

The XENON1T Dark Matter Experiment

The XENON Experiment
Enlightening the Dark

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On Behalf of the XENON Collaboration

SPS, 23-25 August 2016, USI, Lugano



University of
Zurich^{UZH}



The World Map of the XENON Collaboration



21 institutions, 10 countries, ~130 scientists.



The XENON Dark Matter Program



XENON10

2005-2007

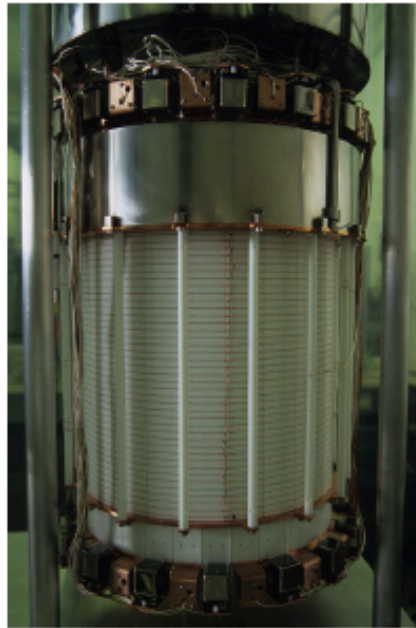
M = 25(15) kg

L = 15 cm

$$\sigma_{SI} \simeq 10^{-43}$$

(100 GeV)

Yuehuan Wei (Zürich)



XENON100

2007-..**2016**

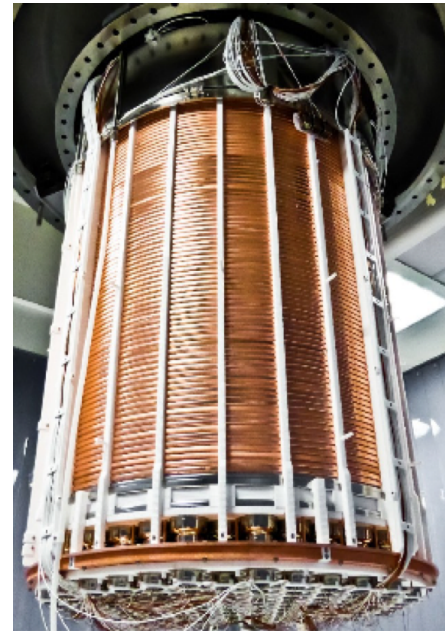
M = 161(62) kg

L = 30 cm

$$\sigma_{SI} = 2 \times 10^{-45}$$

(55 GeV)

SPS, 23-25 August 2016, USI, Lugano



XENON1T

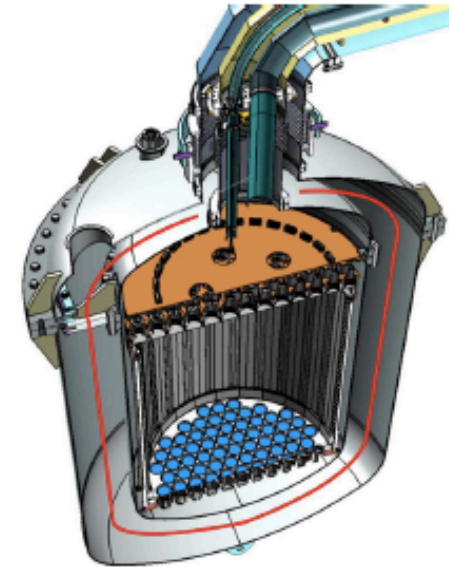
2016 ~

M = 3.5 (2.0) ton

L = 1.0 m

$$\sigma_{SI} = 1.6 \times 10^{-47}$$

(50 GeV)



