XENON Program

Patrick Decowski

Dark Matter Group

Joran Angevaare
IoP - PhD
Start Jan’19

Stefan Brünner
Nikhef - Postdoc
Start Aug’19

Peter Gaemers
Nikhef - PhD
Start Apr’18

Alvaro Loya Villalpando
IoP - PhD
Start Nov’19

<u>MSc students:</u>

- **Olivier Kesber**
- **Gijs Leguijt**
- **Frederick van der Meulen**
- **Davey Oogjes**
- **Leonora Verveld**
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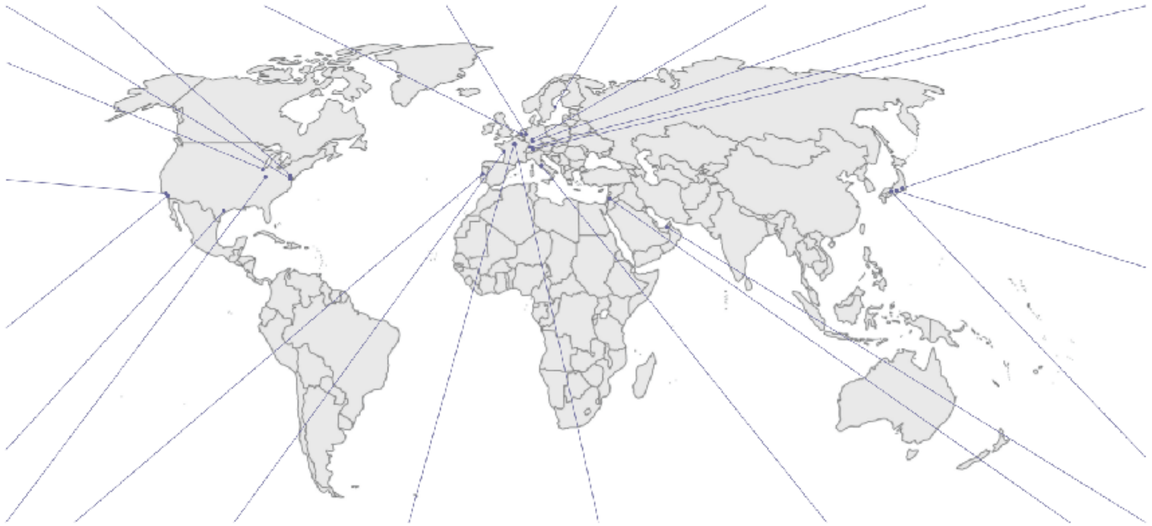
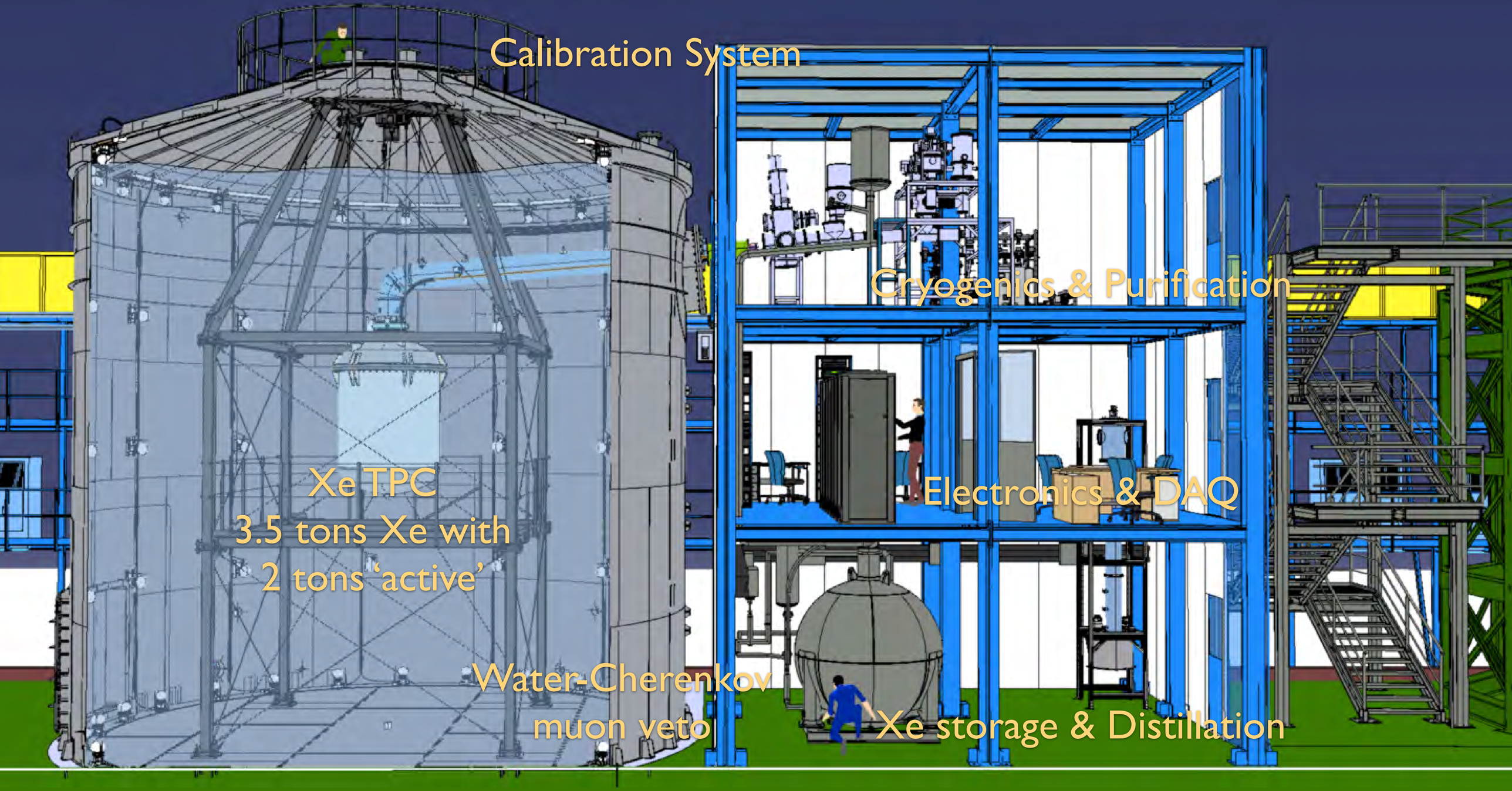
27 institutes,
150 scientists

XENON
Dark Matter Project

Columbia · RPI · Nikhef · Muenster · Stockholm · Mainz · MPIK · Freiburg · Zurich



