

XENON100 Results on WIMP and non-WIMP Searches

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Weizmann Institute of Science

on behalf of the XENON Collaboration

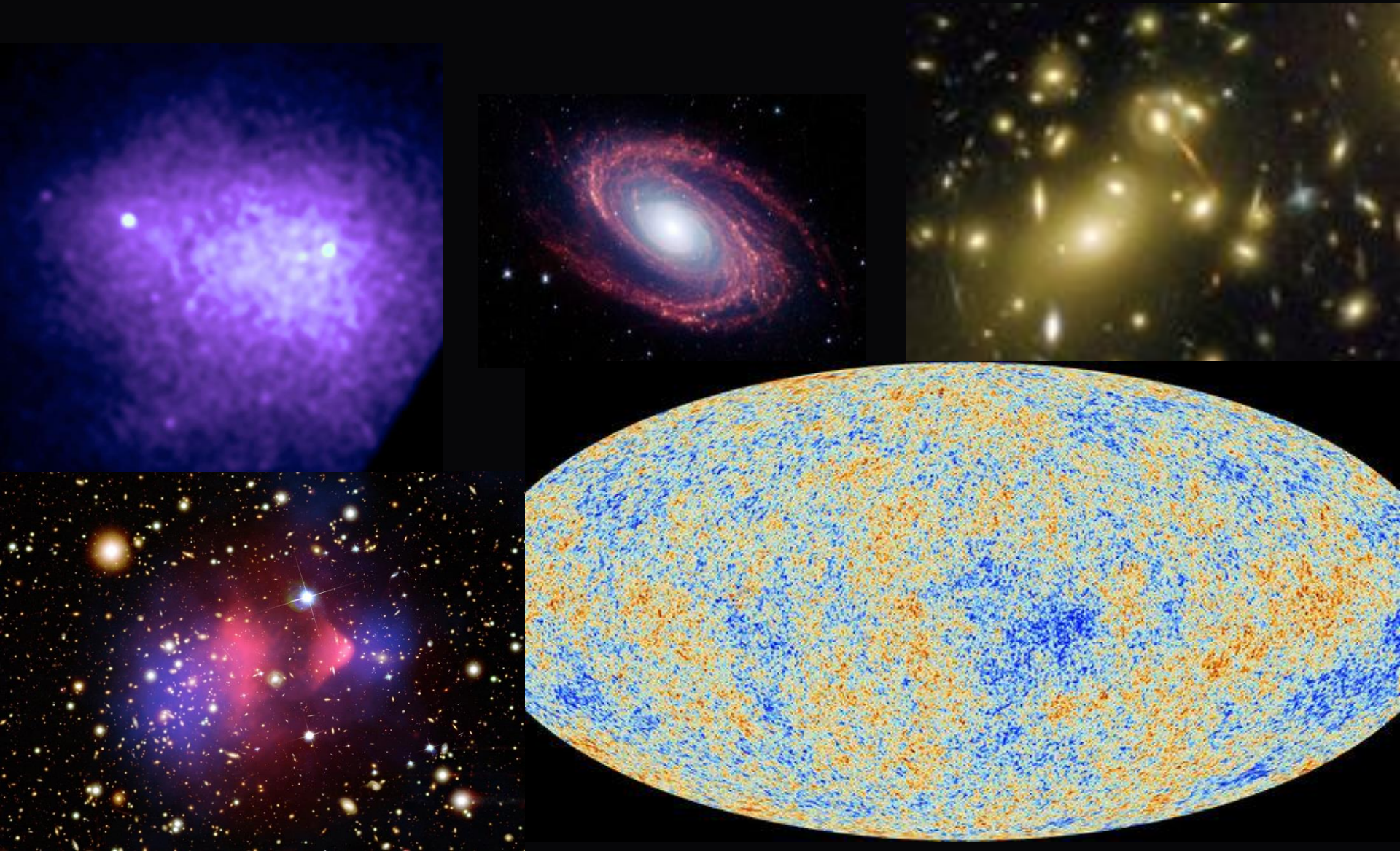
SUSY 2013

ICTP Trieste, August 29 2013



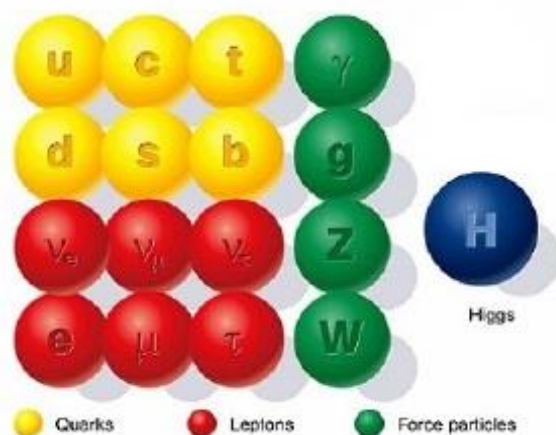
מכון ויצמן למדע
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The Dark Matter Problem

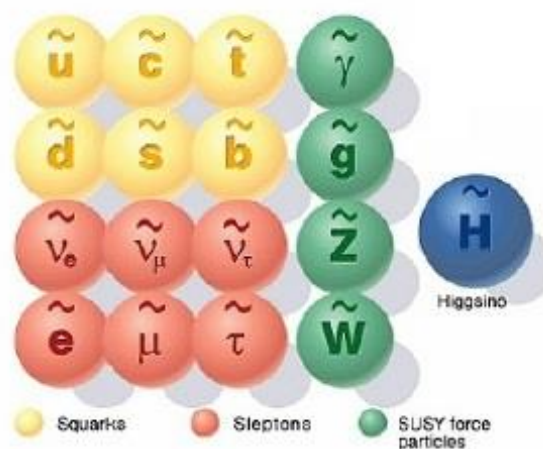


Dark Matter and SUSY

SUPERSYMMETRY

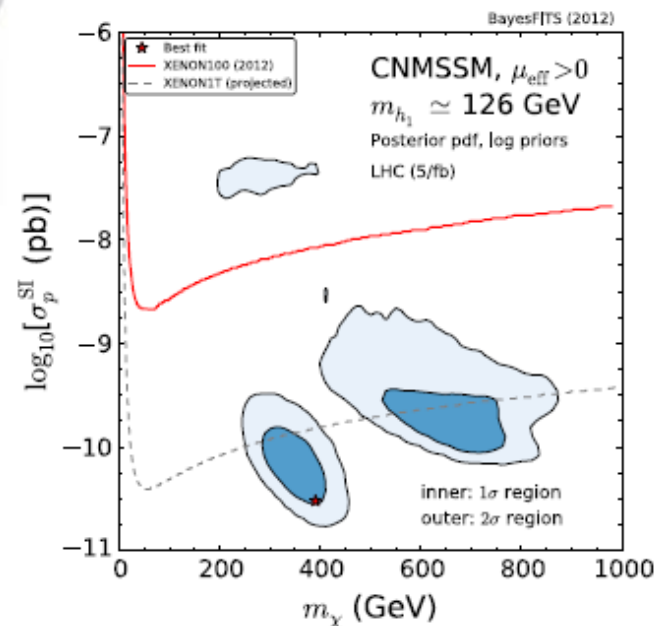


Standard particles



SUSY particles

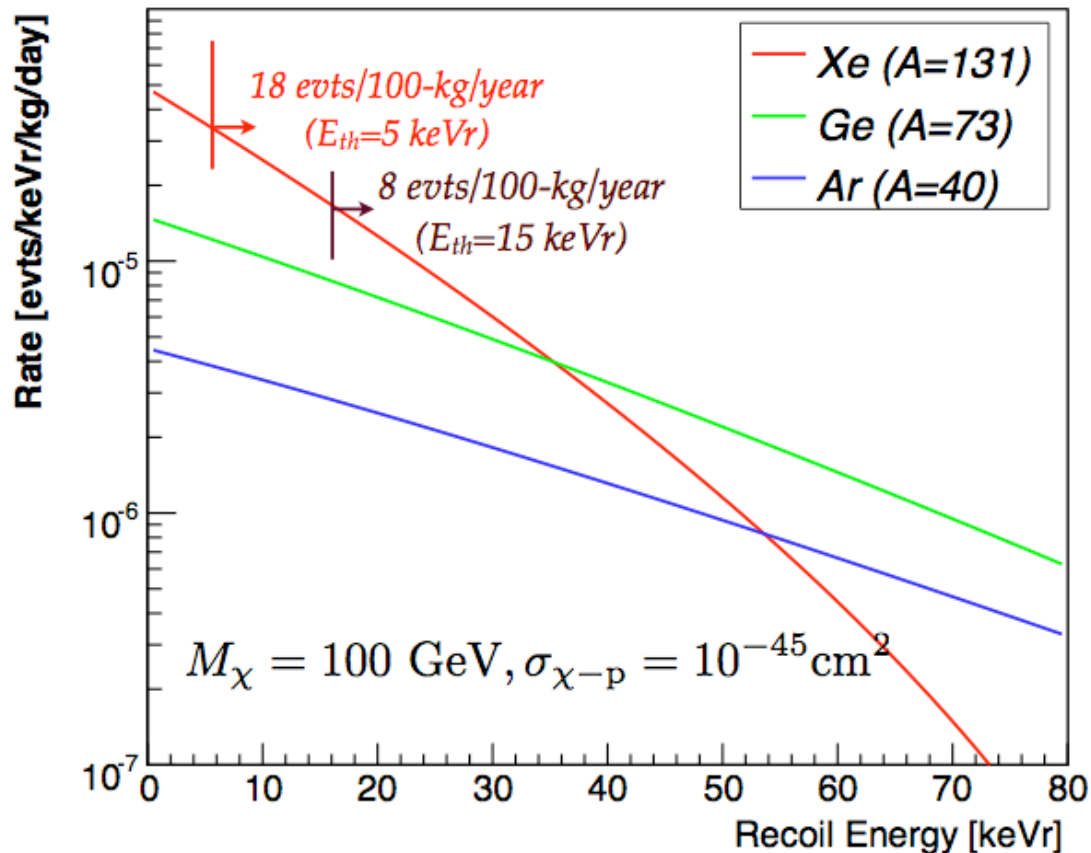
$$\tilde{\chi}_i^0 = a_i \tilde{\gamma} + b_i \tilde{Z} + c_i \tilde{h}^0 + d_i \tilde{H}^0$$



