XENON1T latest results

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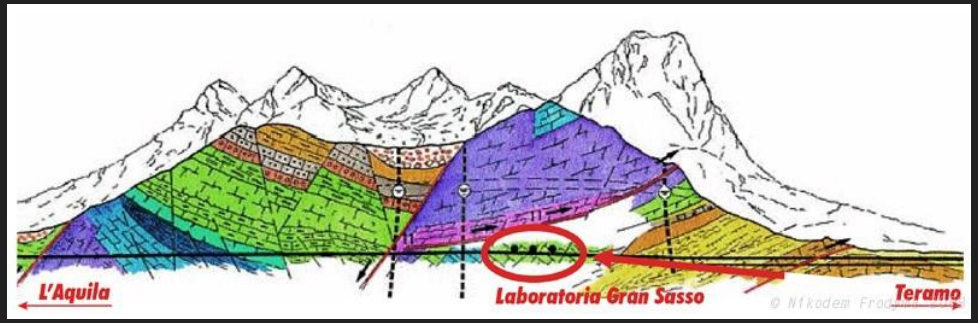
Amsterdam-Paris-Stockholm Meeting 11-10-2017

XENON

“The XENON dark matter project aims at the detection of WIMP dark matter with dual-phase time projection chambers (TPCs), that are filled with a liquid xenon (LXe) target of increasing mass.”



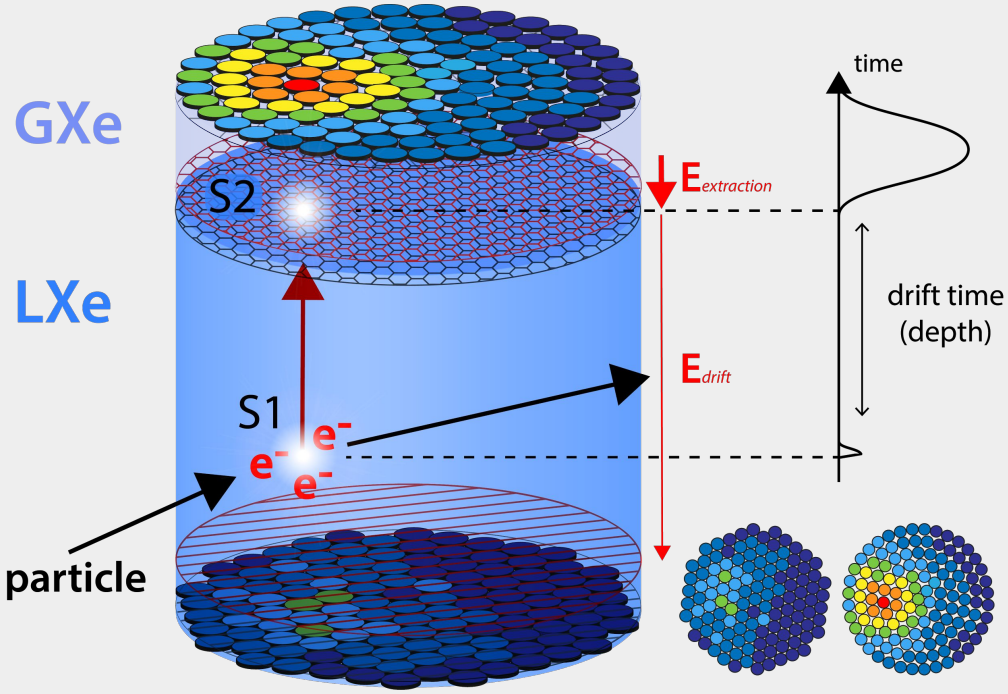
Detecting WIMPs

Dual phase TPCs allow detection of recoils of O(10 keV) and provide:

- Discrimination between electronic and nuclear recoils.
- 3D position reconstruction for fiducialization.

