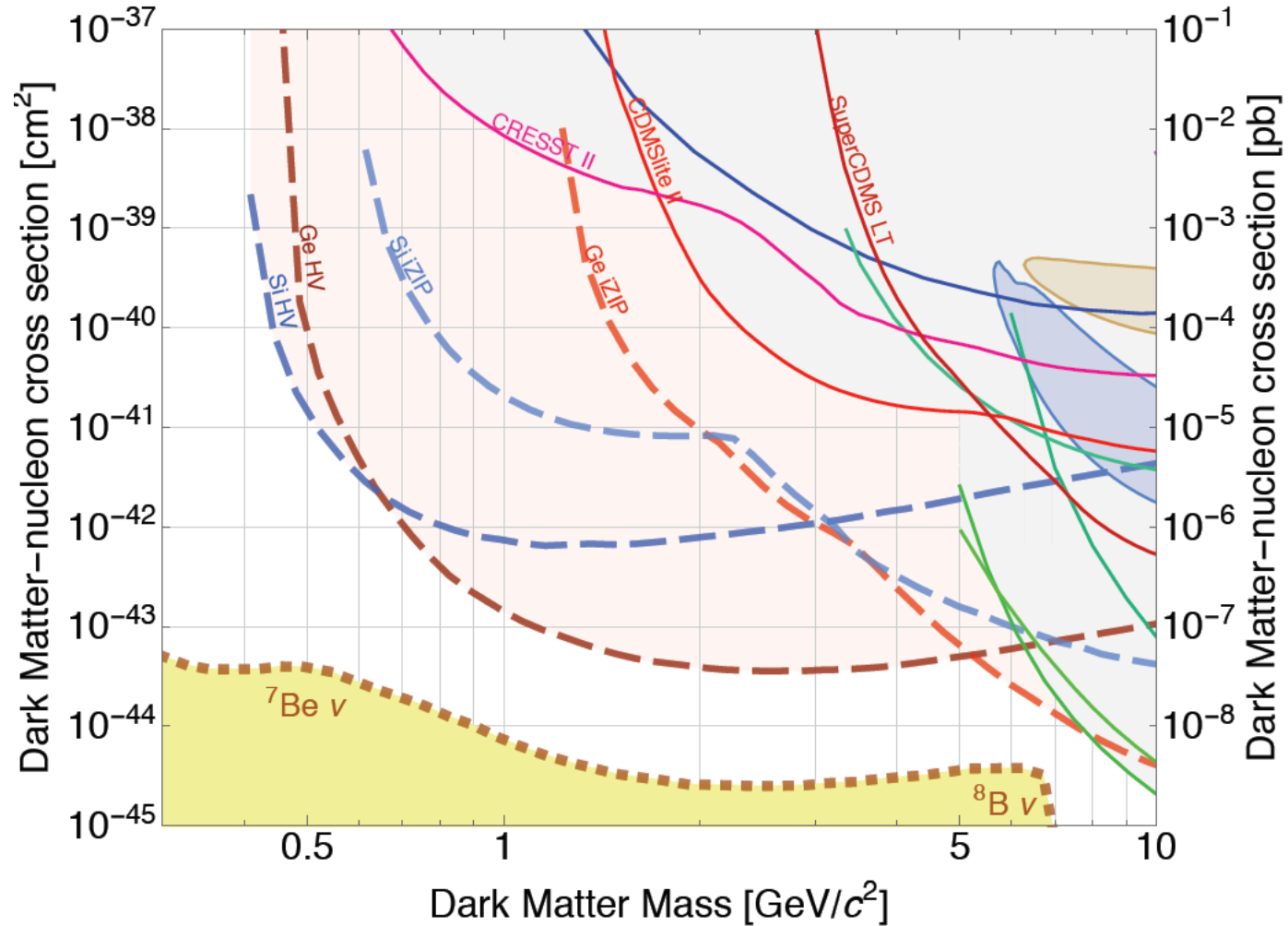