XENONnT

2019 ~

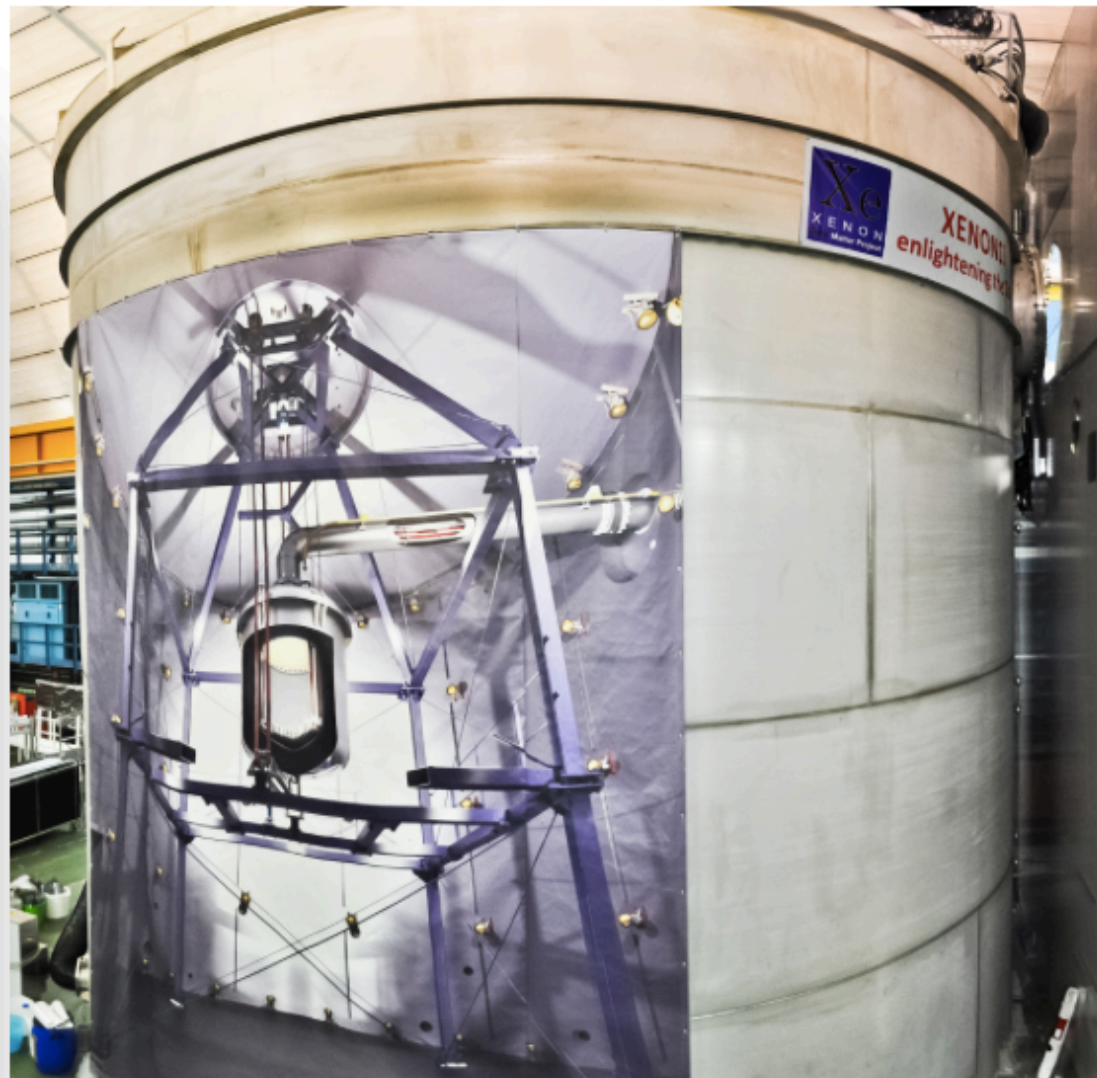
M = 7.5 (5.7) ton

L = 1.4 m

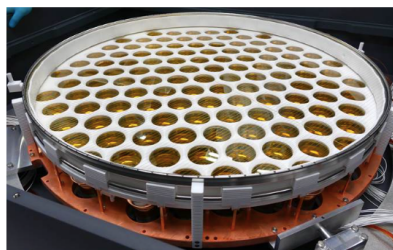
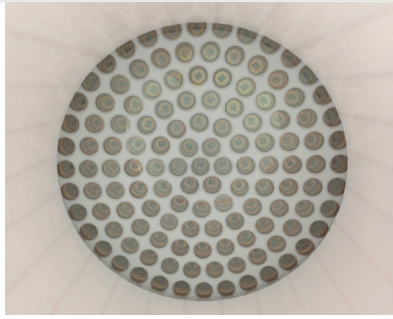
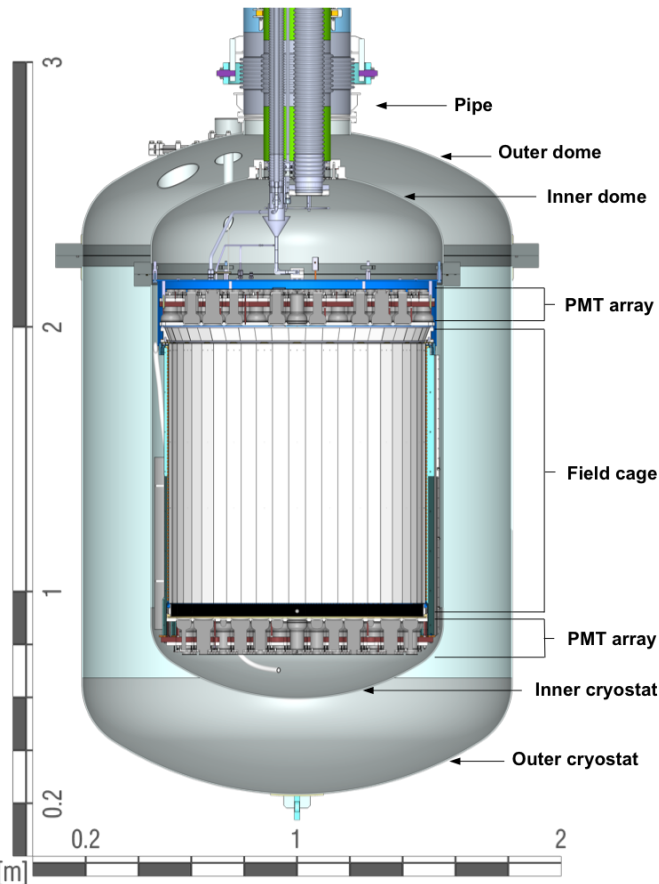
$$\sigma_{SI} = 1.6 \times 10^{-48}$$

(50 GeV)

The XENON1T Experiment



XENON1T TPC: the largest two-phase xenon TPC ...



- 248 low radioactivity R11410-21 PMTs.
- 127 on top and 121 on bottom arrays.
- Ave. gain $\sim 5 \times 10^6$ at 1500V.
- Ave. QE $\sim 34\%$ for 175 nm xenon light.
- Ref: *arXiv:1503.07698*
- (*Eur. Phys. J. C* (2015) 75: 546)

- 3.5-ton xenon in total.
- 2-ton active liquid xenon target.
- 96 cm drift x 96 cm diameter TPC.

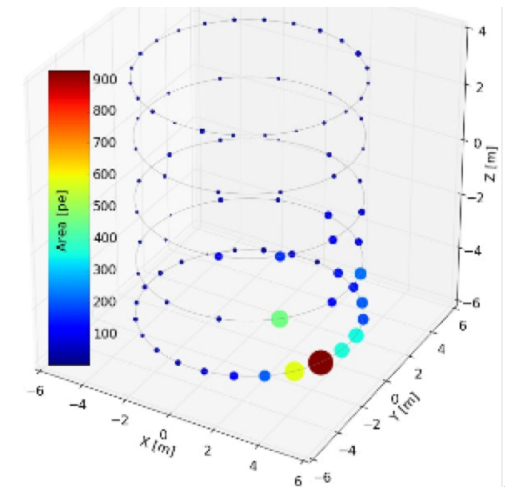
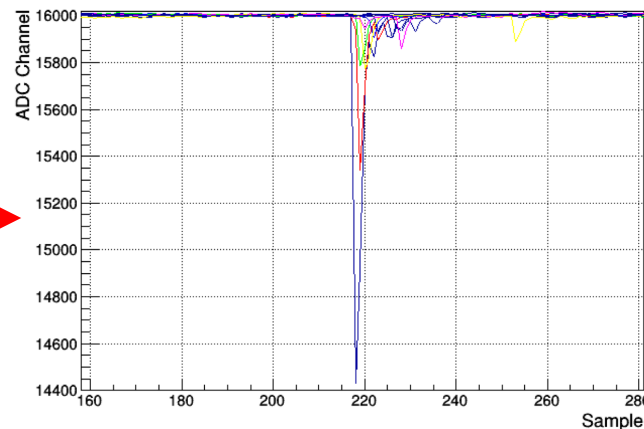
- Constructed Autumn 2015 .
- Currently under commissioning .

