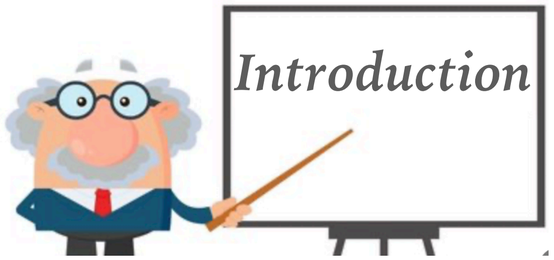
The XENONnT Experiment

Aaron Higuera
On behalf of the XENON collaboration

Outlook



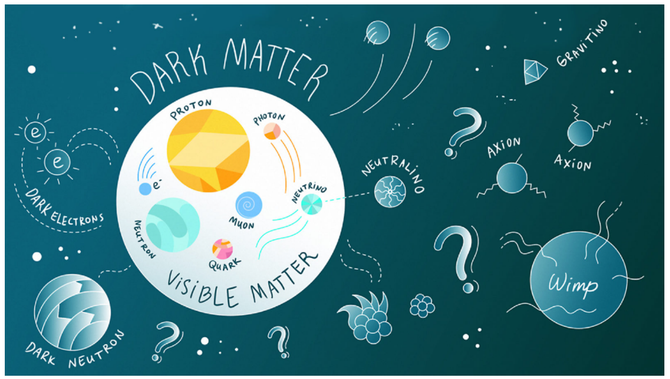
- Dark Matter
- Direct Dark Matter search
- Dual-phase TPC detector

- The XENON Collaboration
- XENONnT Experiment
- XENONnT Systems

- XENONnT Experiment Commissioning
- XENONnT Physics Program

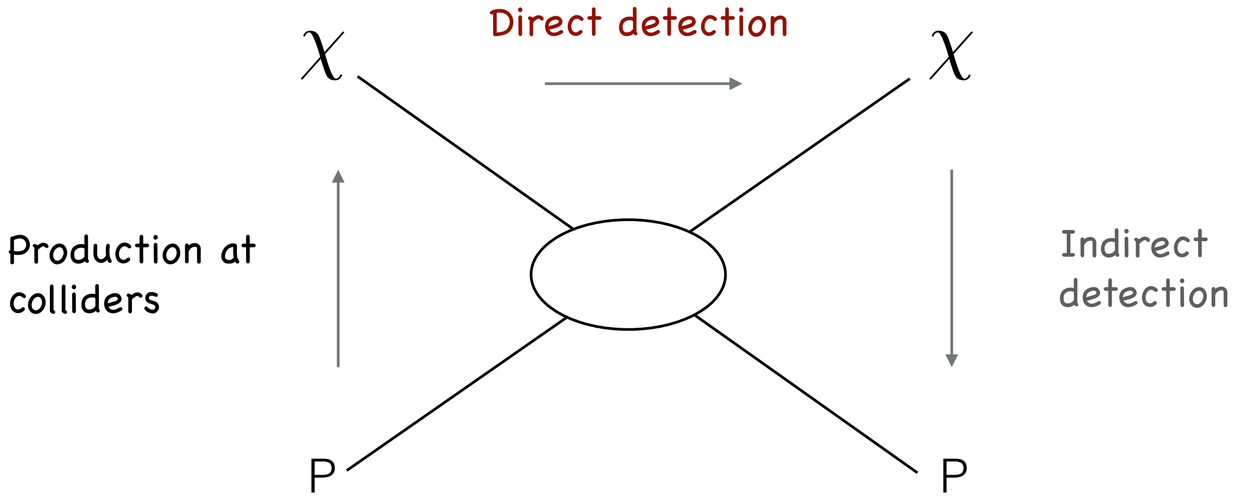
Dark Matter

- Observational evidence
  - Gravitation lensing
  - Galaxy cluster
  - Galaxy rotation
  - Cosmic microwave background
  - …