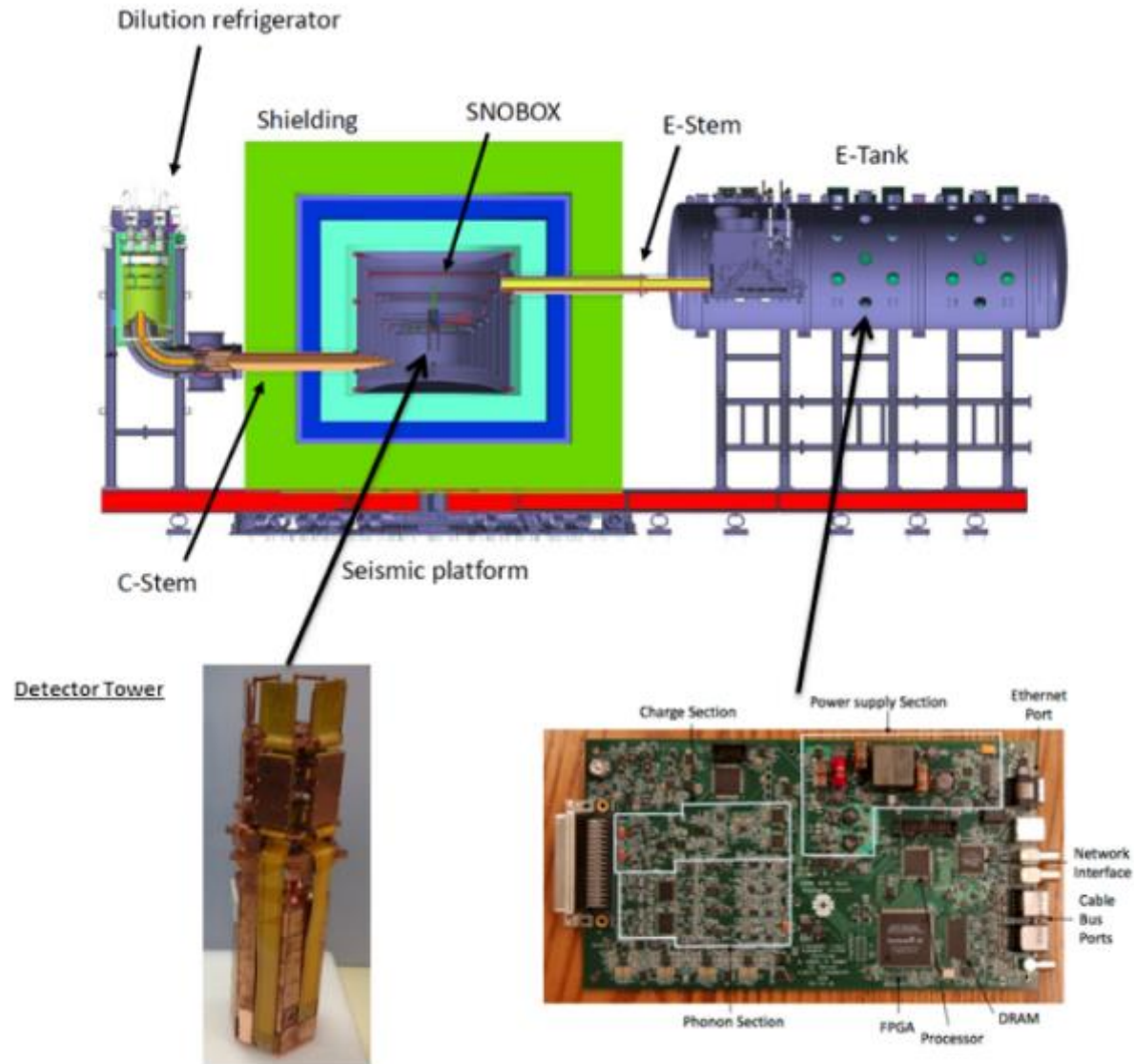# SuperCDMS

