The DarkSide-20k Neutron Veto and its Light Detector

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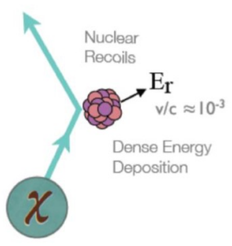
On behalf of the DarkSide-20k collaboration

DarkSide-20k Experiment

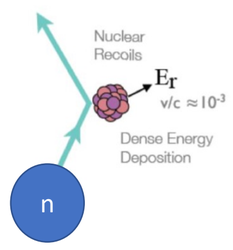
A global liquid argon dark matter experiment which aims to reach high WIMP mass sensitivity (1.5 x 10^{-47} cm^2) in a background free environment.

Signal

- Single nuclear recoil
- Energy 1-100 keV

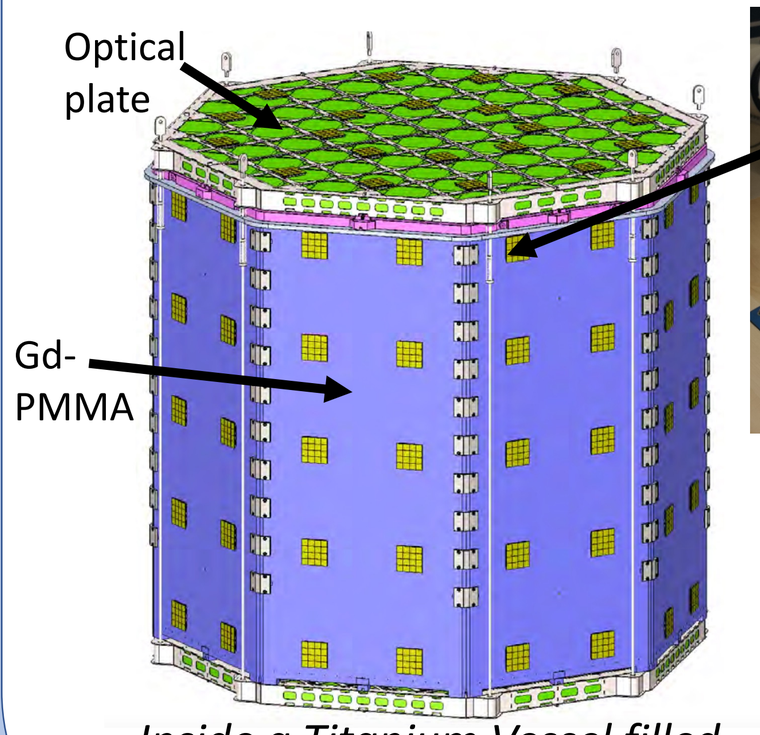


Background



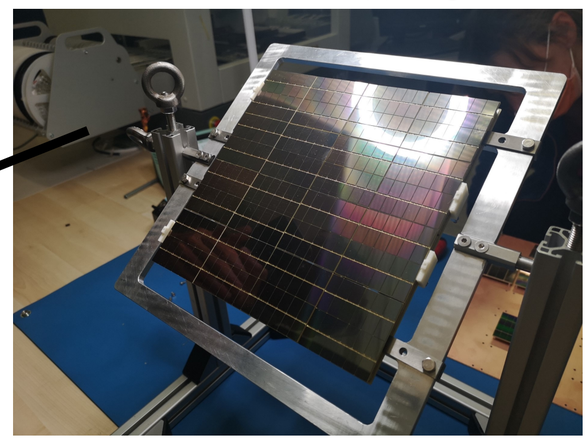
Neutron veto: TPC-veto Integrated System

Neutron capture on Gd produces a gamma cascade (8 MeV). Generates scintillation light in argon detected by veto photo detection unit (vPDU).