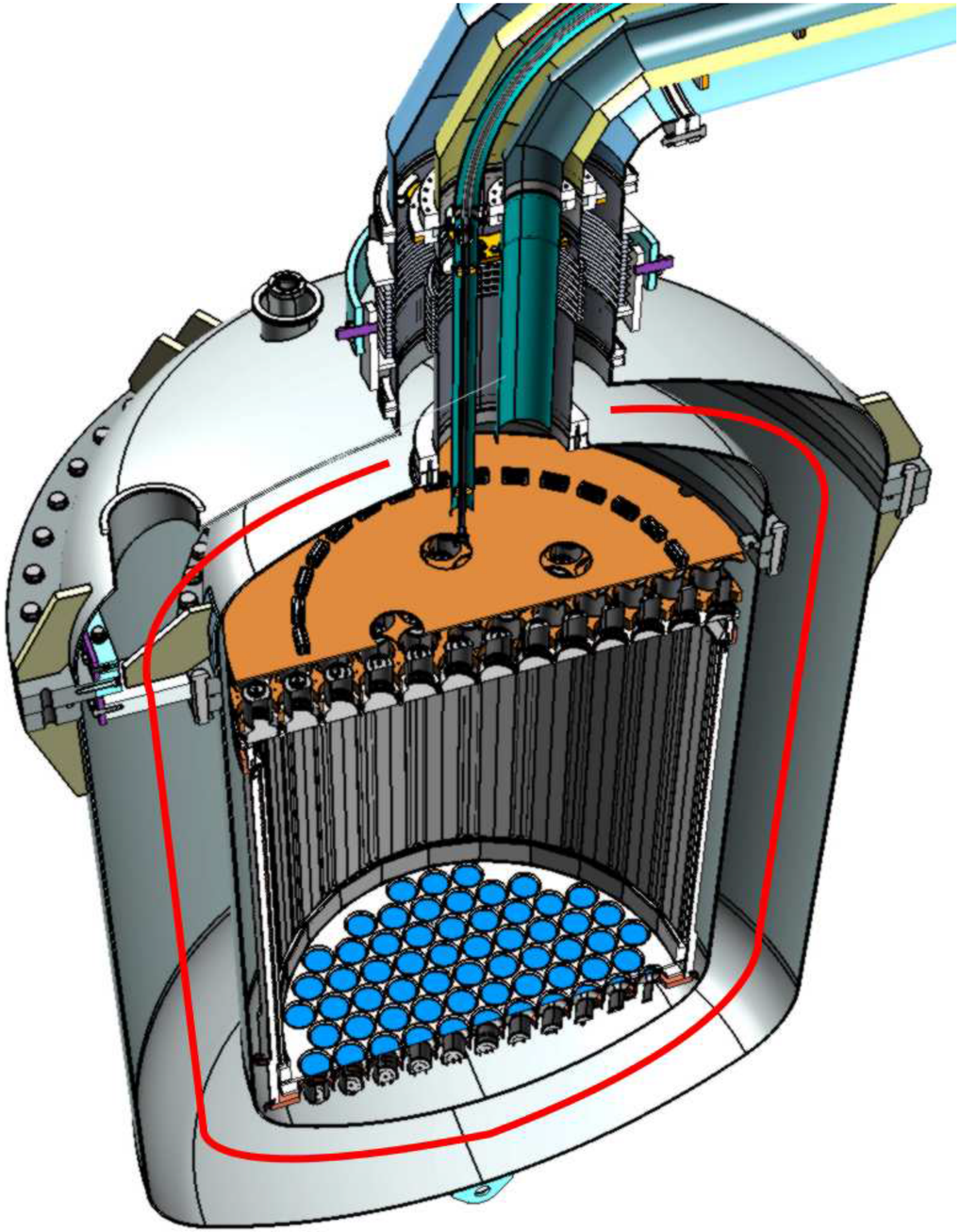
Chicago · Tokyo · UCLA · Nagoya · UCSD · Kobe · Rice · Purdue · Coimbra · Subatech · LPNHE · LAL · Bologna · LNGS · Torino · Napoli · Weizmann · NYUAD


Calibration System
Cryogenics & Purification
Electronics & DAQ
Xe TPC
3.5 tons Xe with
2 tons 'active'
Water-Cherenkov
muon veto
Xe storage & Distillation