May 4th 2017

SuperCDMS Experiment

- SuperCDMS (Cryogenic Dark Matter Search) is a direct detection experiment, aimed to be sensitive to low mass WIMP dark matter particles (< 10 GeV)

- Main experiment will take place at SNOLAB in Sudbury, Canada
  - ~2 km underground

- Uses Ge and Si crystals to detect WIMP interactions with crystal atoms.

SuperCDMS Experiment

Sensitive down to WIMP masses of 0.3 GeV

SuperCDMS Experiment

Detectors will operate at a temperature ≤ 30 mK

Detectors

- SuperCDMS experiment has two types of detectors: HV and iZIP

- HV (high voltage) detectors:
  - Have better sensitivity to low WIMP masses (<5 GeV)
  - Contains only phonon sensors
- iZIP detectors
  - Have better sensitivity to larger WIMP masses (>5 GeV)
  - Contains both phonon and charge sensors

- Both types of detectors have Ge and Si versions

Detectors

HV:

iZIP:

HV:

iZIP:

HV:

iZIP:
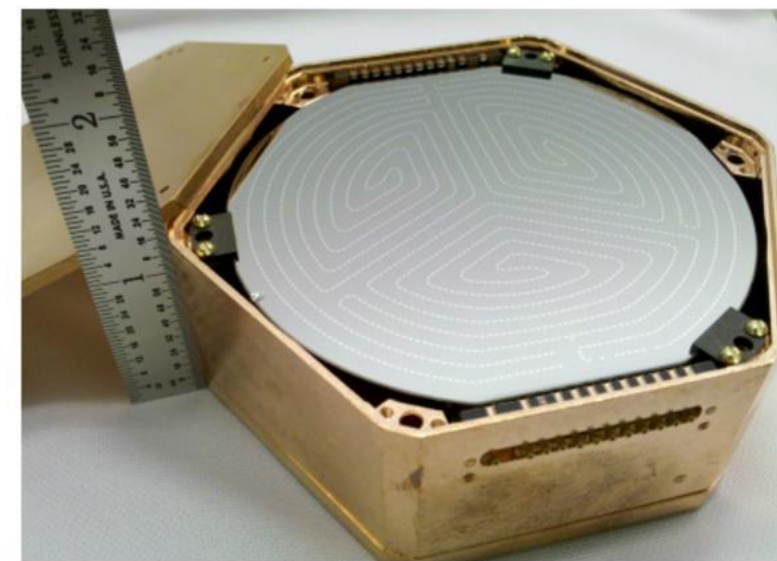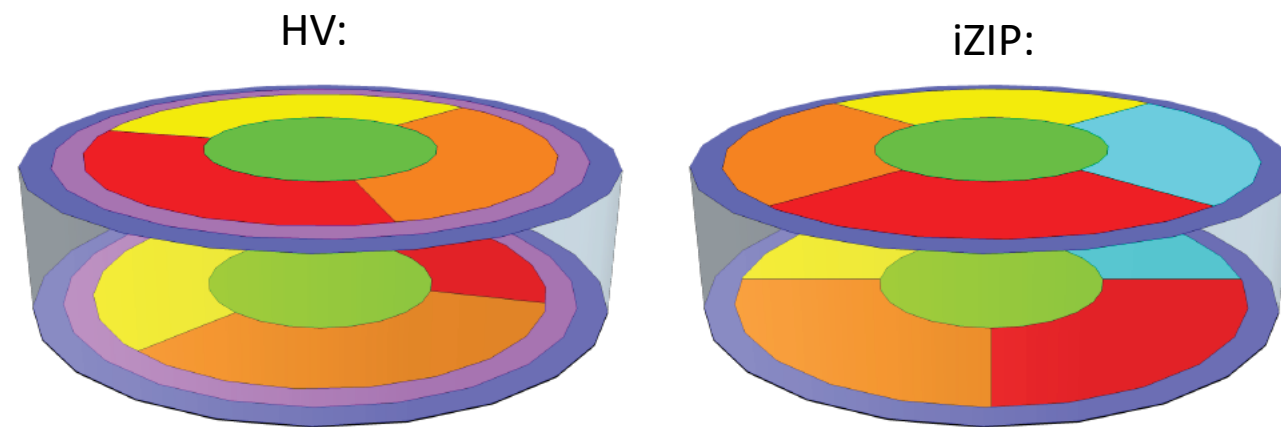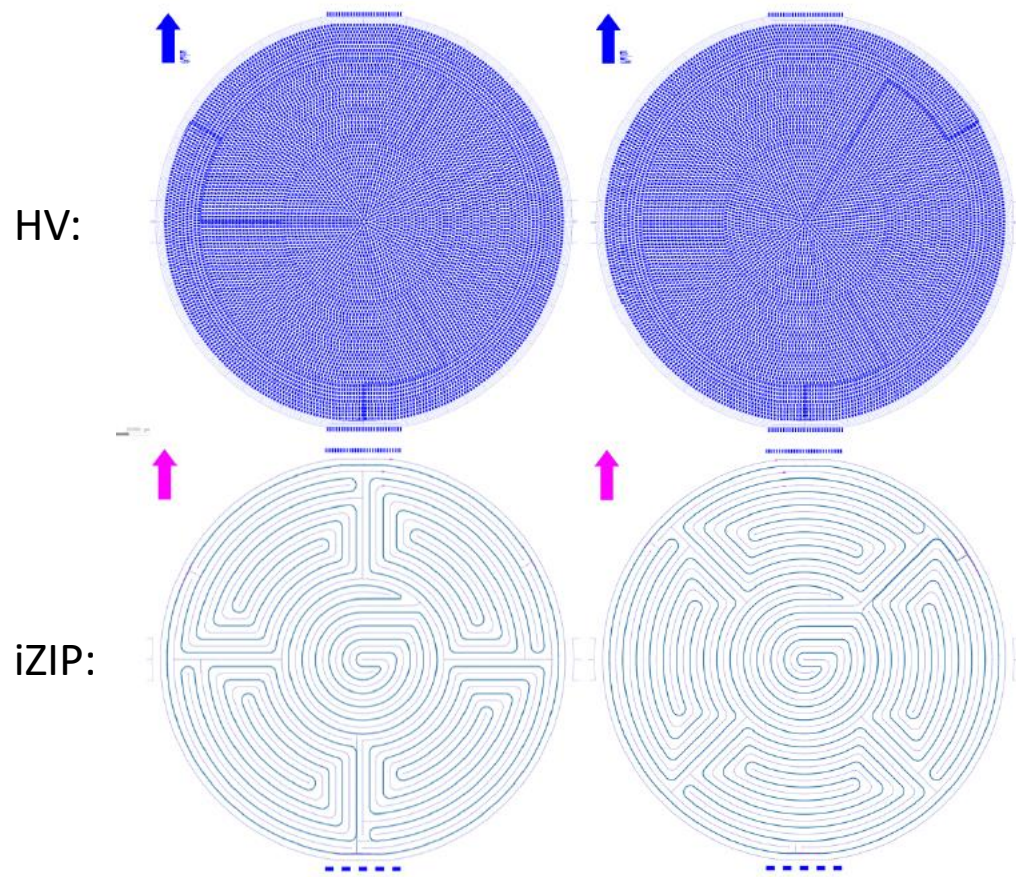
Detection Method

