



The SNOLAB Science Program

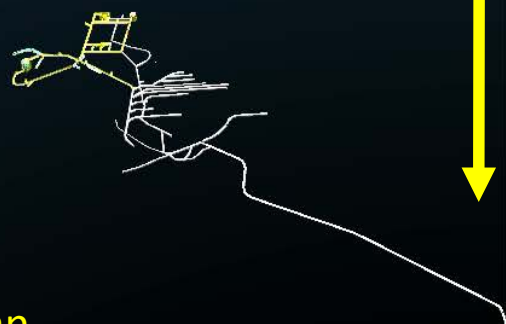
Chris Jillings

Surface
Facility



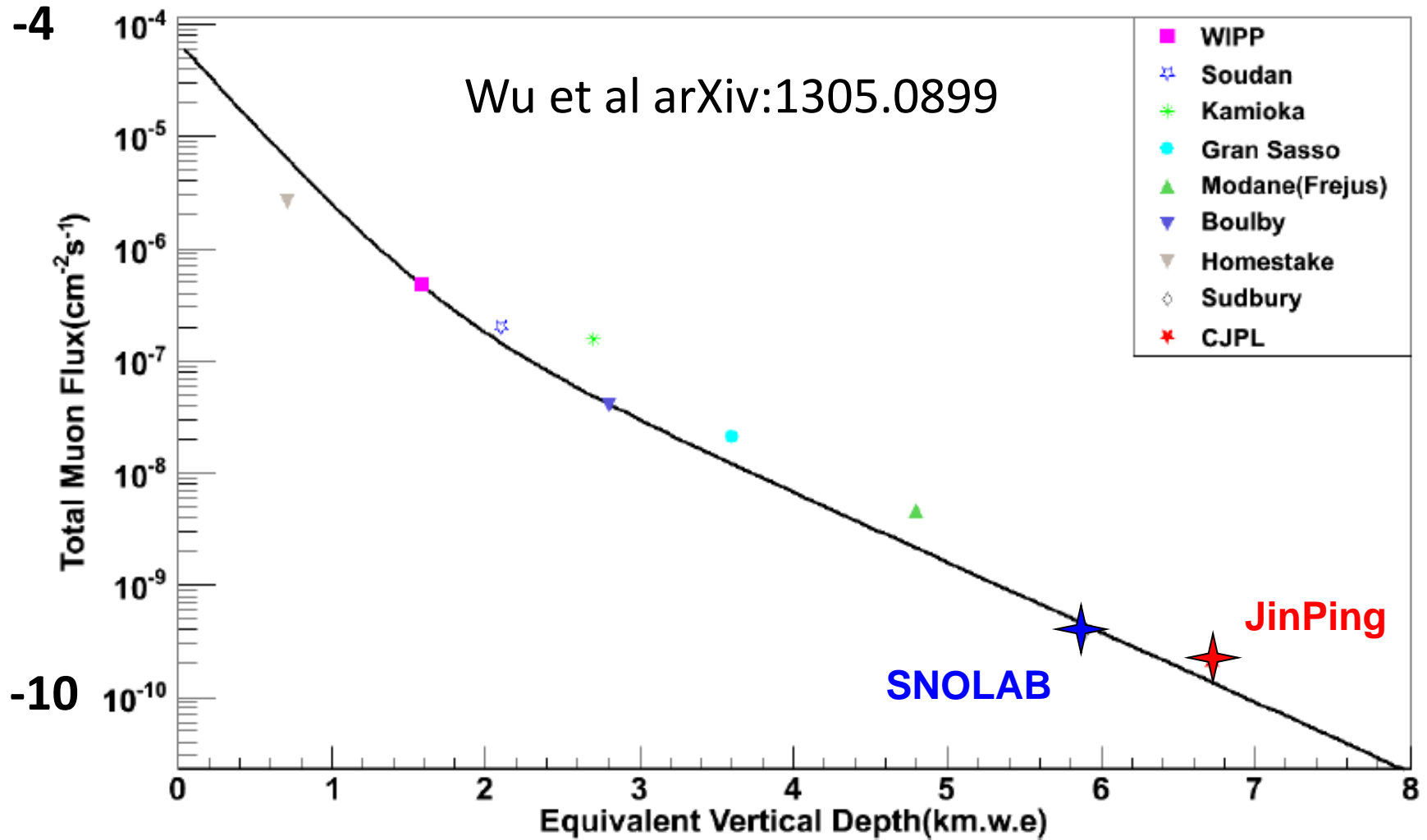
2 km
overburden
(6000mwe)

Underground
Laboratory



Muon Flux = $0.27/\text{m}^2/\text{day}$

Muon Flux [$\text{cm}^{-2} \text{s}^{-1}$] vs Depth [km w e]



Cube Hall
15m x 15m x 15m
+ crane + staircase

Cryopit
15m diam x 15 m high
+ crane

Machine shop

Chiller
1MW capacity

Ladder labs

Water plant

Original
SNO
cavity

Low-background counting



5000 m² area / 37,000 m³ of class 2000 clean room.

Low-background counting facilities at SNOLAB are being discussed by Ian Lawson in Session *Dark Matter A – Underground Laboratories* at 17:20 today.

We are improving our low-background capabilities and are seeking community input: Richard.Ford@snolab.ca is collecting information from any and all interested.

