

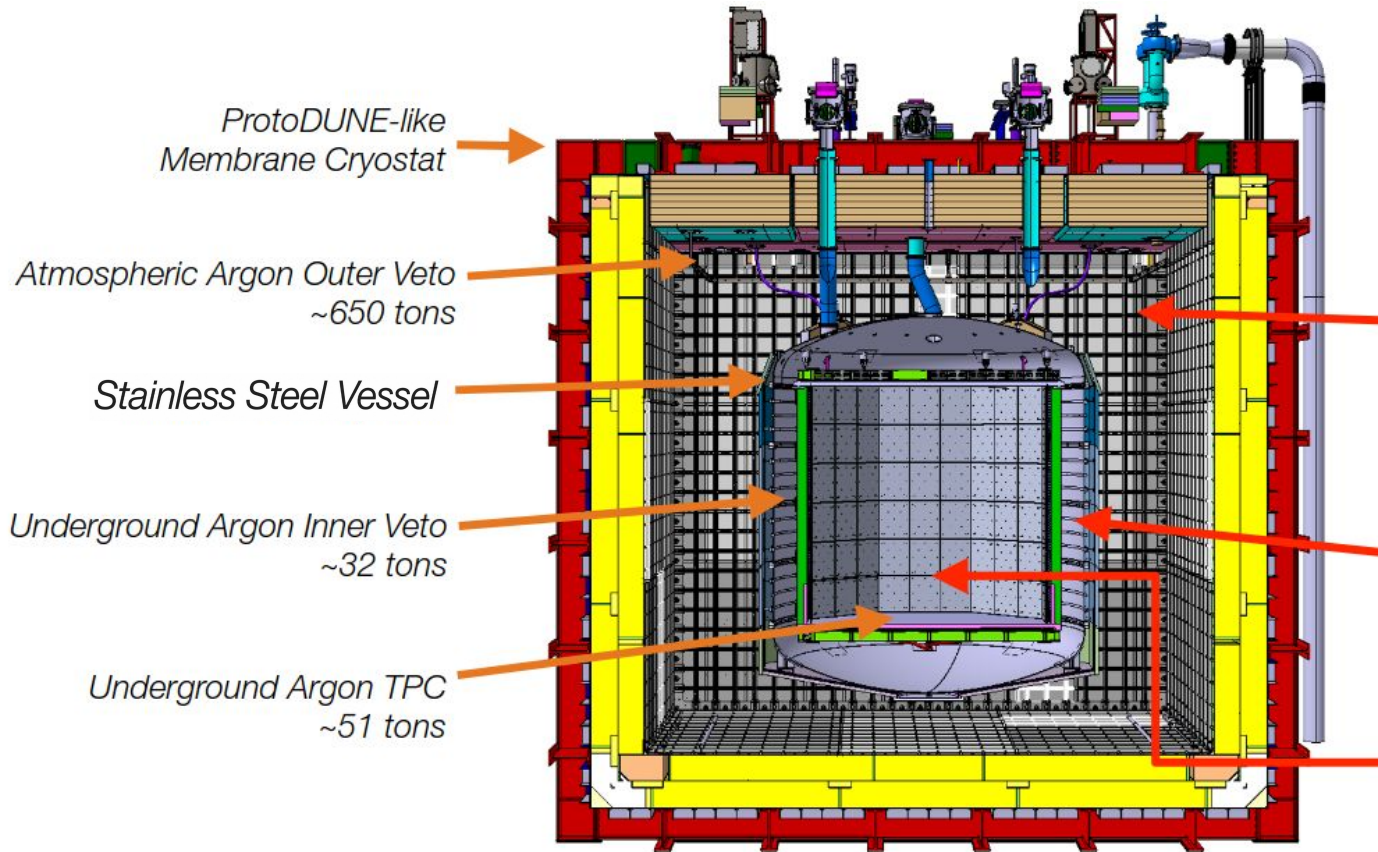
Status of the DarkSide-20k experiment

16th International Workshop
on the Identification of Dark
Matter

Zaragoza, 2nd June 2026

Vicente Pesudo
(CIEMAT / LSC)
for the GADMC

DarkSide-20k: what is it?



DarkSide-20k consists of three nested detectors:

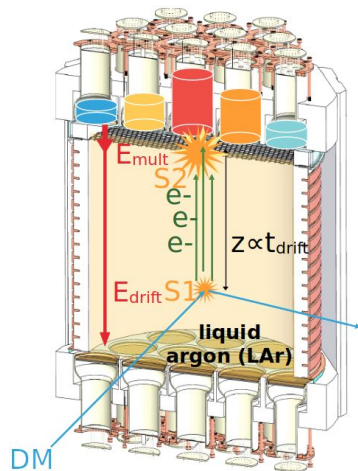
- The **Outer Veto (OV)**, which is filled with AAr and designed to catch cosmogenic neutrons by detecting the primary muon
- The **Inner Veto (IV)**, which uses UAr to tag radiogenic neutrons by detecting gammas from their capture
- The **Dual-Phase UAr TPC**

Dual-phase TPCs

Massive targets

Scintillation detected promptly (S1)

Uniform E field to measure ionization: prevents recombination + drifts e^- to anode



Both provide E information

e^- extracted to gas phase in stronger field to induce electroluminescence (S2)

light pattern in detection plane provides XY information (**cm resolution**)

Time difference between S1 and S2 provides Z info (**mm resolution**)

S2/S1 provides particle discrimination

**At low Energies, S1 and S2 almost featureless:
Unambiguous identification of S1-S2 necessary**

Ar, what's the point?

