

XENON1T Calibration Techniques

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XENON1T





- · Fully funded, construction started
- · Commissioning in late 2014
- · 3.5t total Xe, 2t in TPC, >1t fiducial volume
- Science goal: 2e-47cm2 by 2017

Water Tank

- · 10m high, 9.6m diameter
- Passive neutron shield
- Active muon veto
 - 84 high QE 8" PMTs
 - + 99.5% efficient for through going μ
 - 78% efficient for external μ

Muon induced neutrons: < 0.01 / year



XENON₁T - TPC

- 1m high, 1m diameter
- Drift field 1 kV / cm
- Ultra-ultra-low background
 - < 1 ppt Kr/Xe</p>
 - < 1 µBq 222Rn/kg
 - Expect 100 × less than XENON100
 - Goal: < 1 background event / 2 years



TPC Principle



Detect two signals with photomultipliers:

 \rightarrow Prompt scintillation (S₁)

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 \rightarrow Ionization via proportional scintillation (S₂)

Distinguishing NR From ER



Co6o & Th232 data (blue), AmBe data (red)

Nuclear Recoil



- . AmBe Simulation (GEANT₄)
- · High Rate 16,000 neutrons/day
- DD neutron Generator Gives Qy estimation.



- Trigger Rate 200 events/sec to avoid pile-ups
- Naive Approach very low calibration rate for Co60
- More Energetic source ~30 events/day for Y88
- Higher Activity \rightarrow Pile-ups

- · Using a 10X10X20 [cm]Tungsten Collimator.
- Restricts Z distribution \rightarrow drift time distribution.
- Correctly pair S1 and S2.

- The Pairing Algorithm:
 - Put a source at a known z-position, and hence a known drift time (t_o)
 - Pair S1 and S2 by demanding that in a drift time interval (dt1) around to, only one S2





- Scatter Plot of the events from a collimator (GEANT₄).
- Gives good collimation.



- For 2kHz effective rate -> 1.4 kHz calibration rate.
- After all Cuts (FV + single + energy) ~80 events/day

Summary

- XENON1T sensitivity goal 2e-47cm2.
- Reduce background by factor 100.
- Excellent self shielding imposes challenges for ER calibration.
- Sophisticated approach to achieve enough statistics.

Thank you