Phys. Rev. D 87, 115010 (2013)

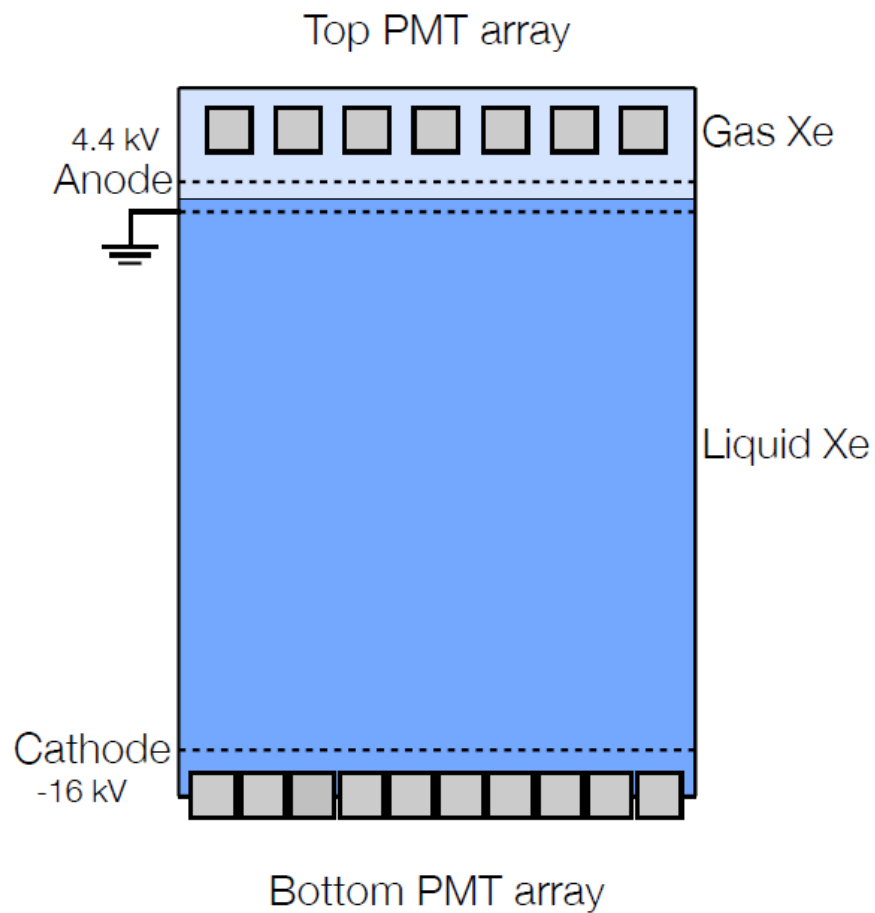
Why Xenon?

WIMP Scattering Rates

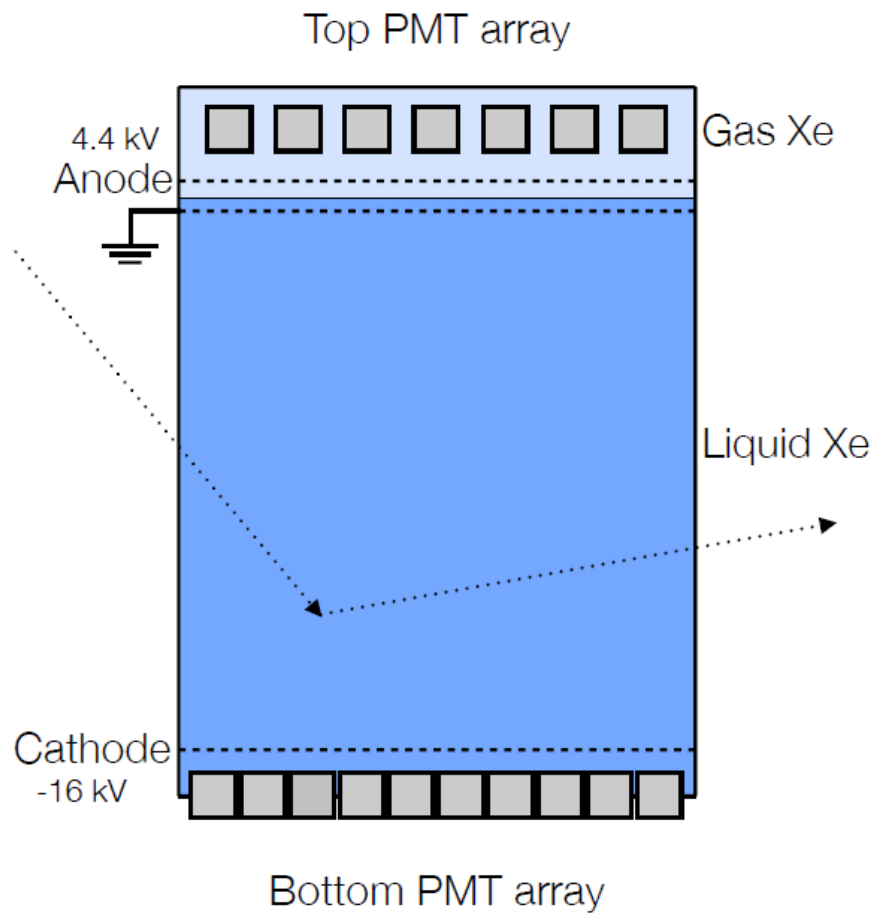


- High atomic mass
- Contains isotopes with non zero spin
- Simple cryogenic
- Excellent self shielding
- No long-lived radioactive isotopes

