PICO-40L Status Update

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Outline

- Bubble chambers for dark matter
- The PICO program
- PICO-40L
- Current status
- Future
Detection Principle

Active liquid is in a superheated state

Bubble formation depends on total energy deposited and $dE/dx$; threshold set by $T$ and $P$

Nuclear recoils make bubbles, electron recoils don’t*  

*see plot

Electron recoil rejection

$10^{-3}$ Liquid xenon

$10^{-6}$ Germanium

$10^{-7}$ Liquid argon

$10^{-10}$ Bubble chamber

NIM A 704 (2013), 111-126

Phys Rev D 95, 082002 (2017)

arXiv:1707.08042v2
Trigger and DAQ

- Trigger signal comes from a difference between successive camera images.
- When a trigger is received, the chamber compresses, preventing further boiling.
- Temperature, pressure, cameras, and piezoelectric sensors are read out.
- Many more temperature sensors this time.
- Acoustics provide event discrimination: bubbles caused by $\alpha$ particles are louder than nuclear recoil bubbles!
Neutron background

- Neutrons that enter the active liquid can elastically scatter off nuclei, mimicking a WIMP signal
- Most neutrons scatter multiple times
- MC gives ratio of multiple bubble to single bubble events

PICO-2L multiple bubble event
Installation Status

PICO-40L is currently being assembled at SNOLAB

SNOLAB is ~2 km underground, in Creighton Mine in Lively, Ontario, and is home to many low-background experiments
Installation Status

Pressure vessel base

Inner jars and bellows assembly
The Goal
The Real Goal
Commissioning Timeline

- June/July: assemble pressure vessel without inner jar, fill with mineral oil, test pressure system, ensure nothing leaks
- August/September: take pressure vessel apart again, insert inner jar, seal everything back up. Commission cameras, piezos, DAQ, etc.
- October/November: Chiller (finally) arrives. Commission chillers, heaters, temperature control system
- December: Take calibration data
- January: Physics data!
Thank you!