XENON1T:

- ~2000 kg of ultra pure liquid xenon target.
- 248 PMTs

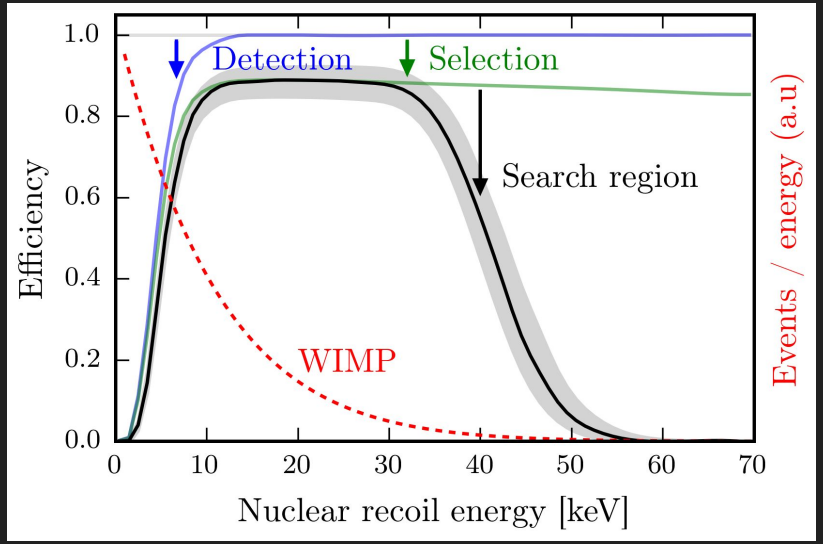


Data Selection

The first science run (SR0, from 22-11-2016 to 18-01-2017) uses 34.2 live days of blinded data.

Select single scatters in the LXe:

- 3-fold coincidence requirement
- Selection efficiencies estimated from control samples or simulation
- Search region defined within 3-70 PE in cS1



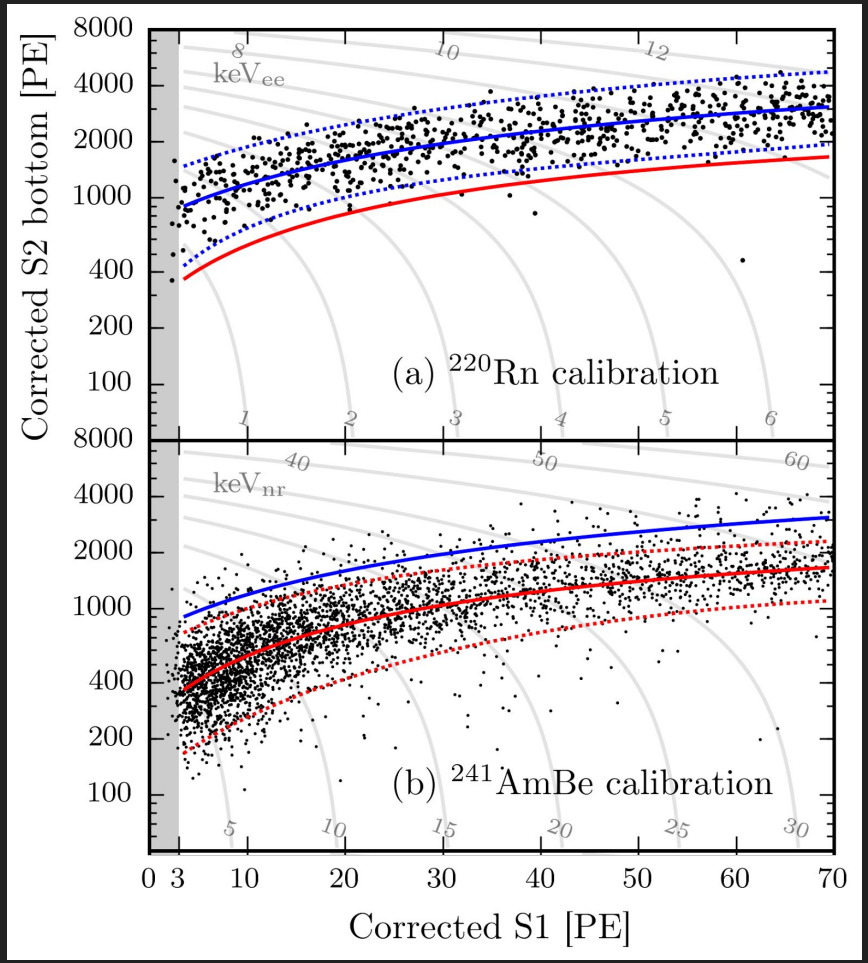
arXiv:1705.06655

Detector Calibration

Calibration data:

- Kr83m, 3.3 days (electronic recoils)
- Rn220, 3.0 days (electronic recoils)
- AmBe241, 16.3 days (nuclear recoils)
- LED data

The data is fitted with a physics motivated model incorporating many parameters. The two most important ones (efficiency and exiton-to-ion ratio) are propagated to the statistical framework.



