



The XLZD Consortium

Towards the 3rd generation of Dark Matter detectors

Luca Scotto Lavina LPNHE/CNRS
on behalf of the XENON-France community



From XENON Project to DARWIN

More than 10 years of growing size detectors. World leading sensitivities

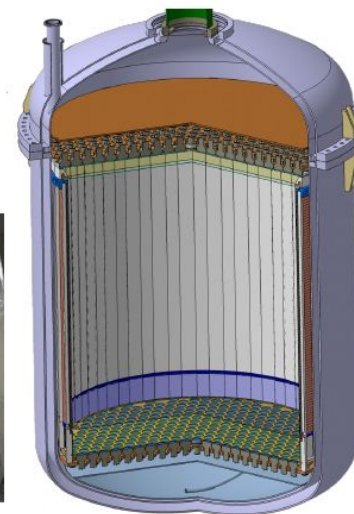
PAST



PRESENT



FUTURE



	XENON10	XENON100	XENON1T	XENONnT	DARWIN
Height	15 cm	30 cm	96 cm	148 cm	2.6 m
Diameter	20 cm	30 cm	97 cm	133 cm	2.6 m
Total mass	25 kg	161 kg	3.2 tons	8.3 tons	50 tons
Active mass	14 kg	62 kg	2.0 tons	5.9 tons	40 tons

The DARWIN baseline

Physics goals : *JCAP 11, 017 (2016)*, *arXiv:1606.07001*

0vbb : *Eur.Phys.J.C 80 (2020) 9, 808*, *arXiv:2003.13407*

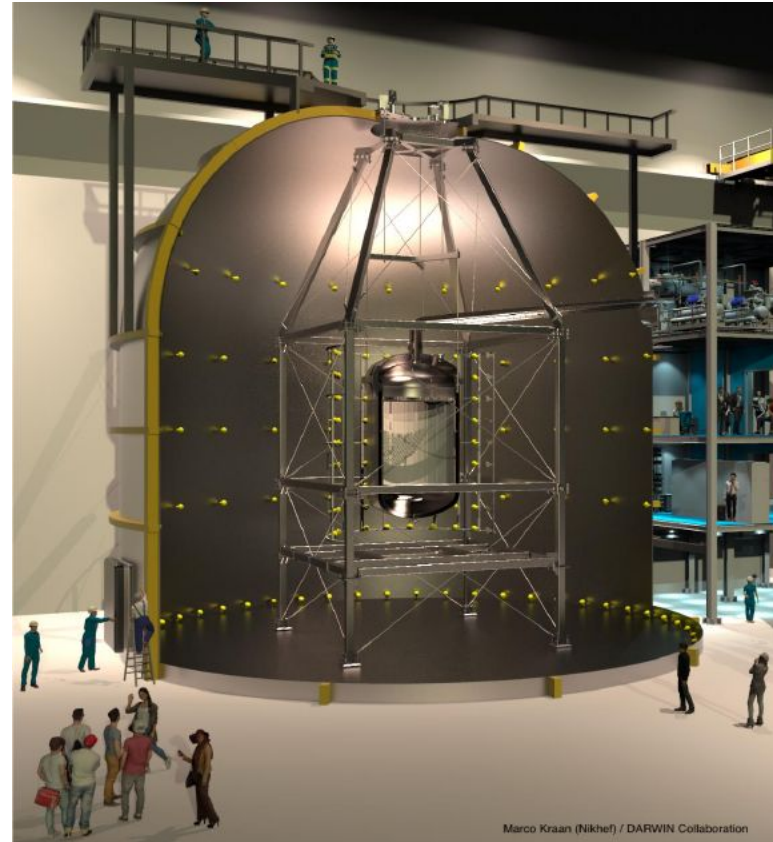
Solar neutrinos : *Eur.Phys.J.C 80 (2020) 12, 1133*, *arXiv:2006.03114*

