Funding decision from CFI end of June

Queen's Shield

- Finalize design for a 60-cm SPC
- Space approval at Queen's
- Initiate contact with Canadian Nuclear Agency

Anticipated Timeline

Funding available for 6N Sphere: Summer 2019

Delivery of copper disks: Fall 2019

Machining and Welding: Winter 2020

Completed sphere: Spring or Summer 2020