

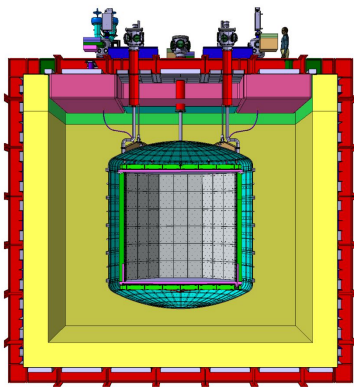
A Newton's cradle graphic is positioned in the top-left corner, featuring five colorful spheres (blue, green, yellow, orange, red) suspended by thin blue lines. A large, light blue circular shape is partially visible in the top-right corner. Another Newton's cradle graphic is located in the bottom-right corner, with its spheres (blue, green, yellow, orange, red) resting on a surface. A large, light blue circular shape is also present in the bottom-center area.

2023 Report

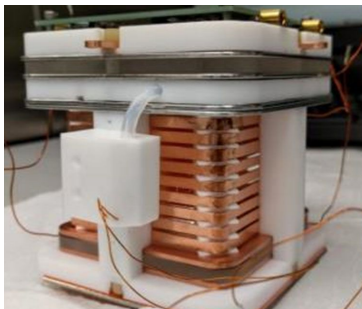
Iftikhar Ahmad

AstroCeNT

2023 in Nutshell



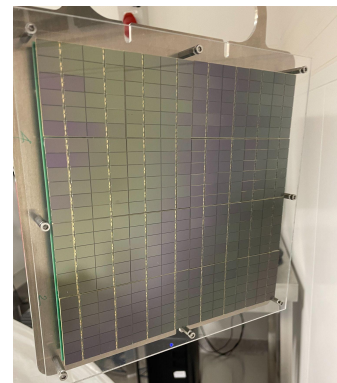
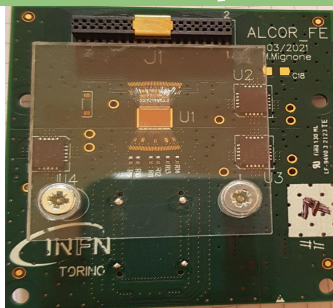
Cosmogenic μ background



ReD experiment

2023

ASIC development



Veto PDUs for DarkSide-20k

ReD experiment

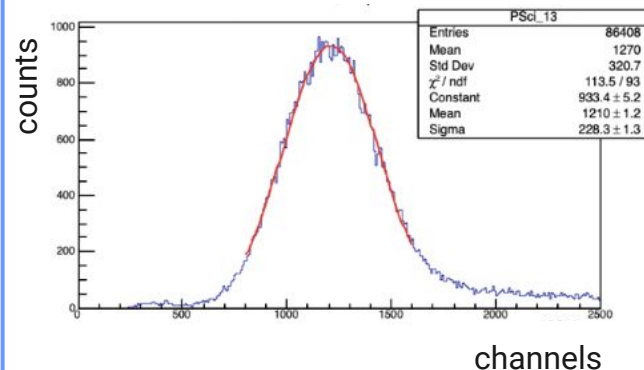


To characterize response of the TPC to neutron induced nuclear recoils and to measure the charge yield for low-energy recoils.

Purpose

- The kinetic energy is calculated by measuring the time of flight.
- Plastic scintillators in the ReD experiment are calibrated with ^{241}Am and ^{137}Cs sources.
- Calibration is important as it gives a normalized response and better tagging efficiency.

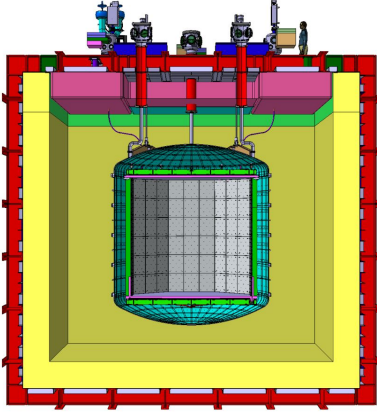
Calibration campaign



18 detectors were calibrated using Cs-137 and Am-241 sources.

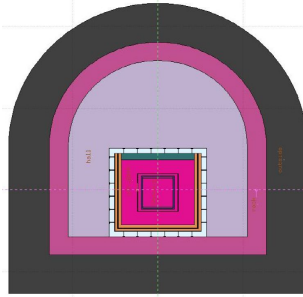
Results

Cosmogenic μ background



- The DarkSide-20k is a WIMP search experiment consisting of 3 nested detectors, all deployed within a ProtoDUNE-style membrane cryostat.
- High energy muons can produce neutrons, which mimics the signal of WIMPs.

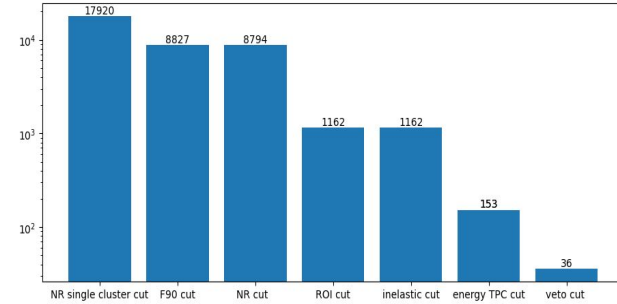
Darkside-20k



Fluka Geometry

- Fired the muons in FLUKA and the recorded neutrons were fired in Geant4 DS-20k geometry.
- The background rate from FLUKA only simulation is **<0.1 events/10 years**.