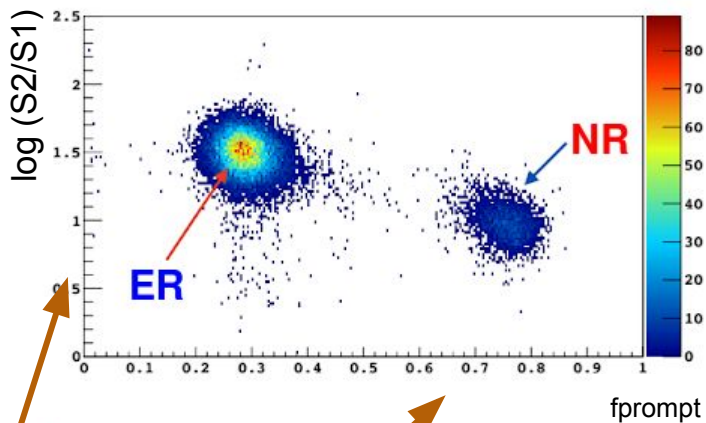
Lower mass than Xe (low-E recoils)

Additional discrimination variable.

Pulse shape of scintillation: singlet vs triplet components

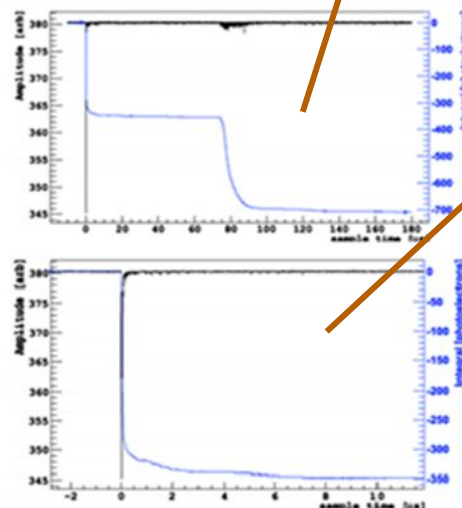
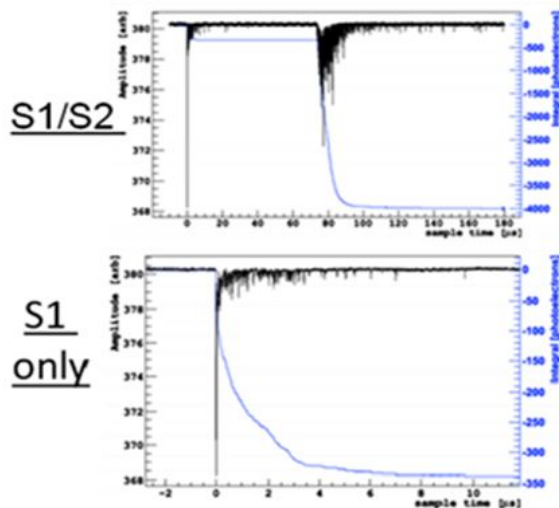
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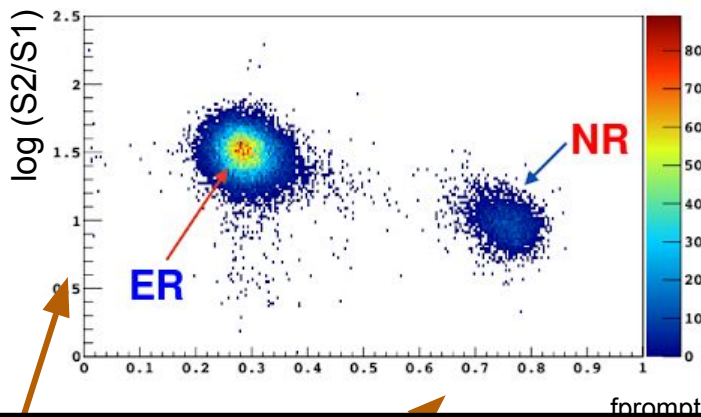
ER-like event