- When a WIMP interaction with Crystal atom:

- Can either be an electron recoil event (ER) or a nuclear recoil event (NR)

- ER events liberate an electron, down-converts to free more electrons

- NR events produce electron hole pairs.

- Luke Neganov phonons produced by drifting charges in crystal

- Detectors measure signal from charges themselves, and from phonon signal

Charge Propagation
Resulting Luke Phonons

V_b
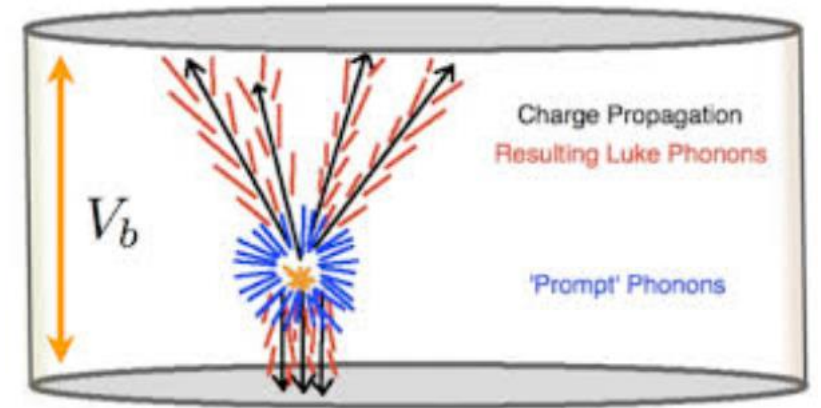
'Prompt' Phonons

Detection Method

- Total phonon signal is initial (prompt) phonons, plus Luke-Neganov phonons:

Charge Propagation
Resulting Luke Phonons

V_b

'Prompt' Phonons

- $E_{phonon} = E_{prompt} + E_{Luke}$

  $= E_{recoil} + n_{eh} * eV$

 $= E_{recoil} \left(1 + eV * \left(\dfrac{Y(E_{recoil})}{\epsilon_{eh}} \right) \right)$
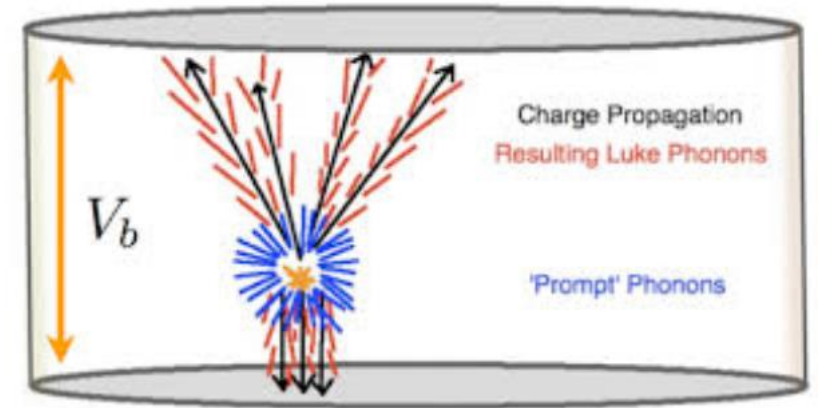
How do we measure such low energies?