Water Plant

130 Litres/minute

Reverse osmosis

Ion exchange

Degassing and regassing
with boil-off nitrogen

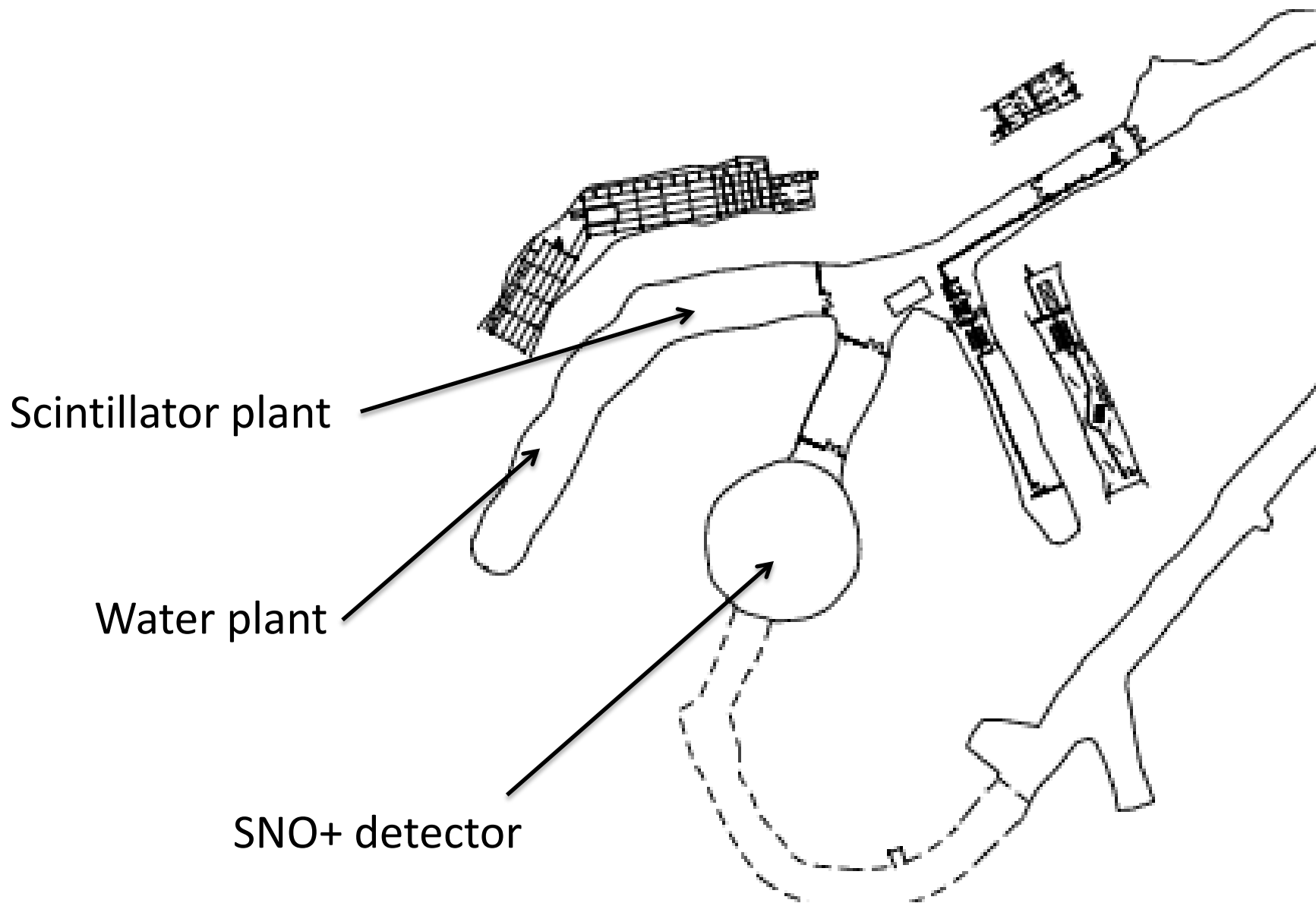


Hard UV to break up
organic molecules

UV to kill bacteria

Delivers water
throughout lab

Radon-monitoring skid
built in



MiniCLEAN
and DEAP-3600

PICO-2L, DEAP-1
and DAMIC

HALO