NR-like event

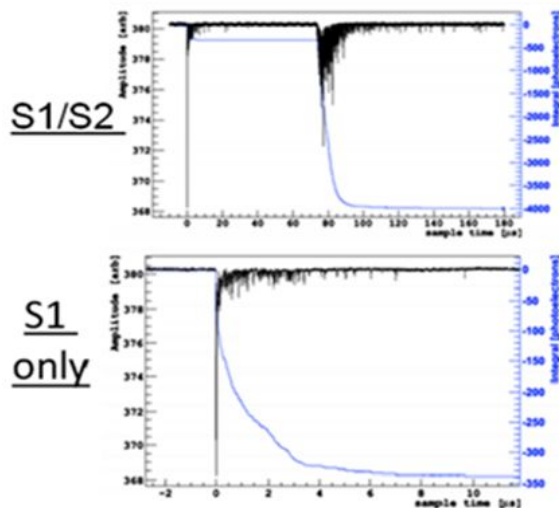


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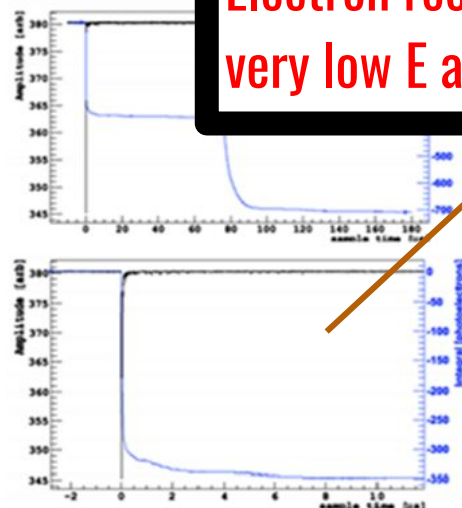
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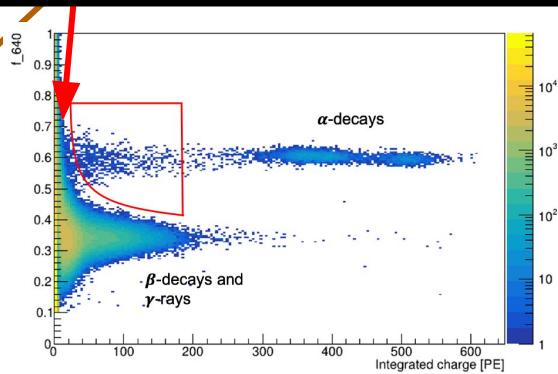
ER-like event



NR

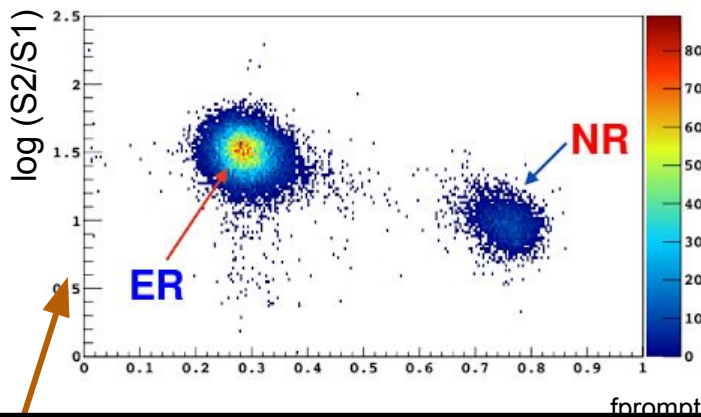


Electron recoils are a bkg to WIMP search only at very low E and depending on ROI definition

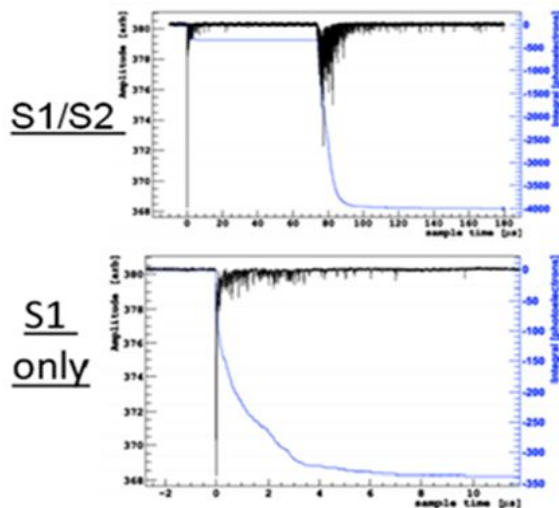


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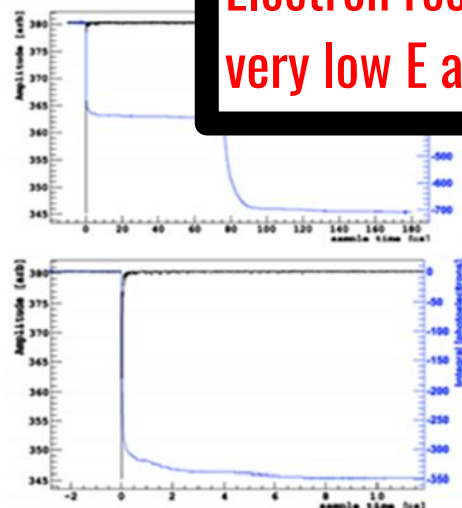
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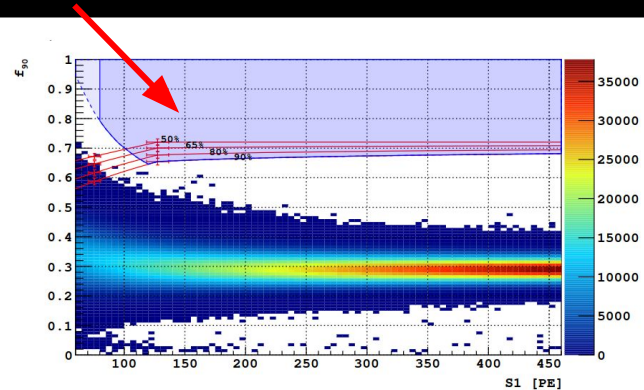
ER-like event