- HV detectors: apply a very high voltage to the detector (~100 V)
- Energy from Luke-Neganov phonons (dependent on eV), dominates
- Small recoil energies are "amplified" by the Luke-Neganov phonons

- Charge information becomes very noisy – this is why HV detectors only have phonon sensors

What I Do:

- Data Acquisition (DAQ)

- 3-level trigger system

- Deadtime-free triggering with use of buffer
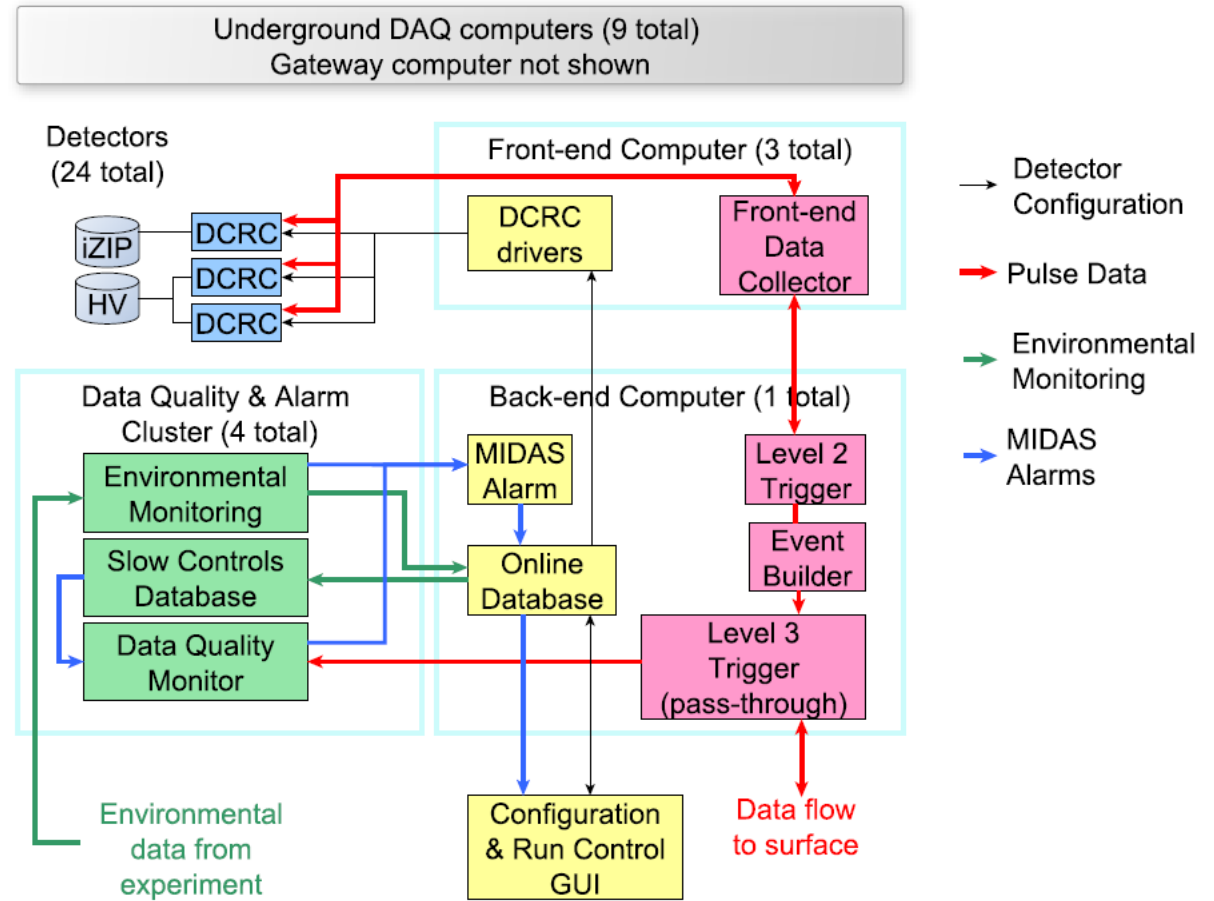
What I Do:

- Creating an IO library to standardize data formatting

- Be able to pack, unpack data

- Can be used across multiple platforms (SNOLAB DAQ, Detector Monte Carlo)