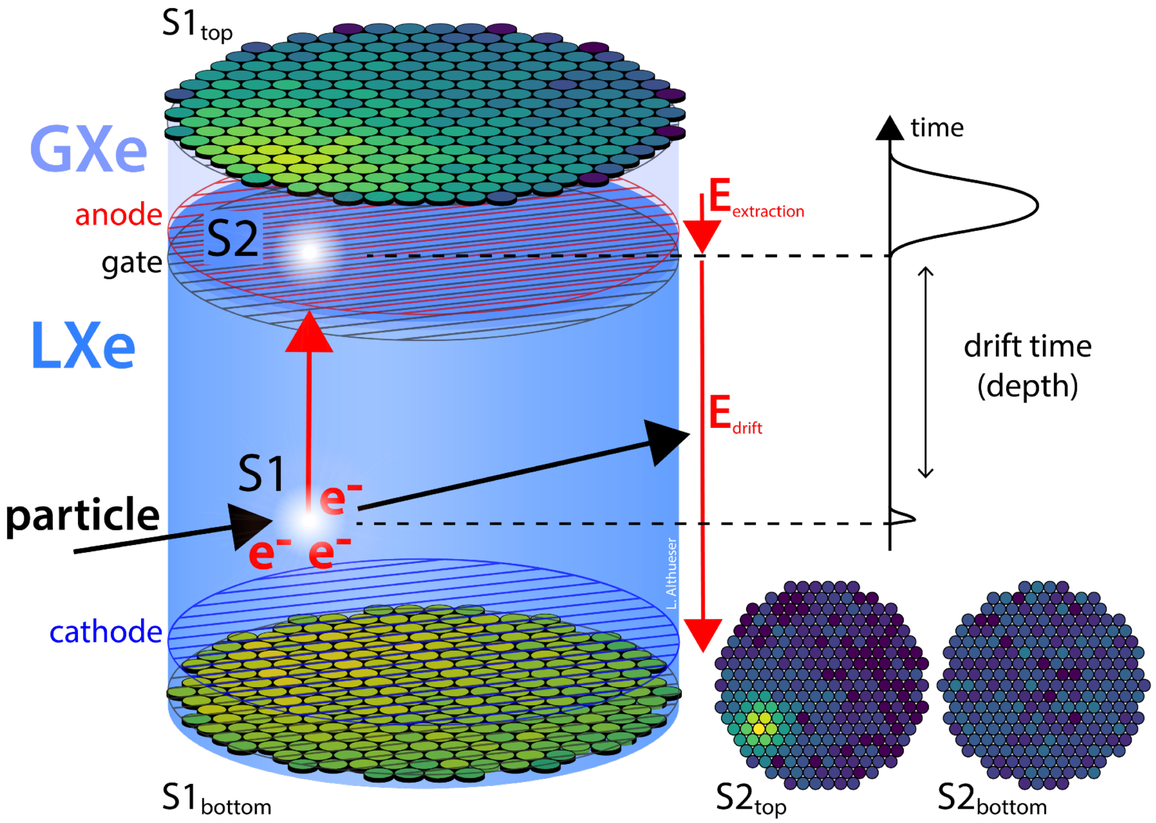


symmetry magazine

- DM Searches
  - Produce DM from ordinary matter
  - Observe visible decay products of annihilation of dark matter and anti-dark matter
  - **Elastic scattering of dark matter particles (direct detection)**



Dual Phase TPC



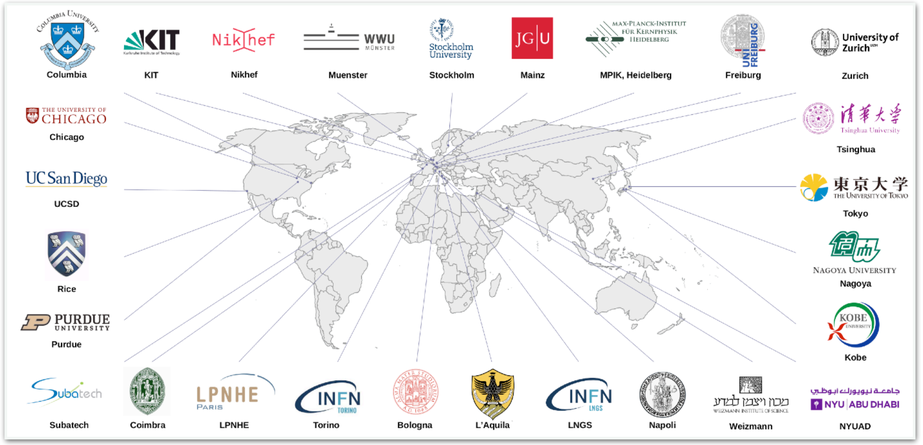
- Liquid and gas phase
- Electric field
- Photon detectors (PMTs) top and bottom
- Prompt signal (S1): from scintillation (UV light)
- Delayed signal (S2): electrons drifted and extracted in the gas phase producing second scintillation
- This allows

  Particle ID $(S2/S1)_{NR,WIMP} < (S2/S1)_{ER}$

  Energy reconstruction

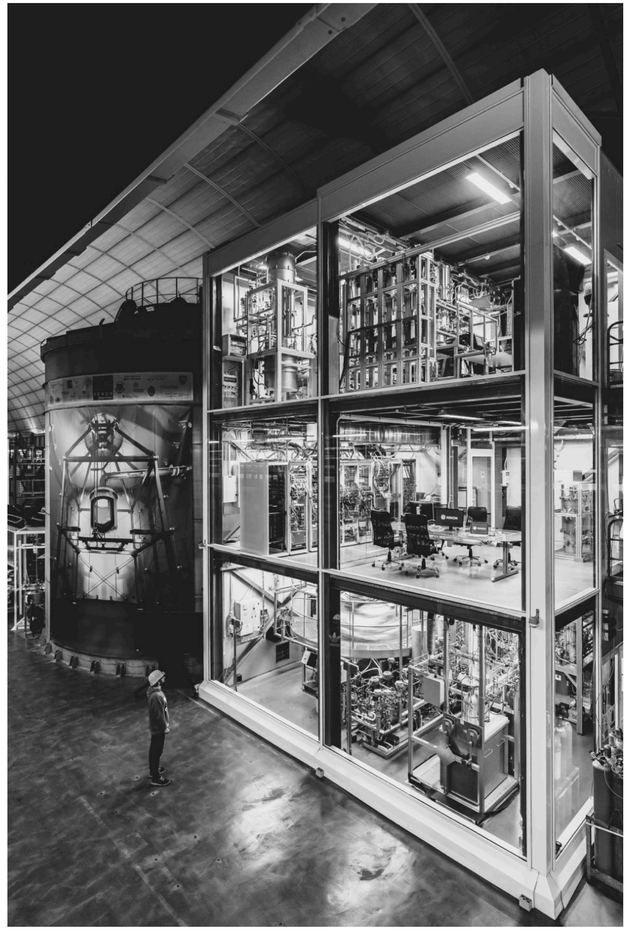
  3D position reconstruction (X, Y, Z)