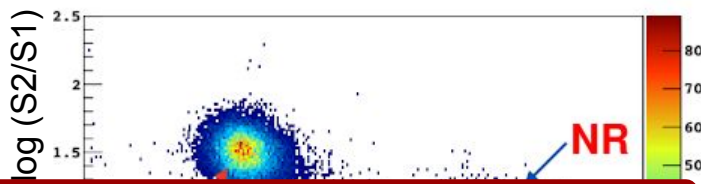
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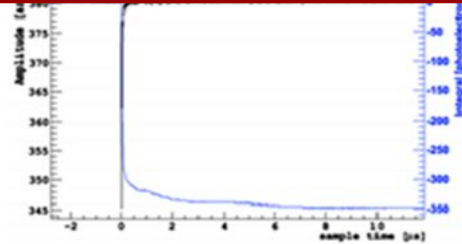
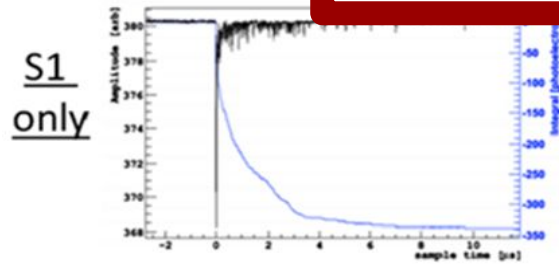
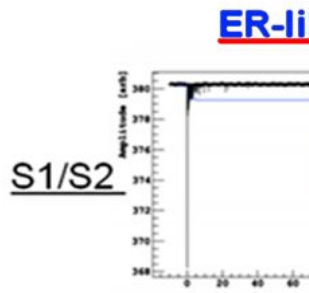


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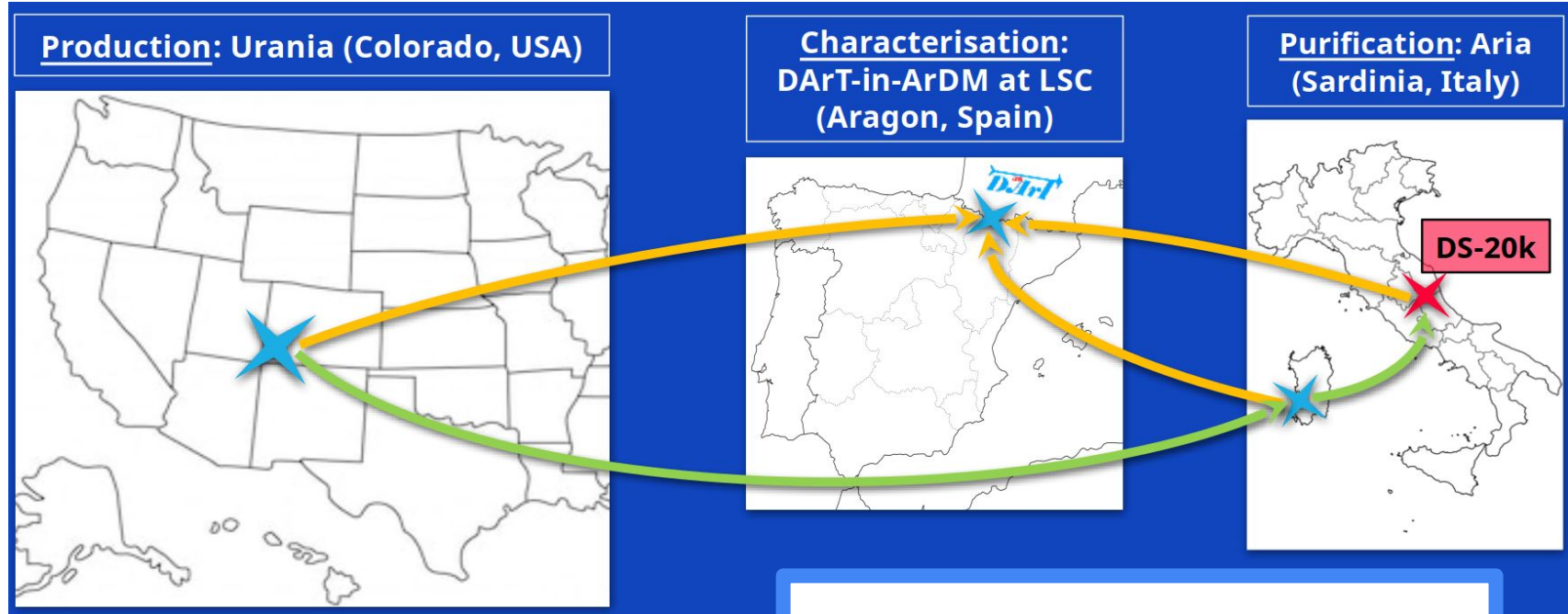
Nature is kind... but not so kind: ^{39}Ar

- 1 Bq/kg in atmospheric Ar.
- Mostly from cosmogenic activation
- At 50 kHz low-E S1-S2 coincidence unfeasible (and certainly not a low background experiment).