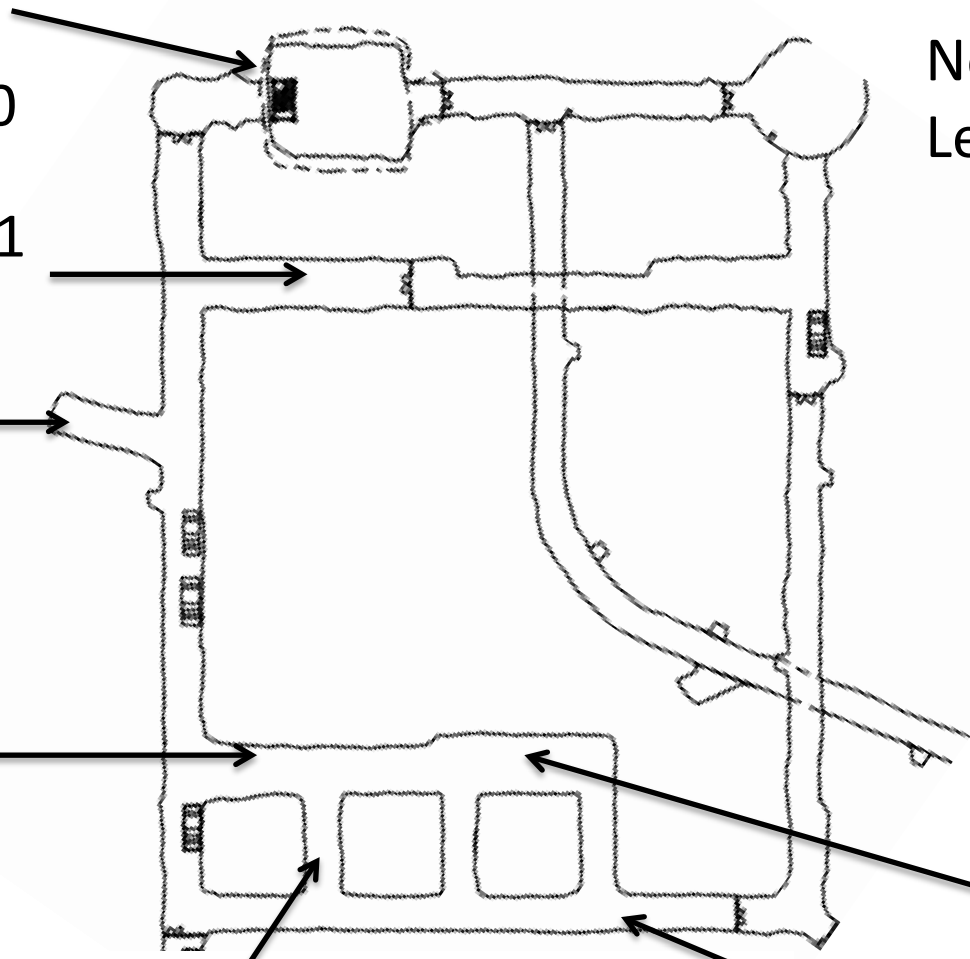
PICO-60

Picasso
(Completed)

Not yet allocated.
Letters of interest.

SuperCDMS

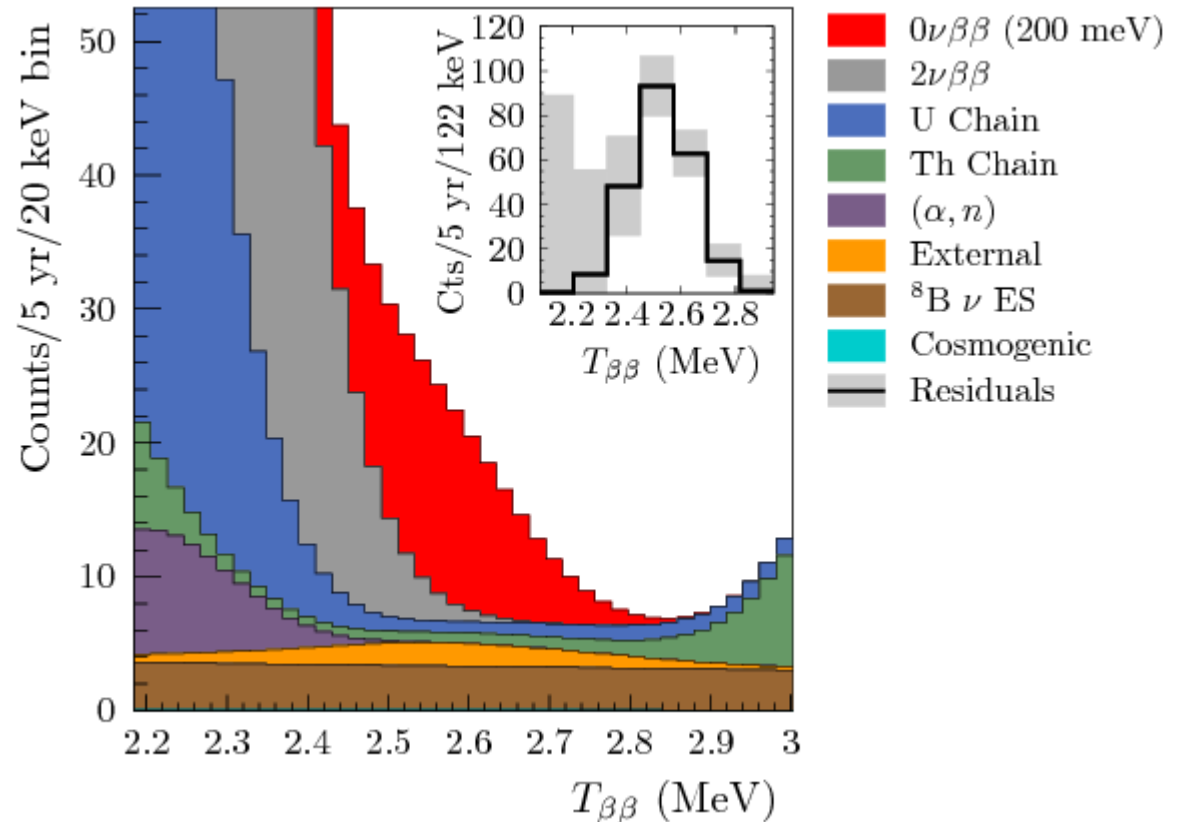
Biology and
genomics



SNO+



SNO+



Neutrinoless double beta decay of Te-130, low-energy solar neutrinos, geo and reactor neutrinos, supernova neutrinos, and nucleon decay.

