NICE - NaI/CsI in Cryogenic Environment

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The intrinsic light yields of **pure** NaI/CsI at **77 K** are about twice higher than those of **doped** NaI/CsI at **room temperature**. Integrated with light sensors working at cryogenic temperatures, those pure crystals can be used for various rare event detections.

Primary physics goals

- Verifying DAMA result in $[0.2, 2]$ keV$_{ee}$
- CEvNS measurement with a threshold down to 10 eV$_{ee}$ in MINER
- sub-GeV dark matter with a threshold down to 10 eV$_{ee}$ in SNOLAB

Experimental approach and setup

We will take a phased approach with rather conventional experimental setup, adding a bit novelty each step forward, as shown in the time table below.

- Phase I: CEvNS detection with MINER
  - Cylindrical crystals (about 1 kg) wrapped with PTFE tape, watched by 2 PMTs from the ends, cooled by liquid N_2 or argon for MINER background measurement down to 0.2 keV$_{ee}$.
  - Switch to SiPM for higher QE and to explore active veto with liquid argon and neon.
  - Switch to TES for 100% QE, single PE trigger and phonon readout.
- Phase II: Verifying DAMA results by collaborating with other collaborations, such as COSINE and SABRE for radio-pure crystals and infrastructure. This can be done partially in parallel with Phase I.
- Phase III: sub-GeV detection in SNOLAB by switching to radio-pure crystals

Existing and future physics results

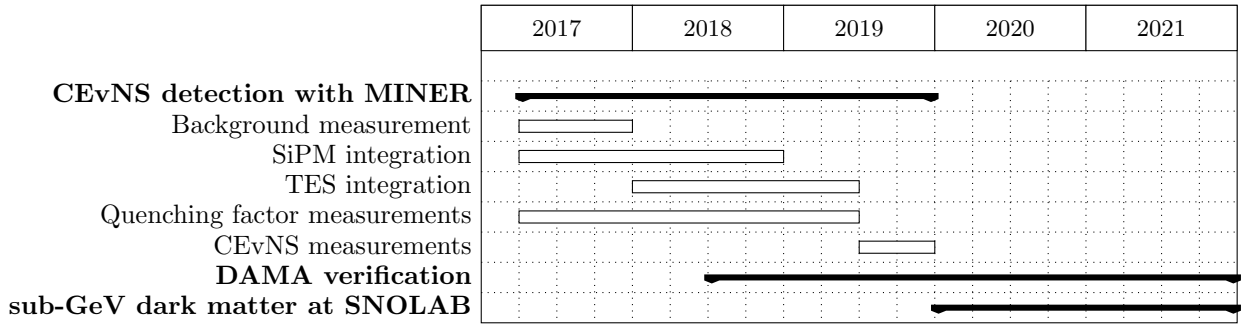
Existing results:

- Highest system light yield in the world: 20 PE/keV (pure CsI at 77 K)

Future results:

- Measurements of quenching factors of pure NaI and CsI
- Integration with SiPM and active veto with liquid argon/neon
- Integration with TES for n/e discrimination or light-only readout

Timescale



Budget

- Phase I: support for a few graduates and a postdoc
- Phase II: $100,000 for 10 kg radio-pure crystals, $100,000 for 20 light sensors
- Phase III: too early to say

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