ch only at
on

UAr program of DarkSide: Urania, Aria and DArT

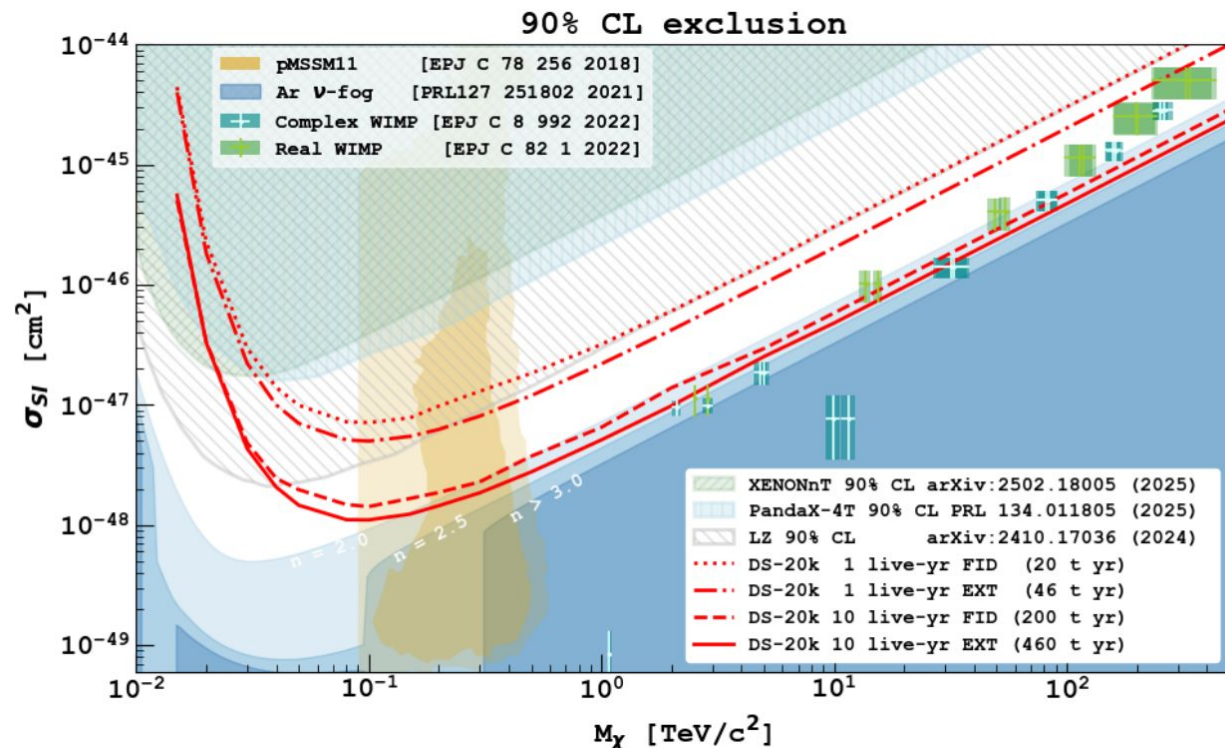


See D. Díaz Mairena's talk later today

A couple of spoilers, though...

- URANIA ready for commissioning
- DArT taking data

DarkSide-20k: main science cases

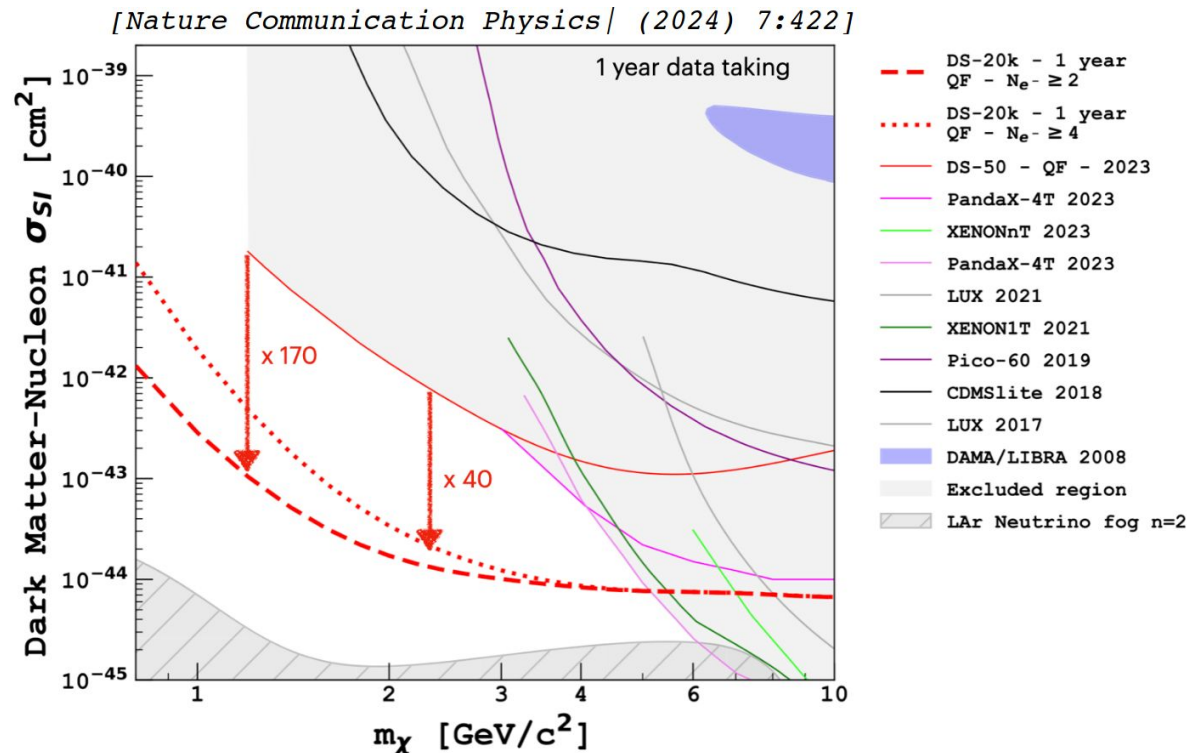


Prospects to lead the search for WIMPs in most of the “canonical” parameter space, particularly at high mass.