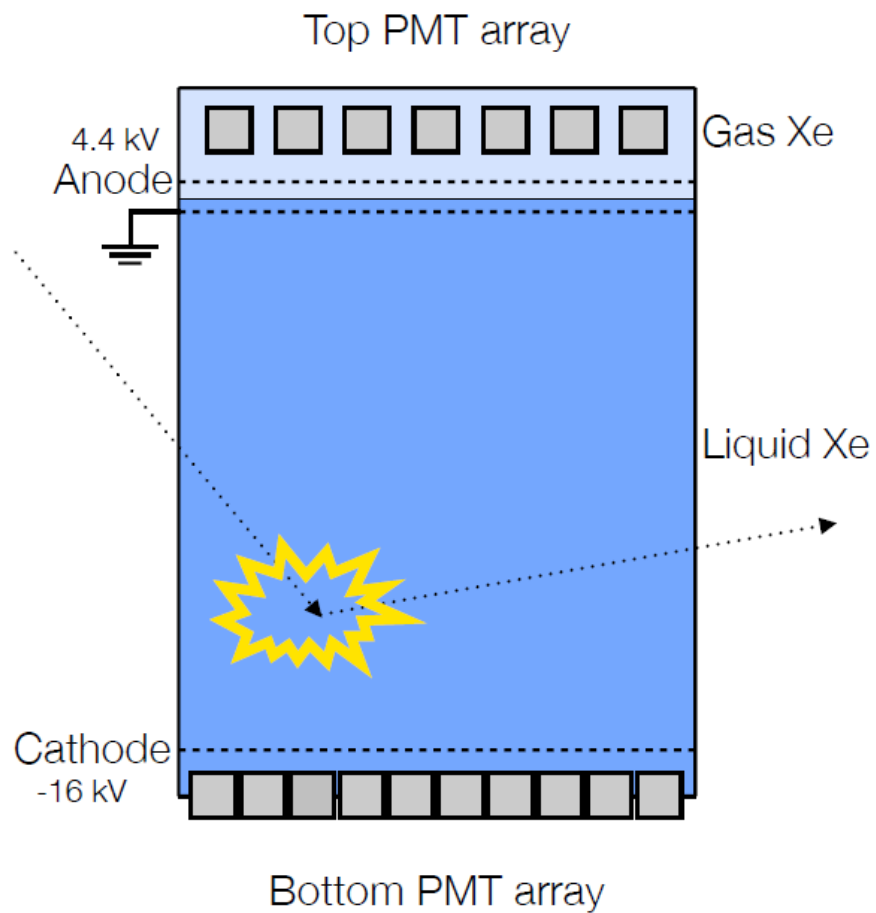
Dual-phase TPC



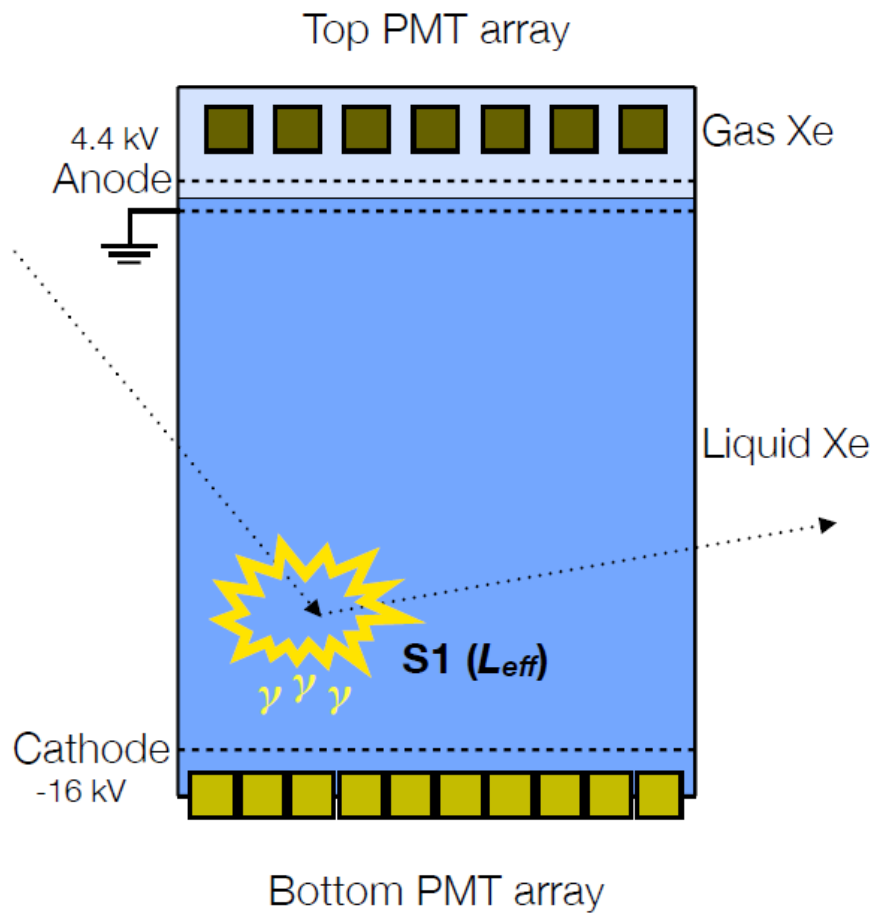
Dual-phase TPC



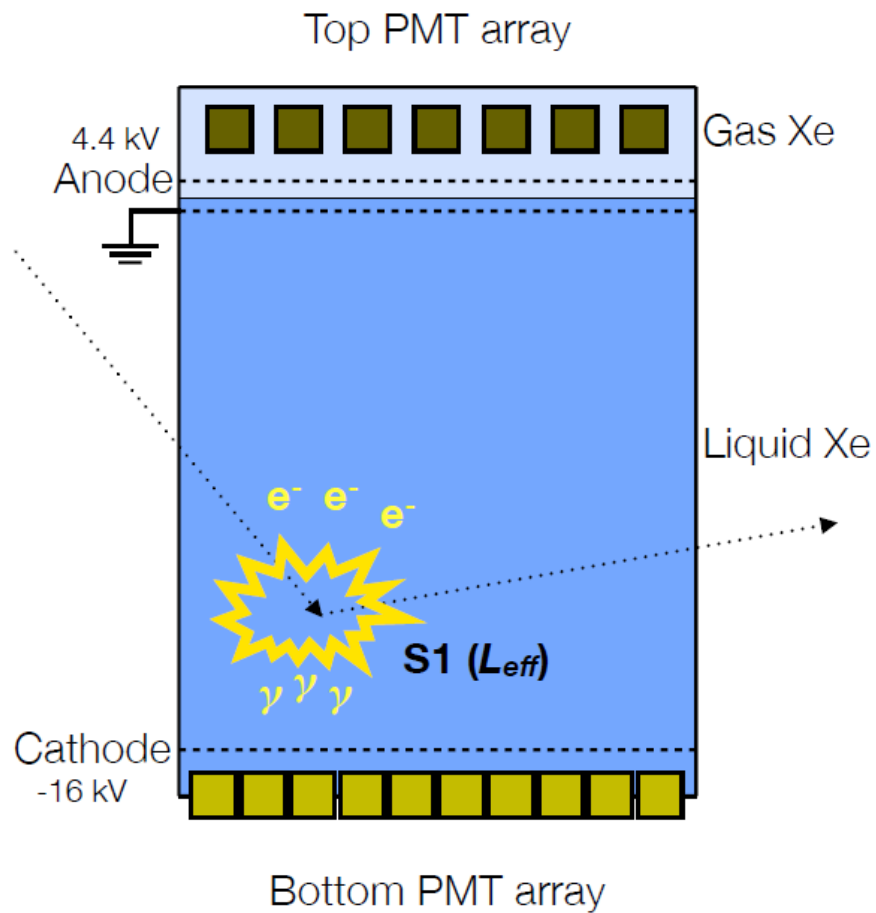
Dual-phase TPC



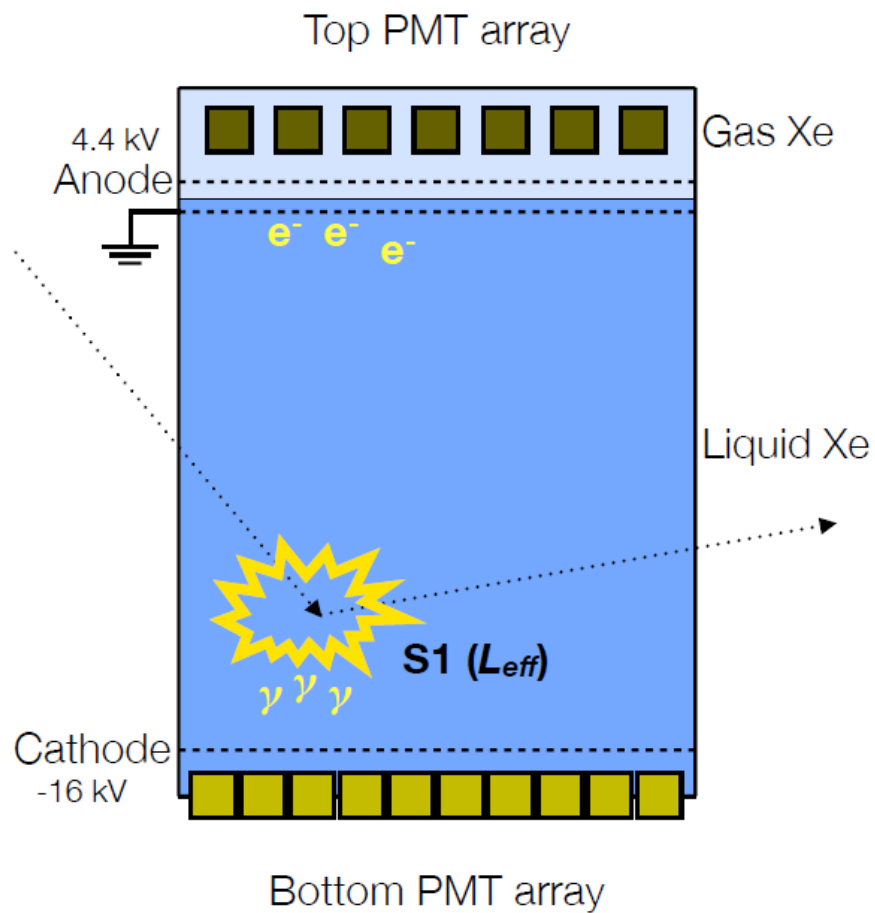
Dual-phase TPC



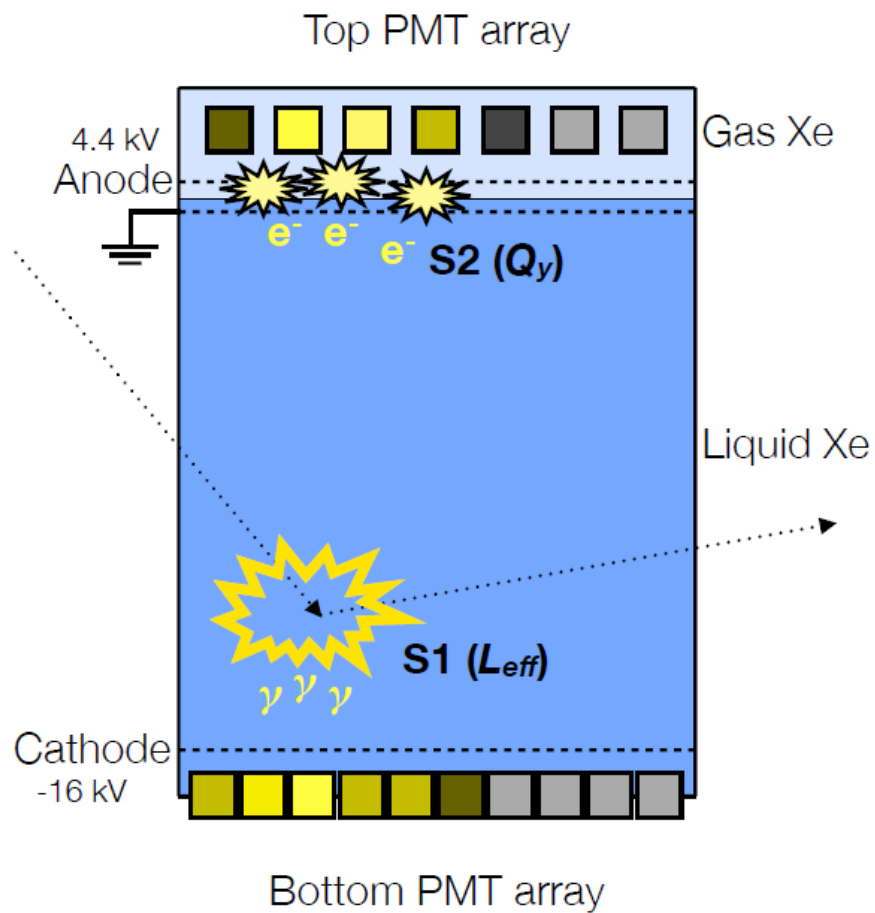
Dual-phase TPC



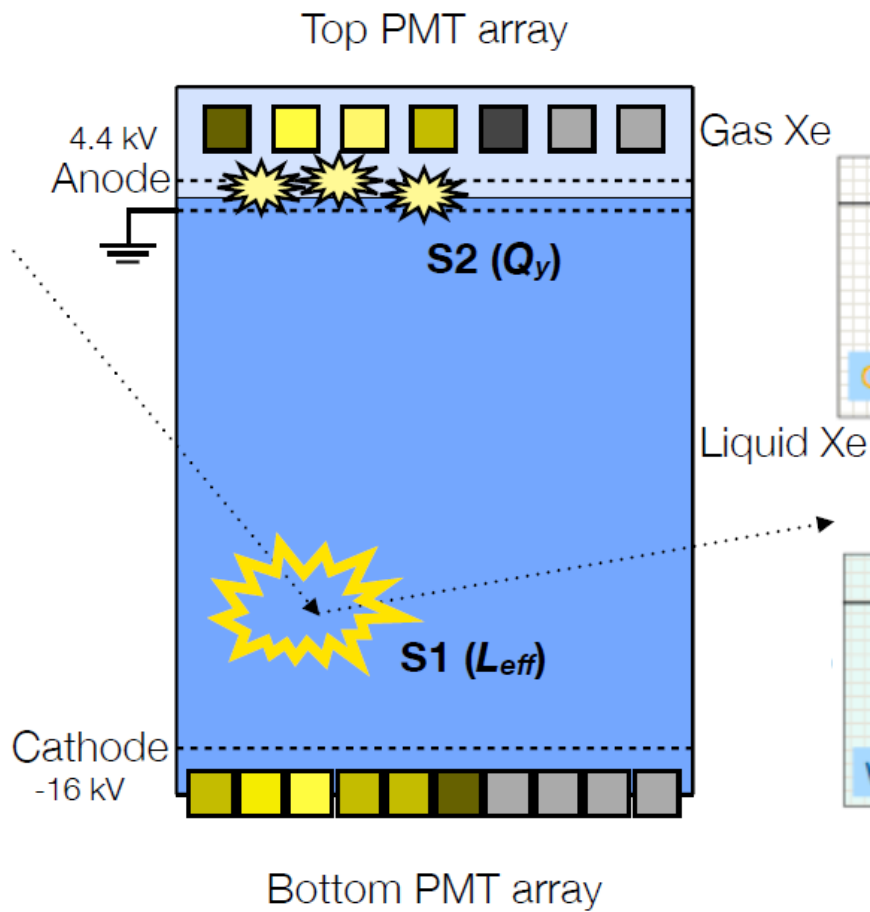
Dual-phase TPC



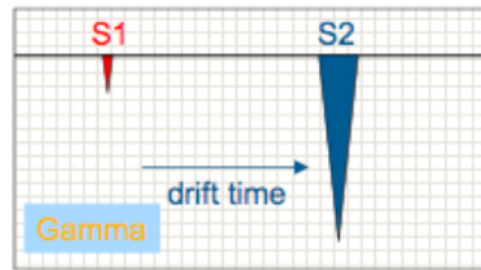
Dual-phase TPC



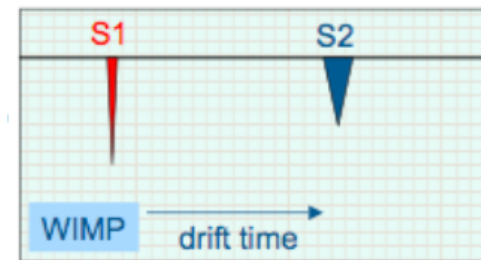