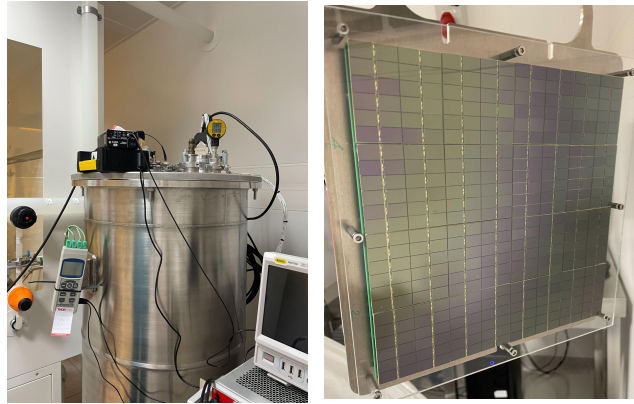
Simulation



- Only **36** events in full live time (**~ 23000 years**) passed cuts.
- The background rate for FLUKA simulation + Geant4 is **$1.5 \times 10^{-2} \pm 2.5 \times 10^{-3}$ events/10 years** which is less than the target of **0.1 events/10 years**.

Results

vPDU testing

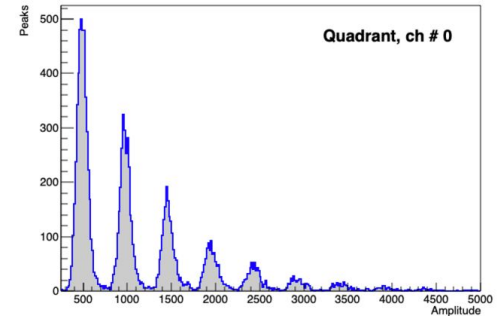
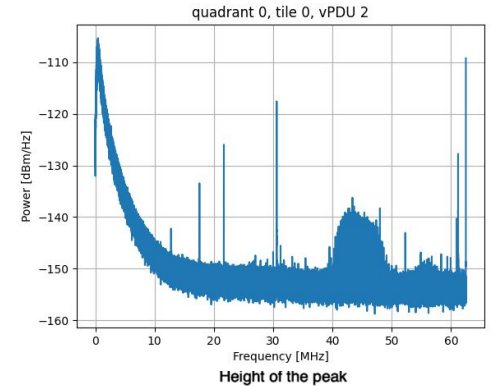


The Darkside-20k veto readout system: characterization of veto Photo detector units (PDU)

PDU

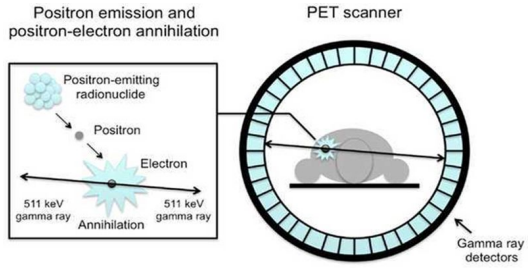
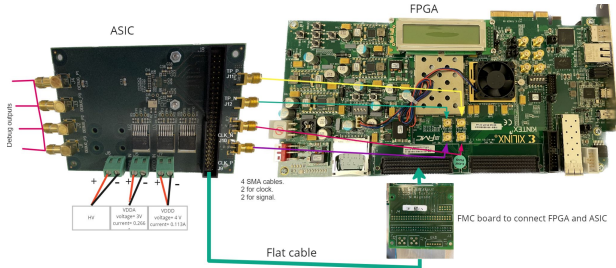
- SiPMs has
 - higher single photon resolution,
 - higher photo detection efficiency as compared to PMTs,
 - low operation voltage,
 - lower cost per area.
- The single unit of a vPDU is an array of 24 SiPMs, called tile, for a total area of 24 cm^2
- There are 4 tiles in a single vPDU

Properties



Results

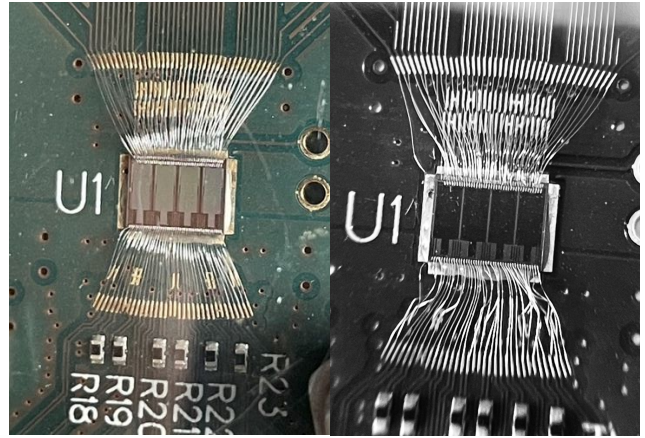
ASIC development



Positron emission tomography

- ASIC (application specific integrated circuit)
 - Potential to replace discrete electronic components
 - Reduce the radioactivity of front-end electronics.
- To study the time resolution of in (LAR and LAR+Xe) and SIPMs at cryogenic temperatures for PET applications.

Properties



- Damage to the wire bonding due to an accident.
- The plan is to fix the wire bonding and test it at cryogenic temperatures

Accident

Summary

1

ReD experiment

The plastic scintillators were calibrated using 2 different sources

2

Cosmogenic background

The cosmogenic background was simulated

3

vPDU testing

The testing is in progress. Now testing vPDU prototypes

4

ASIC development

Fixing the wire bonding for the ASIC is in progress

1

Conference talk

Estimation of Ar-37 activation and decay rate in DarkSide-50 experiment at LIDINE-2023, Madrid

2

Winter school

PhD autumn school on experimental astroparticle physics, Gran Sasso, Italy

3

Scientific activities

Calibration of plastic scintillators and deployment of Ar-37 calibration source

4

Courses

The Universe in X-rays, Introduction to Dark matter, Astrophysics

Thank you