> Time-projection chamber

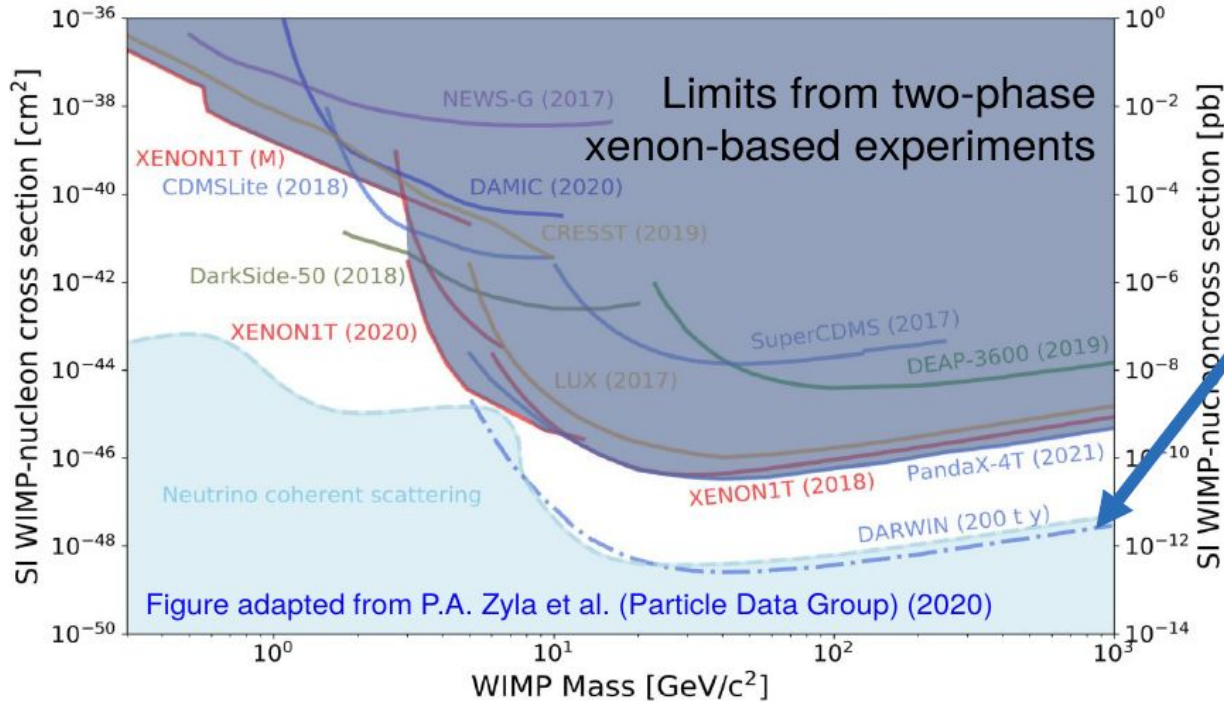
- 40 "active" tons of LXe
- 2.6 m in diameter and height
- Baseline: 955+955 3" PMTs
- PTFE reflectors for better light collection

> Goal – low background

- Deep underground (3500 m.w.e @ LNGS, other labs in consideration)
- Ultra-low background cryostat
- Active and passive Rn mitigation
- Outer neutron and muon veto



The WIMP landscape (Spin Independent elastic scattering)