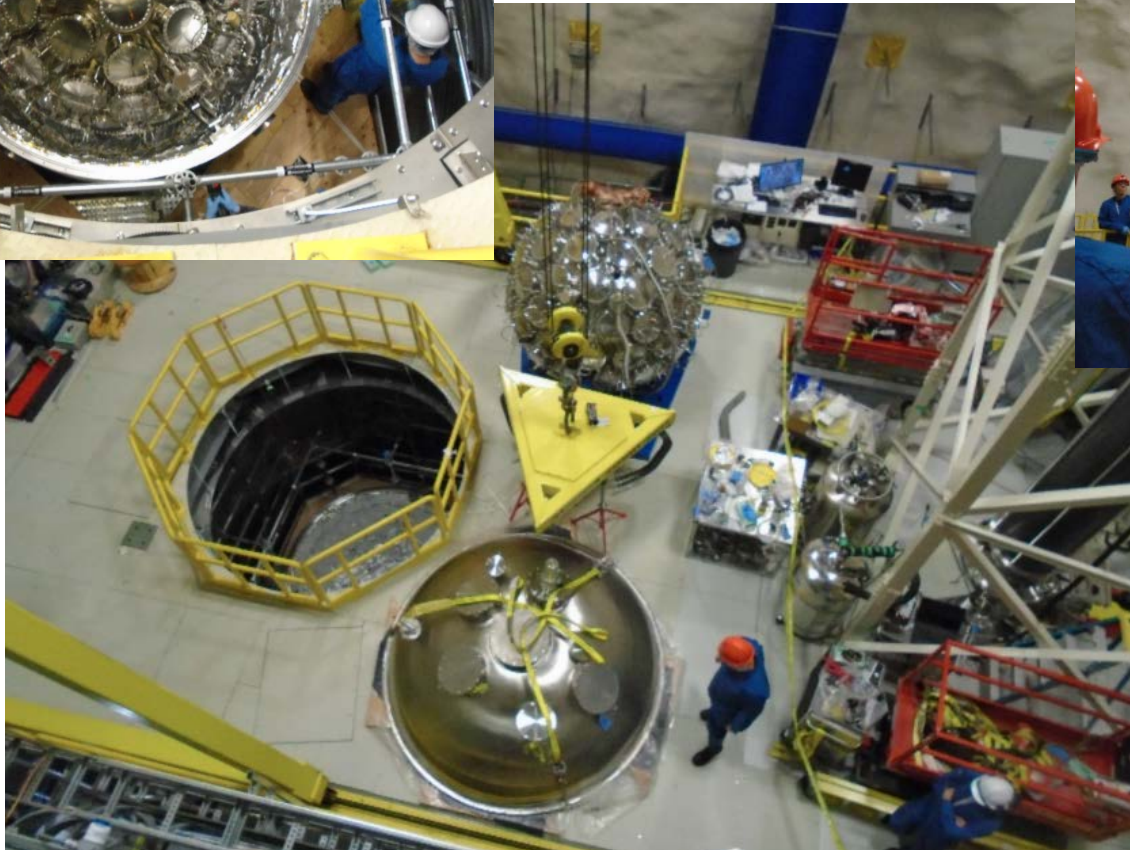
talk by Jose Maneira (Neutrinos B: Double Beta Decay – Tuesday)

MiniCLEAN
is installed
and cooling



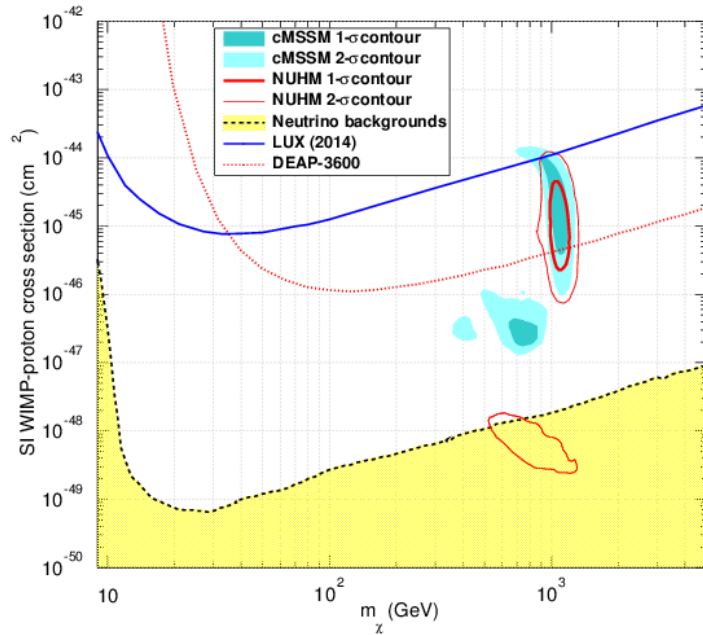
Ar-39 spike test

10x activity
of ^{nat}Ar

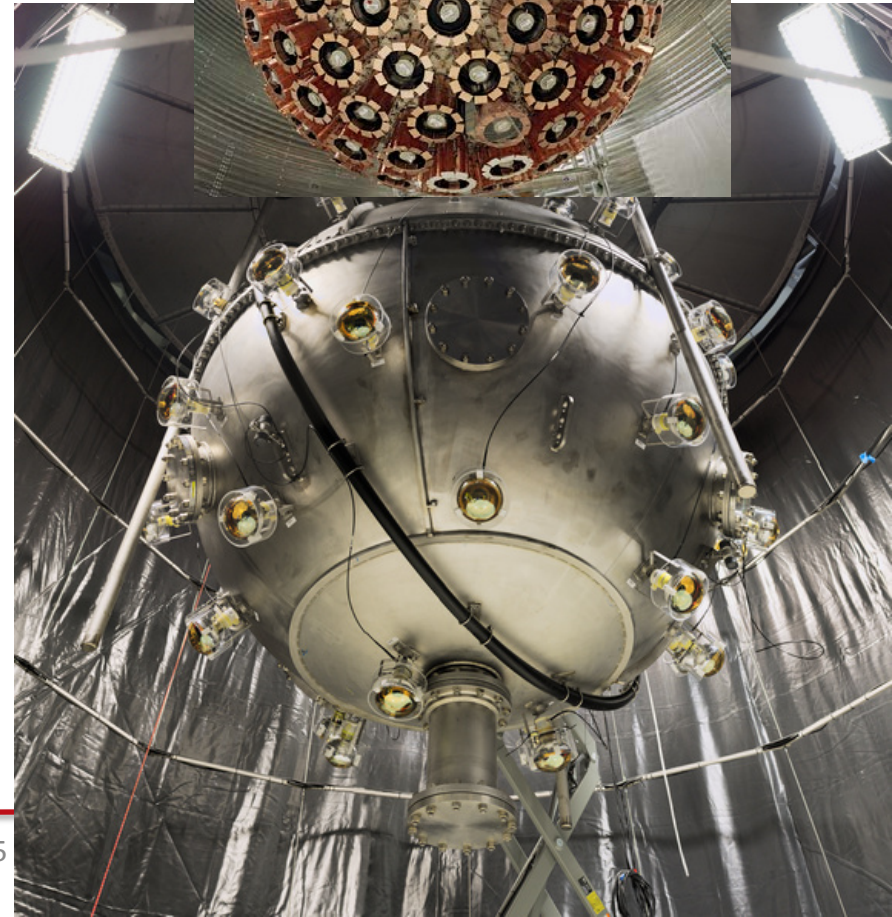
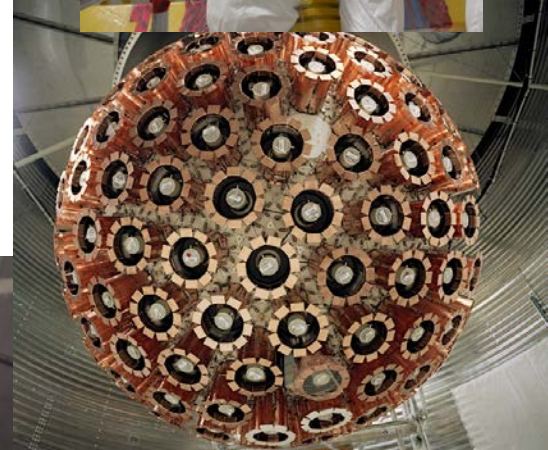