Xe
XENON
Matter Project
XENON1
enlightening the

TPC assembly during Fall 2015

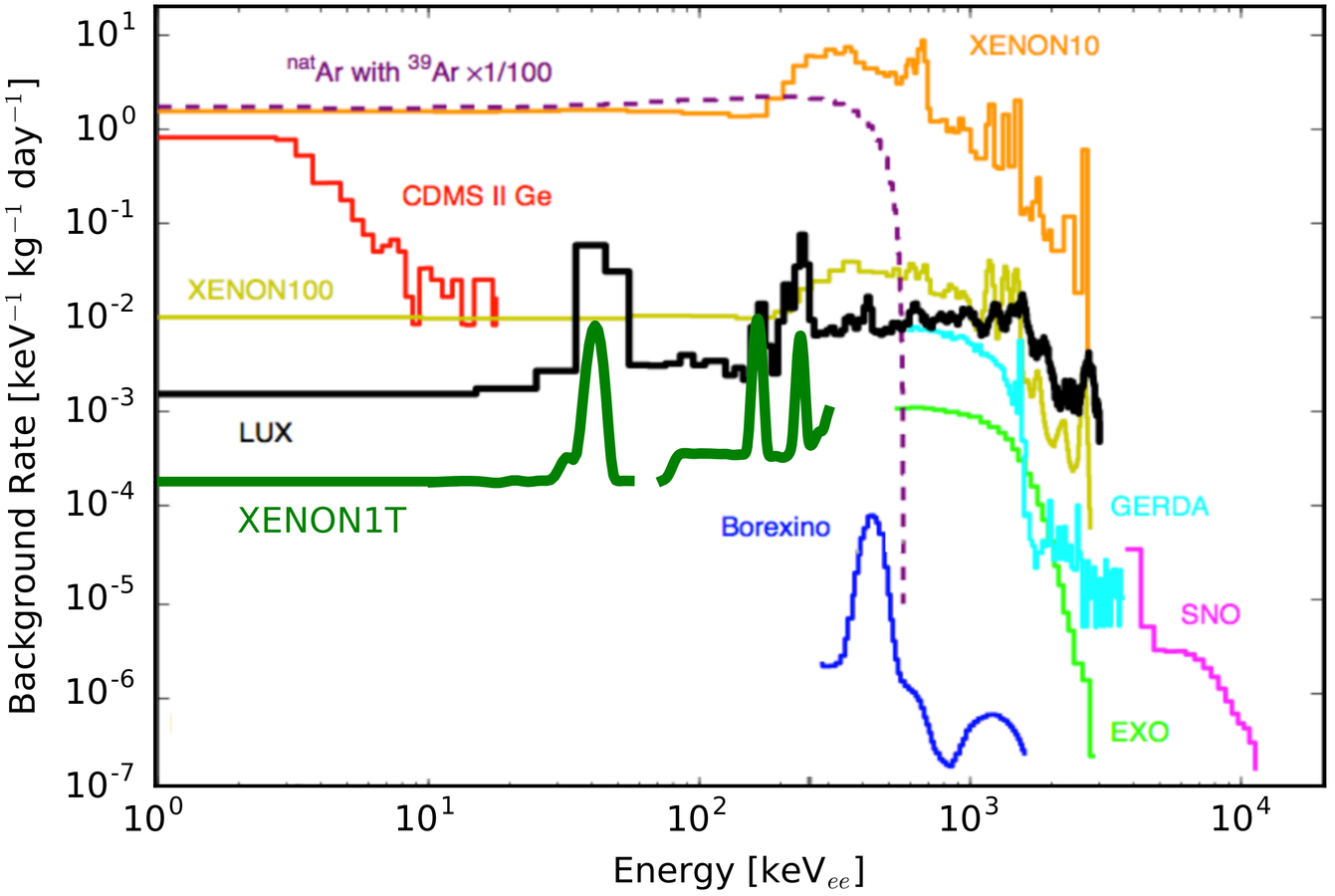
From XENON1T to XENONnT



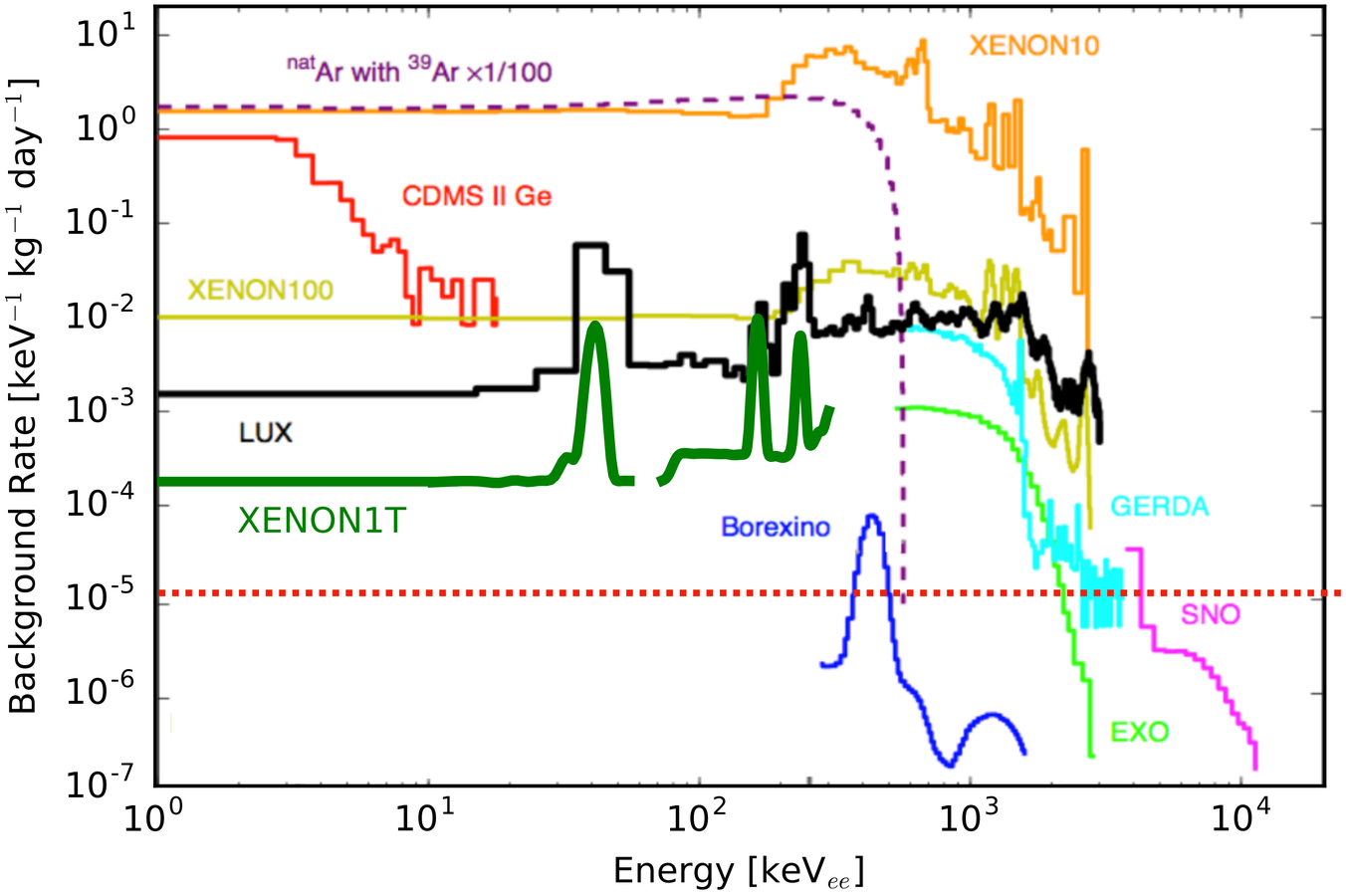
- Reuse most of XENON1T
- Larger inner cryostat vessel
- New TPC
  - Additional ~250 PMTs (494 total)
  - Total of 8.4 tons of LXe
- 10x lower ^{222}Rn
- Neutron Veto System
- LXe purification
- Detector being built - Start in 2020

Similar efforts: LZ (USA), PandaX-xT (China)