Water Cherenkov Muon Veto

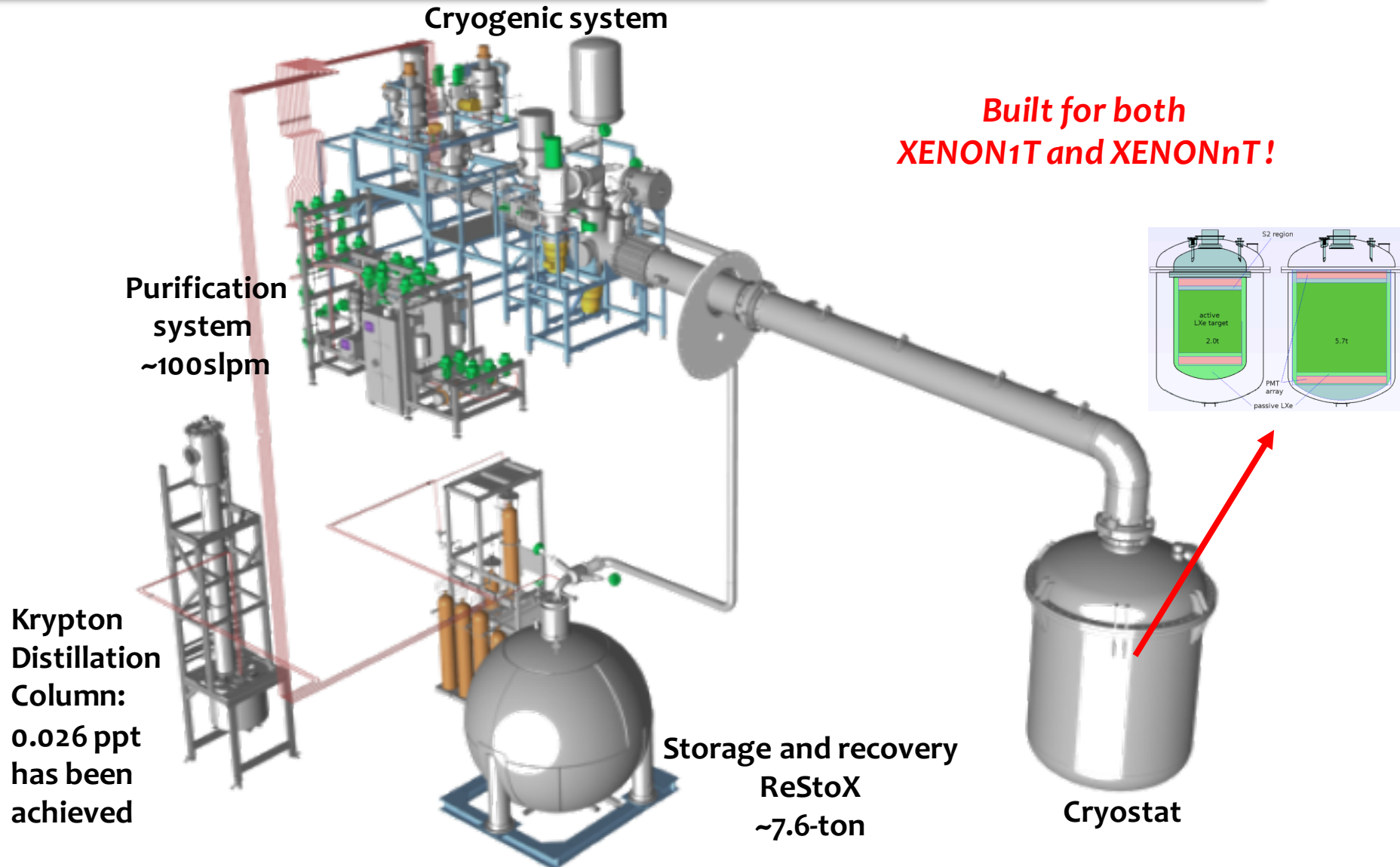


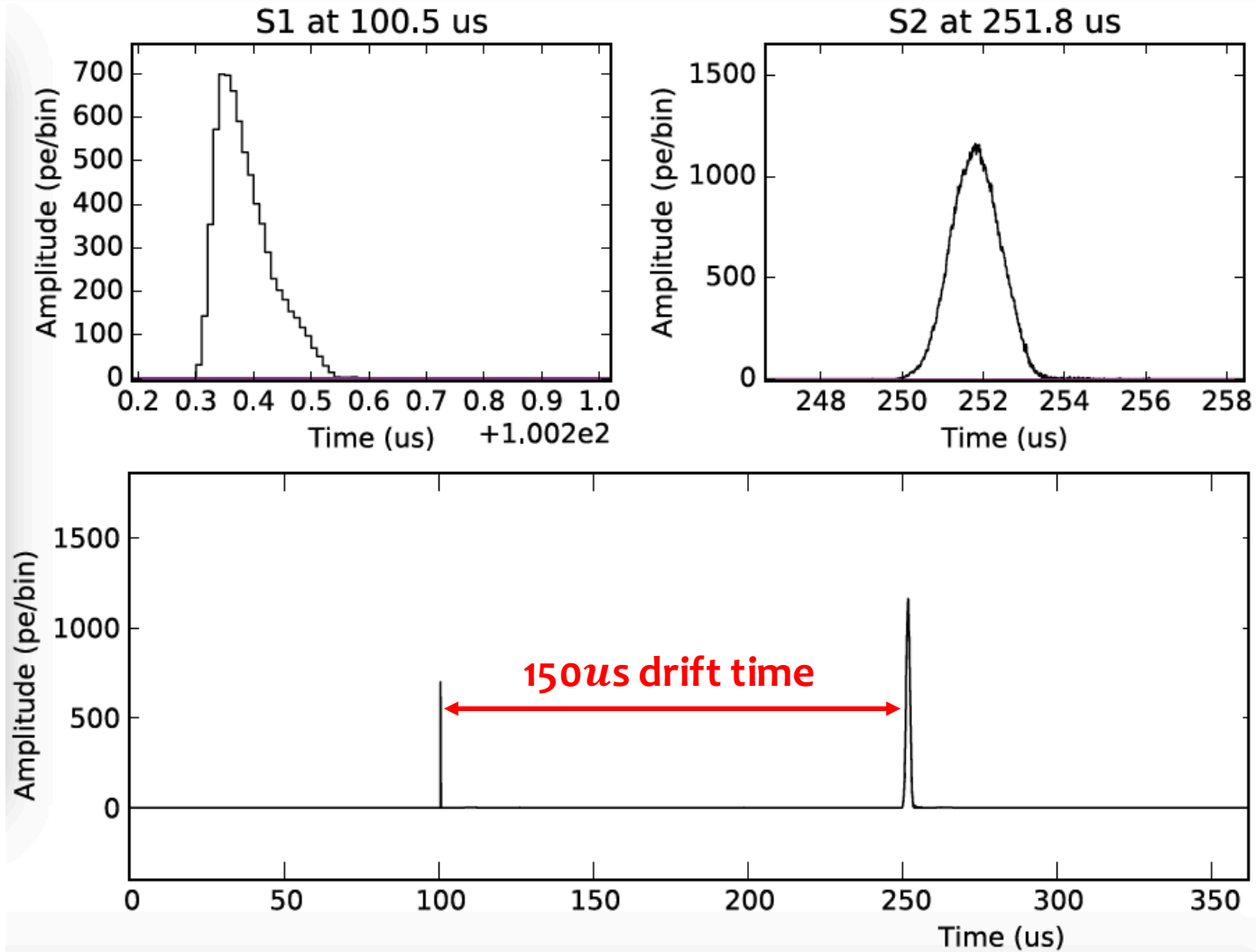
- Stainless steel tank internally covered with reflector film, $\sim 700\text{m}^3$ DI water.
- 84 high QE PMTs (8").
- 99.78 % veto efficiency for muons.
- 71.4 % for induced shower from interactions inside the rock.
- Ref: JINST 9(2014)11006