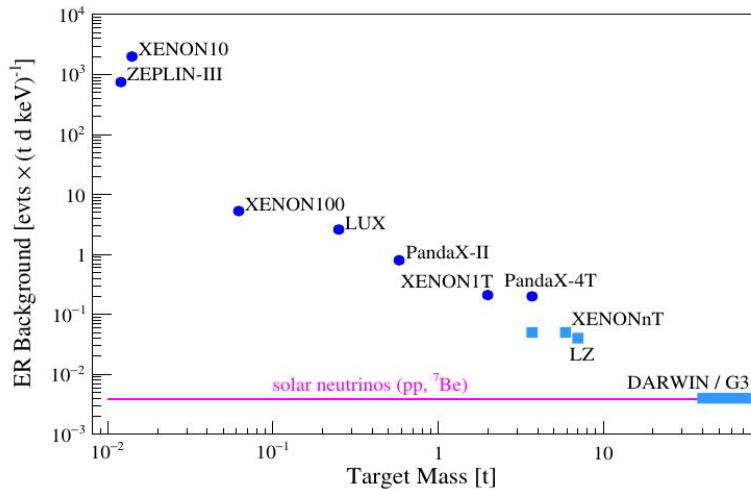
DARWIN - the next generation



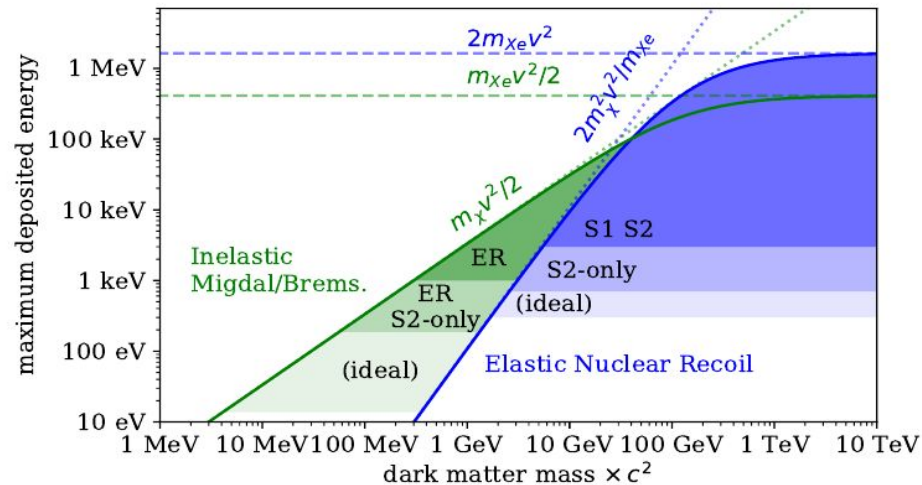
Towards higher sensitivity

Community white paper : arXiv:2203.02309, 672 authors

Larger target mass and lower background



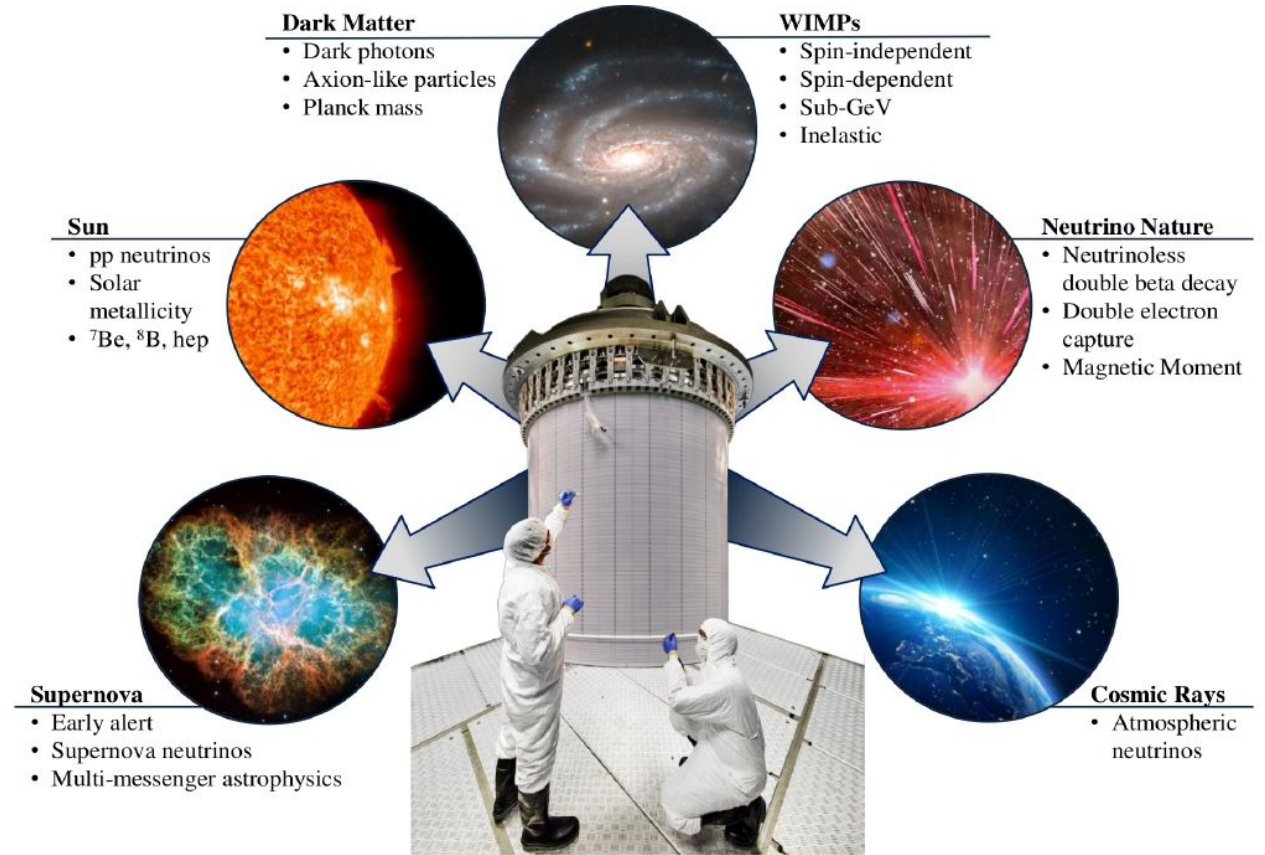
Lowering the threshold with different analysis techniques