Lowest Background of any DM experiment

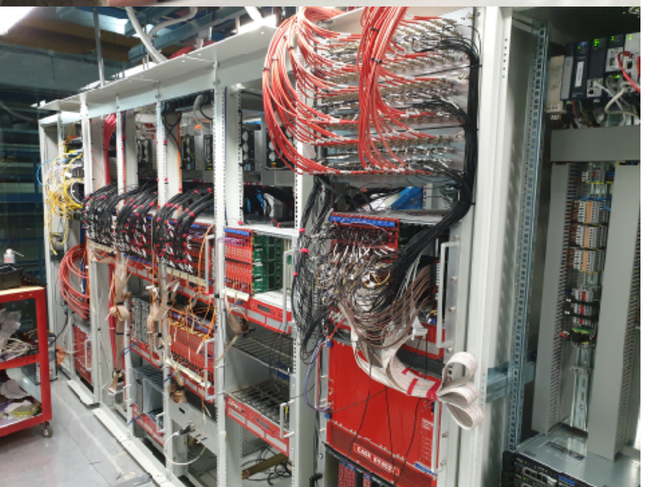


Lowest Background of any DM experiment



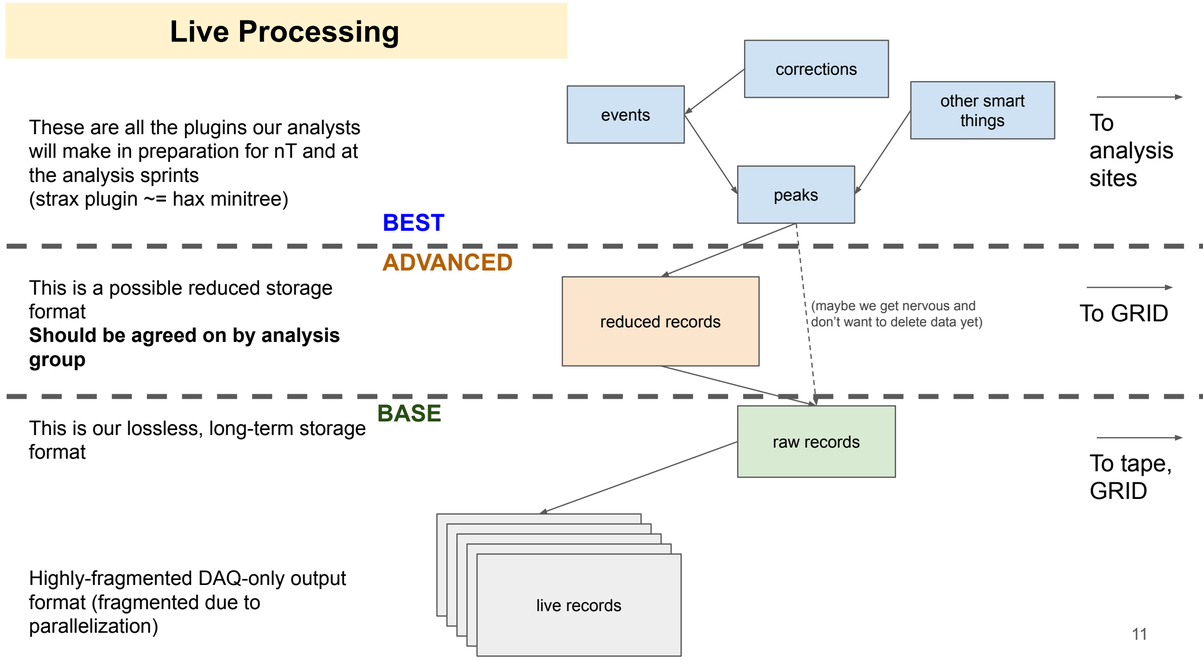
Aim XENONnT
>10x lower BG

PhD Sander Breur



Upgraded DAQ System

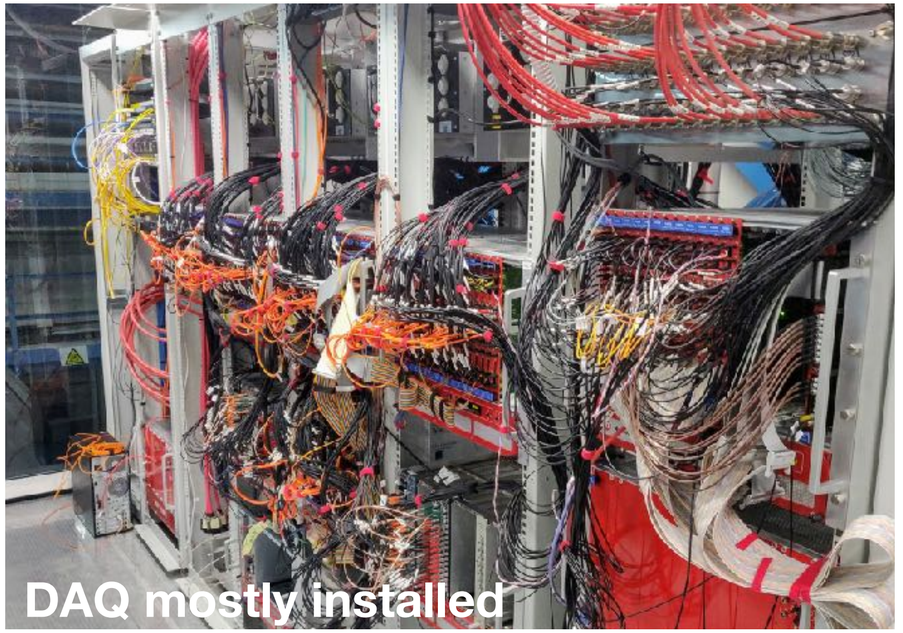
- “Triggerless” DAQ - all signals readout continuously
  - Lower thresholds & new event signatures
- Two different gain readouts
  - “Dark Matter”: ~10 keV
  - 0ν2β: 2.5 MeV

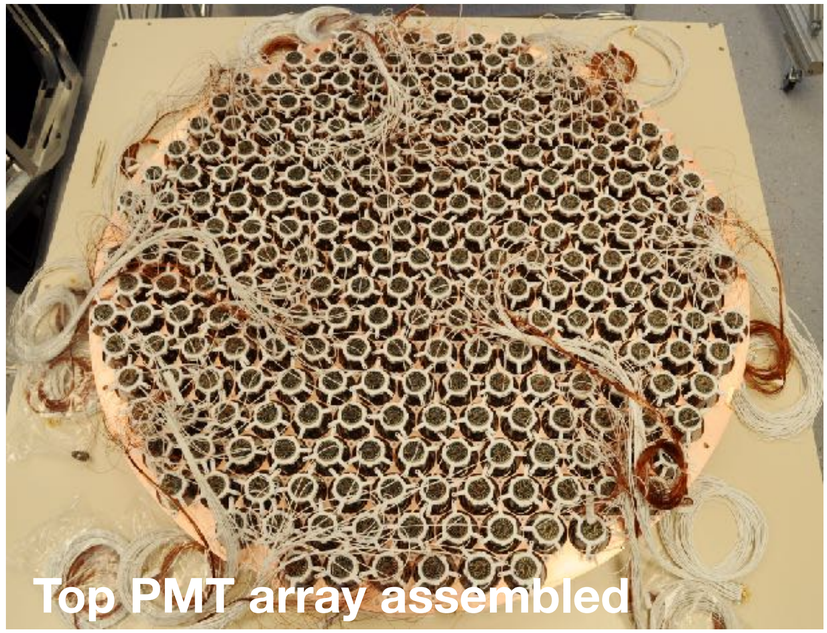


XENONnT Installation Ongoing

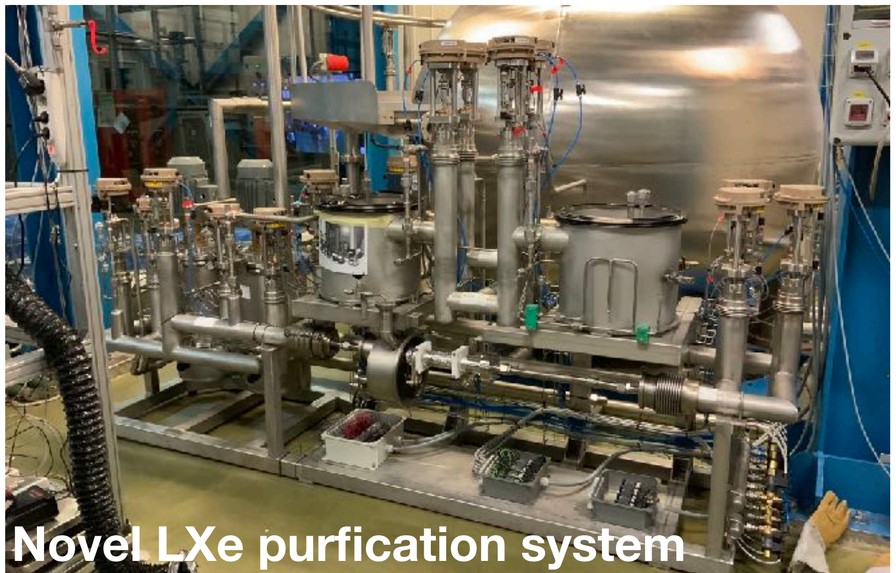
On schedule for a start in early 2020!