The first Muon detected →

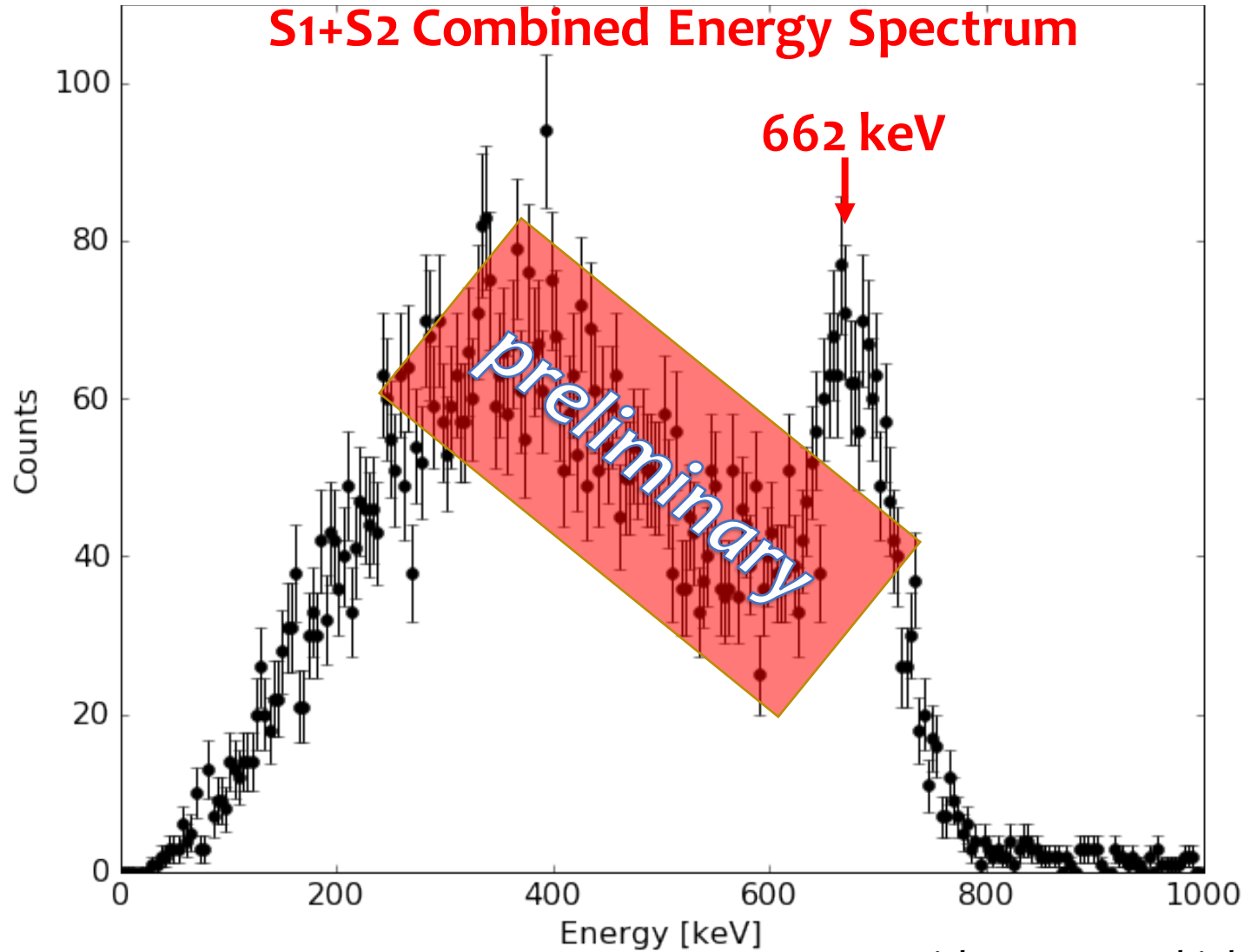


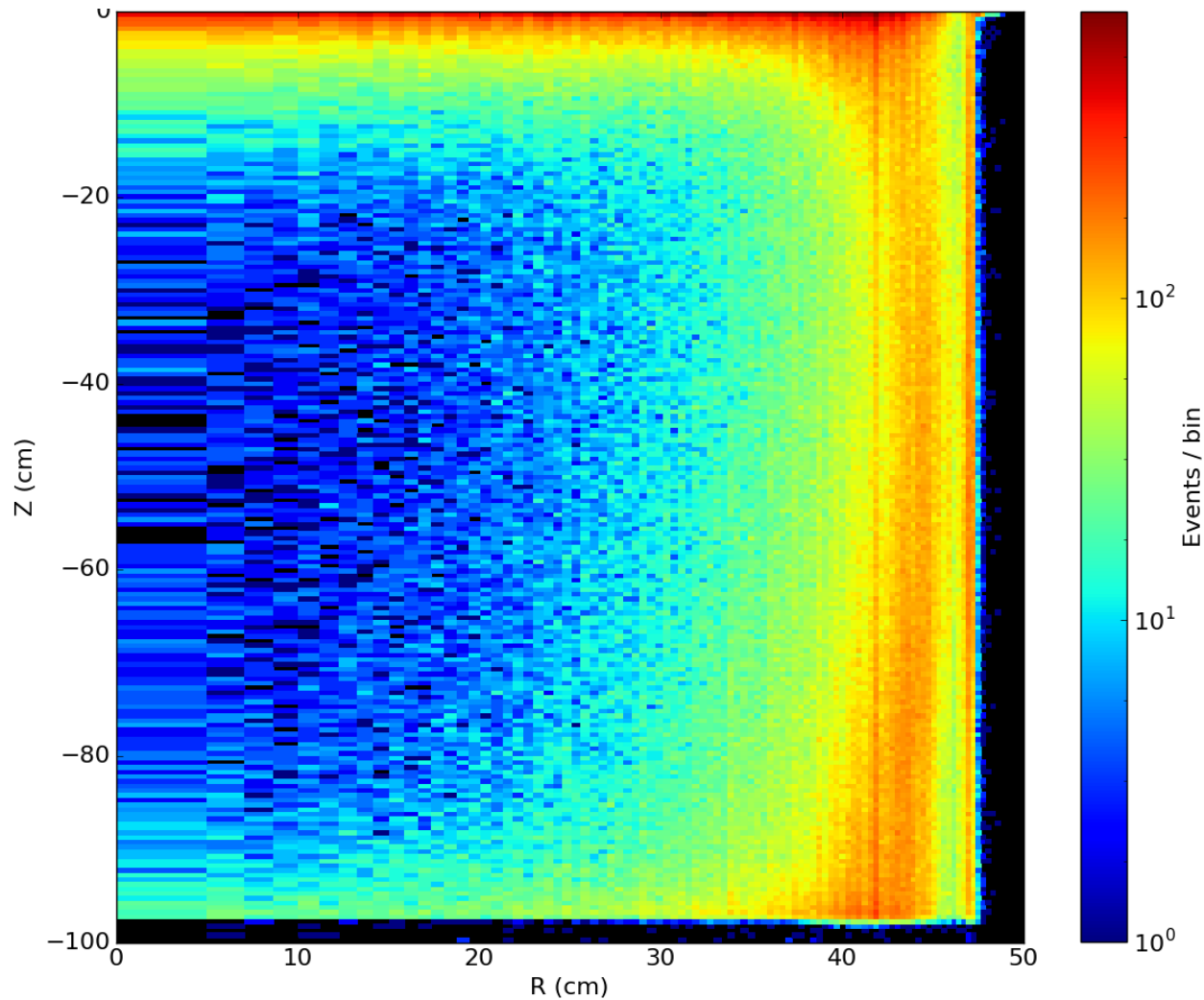
XENON1T/nT Xenon Handling Systems