Best sensitivity to spin-independent wimp-nucleus interaction cross section:

$$\sigma_{SI} = 10^{-48} \text{ cm}^2 @ 100 \text{ GeV}/c^2.$$

DarkSide-20k: main science cases

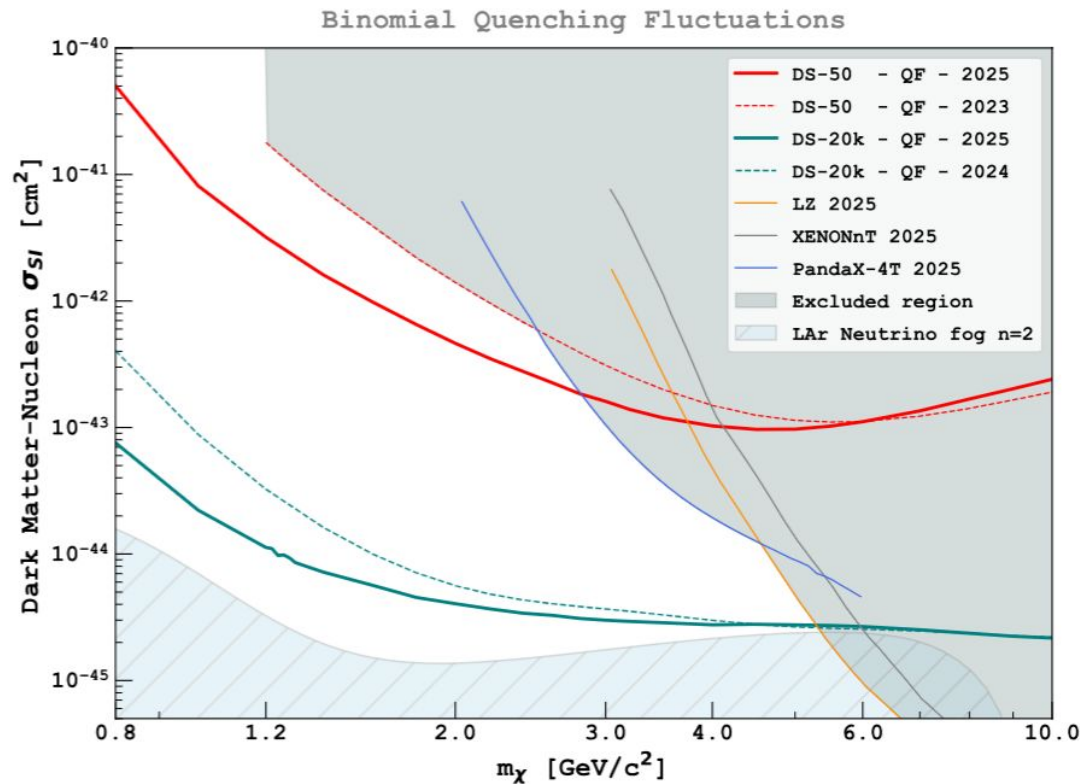


Prospects to dominate the search for light ($\sim \text{GeV}/c^2$) WIMPs:

Improve current sensitivity by more than two orders of magnitude in some regions of the parameter space in 1 year of data taking.

Comm. Phys. 7, 422 (2024)

DarkSide-20k: main science cases

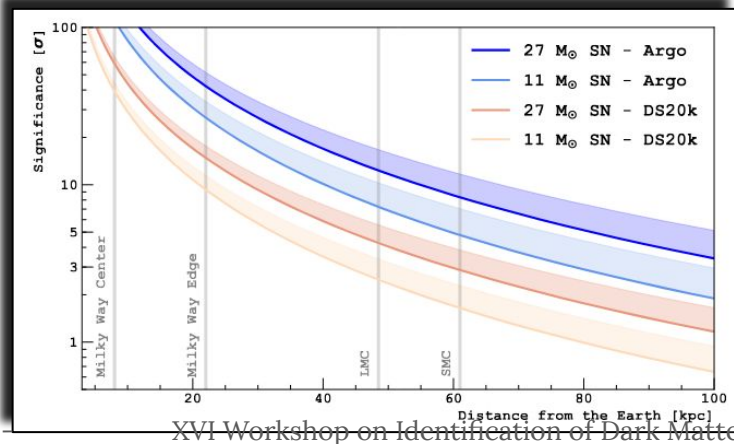
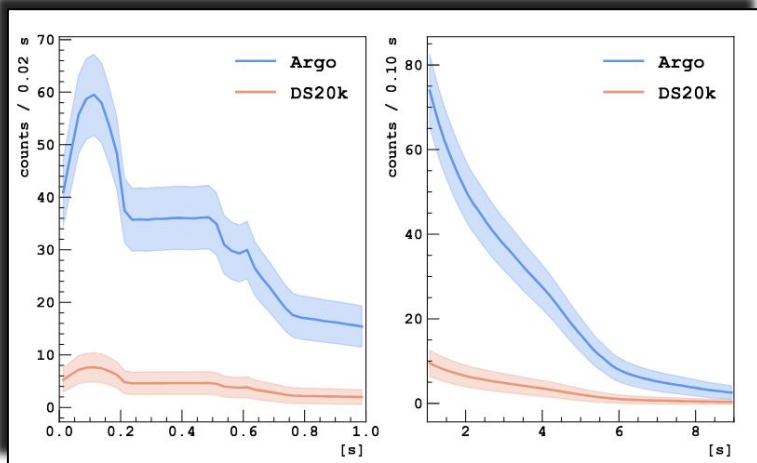


