CLEAN

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CLEAN stands for: Cryogenic Low Energy Astrophysics Noble Gasses

Neutrino-electron scattering events:
\[ \nu + e^- \rightarrow \nu + e^- \]

Neutrino-nucleus scattering events:
\[ \nu + Ne \rightarrow \nu + Ne \]

Wimp-nucleus scattering events:
\[ \chi + Ne \rightarrow \chi + Ne \]
Why neon?

- Has no long lived radioactive isotopes
- Can be purified with cold traps
- Relatively inexpensive
- Transparent to its own scintillation light
- Denser than helium
- Good pulse shape discrimination
Collaborators:

- Queen’s University: M. Boulay
- Boston University: D. Gastler, E. Kearns
“Pico-CLEAN”

5 cm diameter, 5 cm tall

“Micro-CLEAN”

20 cm diameter, 10 cm tall

“Mini-CLEAN”

50 cm diameter

5 cm diameter, 5 cm tall

Source manipulator

Vacuum can

Pulse-tube refrigerator

Inner vessel

LHe/LAr

PMTs

Wavelength shifter plates
10 meters
12 meters
H$_2$O shielding
Dewar support
77 K
27 K
Photomultipliers
Fiducial volume
Liquid neon
5,000 neutrino events/year, assuming SSM, LMA
Solar Neutrino Signal
10 tonne fiducial volume, 1 year

Dark matter sensitivity with Liquid Neon
Space Requirements:

- Main detector:
  - 12 m diameter, 14 m height
- Experimental room above
  - 100 m²
- Connected “control room”
  - similar in size to experimental room
- Connected by 10 bar “blast door”
Infrastructure
Requirements:

• Water Purification:
  • $10^{-10}$ g/g U/Th
• Power:
  • 300 kW during filling
  • 50 kW during regular operations
• Cryogen purge shaft (~5 m³/min)
Depth Requirements:

- Muon induced backgrounds:
  - fast neutrons
  - cosmogenic products
  - stopping muons in detector
Summary:

• We have completed preliminary measurements of:
  • Scintillation properties in Ar and Ne
  • Purification with charcoal for Ne
  • Low temp PMT testing

• We will soon start construction of mini-CLEAN

• Long term: 100 tonne detector for p-p neutrinos and WIMP dark matter