Test of Grids in LXe

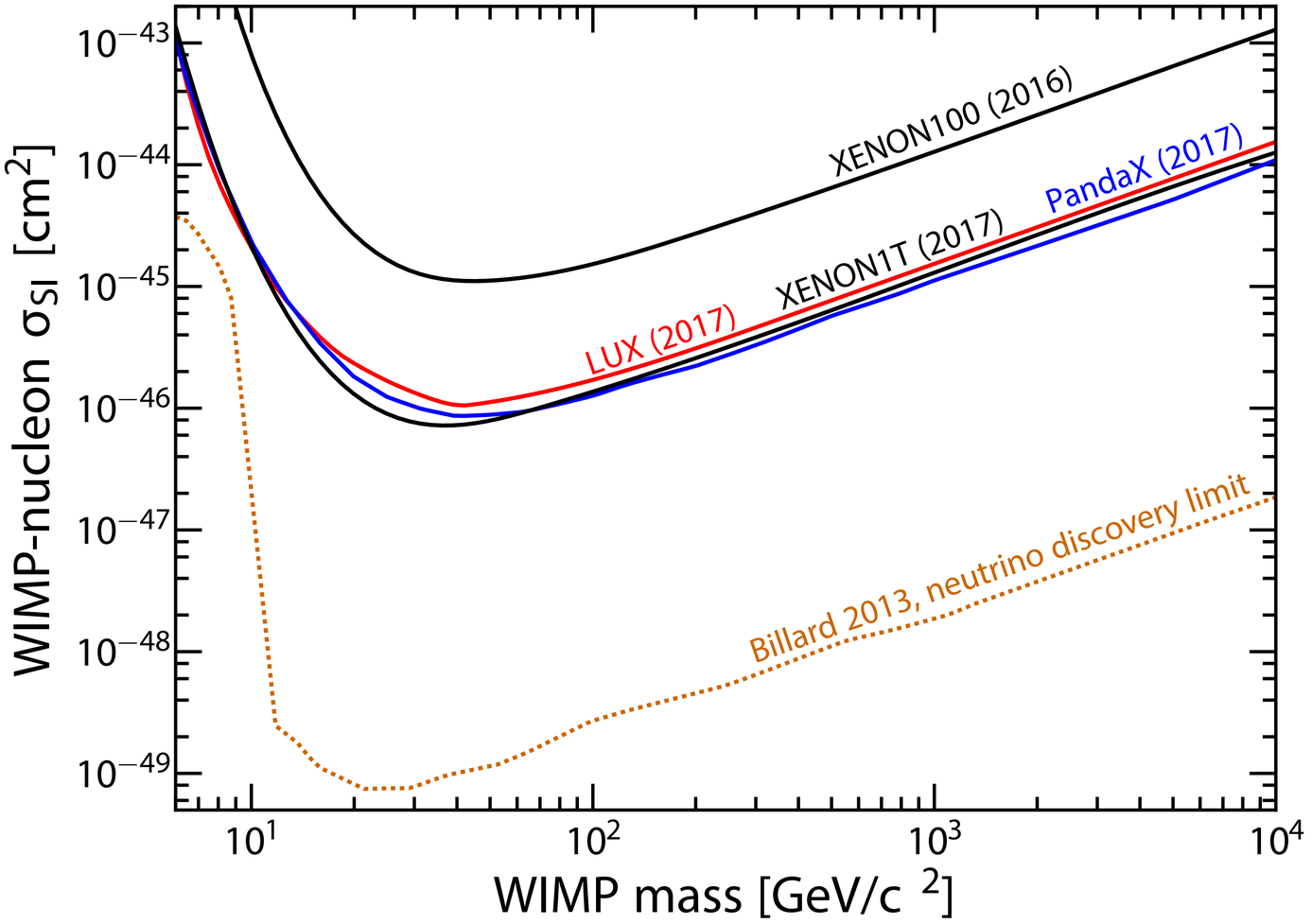

DAQ mostly installed


Top PMT array assembled


Cryostat Modified


Novel LXe purfication system

XENON1T: 1 ton x year Exposure



PRL 121, 111302, arXiv:1805.12562

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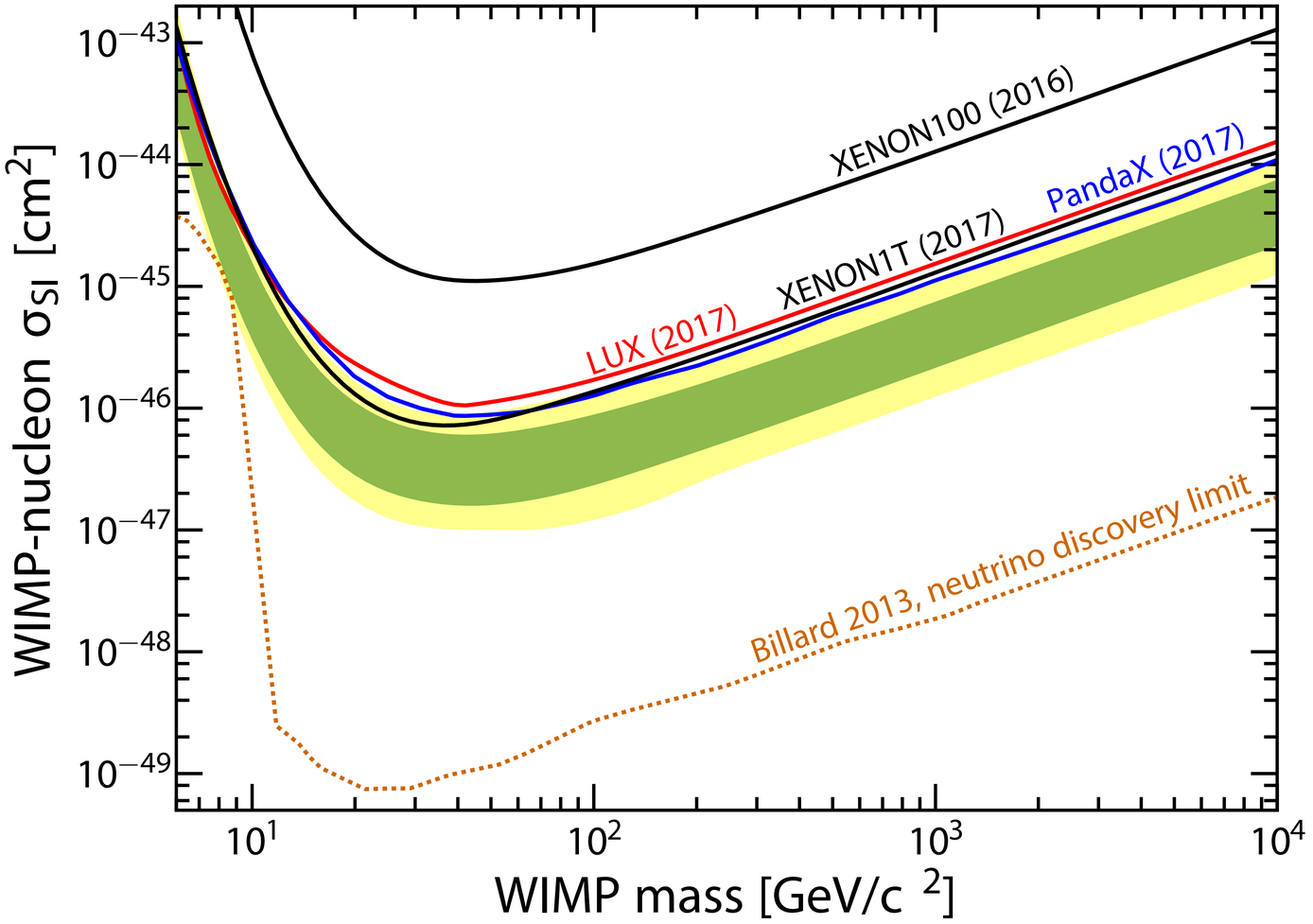