The XENON Collaboration



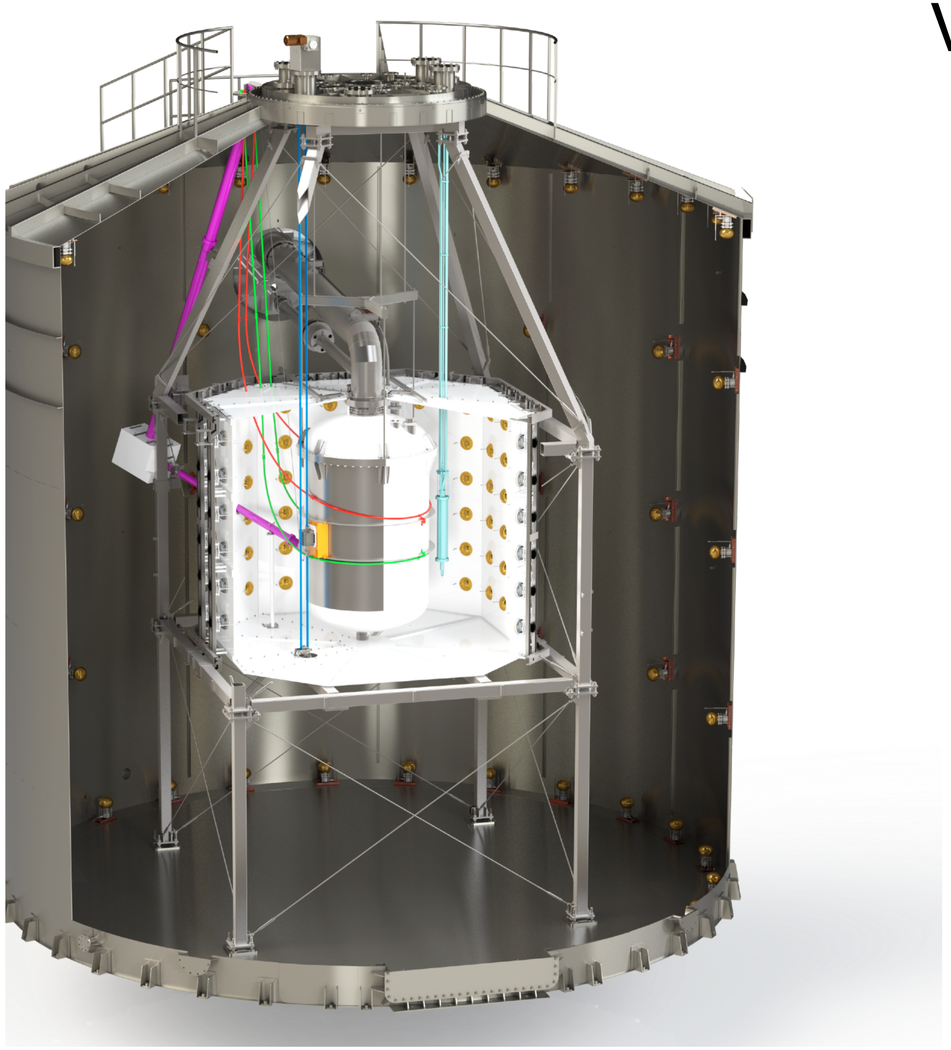
170 SCIENTISTS
&
27 INSTITUTIONS

	XENON10	XENON100	XENON1T	XENONnT
	2005	2008	2016	2020
Active mass	15 kg	62 kg	2.0 t	5.9 t
Background	~1000	5.3	0.2	* 0.04
Sensitivity	4.5×10^{-44}	1.1×10^{-45}	4.1×10^{-47}	* 1.4×10^{-48}



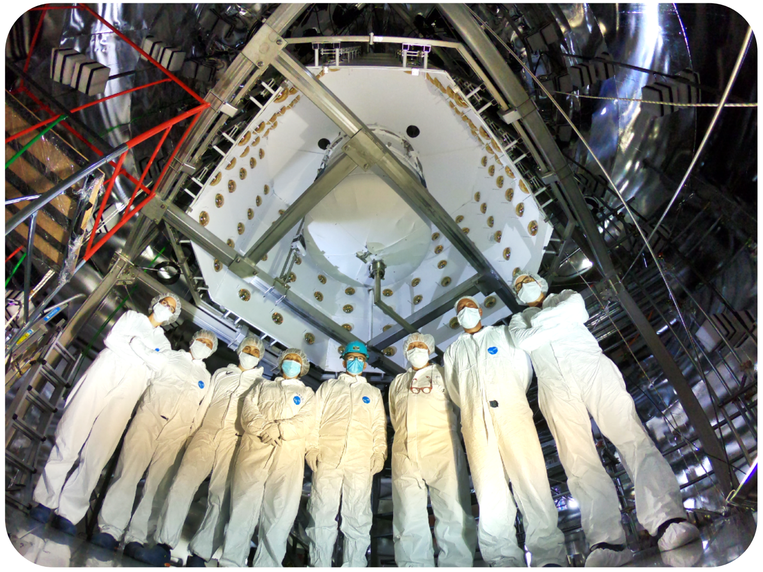
The XENONnT Experiment located at LNGS (Italy) underground laboratory (3600 m.w.e)