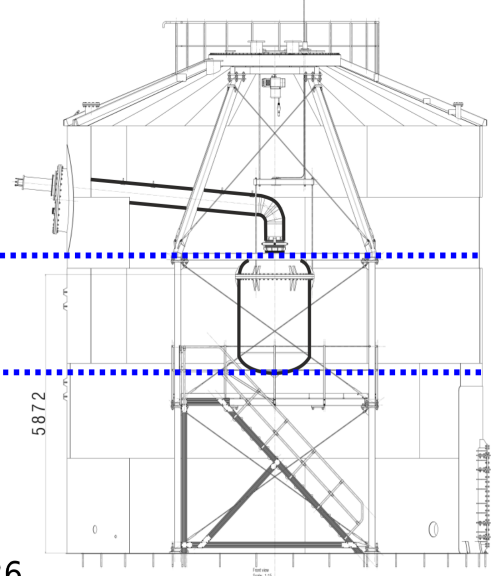
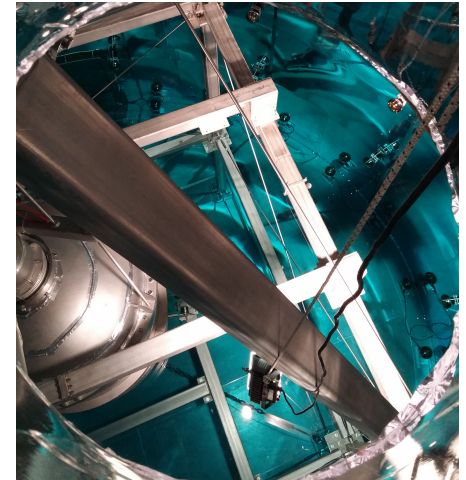
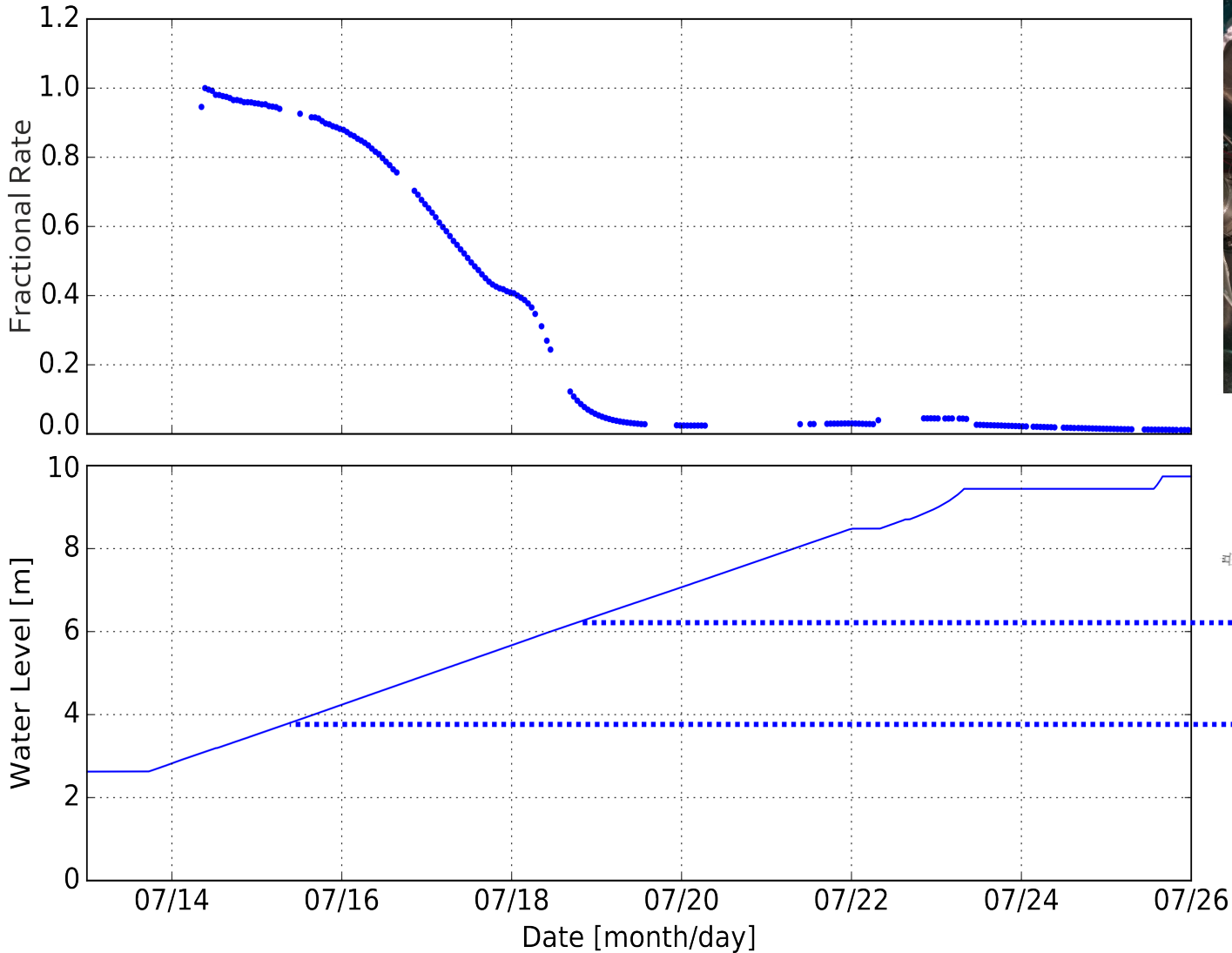