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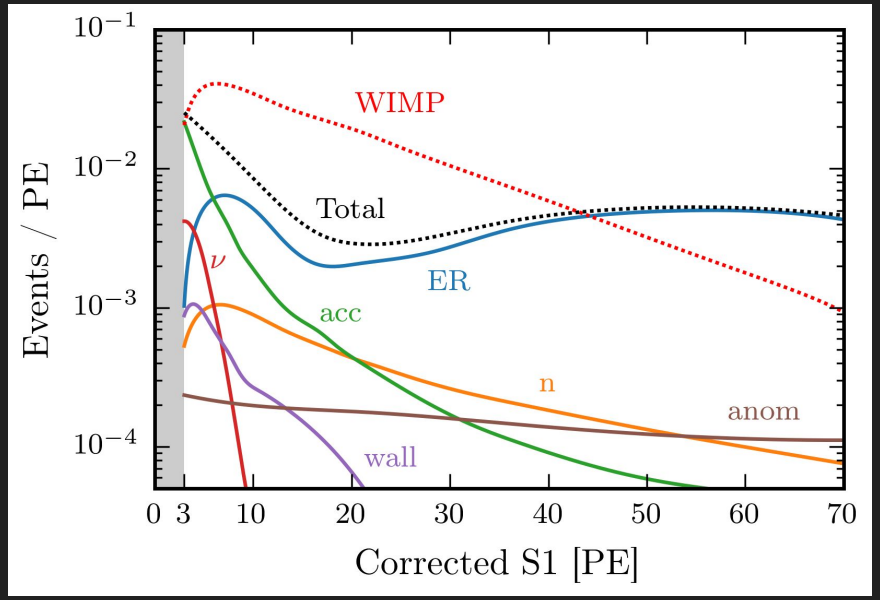
Backgrounds

	Full
Electronic recoils (ER)	(62 ± 8)
Radiogenic neutrons (n)	0.05 ± 0.01
CNNS (ν)	0.02
Accidental coincidences (acc)	0.22 ± 0.01
Wall leakage ($wall$)	0.5 ± 0.3
Anomalous ($anom$)	$0.10^{+0.10}_{-0.07}$
Total background	63 ± 8
50 GeV/c^2, 10^{-46}cm^2 WIMP	1.66 ± 0.01



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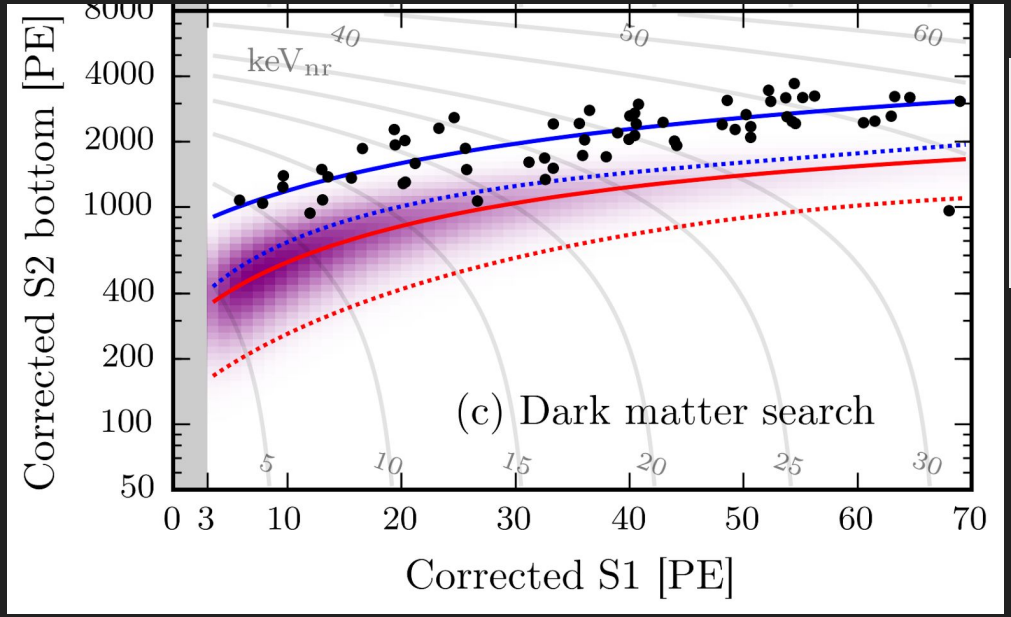
Results