XENONnT Experiment

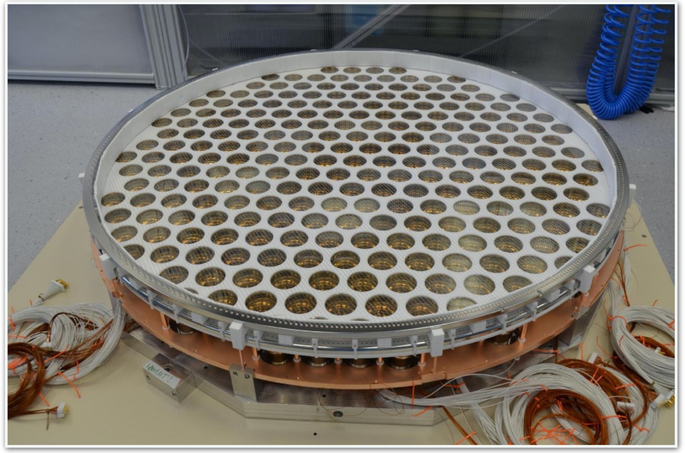


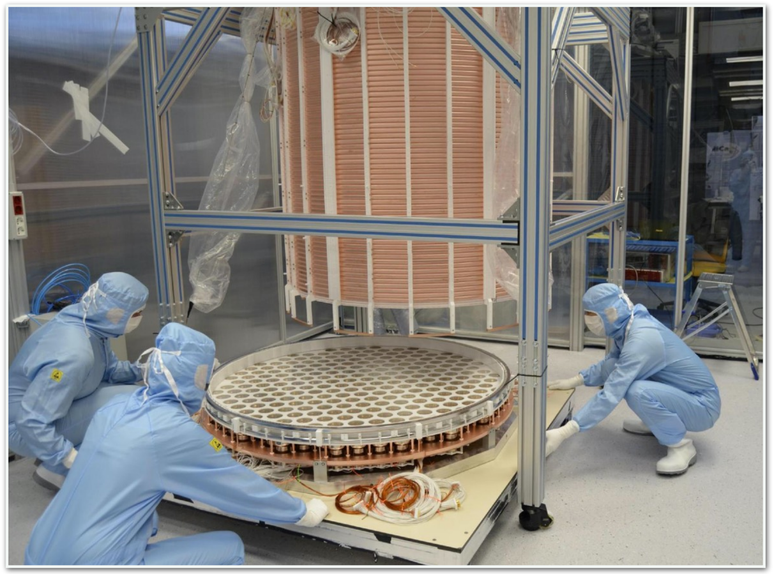
Veto Systems

- ☑ Muon veto
  - ✦ 700 tons of pure water
- ☑ **New Neutron veto**
  - ✦ Neutron background suppression
  - ✦ Gd-doped water Cherenkov detector
  - ✦ With 87% projected neutron tagging efficiency
  - ✦ Radiogenic neutron background in the ROI 0.041 $(ty)^{-1}$ vs 0.321 $(ty)^{-1}$ w/o neutron veto



XENONnT Experiment

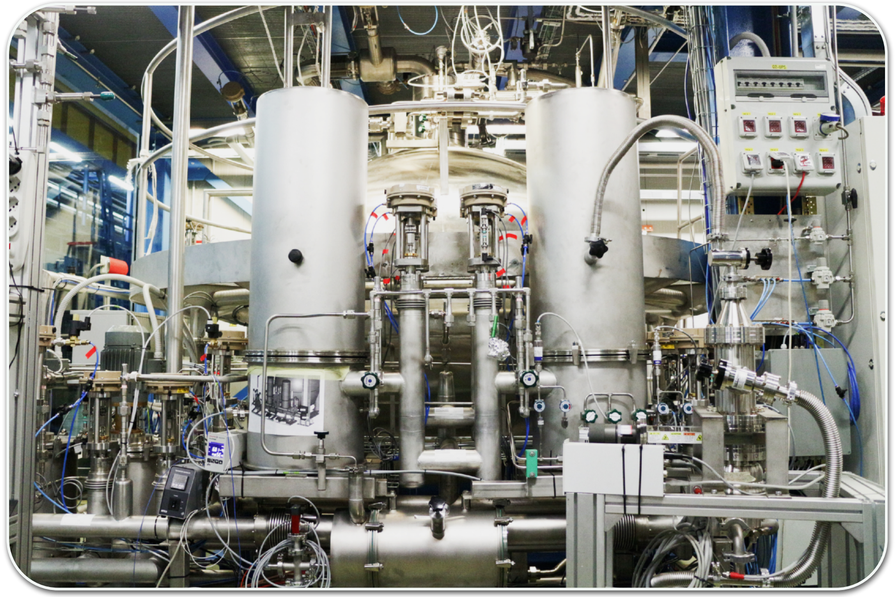




DP-TPC

- ☑ 8.6 tons of LXe
- ☑ 5.9 tons of active mass
- ☑ 494 PMTs
- ☑ 1.5 m drift length

XENONnT LXe Purification & Radon Removal



New Liquid Xe Purification System

- ☑ Fast flow rate
- ☑ Ultra low Rn emanation system
- ☑ New system improve signal detection thanks to better target purity

New Radon Removal System

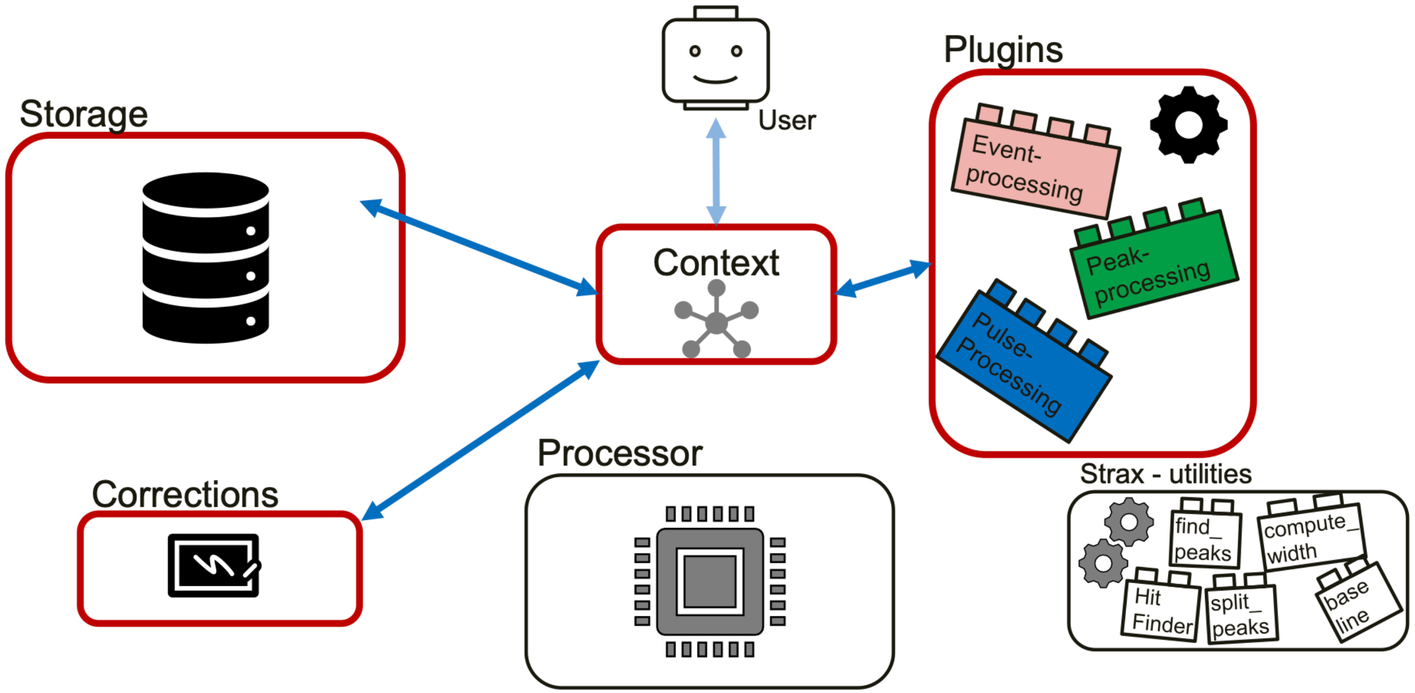
- ☑ Dedicated Rn cryogenic distillation column
- ☑ 1μBq/kg ^{222}Rn level (designed), improve over XENON1T (13μBq/kg)