Inside a Titanium Vessel filled with 32 tons of underground liquid Argon

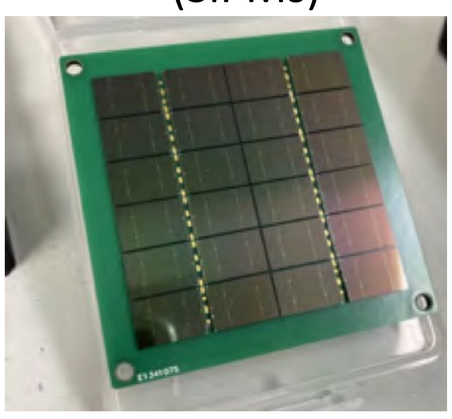
vPDU



- 16 Tiles
- Single PCB for Tile & amplifier + 1 large PCB for control signals
- ASIC amplifier
- Sum of 4 amplified tile signals,4 outputs

Veto Tile

Silicon PhotoMultiplier (SiPMs)

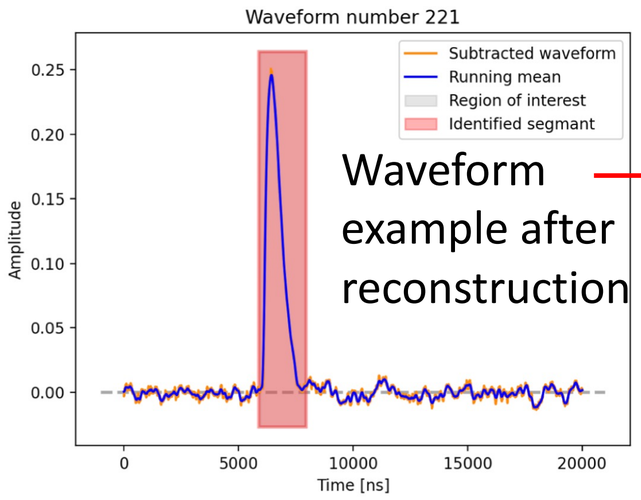


24 SiPMs
total area: 5x5 cm^2

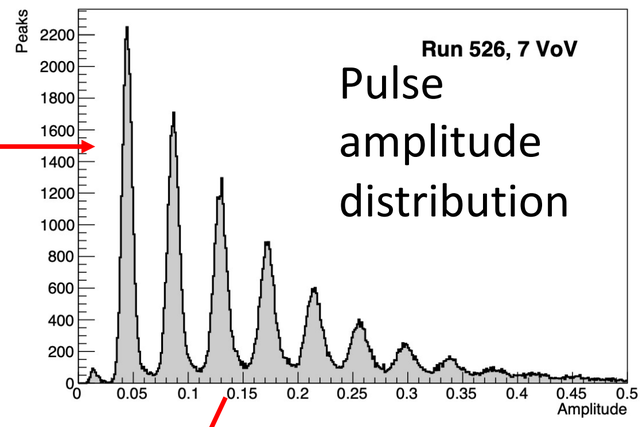
Front-end electronics

Dynamic range: 700 mV

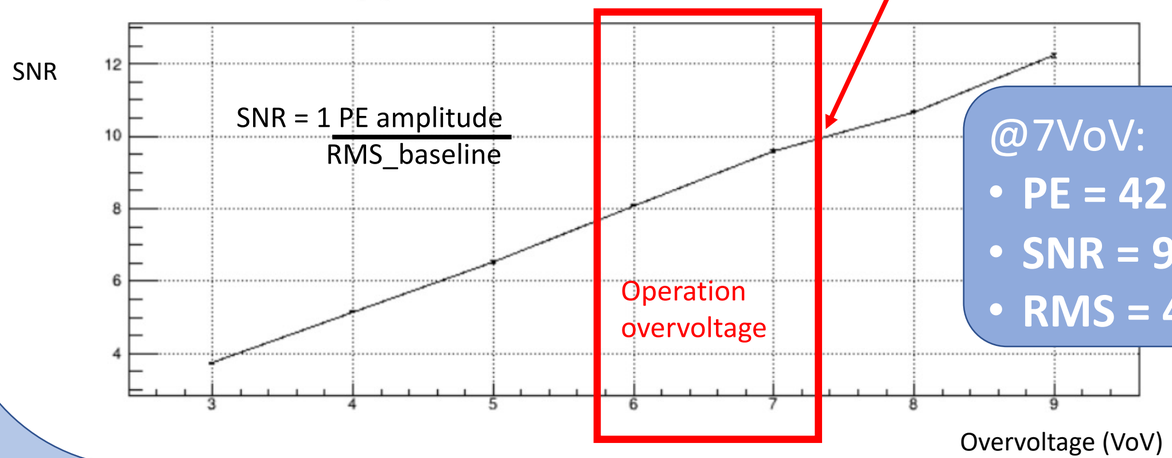
Veto Tile: Preliminary Results



Waveform example after reconstruction



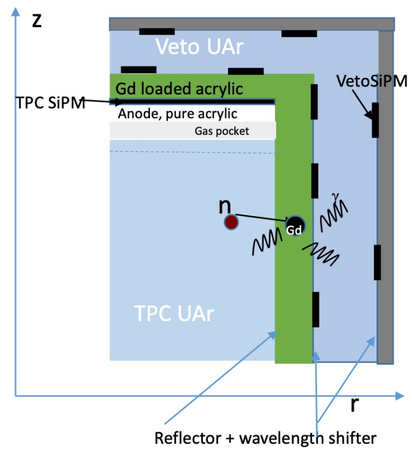
Pulse amplitude distribution



@7VoV:
- **PE = 42 mV**
- **SNR = 9.5**
- **RMS = 4.5 mV**

Neutron Veto Performance

Monte-Carlo simulation, including PDU performance, develop to study neutron veto efficiency.



