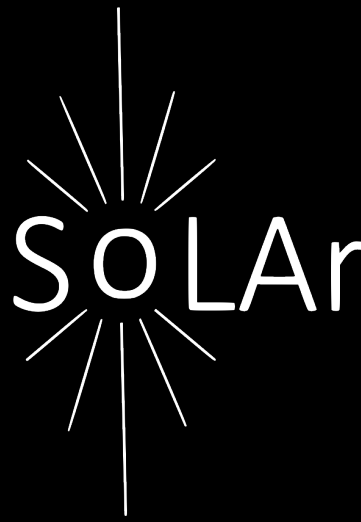

SoLAr: A novel technology for solar neutrino detection

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– NuPhys 2023

MANCHESTER 1824

The University of Manchester

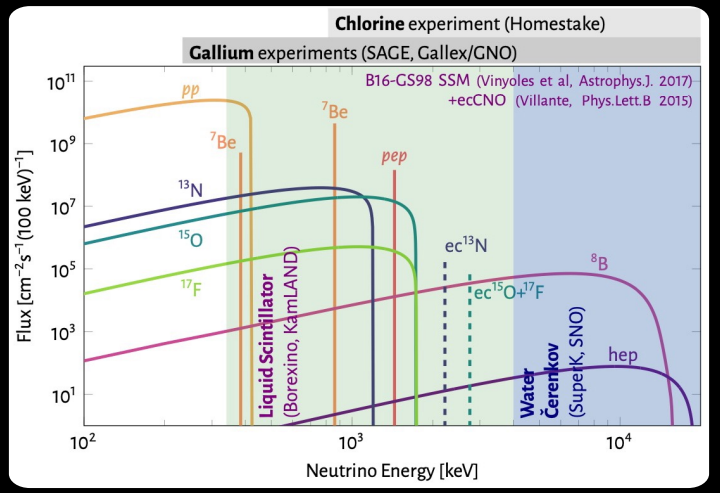
The SoLAr detector

Novel detector concept

- Pixelated readout providing true 3D reconstruction from both charge and light
- Integrateda rray of VUV SiPMs on anode plane
- Easily scalable for a kiloton-scale Lar-TPC
- Online localized triggering for dealing with high data rates

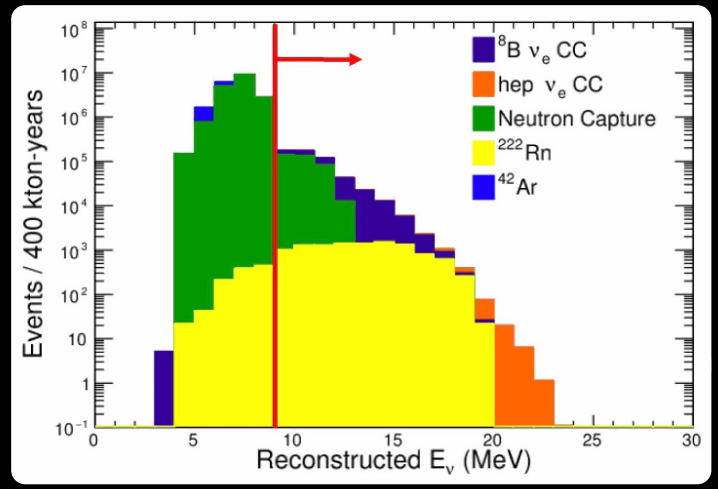
Physics motivation

- Detecting of the Solar ^{8}B and hep neutrino fluxes via both CC and ES reactions
- Detecting other processes in the MeV scale
- Detecting Supernova neutrino bursts