63 events pass selection in a 1T fiducial volume, compatible with background only hypothesis

Electronic recoil background rate of (1.93 ± 0.25) 1e-4 events/(kg day keV_{ee}), the lowest in this type of detector.



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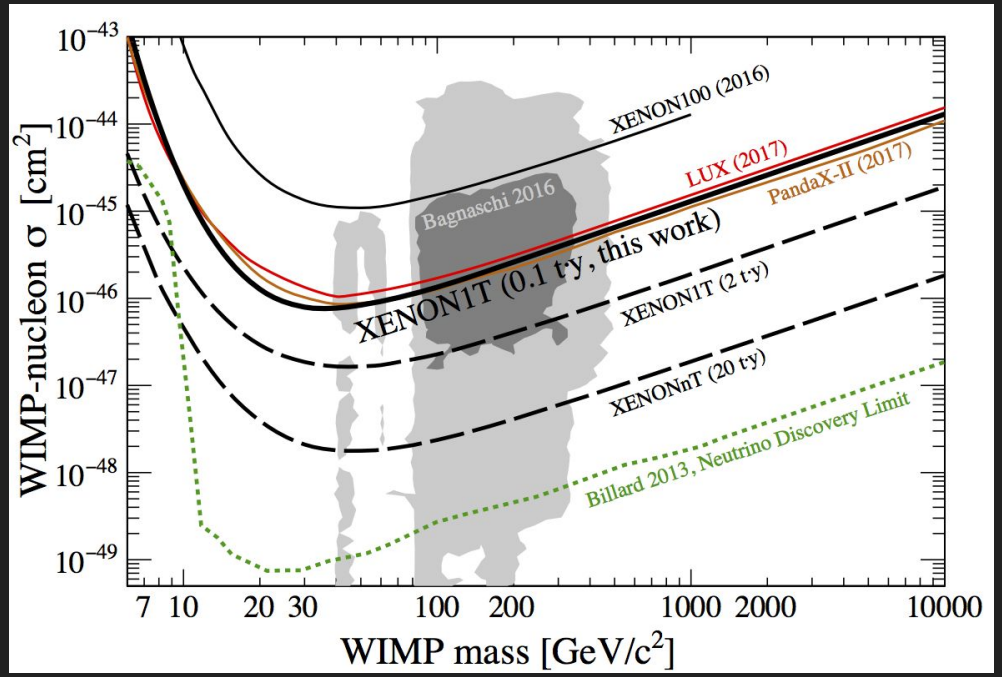
The Exclusion Limit

Using an extended unbinned profile likelihood.

90% limit on the spin independent WIMP-nucleon cross section.

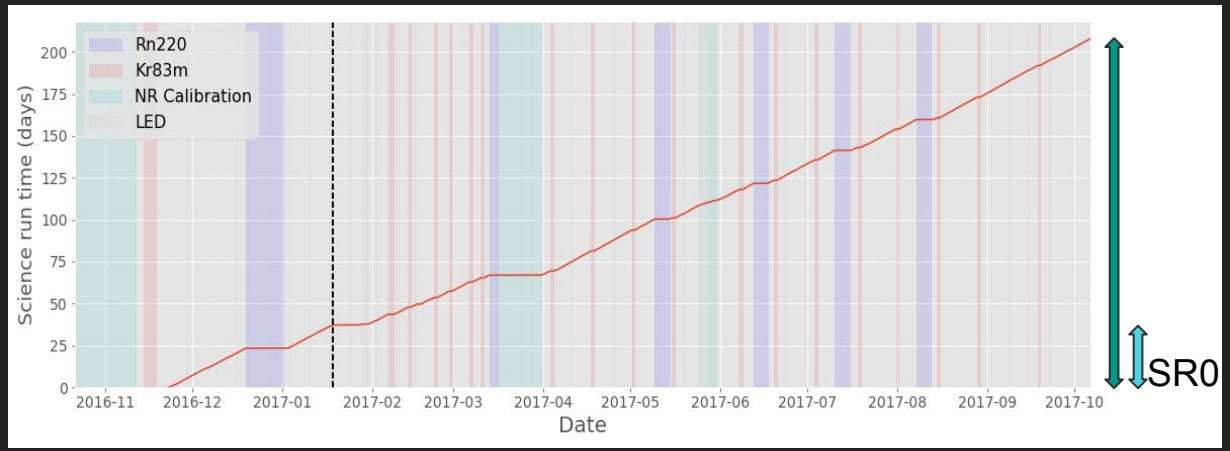
Strongest exclusion for 35 GeV/c^2 WIMPs at 7.7 x 10^{-47} cm^2