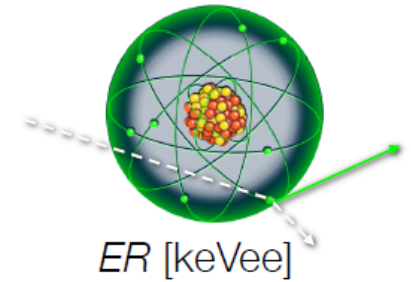
Dual-phase TPC



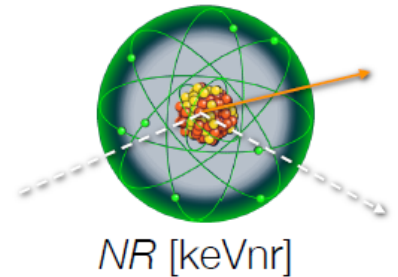
$$(S2/S1)_{n,WIMP} < (S2/S1)_{e,\gamma}$$



e/γ electronic recoil



$n/WIMP$ nuclear recoil



The XENON Collaboration



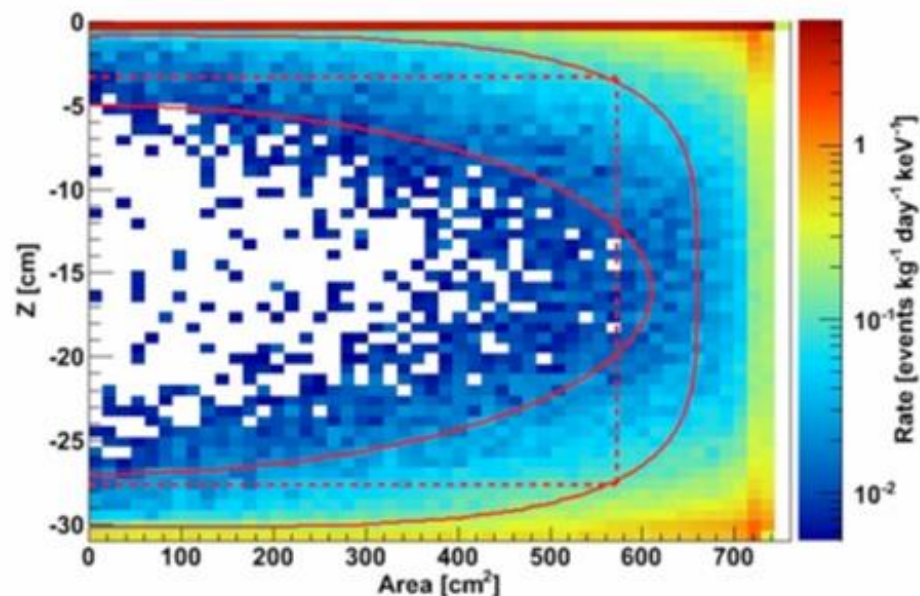
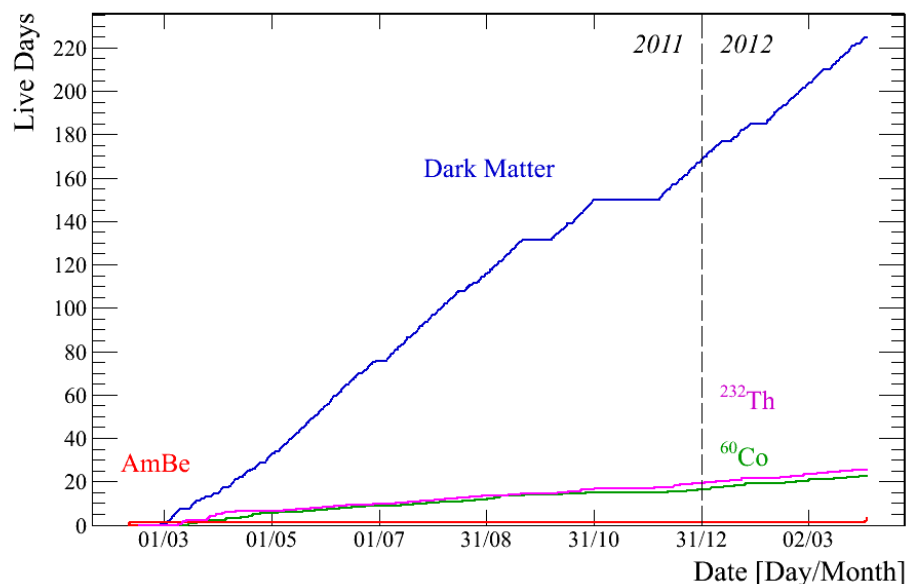
XENON100



- Located at LNGS under 1400 m of rock
- 161 kg of LXe, 62 kg of target mass
- 242 high QE PMTS
- Electric field of 0.53kV/cm
- Radio-pure
- Passive shielding