Single phase liquid-argon / liquid-neon detector for dark matter

DEAP-3600 is commissioning



- > Pietro Giampa
(Dark Matter A on Monday)
Acrylic re-surfacing and cooldown.
- > Berta Beltran
(Dark Matter A on Tuesday)
Optical commissioning





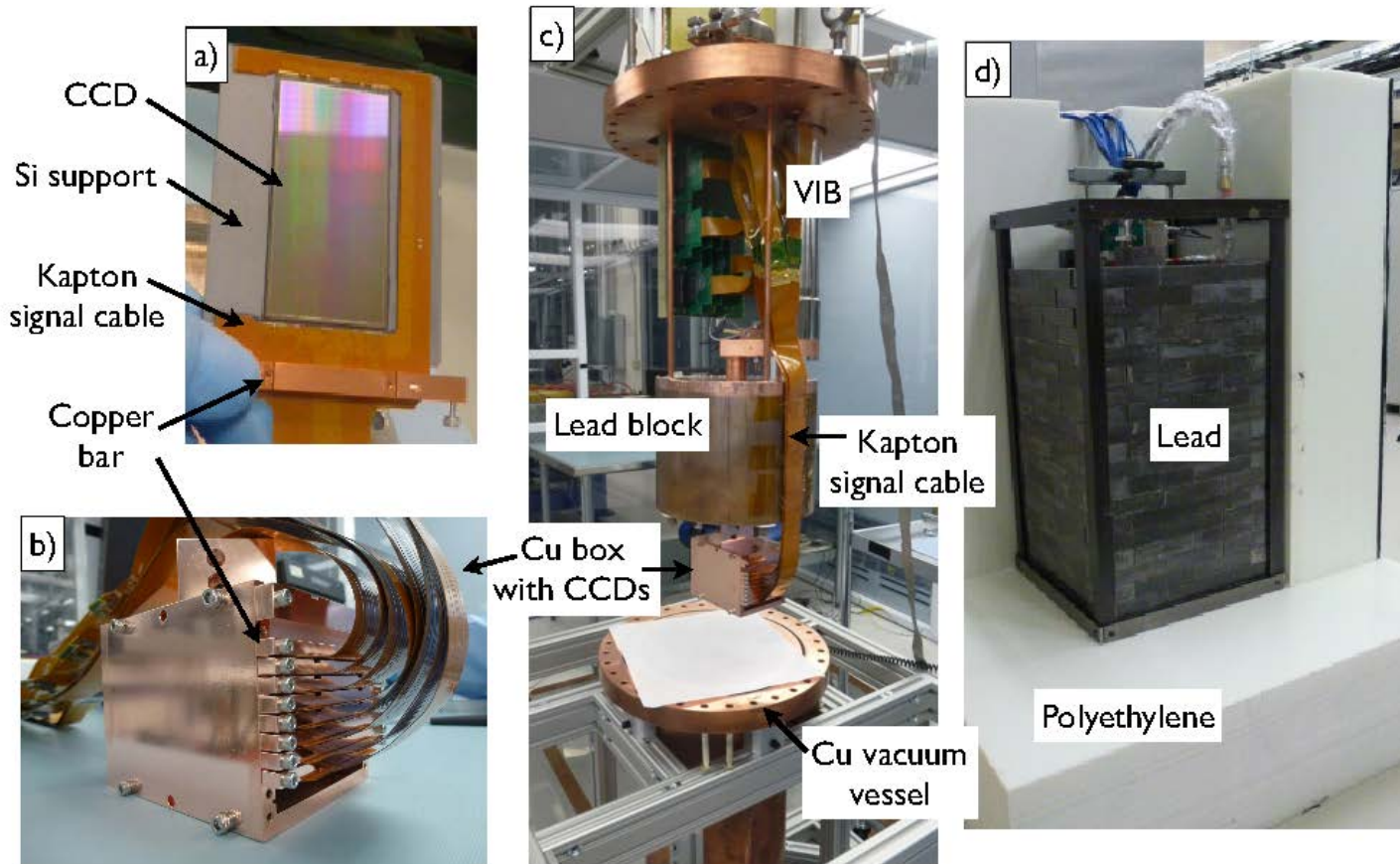
**Cube Hall: water tanks closed.
safety vent pipe ready.**

2015-09-05 20:44:31

DAMIC

Figure from 2015 JINST 10 P08014

Low mass dark matter with CCD



Talk by Paolo Privitera (Dark Matter A Monday)