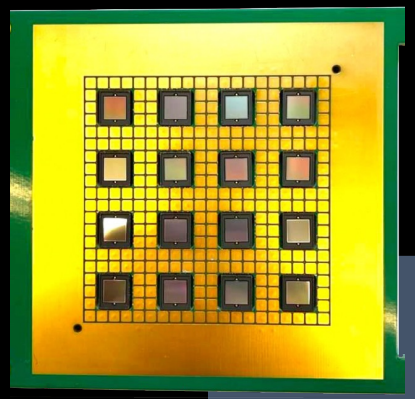


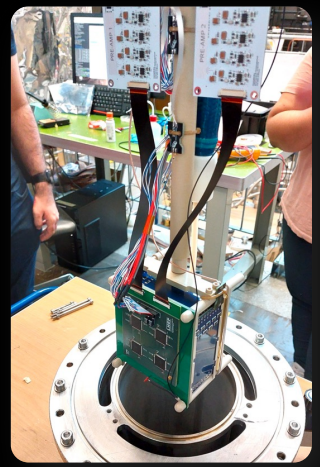
Challenges

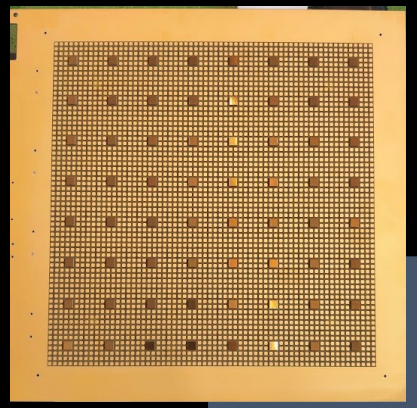
- Achieve an excellent energy resolution
- Low-energy background mitigation strategy
- Neutrino flavour tagging
- Identify neutrino direction (angular resolution)
- Calibration at MeV energies across the detector
- An efficient event reconstruction for online triggering



Completed SoLAr prototypes







Small scale prototype V1

✓ successfully tested October 2022

- $7x7\ cm^2$ anode plane
  - 3 stacked PCBs
- 16 ceramic packaged VUV SiPMs with connector pins
- 4 LArPix v2a chips
- Observed cosmic muon tracks

Small scale prototype V2

✓ successfully tested July 2023

- $30\ x\ 30\ cm^2$ anode plane - single PCB
- 64 SMD packaged VUV SiPMs
- 20 LArPix v2b chips – slots for 64 chips
- Observed cosmic muon tracks and ^{60}Co gamma source

Proposed SoLAr prototypes

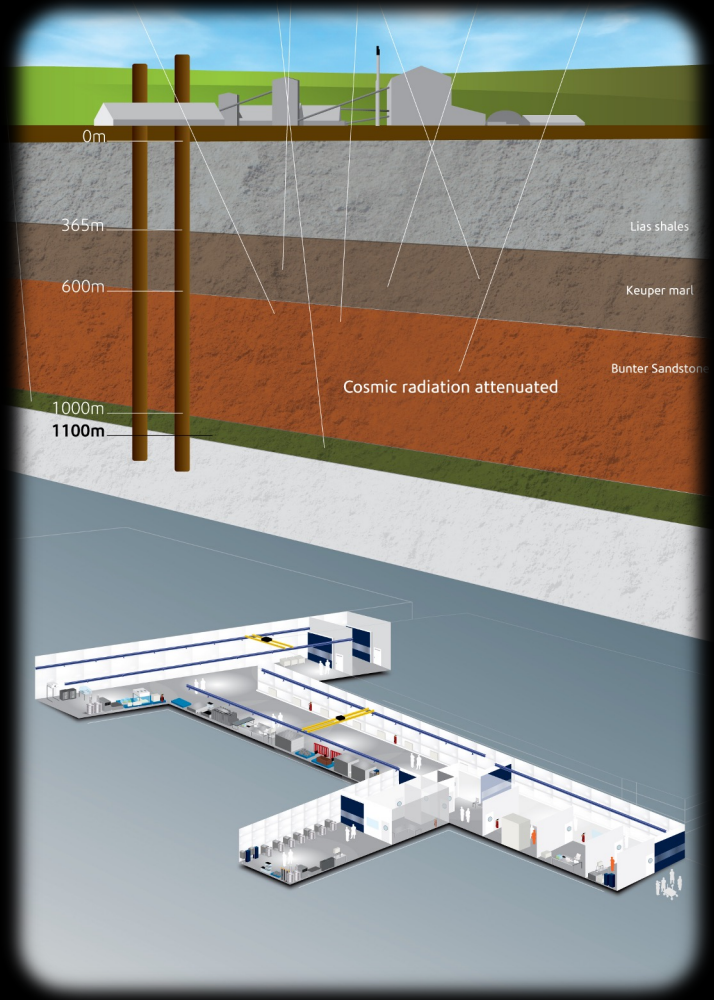
Small scale prototype

- Custom-made SiPMs with charge pads mounted on top of photosensitive cell
- Test of alternative readout chips when available:
  - LightPix
  - Q-Pix

Mid scale Demonstrator

- 2025-2028 prospect at Boulby Underground Laboratory
- Few-ton scale LAr detector underground
  - $1100m$ overburden
- $30cm^2$ readout anode tiles
  - $\approx$ 6400 pixels per tile
- First measurement of flavor tagged solar neutrinos in Lar

Boulby Underground Laboratory



Thank you!