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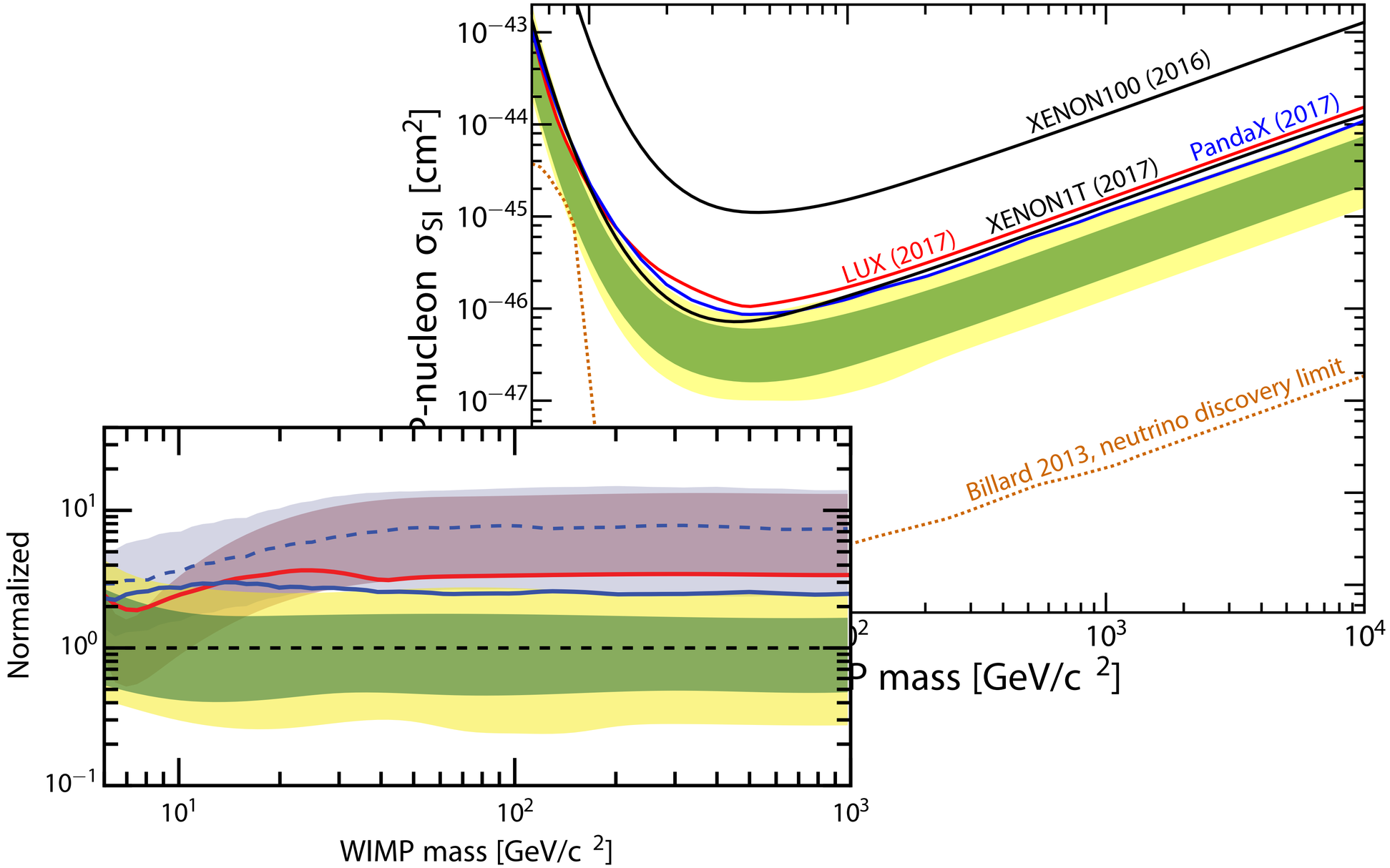

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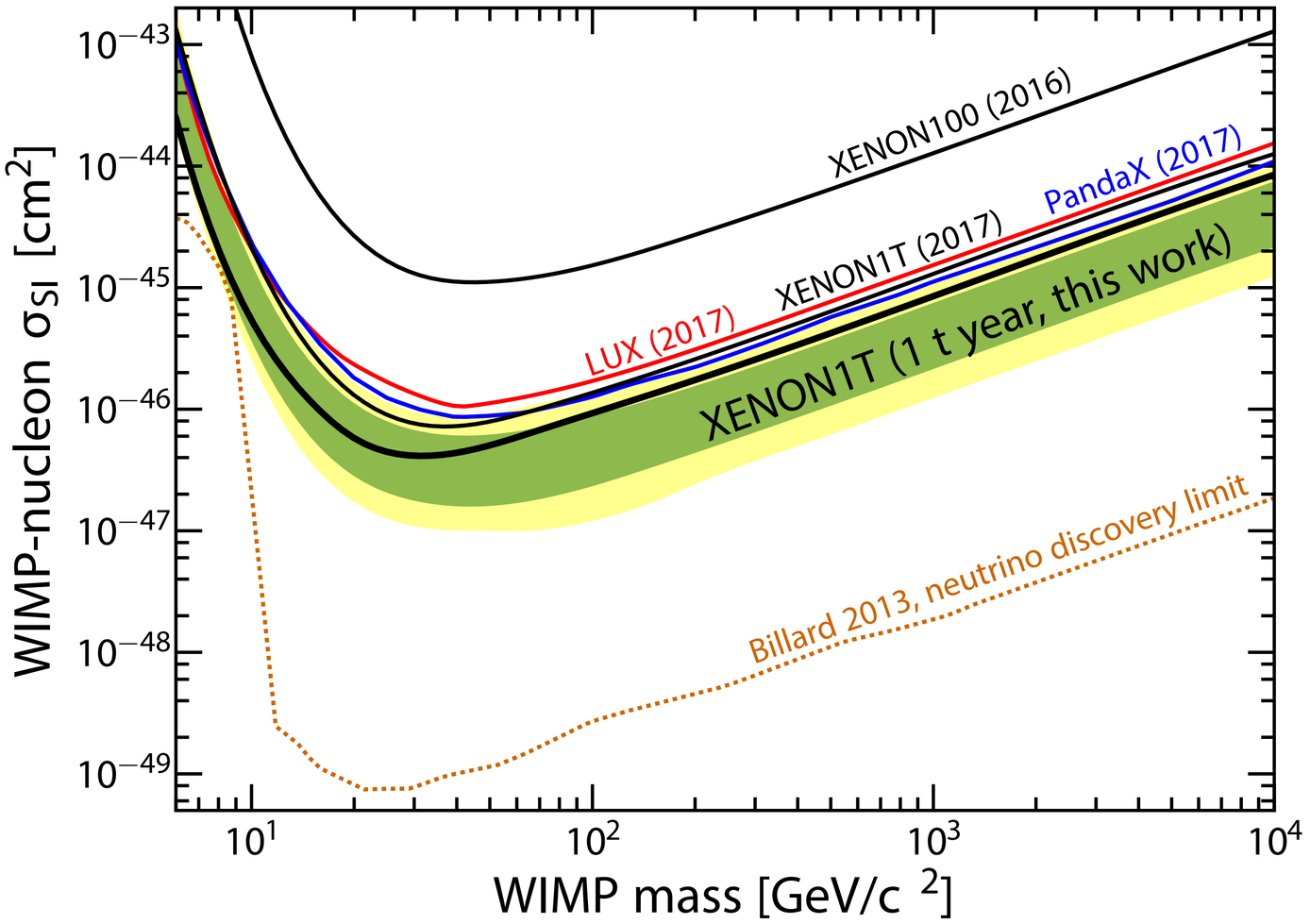