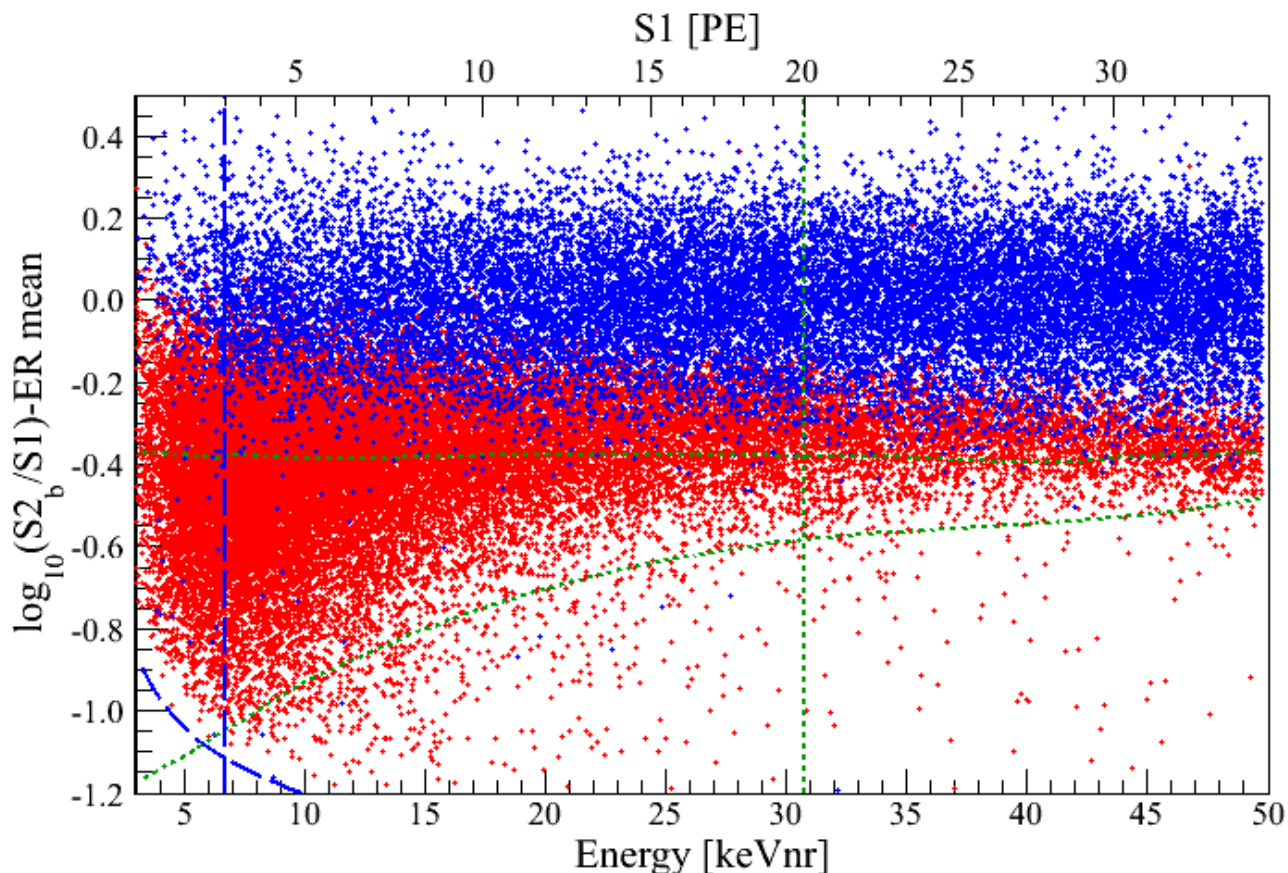


2011/2012 data



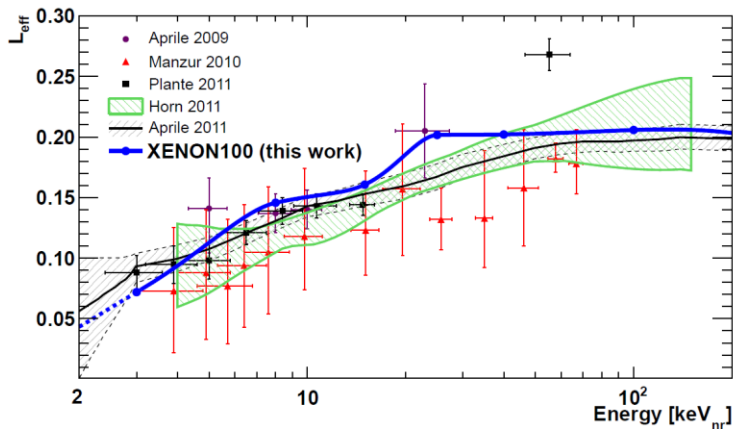
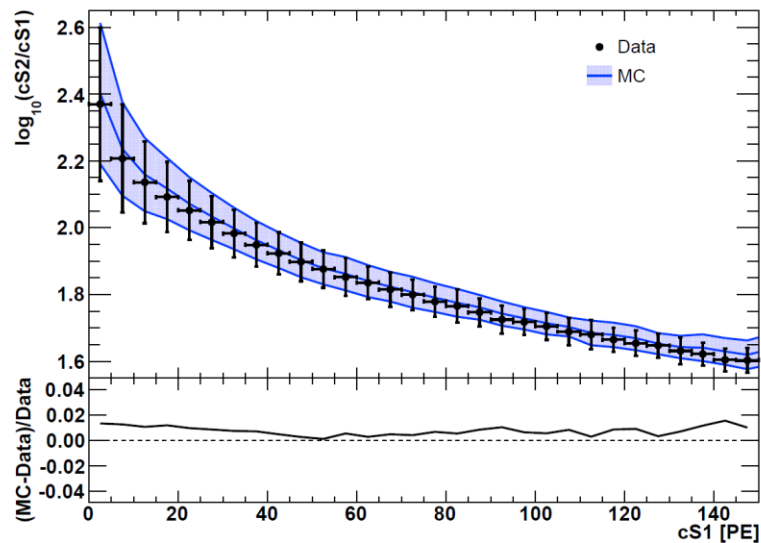
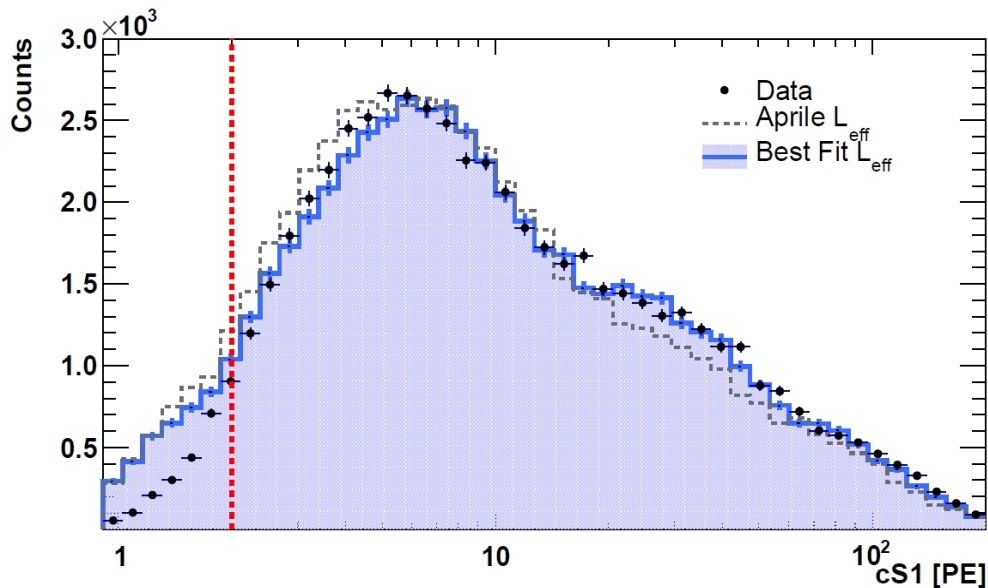
- More than double exposure (live time x fiducial mass)
- Excellent stability
- 34 kg of fiducial volume
- Low threshold (6.6keVnr)
- Low Kr contamination

ER/NR Calibration



- ER calibration: ^{60}Co and ^{232}Th , NR Calibration: AmBe
- 99.75% ER rejection for 50% efficiency loss on NRs

NR Detector Response



- Good agreement down to 3 keV_{nr}
- L_{eff} matches measurements
- Excellent understanding of the detector response to NRs