XENONnT STRAX(EN)

STRAX/STRAXEN: STReaming Analysis for Xenon ExperimeNts

- ☑ Trigger-less
- ☑ Faster

  0.2 MB/s/core (pax) —> 60 MB/s/core (straxen)



XENONnT Commissioning

Despite challenging times, the XENON collaboration successfully completed the installation of the XENONnT experiment on the fall of 2020

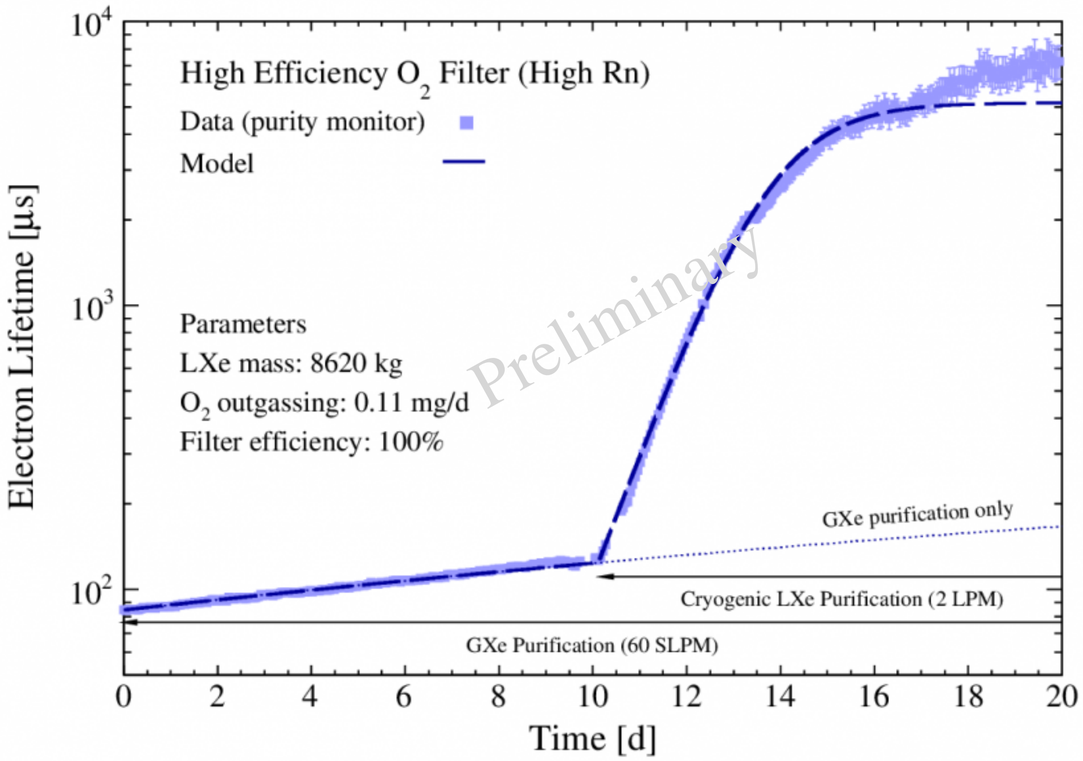
And start the commissioning early this year

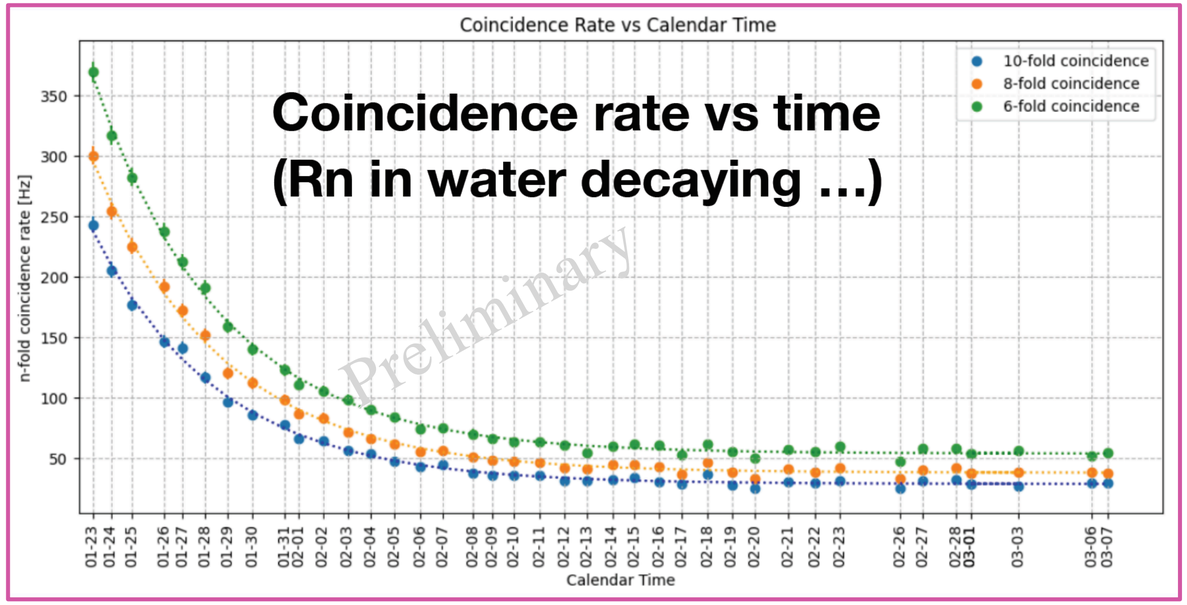
https://www.nytimes.com/

https://www.appec.org/news/

XENONnT Commissioning

Thanks to the new LXe purification system high purity has achieved (>7ms)