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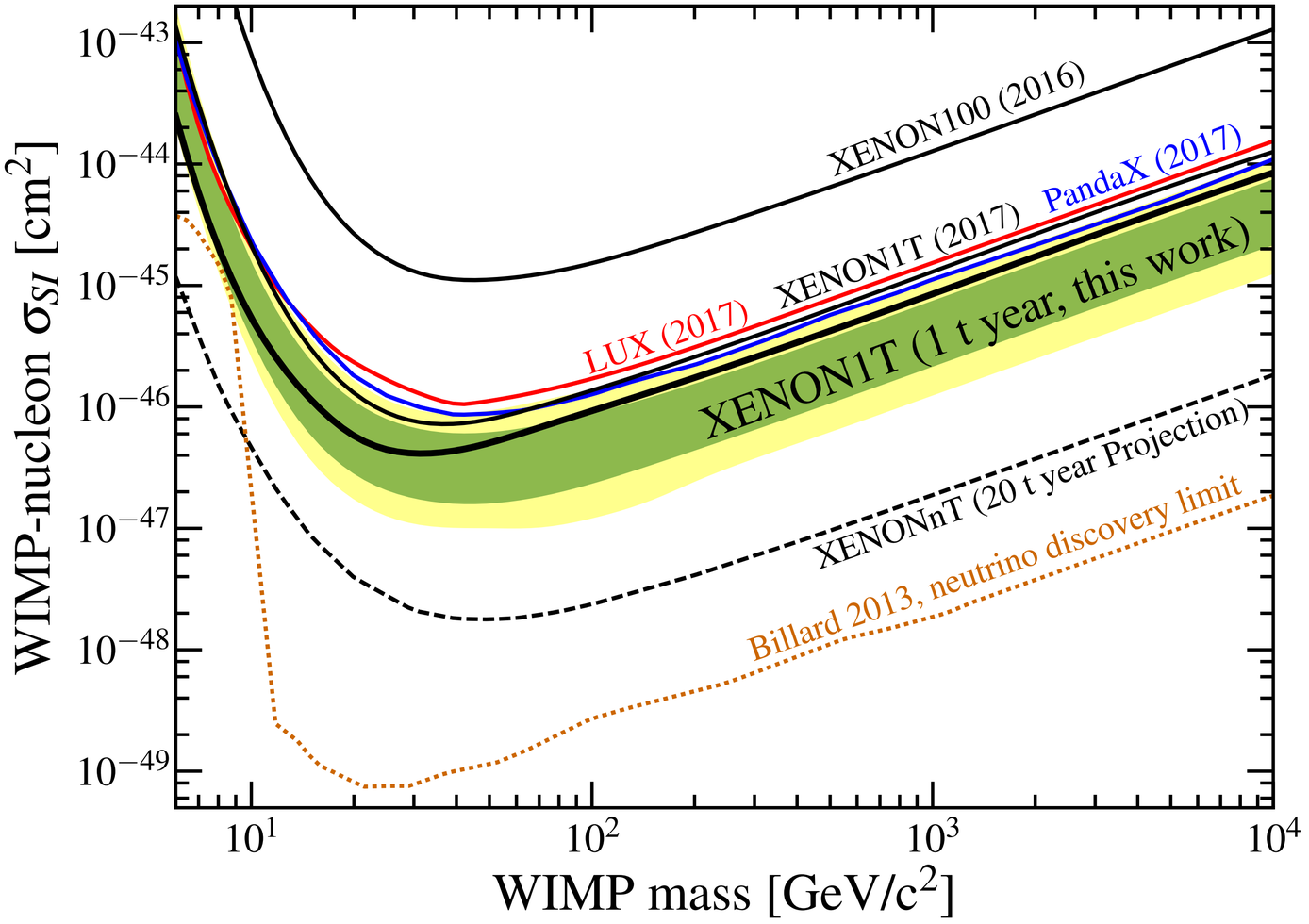

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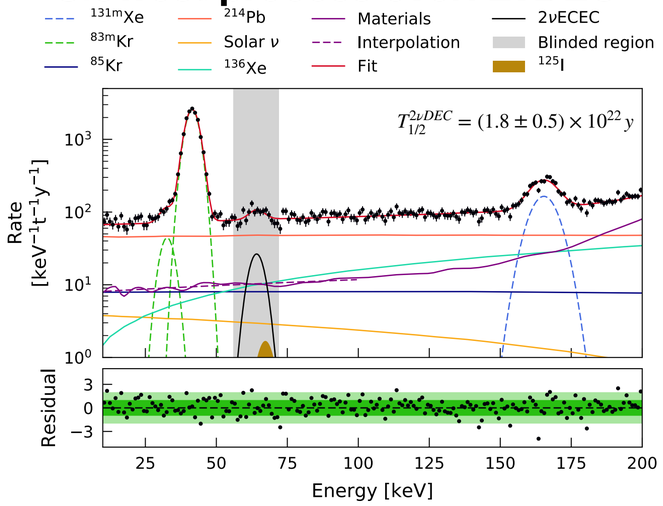
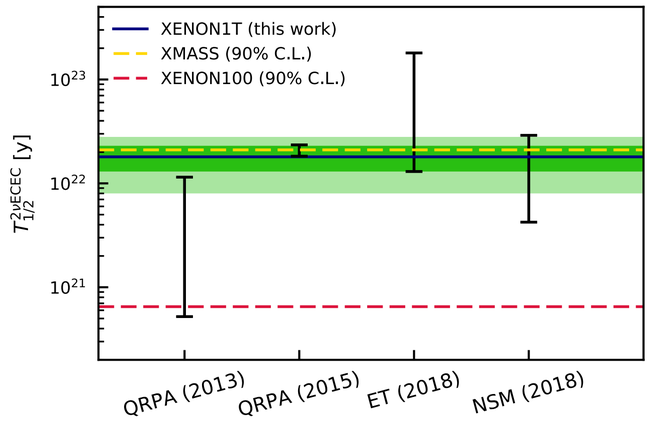
Other XENON1T Analyses Ongoing