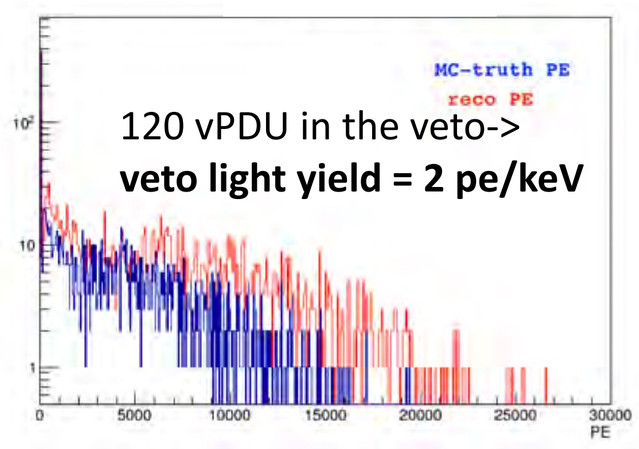
Neutron background reduction:

- Single nuclear recoil selection
- Position cuts
- Energy in TPC > 50 keV OR energy in the veto > 200 keV

Neutron inefficiency:

- **1.6E-5** for neutrons coming from all detector components
- **inefficiency is increased by 20%** when including electronics response, SiPM noise effects and pile-up

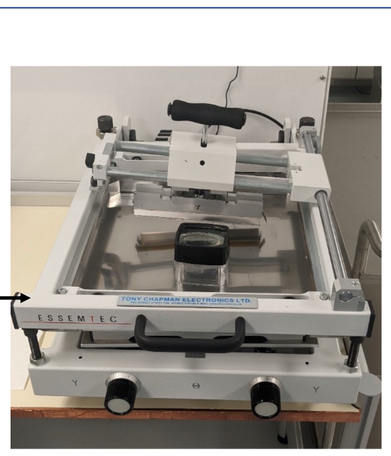
Photo-electron (PE) distribution in the veto



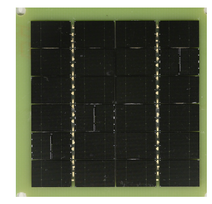
< 0.1 event in full exposure of 200 ton x years

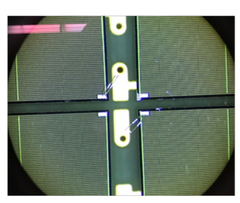
UK Facilities to Produce vPDU

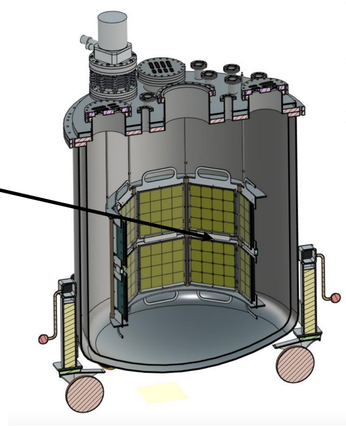
Front end assembled @Birmingham



Tile bonding @Liverpool / RAL







Warm/cold testing setup under construction @Manchester/ Liverpool

First vPDU planned to test this summer