Electron lifetime reaching a few hundreds μs ...







XENON1T Background MC Study

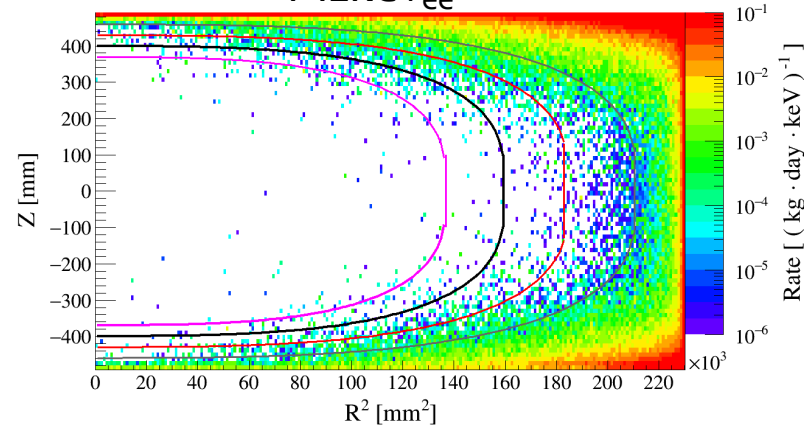
Ref: arXiv:1512.07501 (JCAP04(2016)027)