pMSSM10 theory shaded

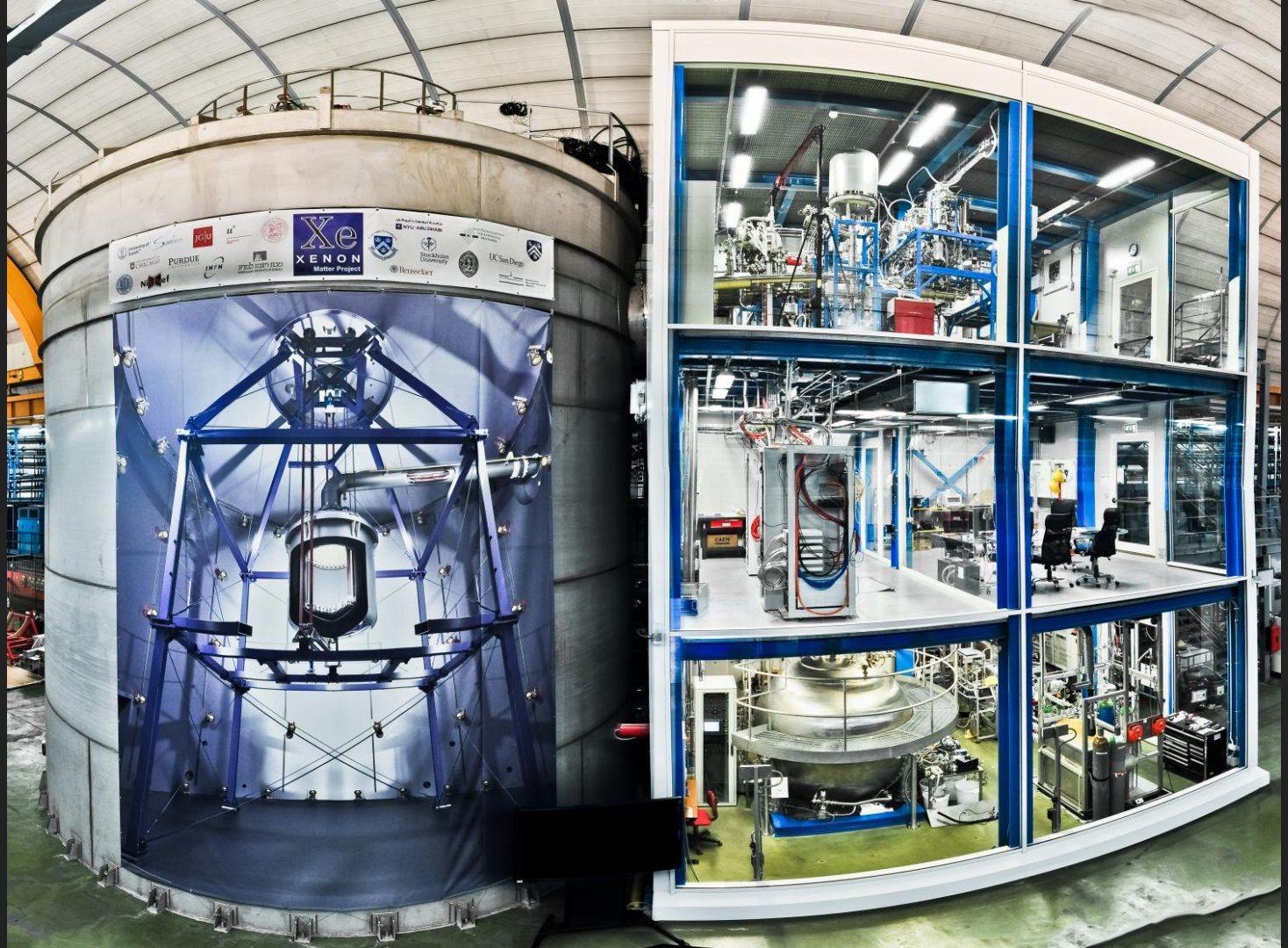
Future Analyses

- XENON1T is still taking data, the next analysis is underway and will have a much larger exposure.
- XENONnT (volume ~8000 kg) is being built to replace XENON1T.