DARWIN physics goals

Community white paper :

arXiv:2203.02309, 672 authors



DARWIN evolution and XLZD

DARWIN Collaboration grown to more than 200 scientists from 38 institutions (recent ones: 2 groups from Melbourne, Bern, Barcelona, Darmstadt, Sydney)

Forming the **XLZD consortium** :

- 104 group-leaders in 60 institutions and 16 countries
- joint white paper on physics reach
- first in-person meeting at KIT in June 2022
- **xlzd.org**



Active R&D and design phase

- Radiopurity mitigation (ERC Muenster)
- Long drift performances (ERC Zurich)
- Large diameter performances (ERC Freiburg)
- Light sensor development
- **Electrodes for secondary scintillation signal**
- **Scaling cryogenic facilities**
- Mechanical and engineering studies
- Simulation techniques

Current **French contributions** (besides analysis):

- R&D on electrodes (see XeLab talk in this DUPhy meeting)
- Design of a Storage and Recovery System
- Leading the TDR on cryogenics



French Network under DARWIN umbrella

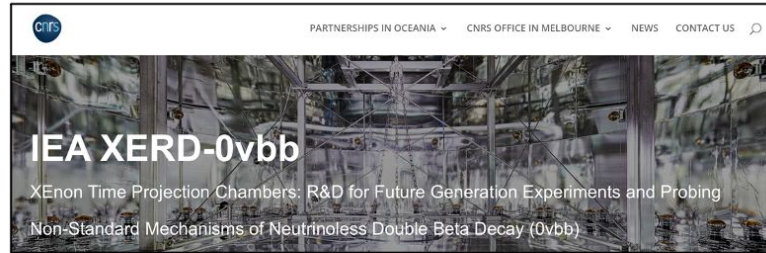
- **CNRS - IMT Atlantique / University of Melbourne :**
 - XERD - $0\nu\beta\beta$ - DM with UoM collaborators : Sara Diglio
- **CNRS / University of Tokyo (ILANCE) :**
 - R&D with UTokyo XENONnT collaborators : Romain Gaio
- **CNRS / Helmholtz Foundation (DMLab) :**
 - DARWIN identified as the DDM detector
 - <https://dmlab.in2p3.fr/>
 - Julien Masbou as PI for DARWIN

XEnon Time Projection Chambers: R&D for future generation experiments, 0vbb and Dark Matter searches

- Cotutelle IMT Atlantique – UniMelb [01/2022 - 12/2024] → 1 PhD Student (Marina Bazyk)
- IEA CNRS – UniMelb : XERD-0vbb [03/2022-12/2023]
- PhD Joint Call CNRS – UniMelb : XERD-DM [10/2022-11/2025] → 2 PhD Students (Lorenzo Principe & Owen Stanley)
- AUFRANDE : Australia-France Network of Doctoral Excellence (MSCA Cofund call) [09/2023-11/2026] → 1 PhD to recruit

[10.03.2022] A new continent on the DARWIN world map

We are pleased to announce that two groups from the University of Melbourne join DARWIN's endeavour to realize a multi-ton scale observatory for astroparticle physics . Welcome to the PIs Elisabetta Barberio and Nicole Bell and their teams!



University of Melbourne
@UniMelb

April 2022

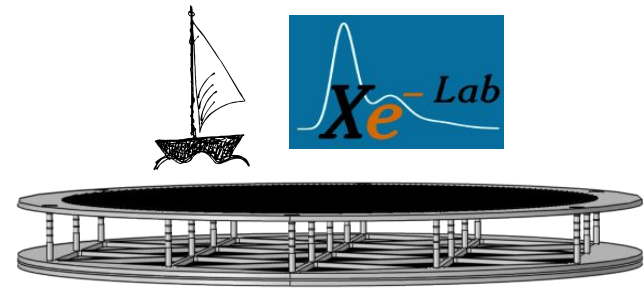
Five new joint PhD projects have just been announced as part of our partnership with @CNRS. Tap through to read more about the partnership and see the full list of projects.



