Search for Coherent Elastic Solar Neutrino-Nucleus Scattering in XENONnT

8 July 2023

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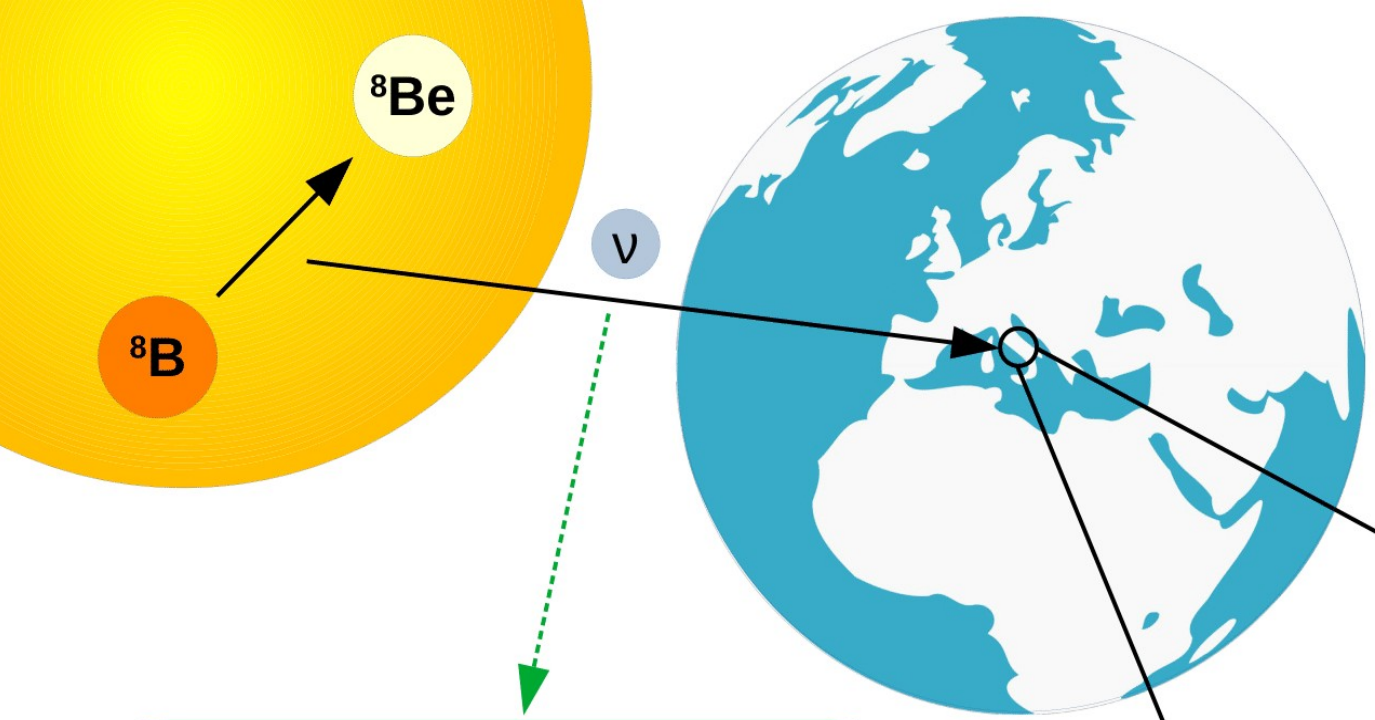
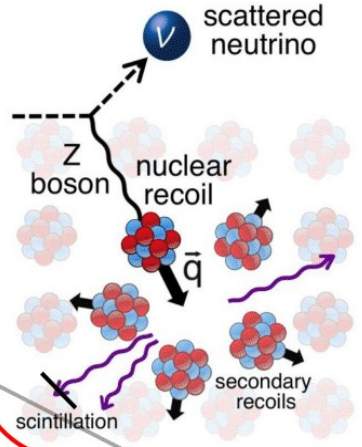
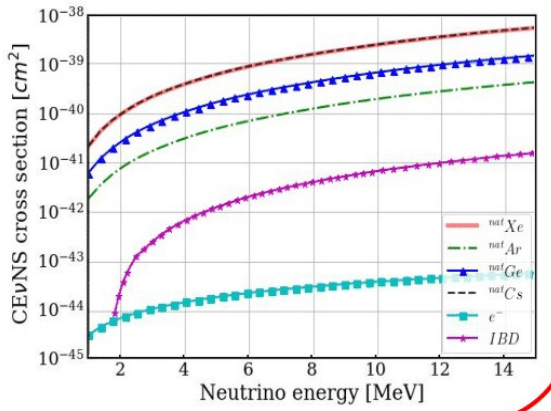
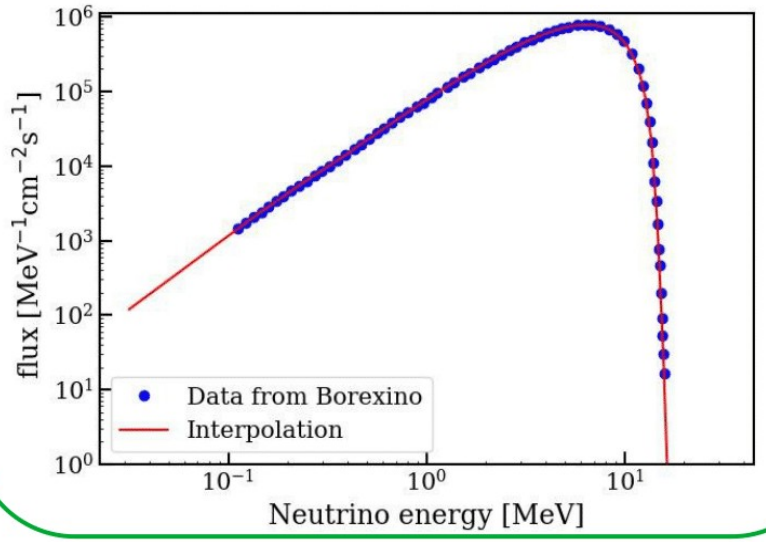