Poster by Diego Torres Machado

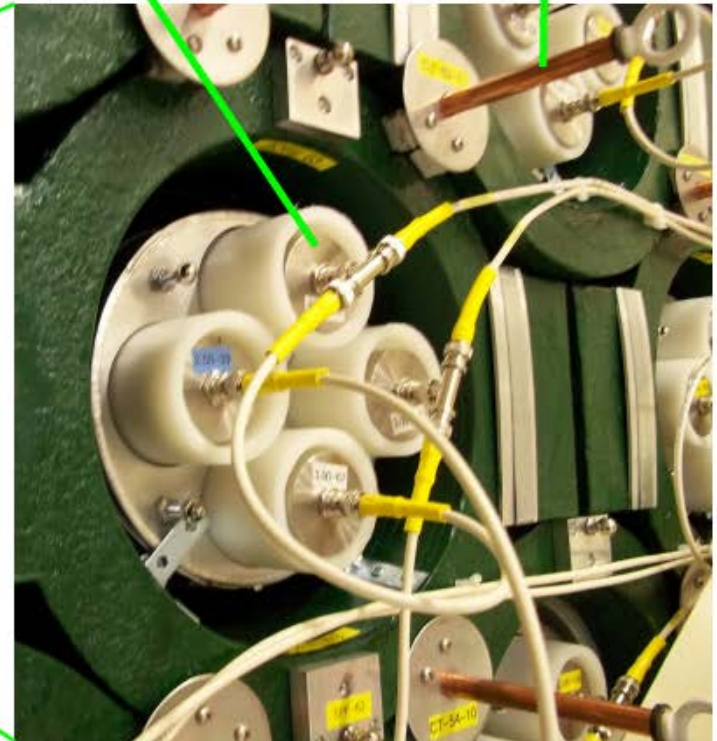
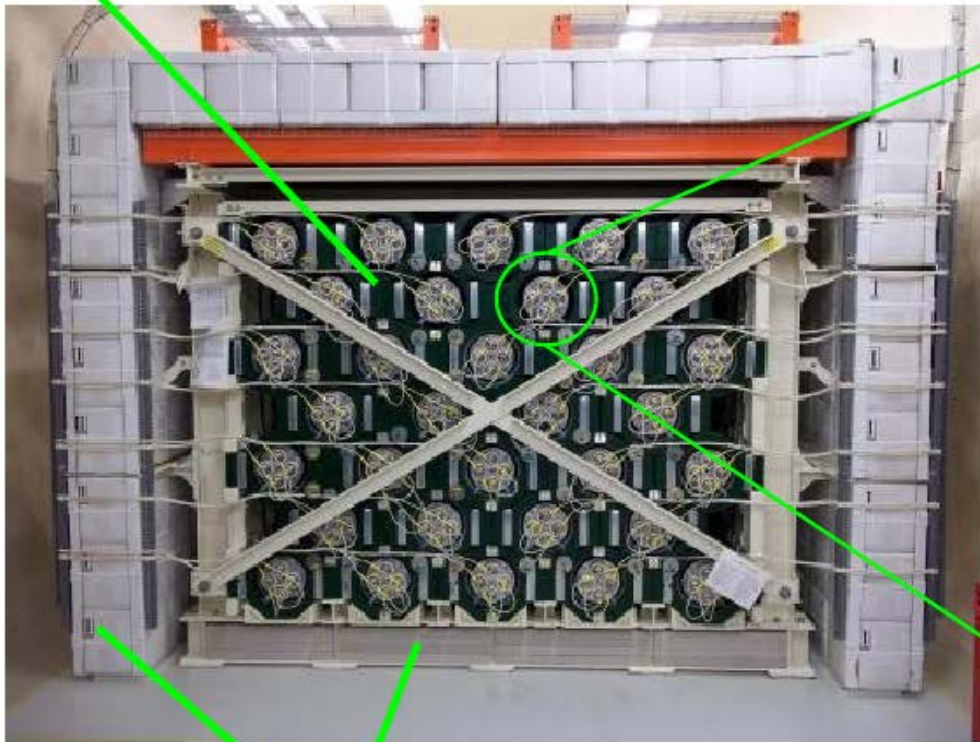
HALO

Supernova neutrino detector. 73 tonnes lead.
Neutrinos not antineutrinos.