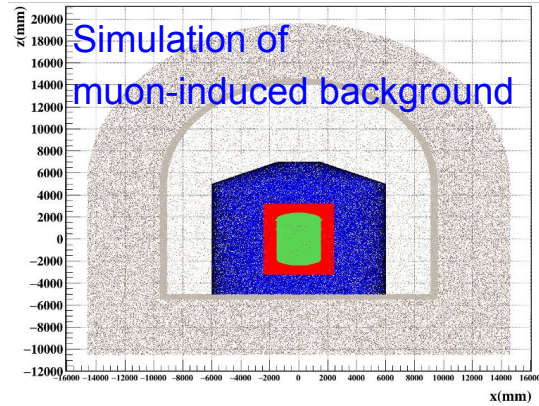
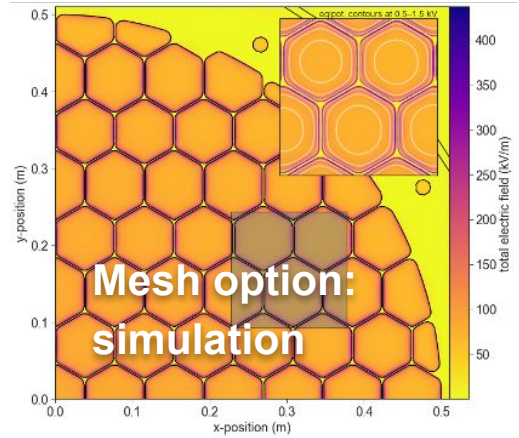
Next meeting: Nov @UniMelb

- 51 cofinancing Partners (22 Implementing, 15 Associated academic, 14 Associated non-academic) in both countries.
- All DCs will be dual-enrolled in doctoral degrees at both French (FR) and Australian (AU) University Partners with co-supervision under Cotutelle agreements

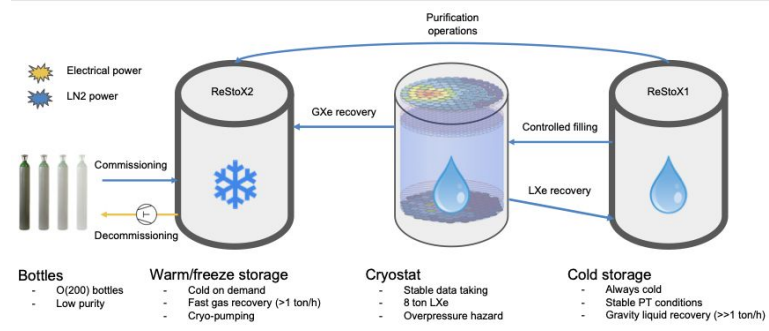




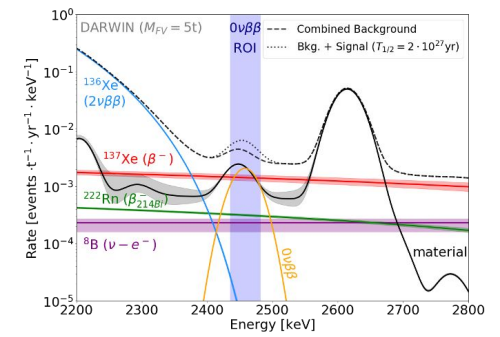
XeLab Project:
see N.Garroum and Y. Xing talk



Storage & Recovery



Neutron capture (¹³⁷Xe) for neutrino physics



- **XENONnT is the current XENON Project phase. First results published (see E.Masson talk) and stay tuned for the next to come**
- **Next step is DARWIN: currently in its R&D phase**
- **Wide variety of physics goals: from DM to neutrino physics**
- **Enlarged community with LZ → The XLZD Consortium**
- **XENON-France currently highly involved on management and R&D**
- **DARWIN present in many CNRS/IN2P3 International Labs. We want you to grow the French community and profit of your expertise in low background experiments!**
- **DARWIN “Light TDR” will be prepared in 2023. Strategic to join now**