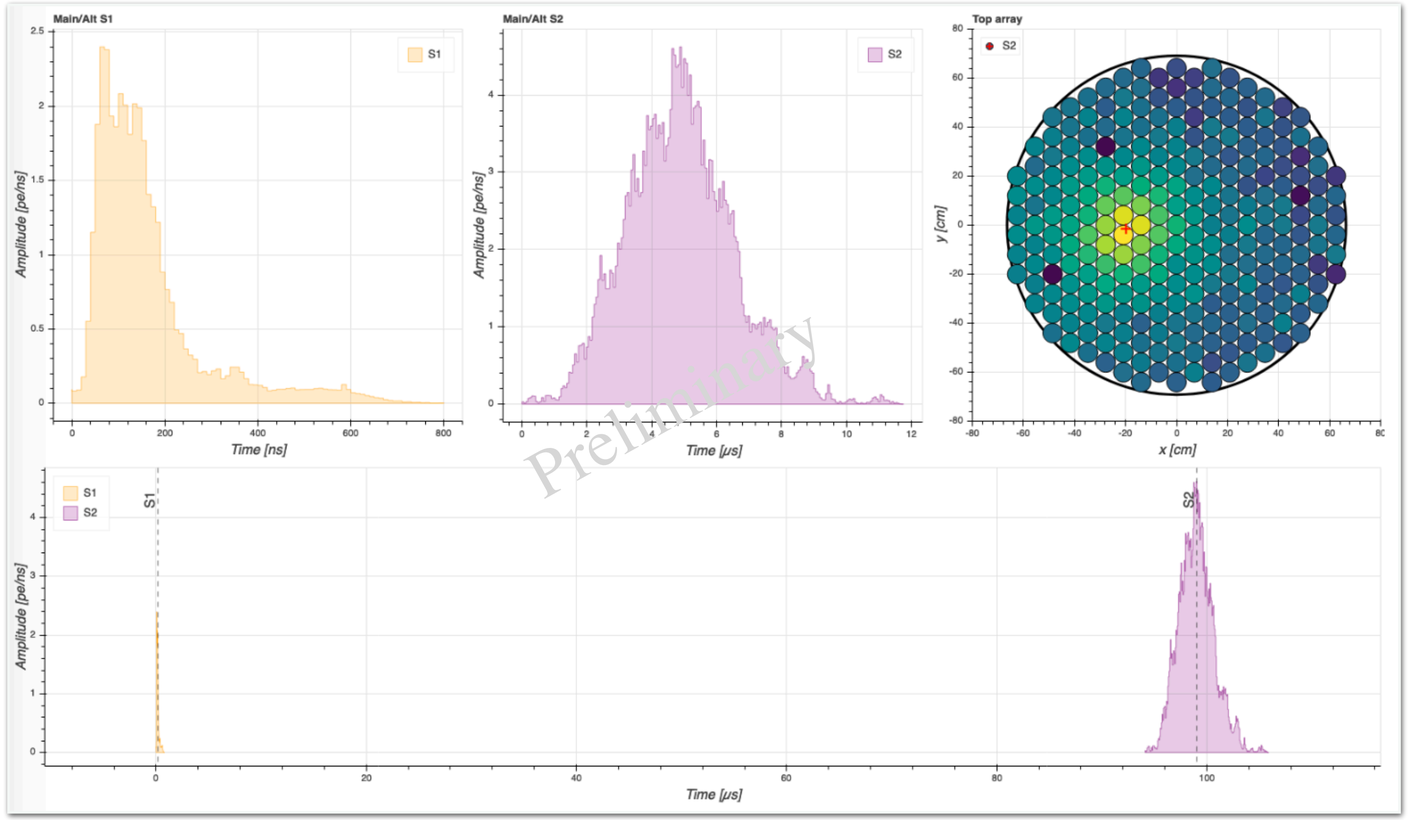


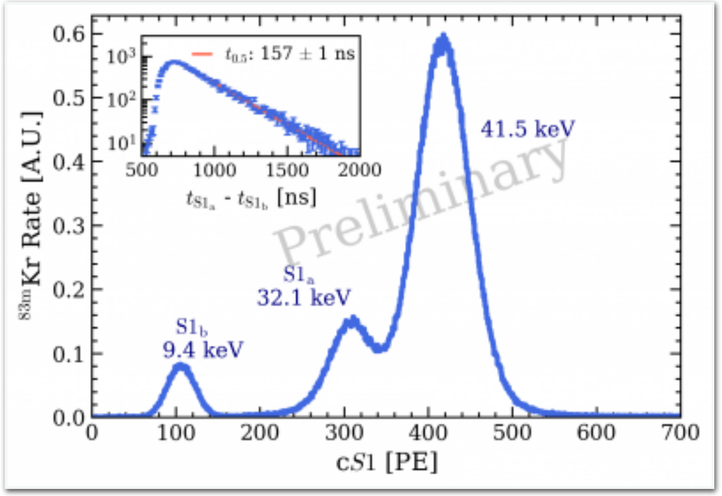


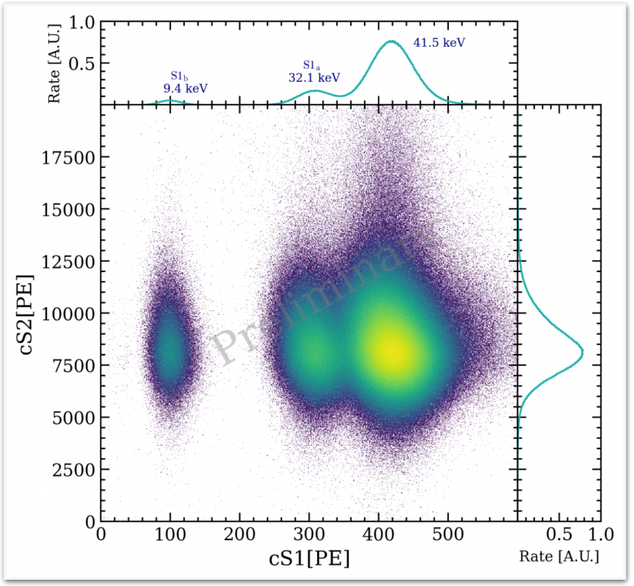
Commissioning of the neutron veto after filled with water