Lead

^3He Counters

Calibration Tube

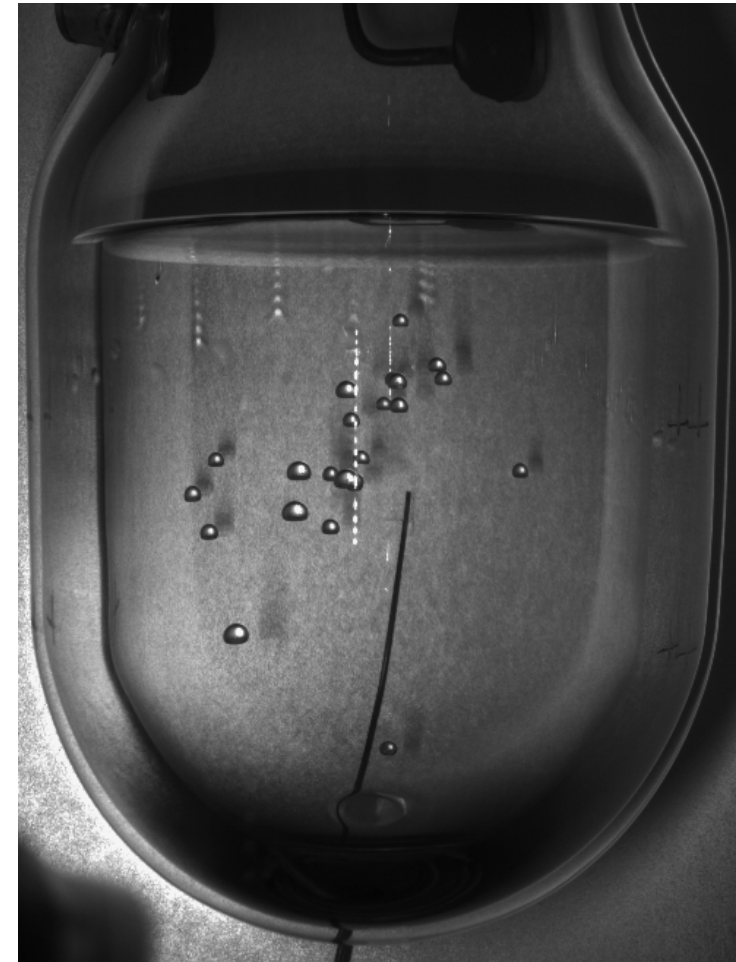
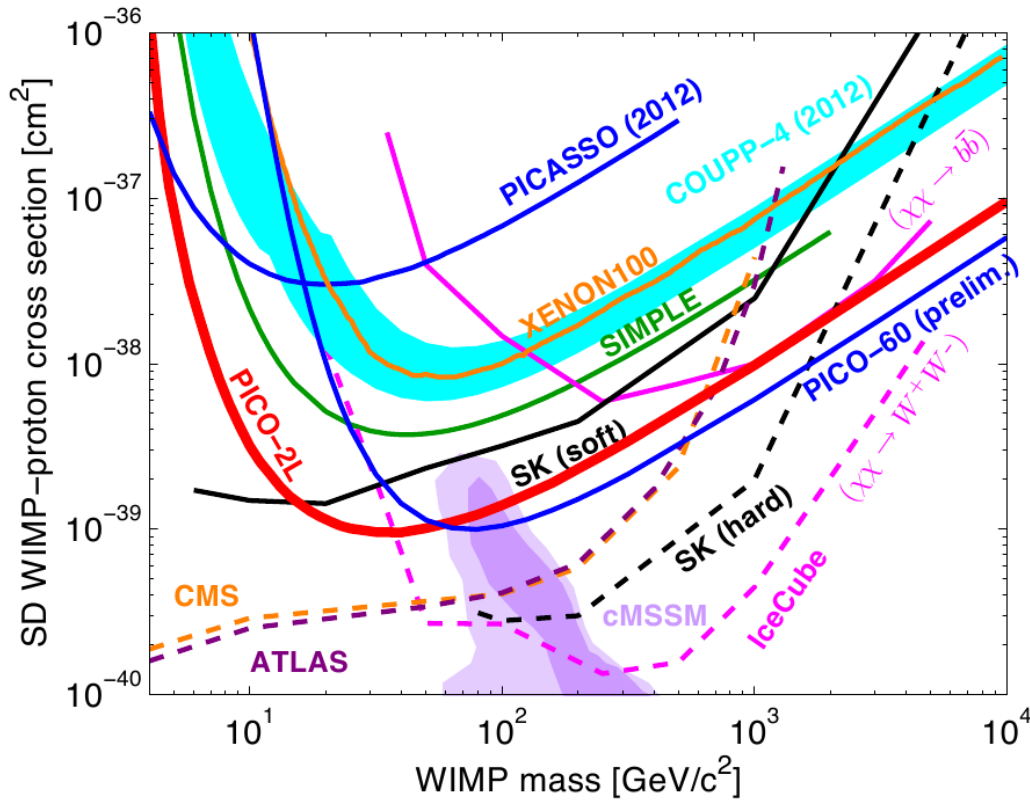


Water, Plastic

PICO bubble detectors for dark matter interaction

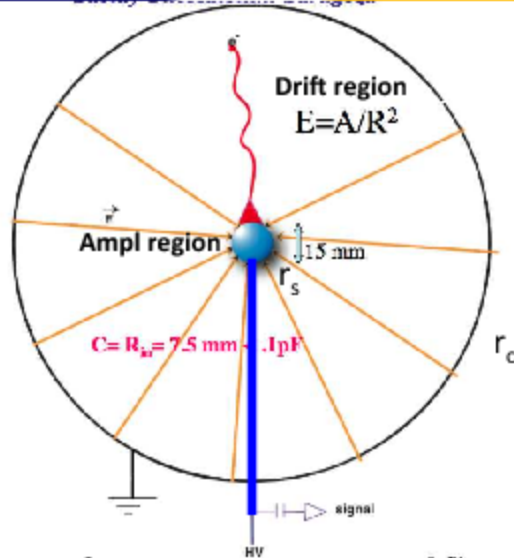
PRL 114 231302 (2015)

Bubbles from a neutron source calibration PICO-2L



Russel Neilson (Dark Matter A on Monday)

Spherical gas detectors New Experiments With Spheres

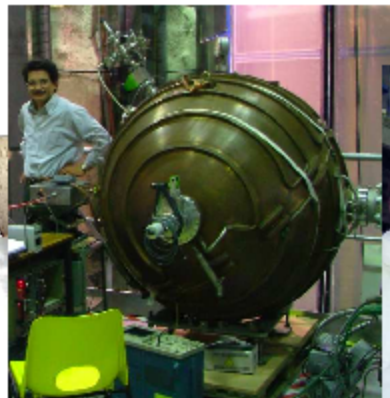
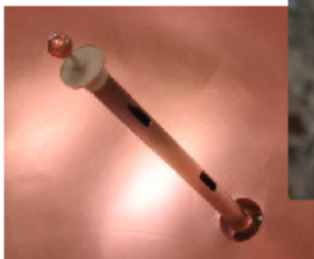