**Prospects to dominate
the search for light
($\sim \text{GeV}/c^2$) WIMPs:**

Prospects for 10 year
exposure [[arXiv:2511.13629](#)
approved by PRD] with
improved liquid argon
ionization model
[[Eur. Phys. J. C 86:220 \(2026\)](#)]

See M. Ave's talk

DarkSide-20k: main science cases



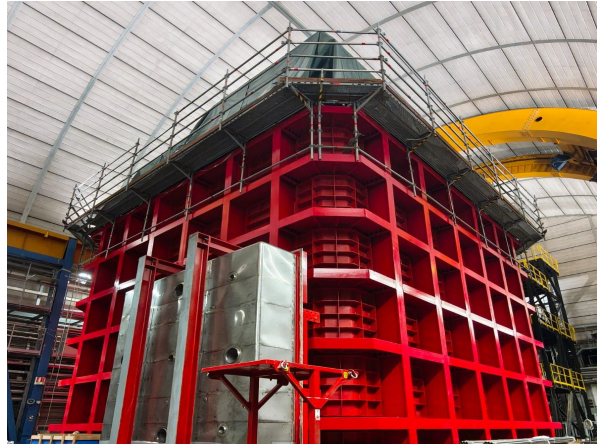
Best sensitivity to
neutrinoless double
electron capture in ^{36}Ar

Sensitivity to SuperNova
neutrinos (~180 CEvNS
events expected for a
11 $M_{\odot}$ Supernova in the
galaxy) [JCAP03(2021)043]

Sensitivity to ^8B solar
neutrinos via CC

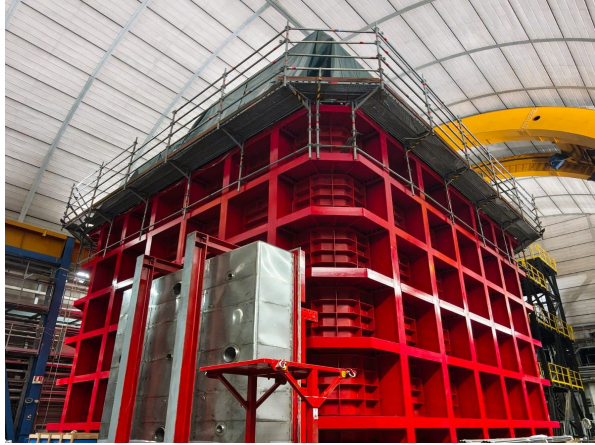
See G. Vera's talk

DarkSide-20k: Current status



**How far are we from
seeing all this?**

DarkSide-20k: Current status



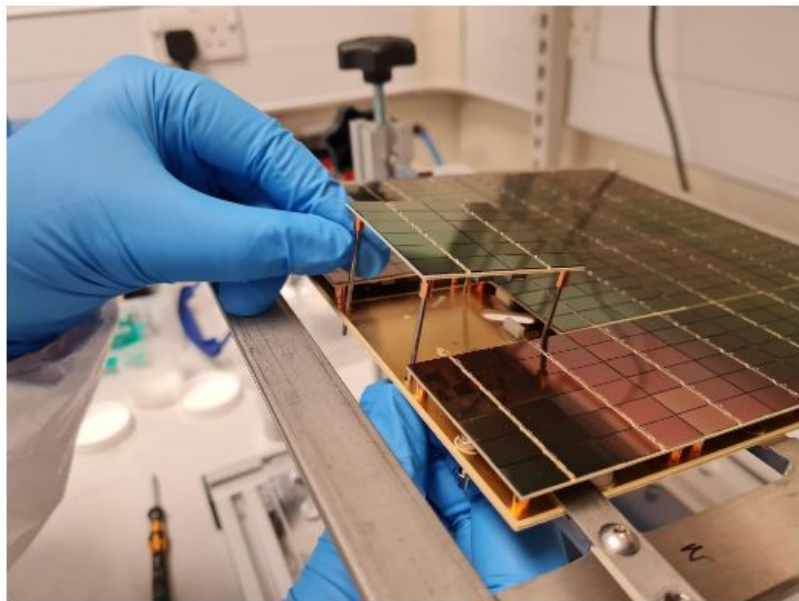
- Cryostat and internal crane installed.
- Clean room panels and aerualic plants design completed; contract being assigned right now.
- Design ongoing for electrical and safety plants.
- Cryogenics system atmospheric Ar 90%.
- Cryogenics system underground Ar to be upgraded by the end of the summer.
- Integration sequence defined.
 - Fine tuning going on.
- Gamma flux measurements performed outside and inside of the cryostat.
- Measurement of MeV-neutron flux inside the cryostat ongoing.

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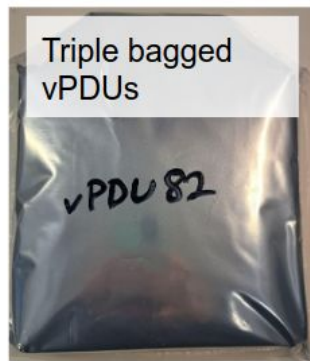
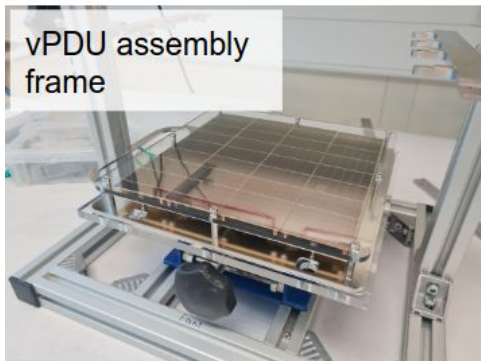
DarkSide-20k: Current status



One of the main RnD outcomes of DarkSide-20k: production of **radiopure cryogenic low-noise SiPMs-based photoelectronics** within the collaboration.