XENONnT Commissioning

S1 & S2 signals observed during TPC commissioning

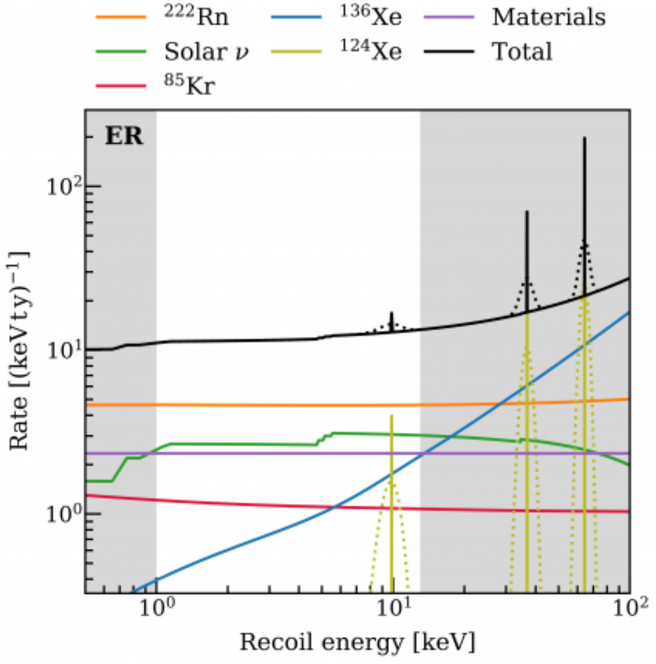


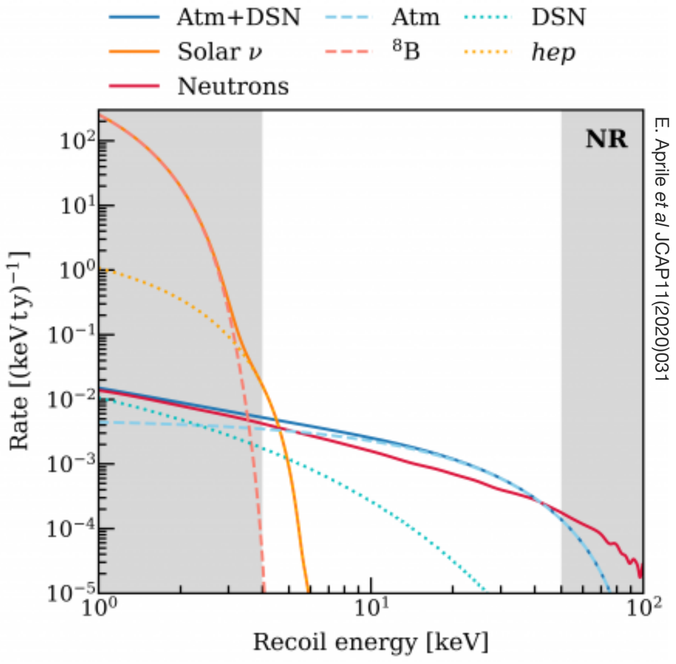


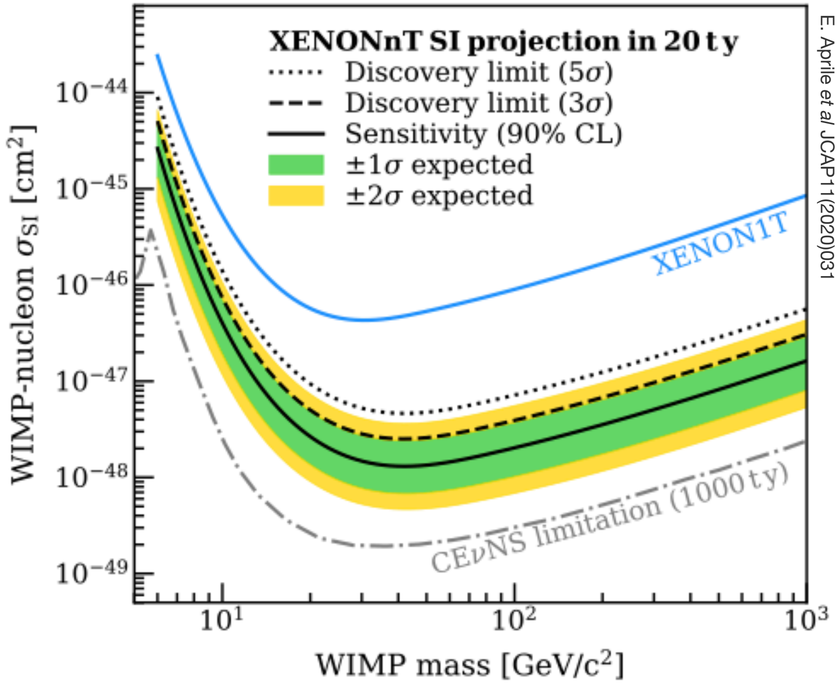


XENONnT Physics Program

Dark Matter direct search



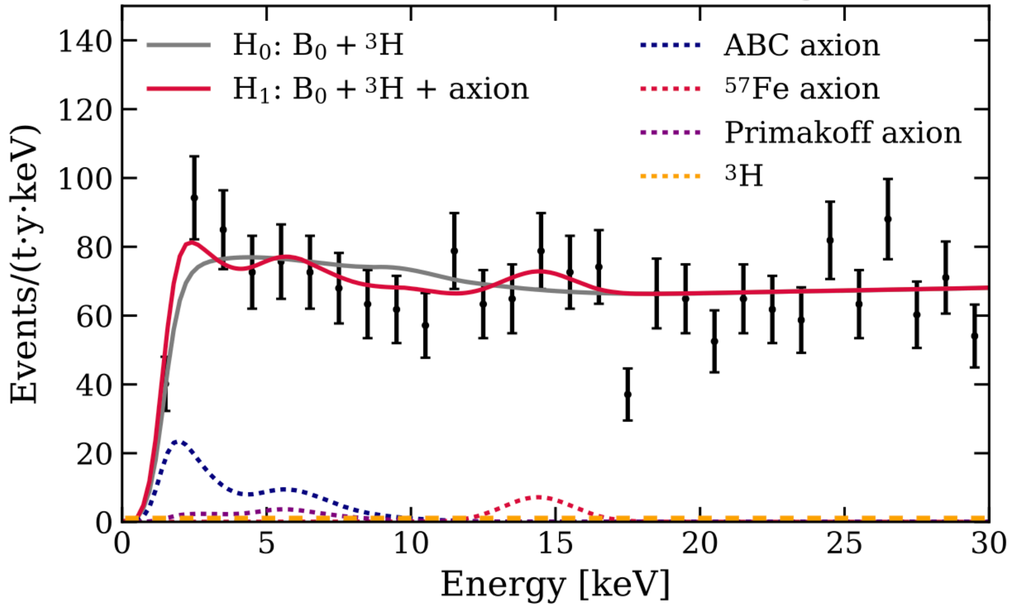


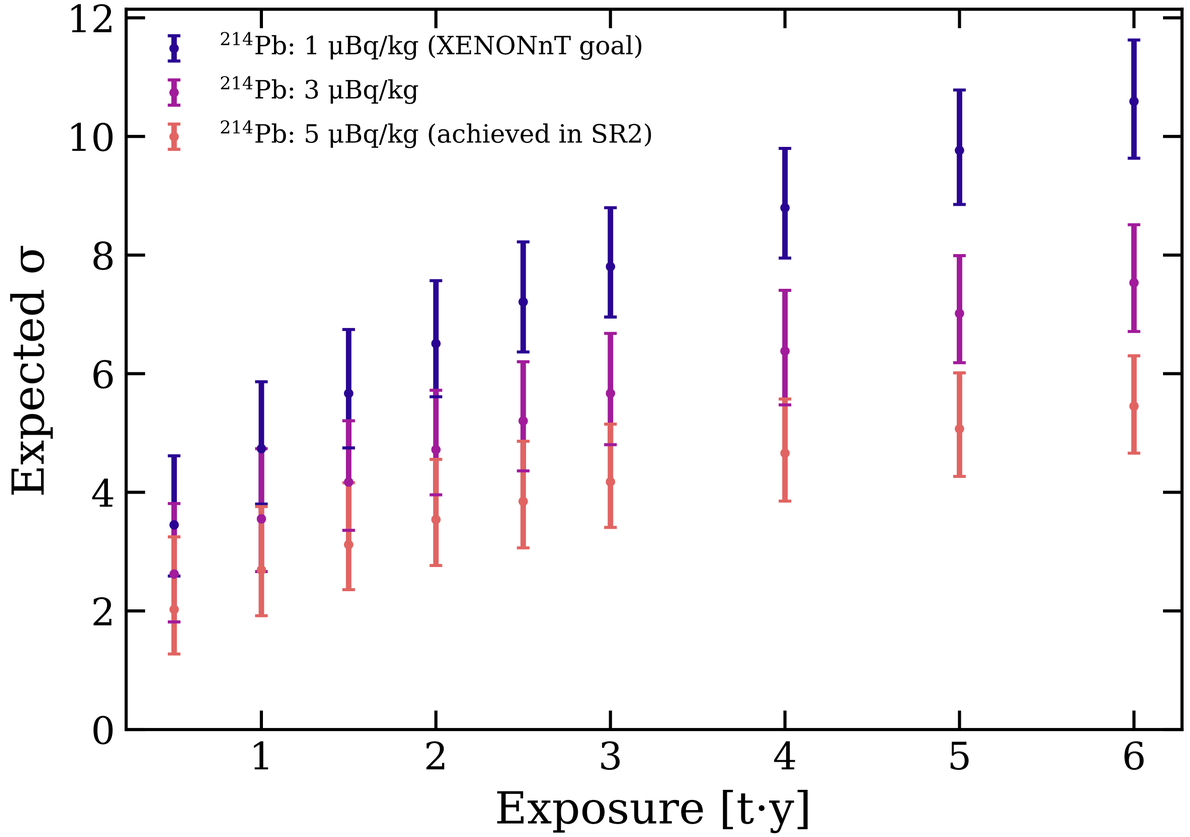


XENONnT Physics Program

XENON1T LE excess investigation

E. Aprile *et al.* (XENON Collaboration)
Phys. Rev. D **102**, 072004





Expected to discriminate axions from tritium with a few months of science data based on energy spectrum alone

REMARKS

- **Despite challenging times, the XENON collaboration successfully completed installation of the XENONnT experiment**
- **Early this year the commissioning of XENONnT systems started and it's ongoing**
- **Stay tuned for results**

Direct dark matter search
- ➡ WIMP models
- ➡ Light dark matter
- ➡ Mirror dark matter
- ➡ Etc…
- ➡

Solar Neutrinos
- ➡ ^{8}B CEvNS
- ➡ pp elastic scattering
- ➡ Magnetic moment
- ➡

More
- ➡ Neutrinoless double beta decay
- ➡ Super nova neutrinos
- ➡ Solar axions

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