Background Prediction

ER background

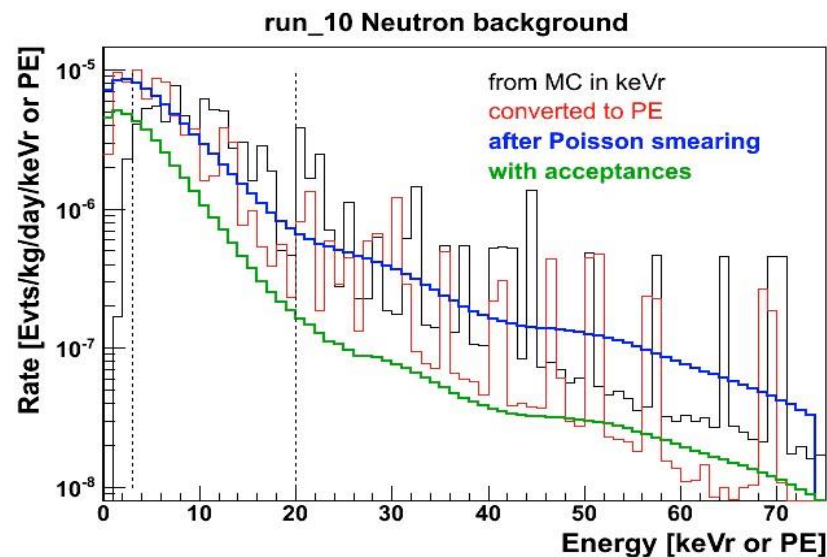
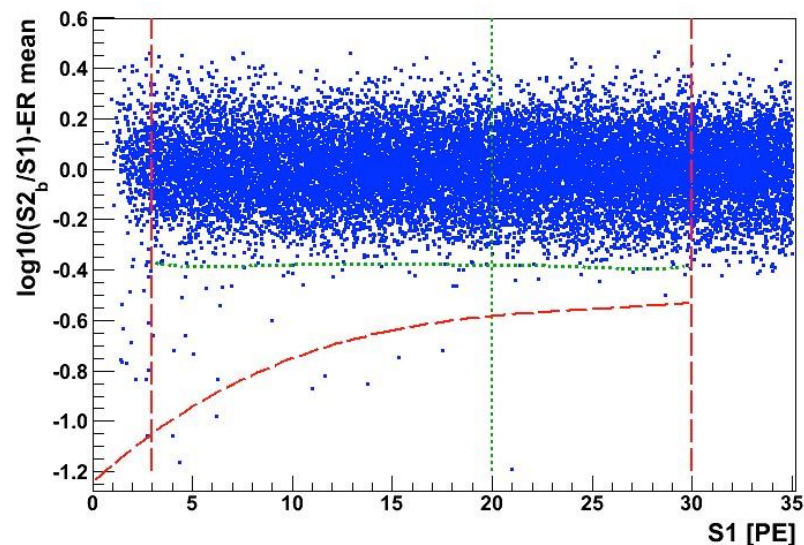
- Radioactivity of the detector
 - Intrinsic radioactivity of the LXe
- ➔ (0.79 +/- 0.16) events

NR background

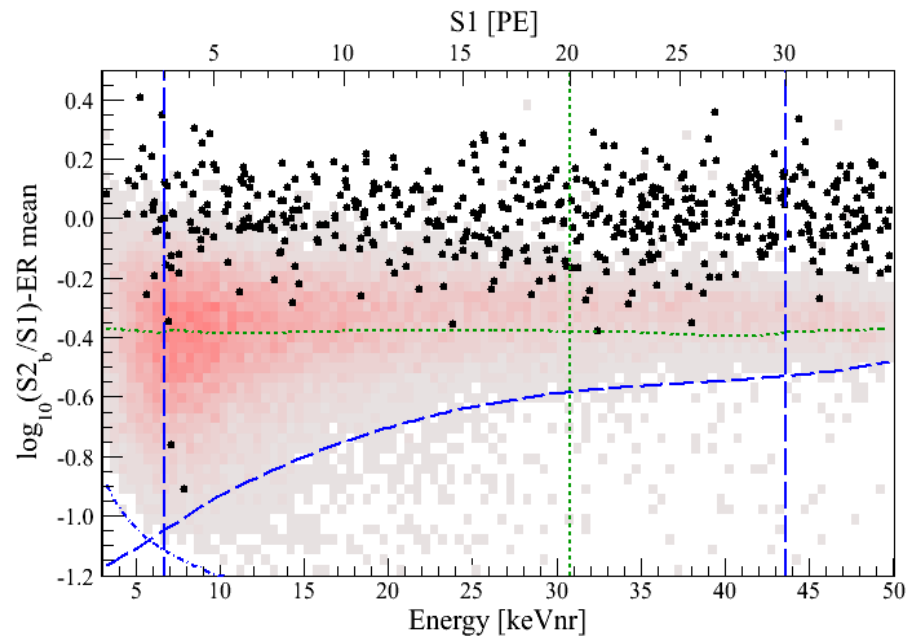
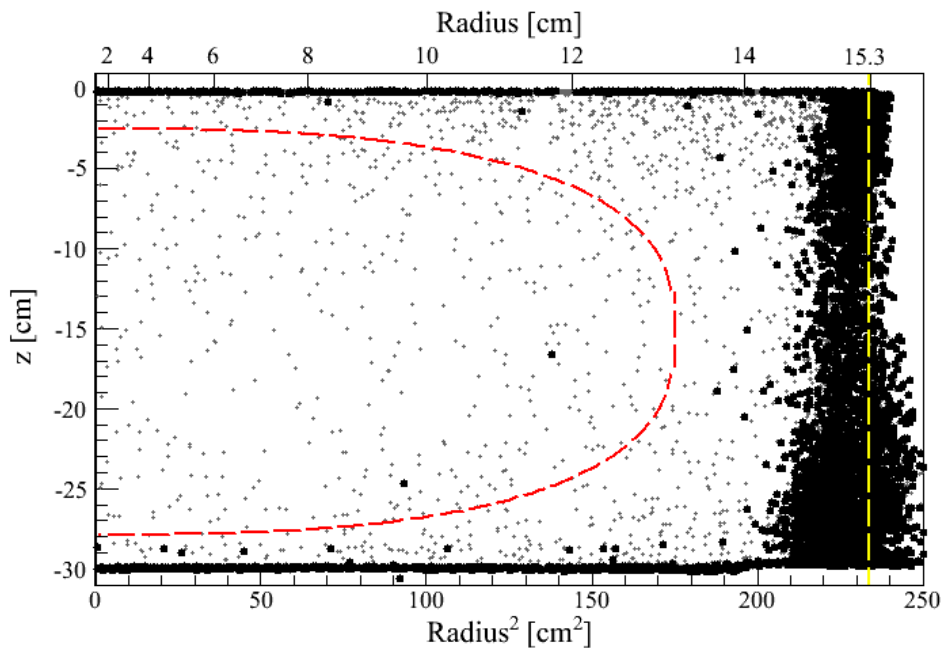
- (α, n) + S.F. and muon induced neutron
- ➔ (0.17 + 0.12-0.07) events