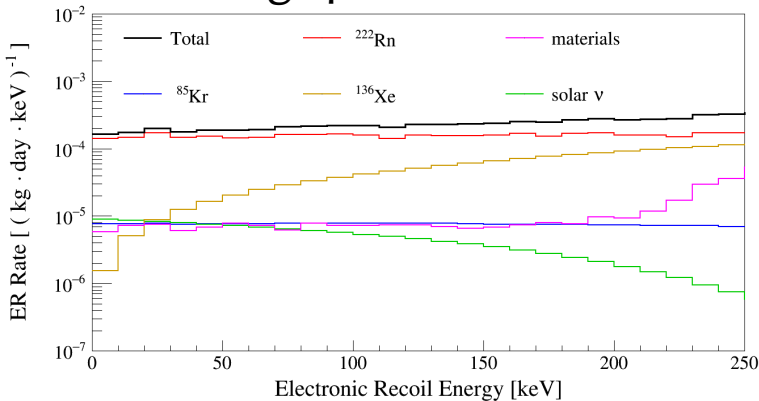
ER Background

ER bkg from materials

1-12keV_{ee}



ER bkg spectrum in 1-ton FV

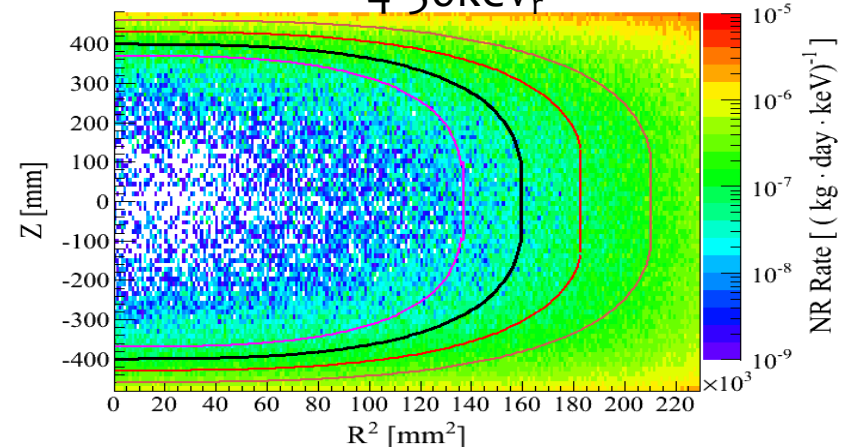


ER rejection 99.75%

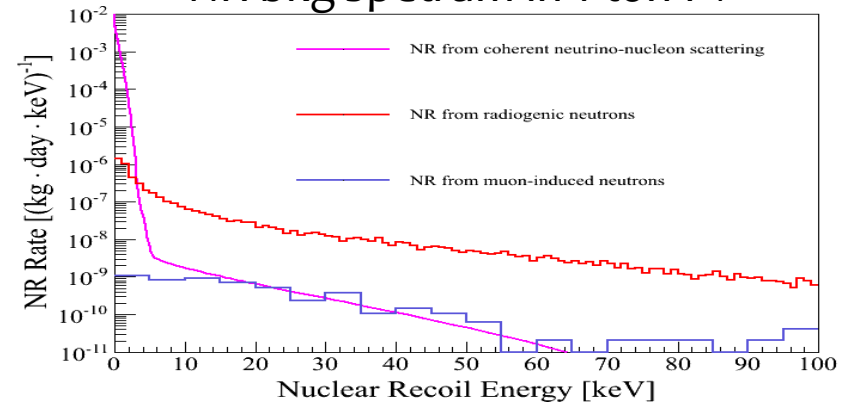
NR Background

Radiogenic NR bkg from materials

4-50keV_r

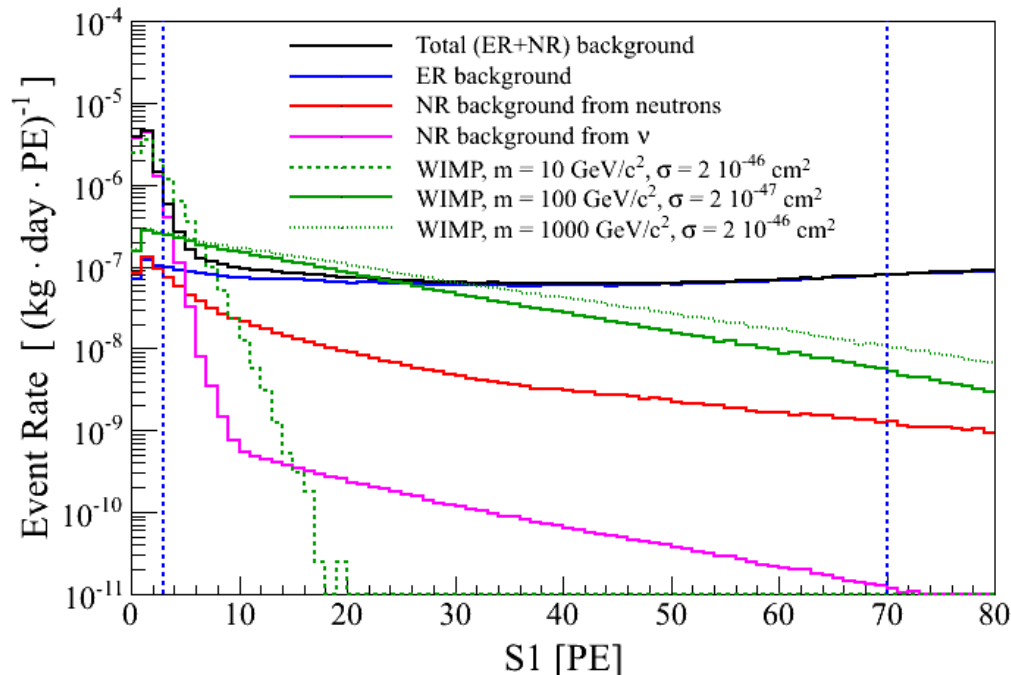


NR bkg spectrum in 1-ton FV



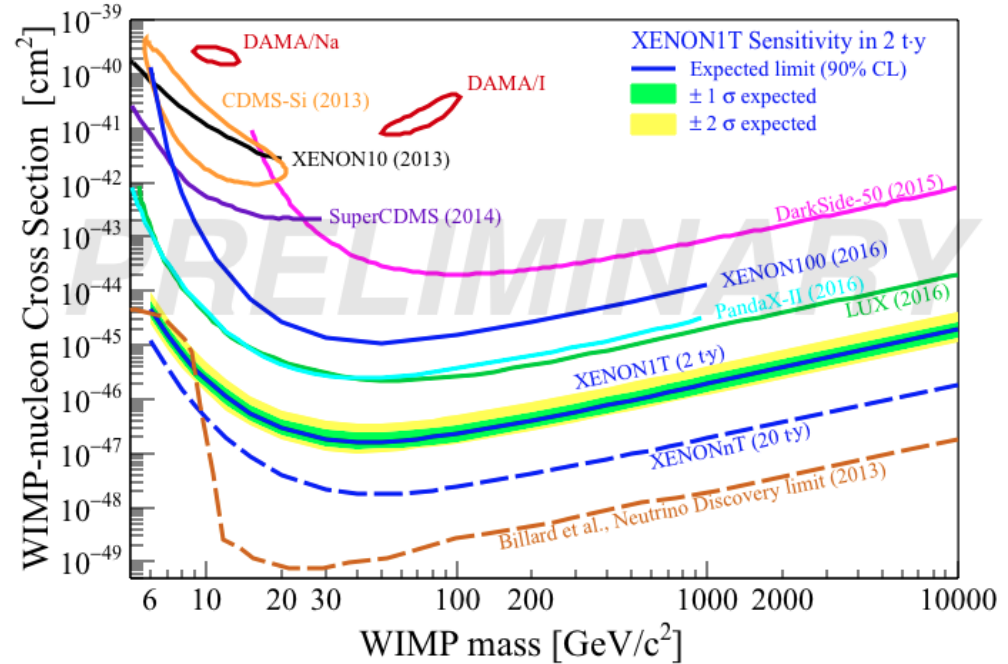
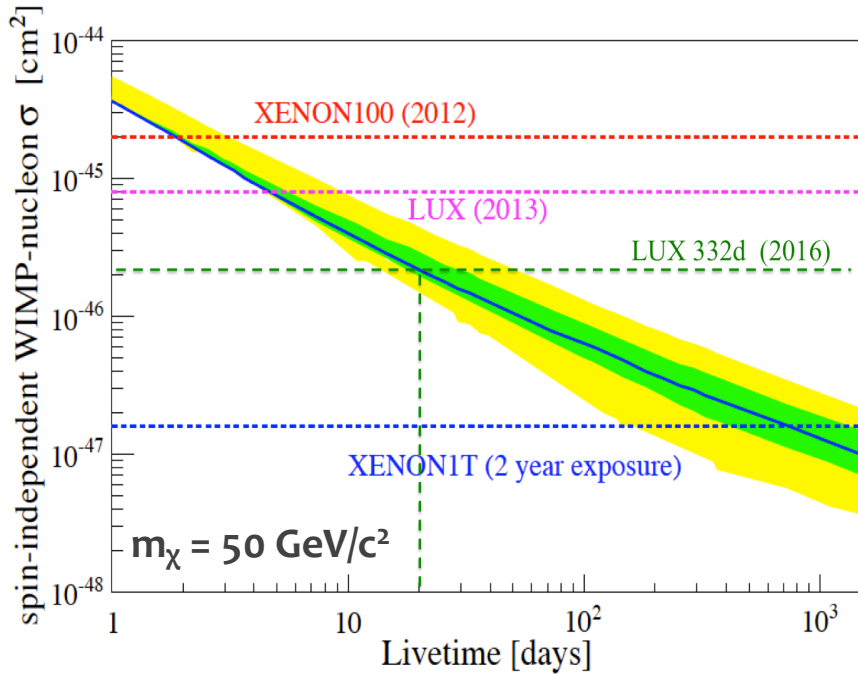
NR acceptance 40%