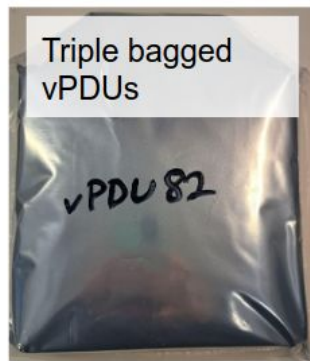
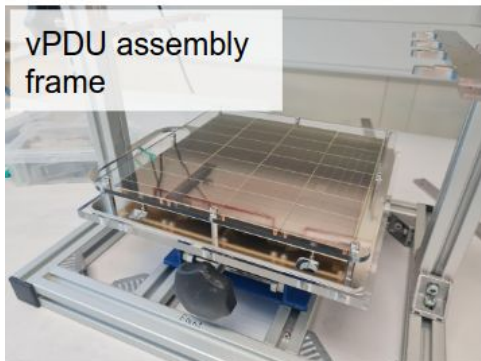
- $24 \times 1 \text{ cm}^2$ SiPMs integrated in 1 tile ($5 \times 5 \text{ cm}^2$). **96% occupancy** in the optical planes.
- 4 x 4 tiles in 1 PhotoDetection Unit (PDU)
- Read out implemented at the quadrant level:
 - 2×2 tiles = $10 \times 10 \text{ cm}^2$
- Slightly different solutions for the
 - TPC (21 m^2 - 528 PDUs) and
 - the veto ($120 + 32$ PDUs).

DarkSide-20k: Current status



- **veto PDUs: 119/120 past tests (detector-ready)**
More are being worked on for spares and outer veto.
 - Production and testing lead by UK groups + AstroCENT.
- **TPC PDUs: 238/528 produced. The goal is achieving a production rate of 8 PDU/week.**
 - Production in NOA (ISO6 CR @ LNGS)
 - Testing in PDU Test Facility (ISO7 CR @ Naples)
- **Specific protocols in place for handling, transportation and storage.**
- **Dust level on SiPMs monitored with ad-hoc scanner.**

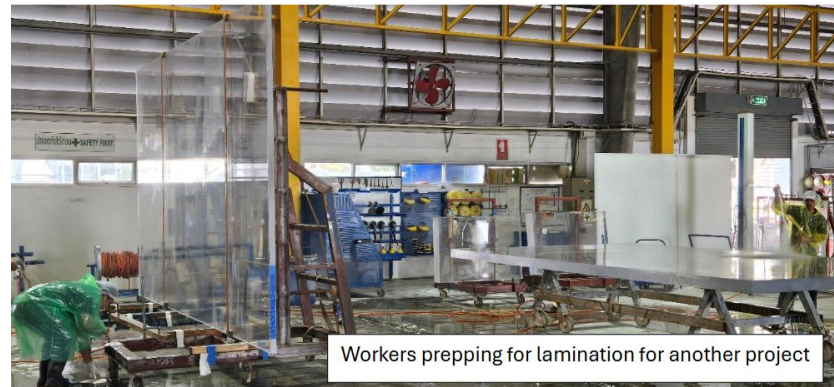
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 - Pr **See A. Marasciuli's poster** (NGS)
 - Te (ISO7 CR @ Naples)
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- Dust level on SiPMs monitored with ad-hoc scanner.

DarkSide-20k: Current status

- Acrylic panels casted and being machined.
- Optical plane structures to be delivered this summer.
- Integration of PDUs in Optical plane to be started upon reception.
- Cobot and CRAB for placing PDUs in Optical plane already @ LNGS being tested.
- Most of the structural material for TPC (SS) assayed, approved and procured.



DarkSide-20k: Current status



Goal: keeping detector-induced background 1 order of magnitude below CEvNS (3.2 events in 200 ty).

Radiopurity and cleanliness at the core of all of it:

- **Conscious choice of technical solutions based on performance + potential background $[(\alpha, n)]$.**
- **Every component assayed (at the single capacitor level).**
- **Ambient Rn concentration, exposure time and potential impact is being factored in in the background estimates.**
- **Specific tests performed to approve bags and storage solutions in terms or Rn-tightness.**
- **Cleaning protocols to mitigate surface ^{210}Po activity defined on a component per component basis (not only material).**

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- **Cleaning protocols to mitigate surface ^{210}Po activity defined on a component per component basis (not only material).**

See J. Guerrero's talk & G. Zuzel's poster

Conclusions

- **DarkSide-20k** is dual-phase Ar TPC under construction at Hall C of LNGS with the goal of **leading the WIMP** search in **several regions** of the parameter space and make measurements of **relevance in neutrino physics**, particularly in case of a SuperNova burst in the galaxy.
- The **construction project is fully funded** and the schedule detailed at the single-activity level.
- The transition to construction has been materialized and the procurement of critical materials, approved in terms of radiopurity, is close to finalization.
- The detector will be ready for filling end of November 2028 and 120 tonnes of underground Ar will also be ready at that time.

United States

United Kingdom

Italy

Canada

Germany

Brazil

France

Poland

Spain

China

The -20k Collaboration

~400 scientists

~80 institutions

10 countries



Gracias !

~400 scientists
~80 institutions
10 countries

BACKUP