Total expected background

1.0 +/- 0.2 events in 225 days

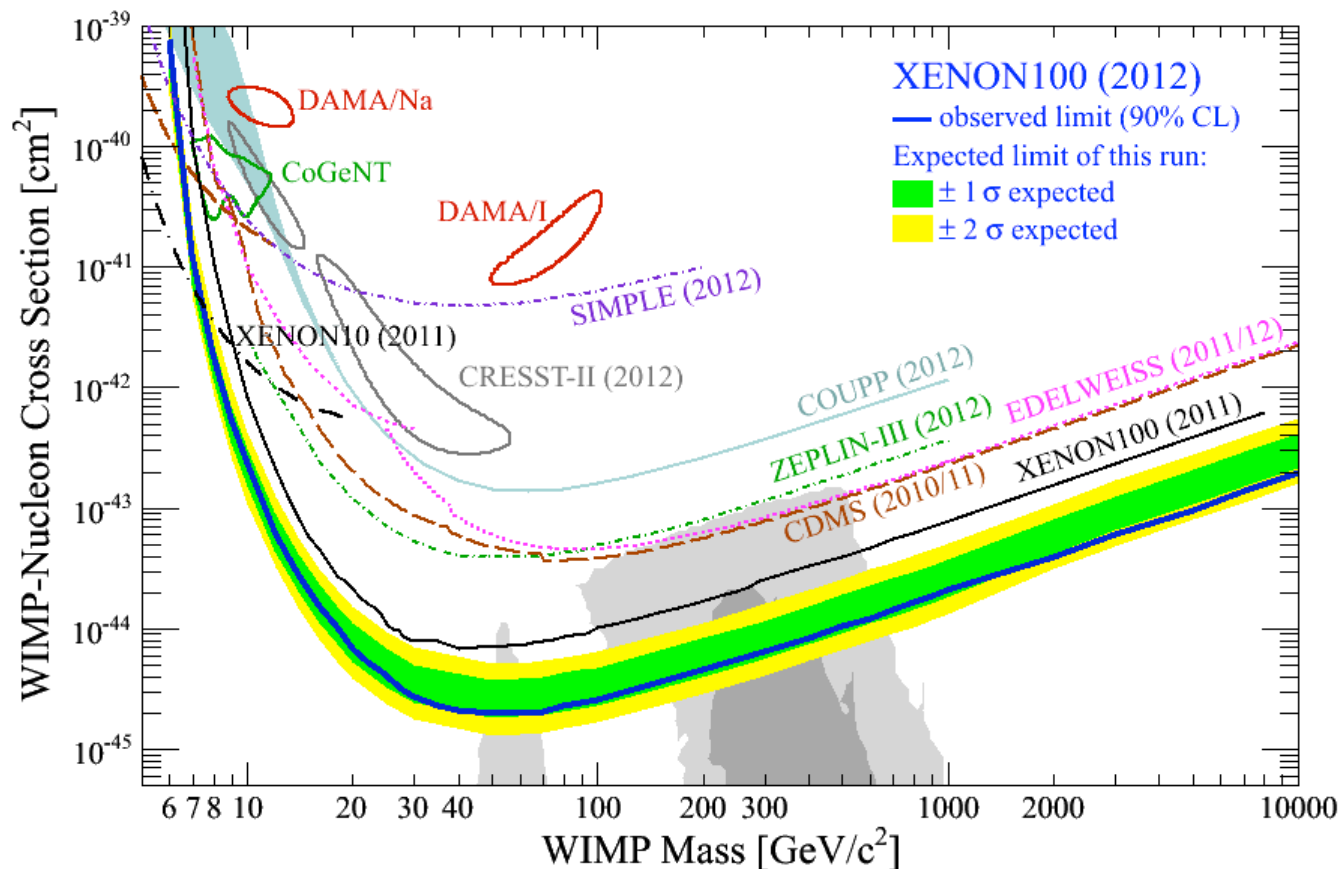


225 Days Results



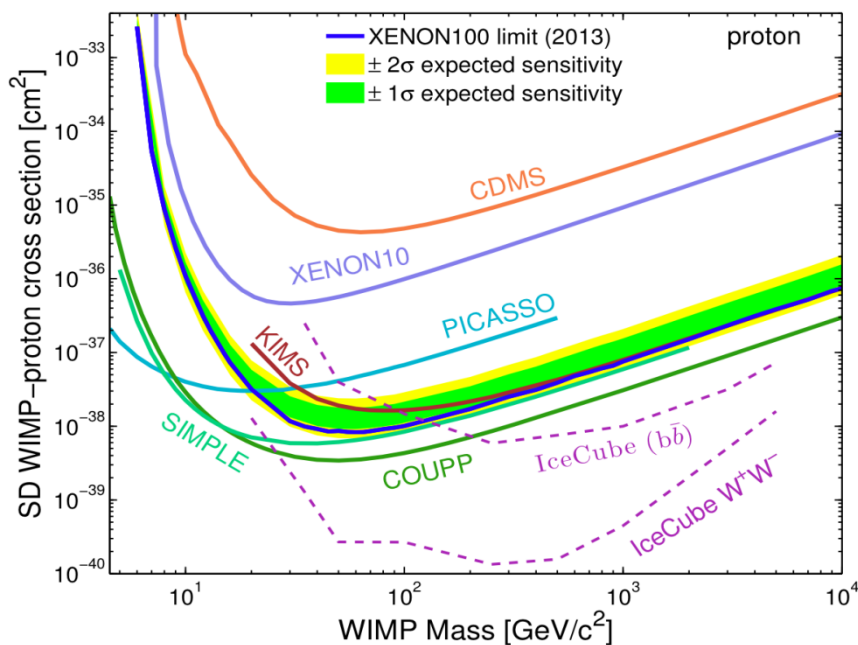
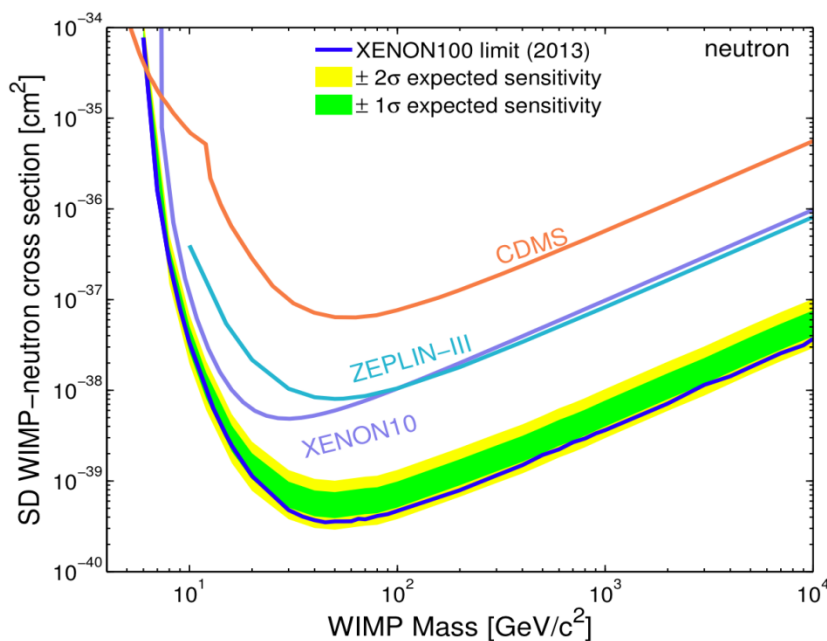
- Expected background of 1 \pm 0.2 events
- 2 events observed
- Compatible with the background hypothesis

Spin Independent



- 225 days x 34 kg exposure
- Limits extracted using the Profile Likelihood method

Spin Dependent



- 2 isotopes with nonzero spin:
129Xe (26.2%) and 131Xe (21.8%)
- Nuclear model (Menendez et al. *Phys.Rev.D86*, 103511, 2012)
- Best sensitivity for WIMP-neutron coupling

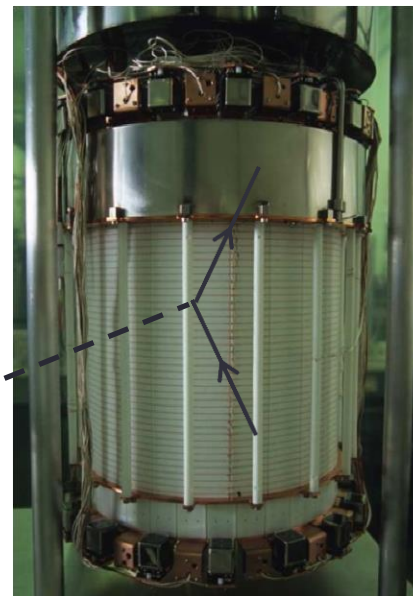
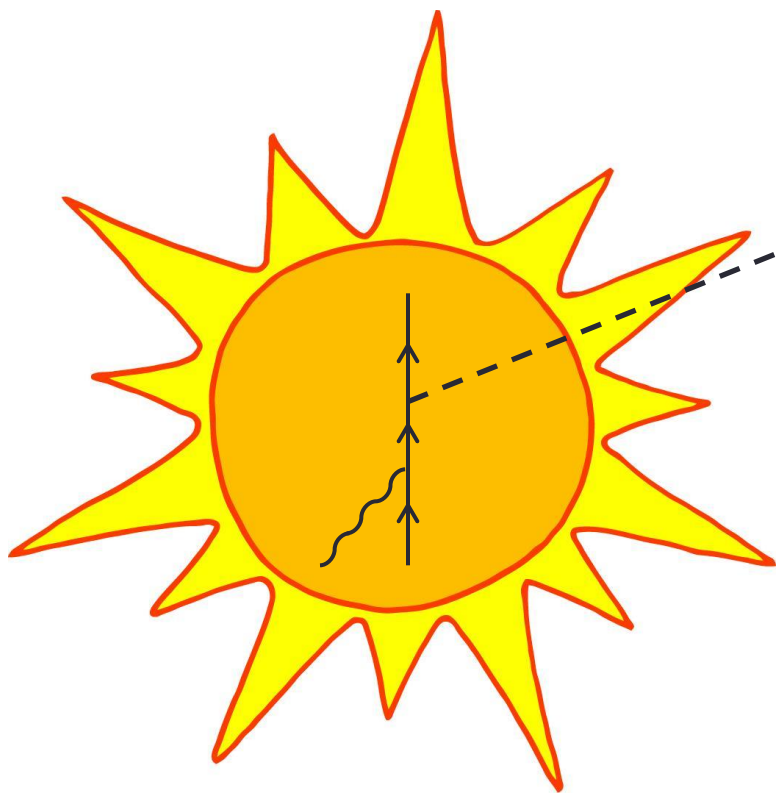
What's next?

not only WIMP search

Axion Search with XENON100

Solar Axions in XENON100

$$L_{BSM} \supset i g_{ae} a \bar{\Psi}_e \gamma_5 \Psi_e$$



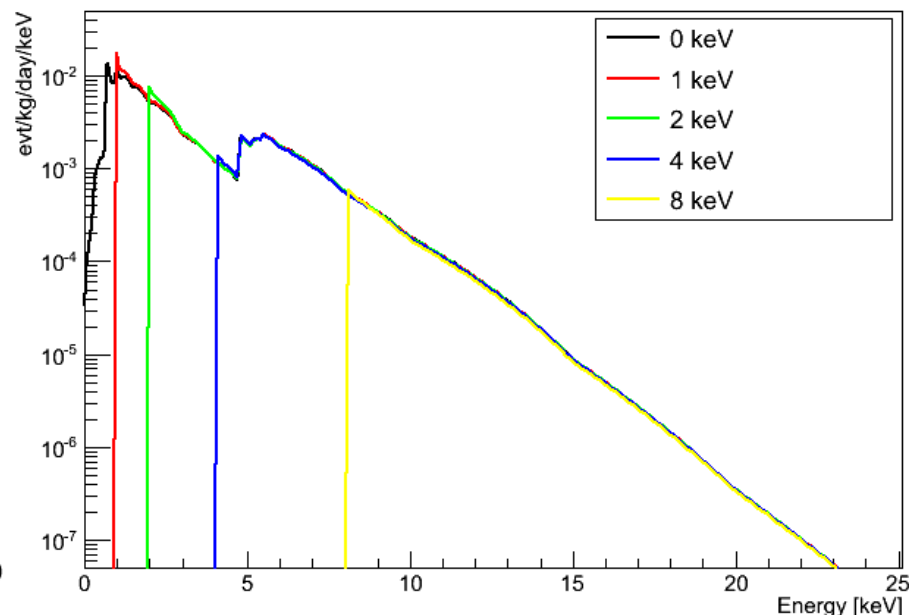
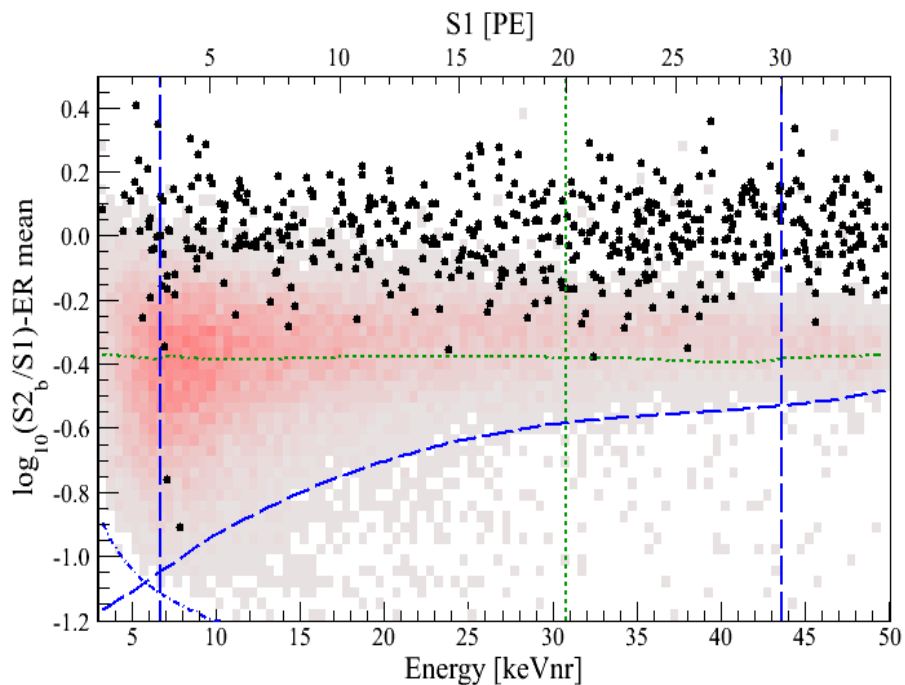
Production:

- *Bremsstrahlung*
- *Compton*

Detection:

Axio-electric effect

Solar Axions in XENON100



- No discrimination
- 400 events in 225daysX34kg
- $O(10^{-2})$ events/kg/day
- $O(10^{-2})$ events/kg/day @ $g_{ae} = 10^{-11}$
- PL approach to include the spectral shape

Conclusion and Prospects

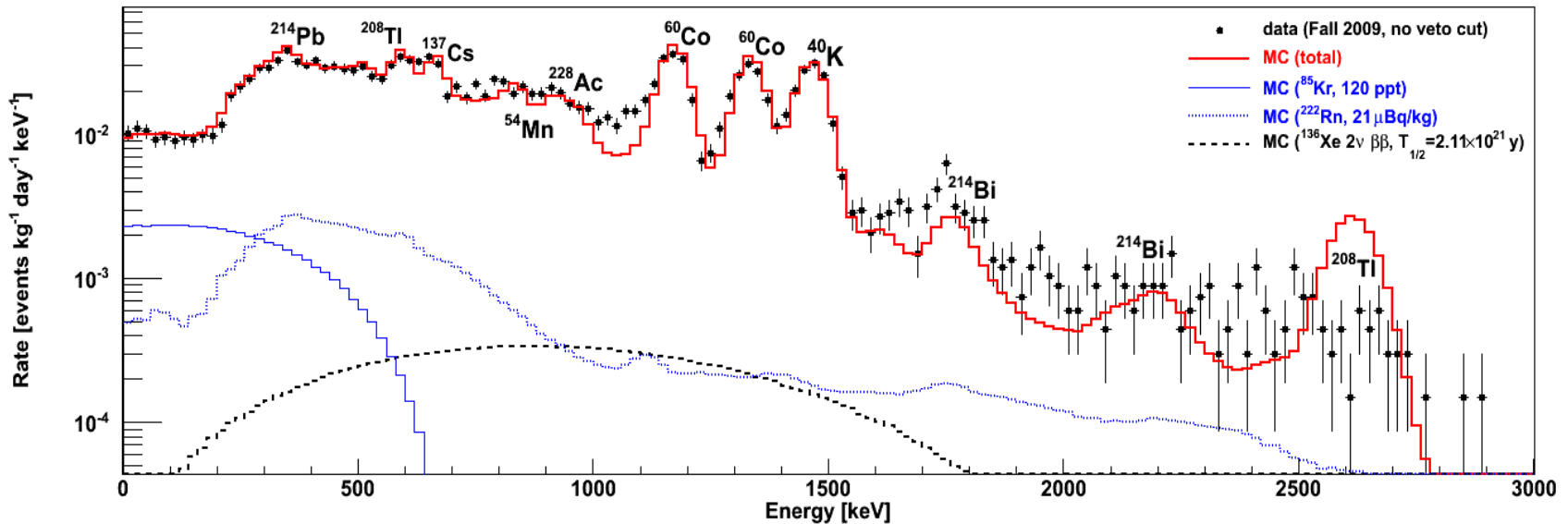
- Strongest exclusion limits on SI interactions
- Strongest exclusion limit on WIMP-neutron SD

Coming soon...

- Axions – Solar & Galactic
- Low mass WIMPs
- **XENON1T**

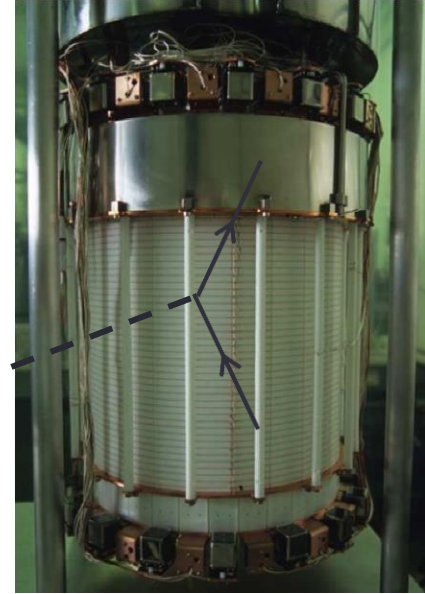
BACKUP SLIDES

Background



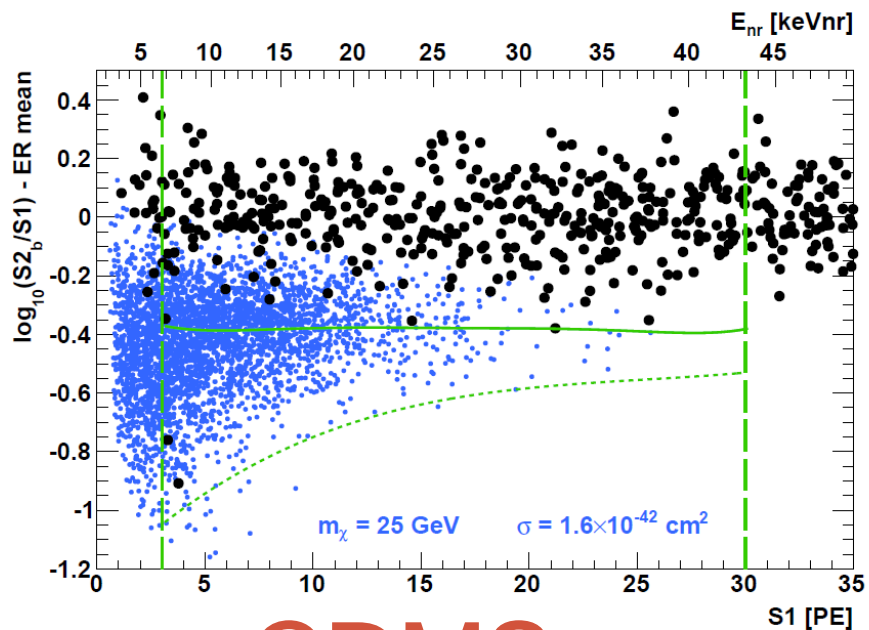
- Extremely good data/MC matching
- Ultra low background has been achieved

Galactic Axions in XENON100

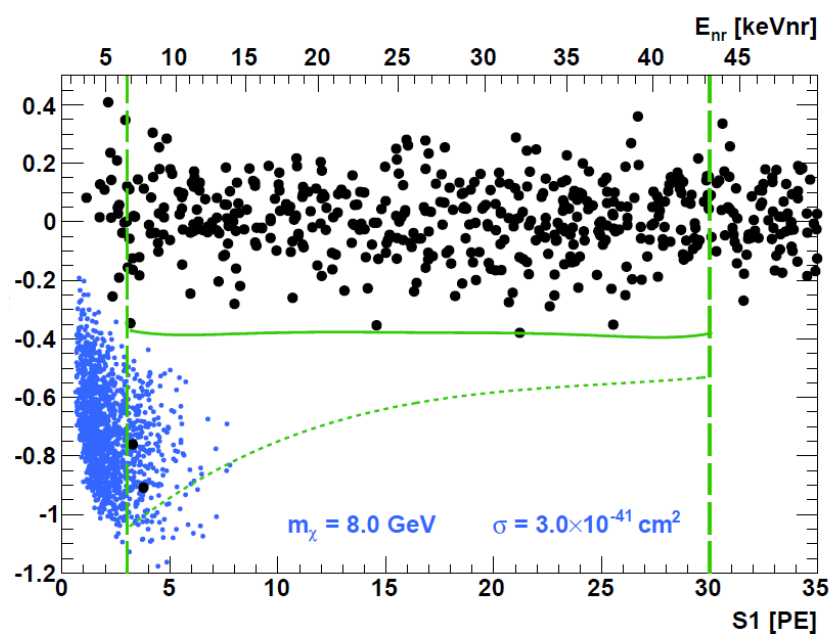


Detection:
Axio-electric effect

CRESST



CoGeNT



CDMS