- Total background with 99.75% ER discrimination and 40% NR acceptance:
~2.1 events/year (3-70PE / 4-50KeV_r / 1-12 keV_{ee} / 1-ton)



Signal (μ_s)	events/year
6 GeV/c ² WIMP ($\sigma = 2 \cdot 10^{-45}$ cm ²)	→ 0.14
10 GeV/c ² WIMP ($\sigma = 2 \cdot 10^{-46}$ cm ²)	→ 0.93
100 GeV/c ² WIMP ($\sigma = 2 \cdot 10^{-47}$ cm ²)	→ 1.43
1 TeV/c ² WIMP ($\sigma = 2 \cdot 10^{-46}$ cm ²)	→ 1.77

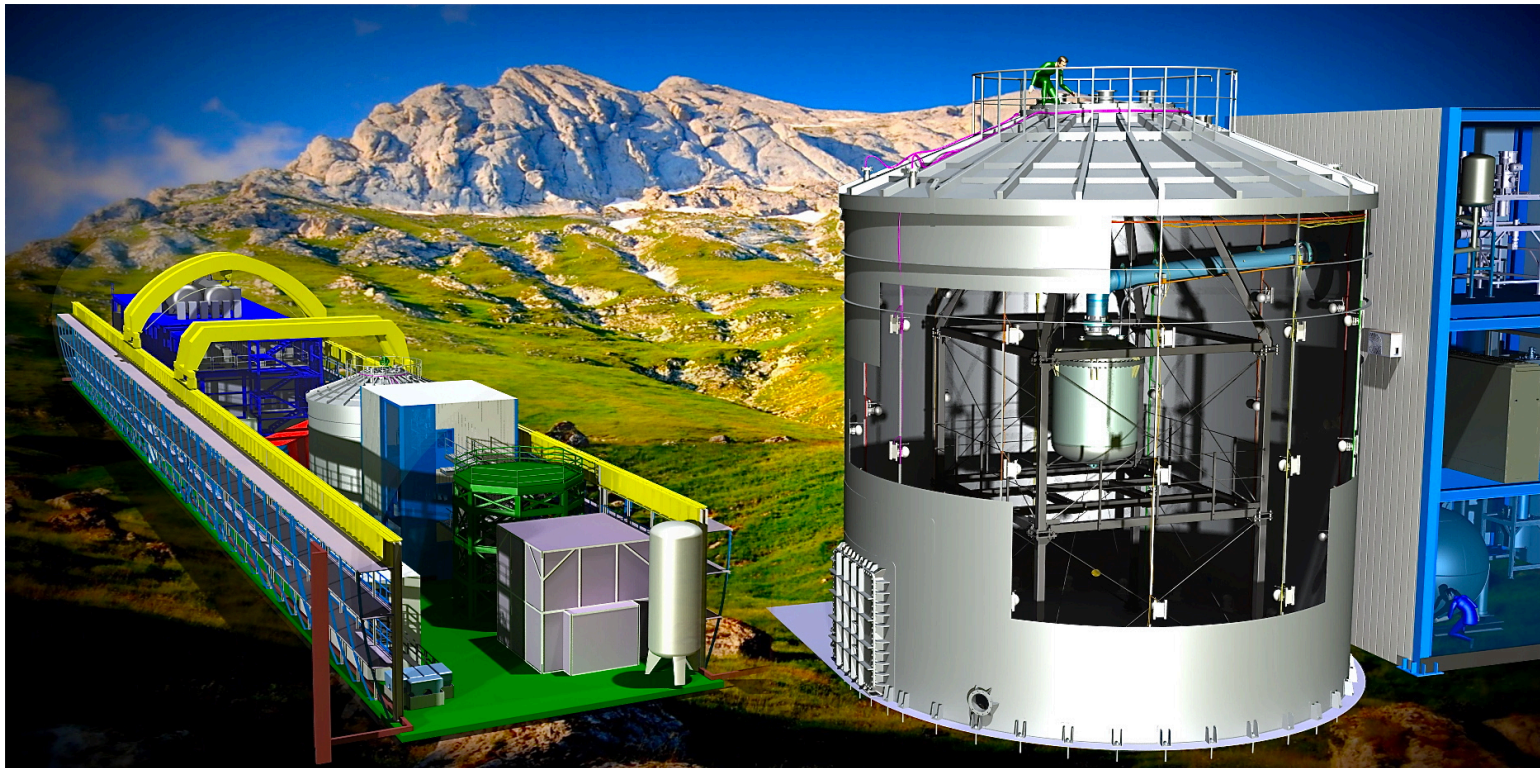
XENON1T Projected Sensitivity



- Only need 20 days to reach LUX sensitivity!
- $1.6 \times 10^{-47} \text{ cm}^2$ @ 50 GeV WIMP with 2 t-yr data.

Summary and outlook

- ❖ The XENON1T experiment construction is finished at LNGS.
- ❖ The commissioning of the XENON1T TPC is currently ongoing, in parallel to the optimization of the running subsystems e.g. cryogenic system, DAQ, electric field, Slow control, PMT arrays, Kr removal. Calibration campaign will begin soon.
- ❖ Science data taking is expected to start soon.



Thanks for your attention !