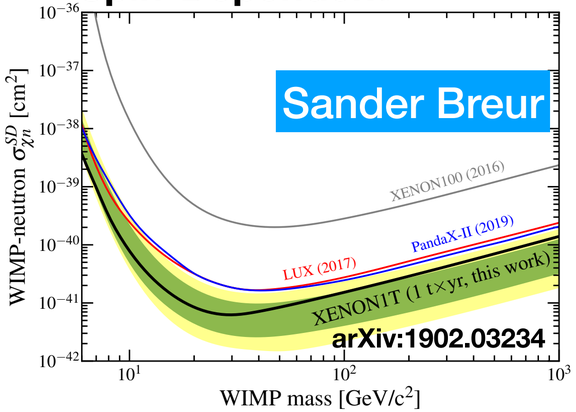
Slowest process ever: 2vDEC





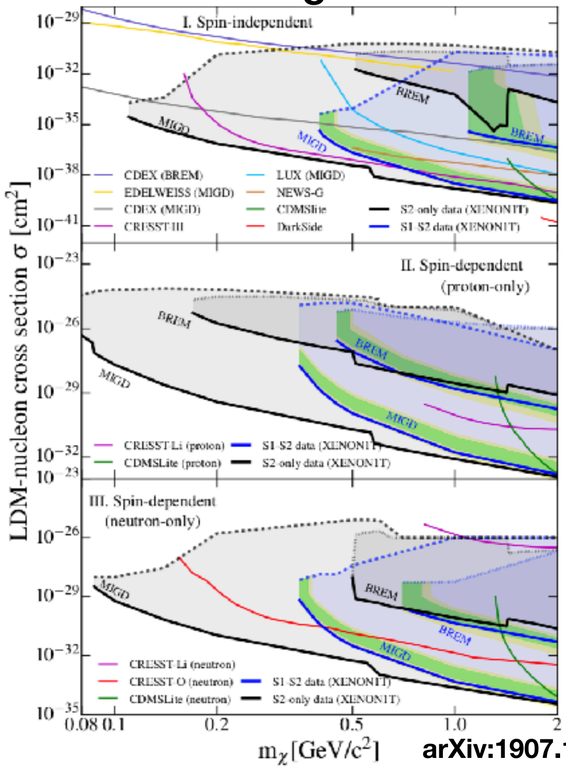
arXiv:1904.11002

Spin-Dependent



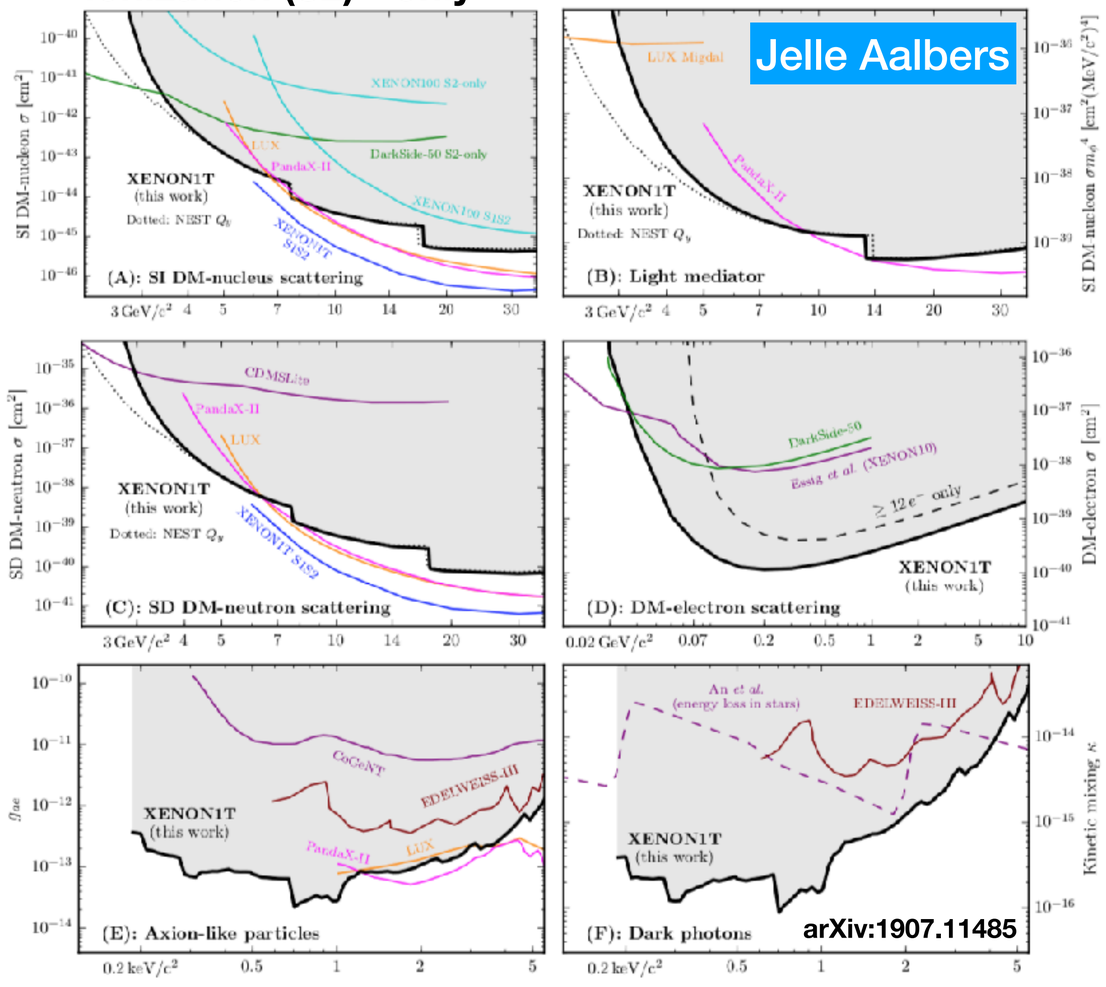
arXiv:1902.03234

Brems + Migdal



arXiv:1907.12771

Ionization (S2) - only



arXiv:1907.11485

Physics Channels

As detector size increases physics channels open up

- **WIMP searches** — NR
  - Spin-independent
  - Spin-dependent and inelastic interactions
- **Solar axions, galactic axion-like particles (ALPs), sterile ν** — ER
  - Alternative dark matter candidates
  - Coupling to electrons via axio-electric effect
- **Supernova neutrinos** — NR
  - Sensitivity to all neutrino flavors (via CNNS)
  - Complementarity to large-scale neutrino detectors
- **Coherent neutrino-nucleus scattering (CNNS)** — NR
  - Predicted by SM, *only very recently observed!*
- **Low-energy solar neutrinos: pp, ^{7}Be** — ER
  - Test/improve solar model, test neutrino models
- **Neutrinoless double beta decay** — ER
  - Lepton number violating process, effective Majorana mass
  - No enrichment in ^{136}Xe required

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NWO VP Program

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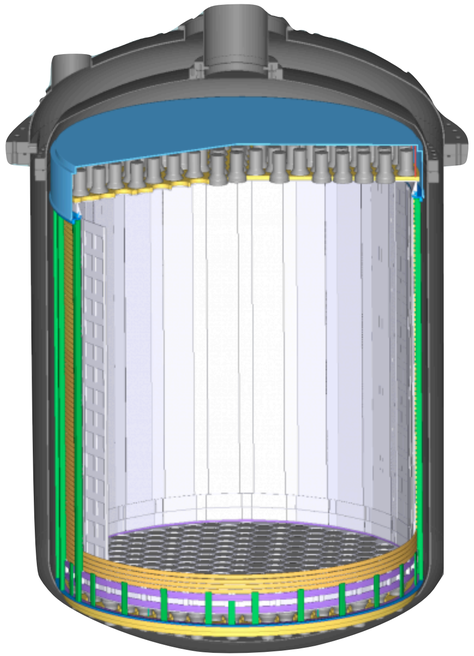
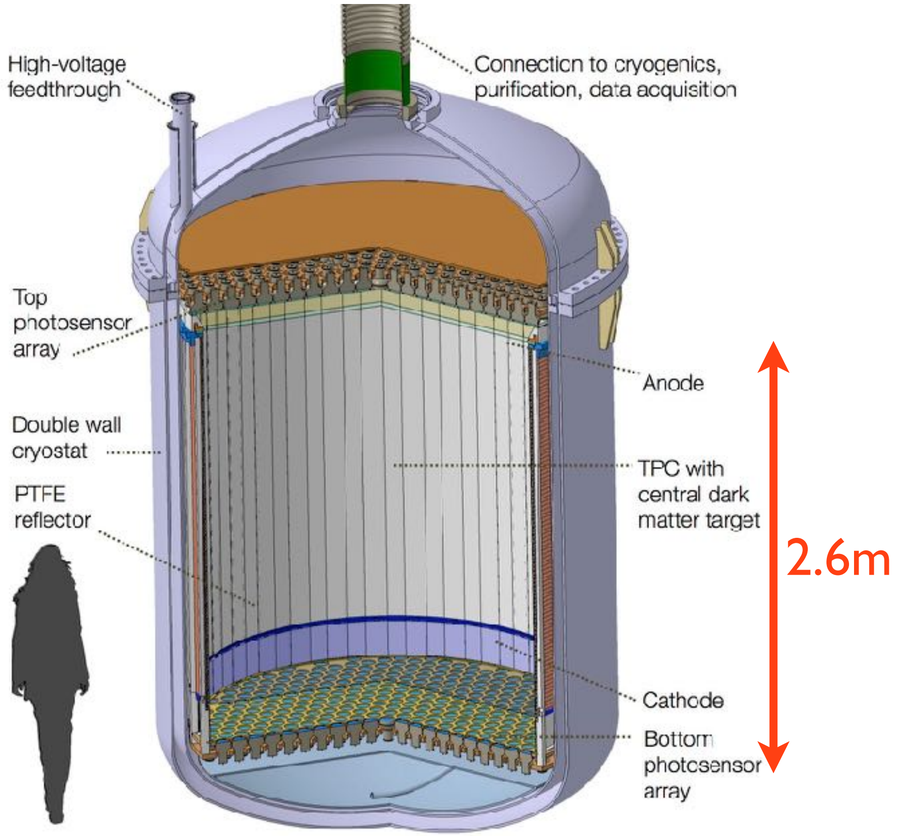
Even larger Xe detectors



XENONnT

8t of LXe total
Reuse a lot of XENON1T infrastructure
Start in 2020



DARWIN

50t of LXe total
Global effort
Start in 2025