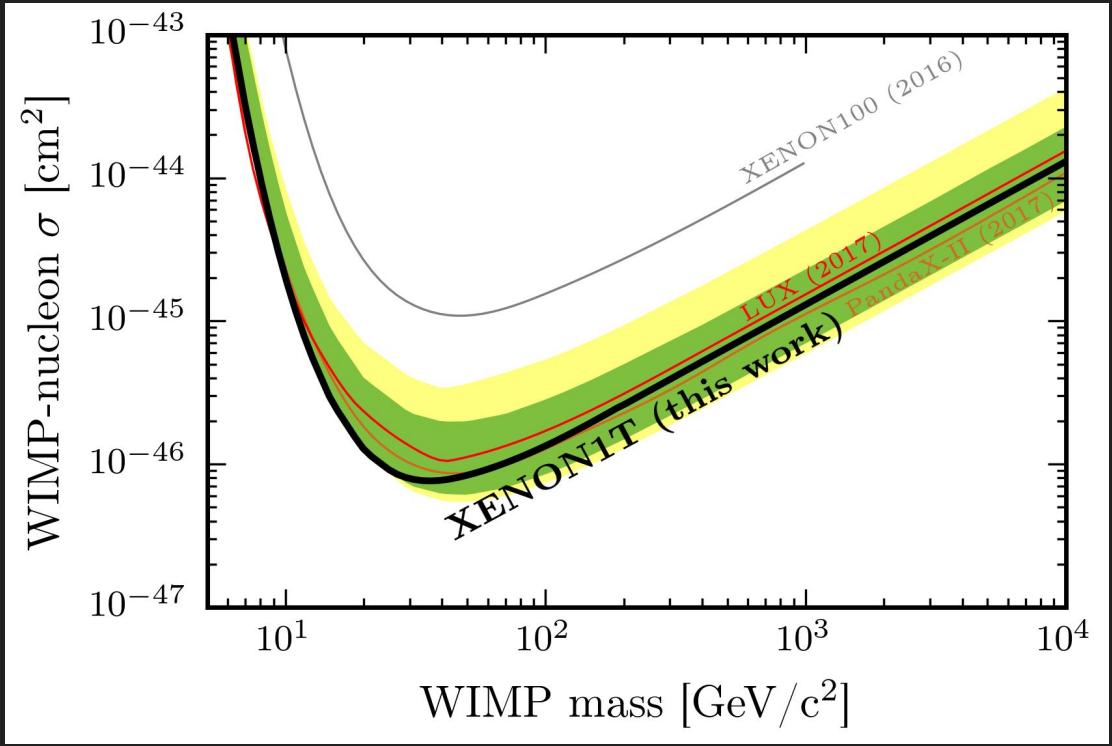


Conclusions

- XENON1T is the world's most sensitive dark matter detector of its kind.
- It has excluded WIMPs down to 7.7 x 10^{-47} cm^2, (90% UL at 35 GeV/c^2)
- XENON1T is still taking data and the next analysis in ongoing with a much larger exposure.
- XENONnT is being built to upgrade XENON1T and take over the search for WIMP dark matter.


Xe
XENON
Matter Project
PURDUE
Stockholm University
UC San Diego
Rensselaer

Bonus Material



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Why use liquid xenon?

- Intrinsic scintillator (178 nm, VUV)
  - Transparent
- Heavy (~125 GeV)
  - Elastic collisions with WIMPs of mass O(100 GeV)
- Dense (2.8 kg/L at -90 degC)
  - Provides self-shielding
- Stable, no long lived isotopes
- Electronic/Nuclear Recoil discrimination
- Allows for both spin-dependent and spin independent measurements.