- Sphere cavity + spherical sensor + HT
- => **Low threshold (low C), does not depend on size**
- **Flexible (Pressure, gas H, He, Ne, Ar, Xe)**
- Fiducial volume selection by pulse risetime
- Large mass / large volume (30 kg) with single channel
- Simple, sealed mode
- 2 LEP cavity 130 cm Ø tested
- 1 low activity 60 cm Ø in operation @ LSM: SEDINE

$$E \approx V/r^2 * r_s$$

for $r_c \gg r_s$

T. Giomataris



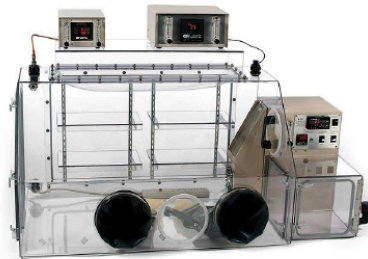
Biology: Effects of low radioactivity levels on growth

McMaster University and the Northern Ontario School of Medicine

C3H 10T1/2 cell line



- Cells will be cultured within SNOLAB and the surface control lab
- Glove box incubators enable matching conditions by controlling air, temperature and pressure
- Cells will be cultured for multiple passages and at periodic intervals tested for:
 - Spontaneous transformation frequency
 - Background levels of DNA DSBs and micronuclei
- The dose-response for induced damage will be examined in low-background adapted cells



There is evidence that small doses of radioactivity are healthy.

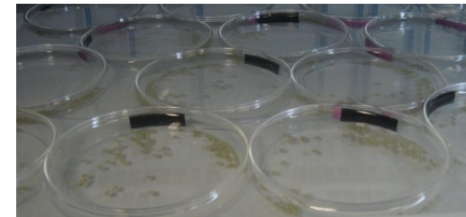
This work tests that at below surface background radioactivity.

Lake Whitefish



Good model organism for examining radiological effects

- Embryogenesis one of the most sensitive life stages to radiation
- Long development period (> 200 days)
 - Extended low-dose chronic exposures
 - Accurate targeting of specific development stages
- Can accurately quantify growth efficiency
- Easy to raise and low maintenance



Slides from talk by C Thome at SNOLAB
Future Projects Planning Workshop.
August 2015

Biology: Metabolism of Underground Workers (Modelled with Fruit Flies)

Laurentian University

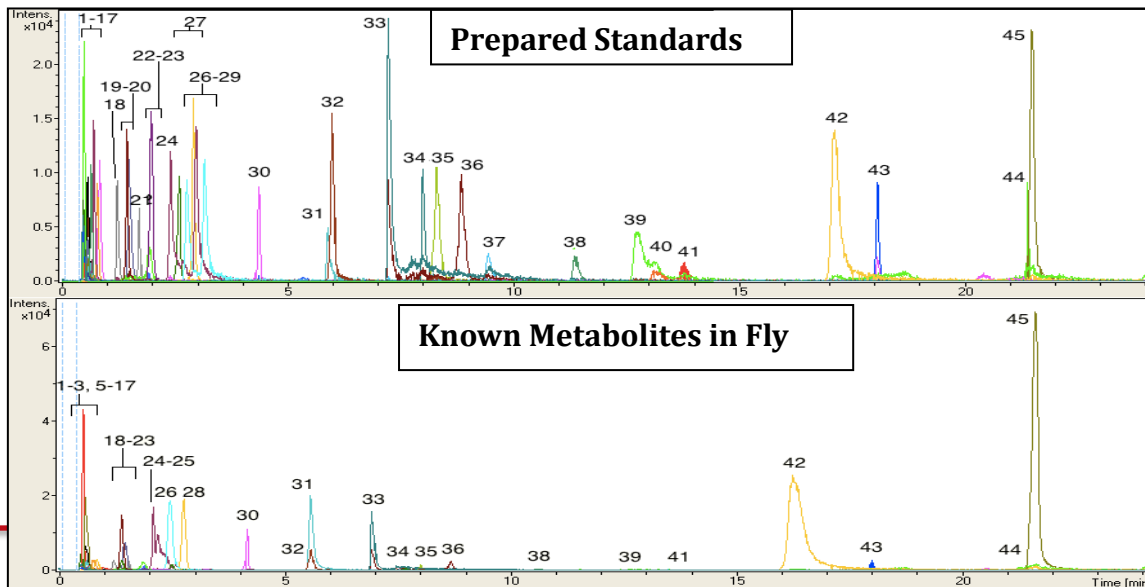


Liquid chromatography / mass spectrometry based metabolomics

LC separates complex biological sample into individual metabolites

Mass spec identifies metabolites based on extremely accurate molecular weight

No, its not that easy



Compare with bench top tests adjusting only a single variable

Slide content: Thomas Merritt

Center of Excellence in Mining Innovation

A mining and engineering database and research facility is now at SNOLAB.

Look for ways that our data two fields can improve data analysis.

Develop instruments for remote measurements in rock.

Provide tools for a central geological/mining database and interpretation of data.

Neutrinos	Dark Matter	Other
HALO	COUPP-4	CEMI
SNO+	DAMIC	Low-background biology
Ge-1T (Majorana)	DEAP-1	Metabolism (fruit flies)
nEXO	DEAP-3600	PUPS (geology)
PINGU test facility	MiniCLEAN	
	NEWS	
	PICASSO-III	
	PICO-2L	
	PICO-60	
	SuperCDMS*	
	DEAP-50T/CLEAN	
	DMTPC	

Taking science data, **Construction/Commissioning**,
Engineering*, LOI or approved, **Completed**

SNOLAB has a varied science program in mining engineering, neutrino studies, dark matter direct detection and biology.

We continue to augment our facility and are soliciting advice from the community for low-background counting improvements.

(some) Space is available. Please contact the Director, Nigel Smith, for information on letters of interest.