Coherent elastic scattering of neutrinos

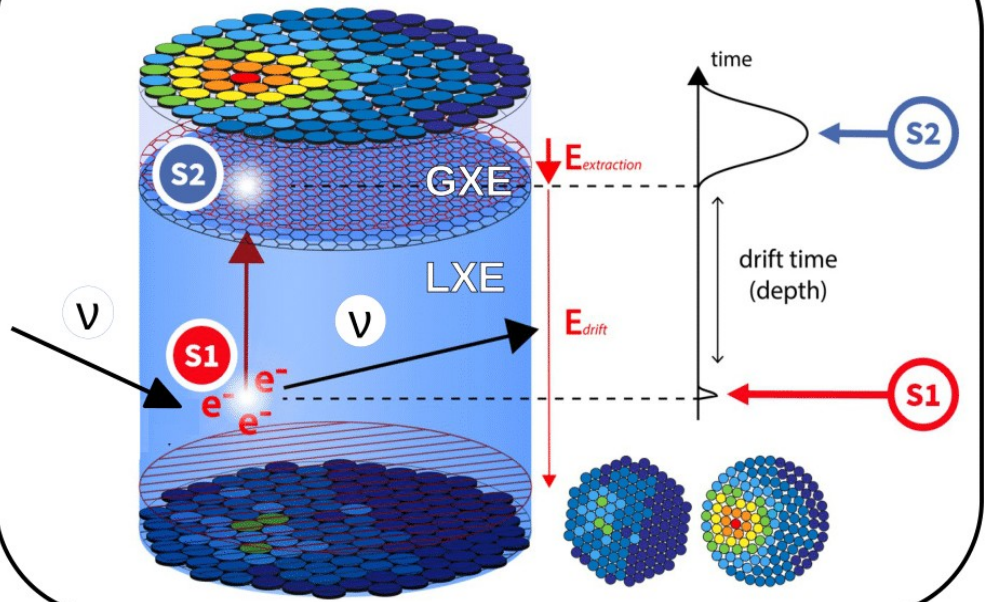


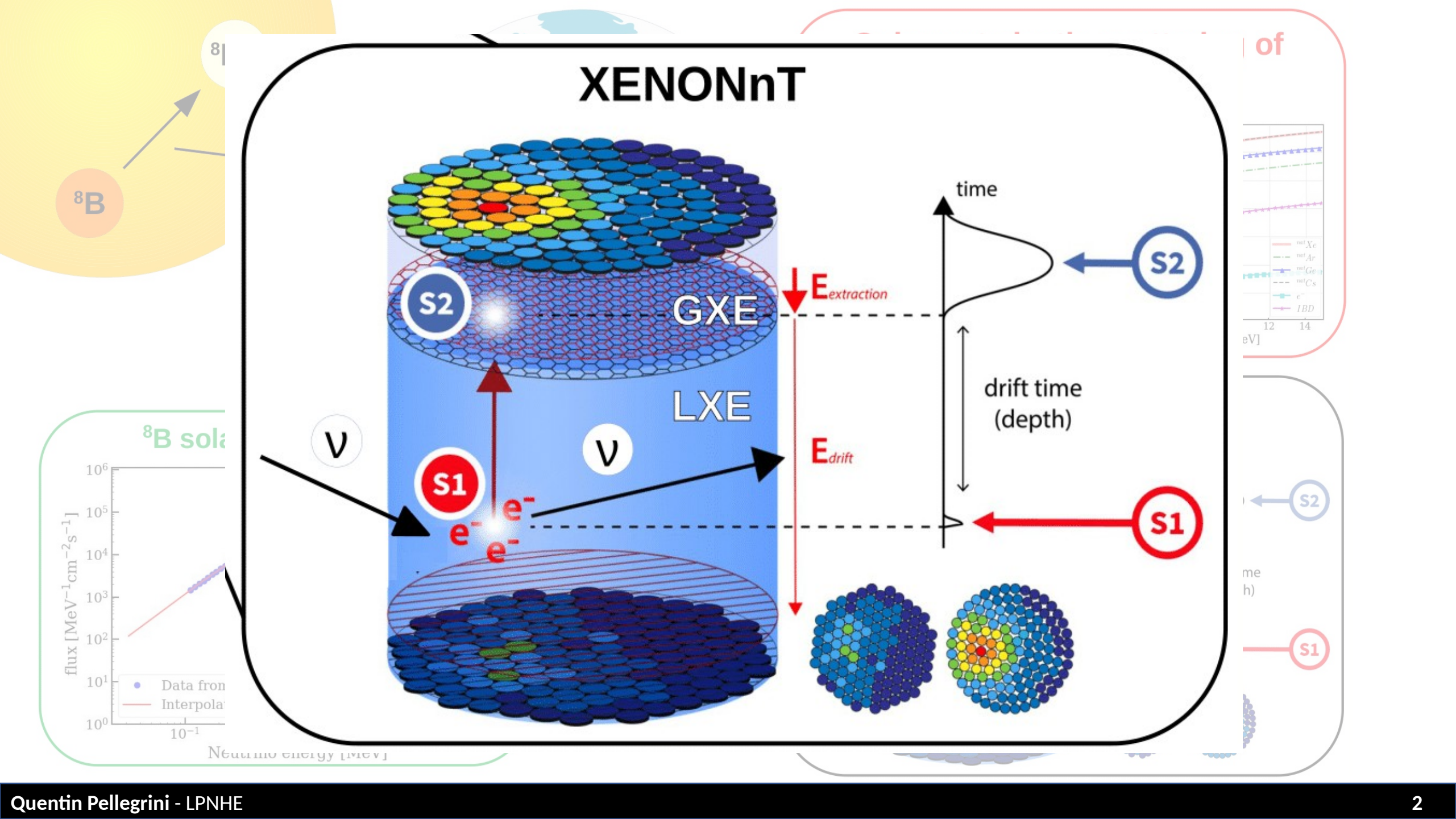


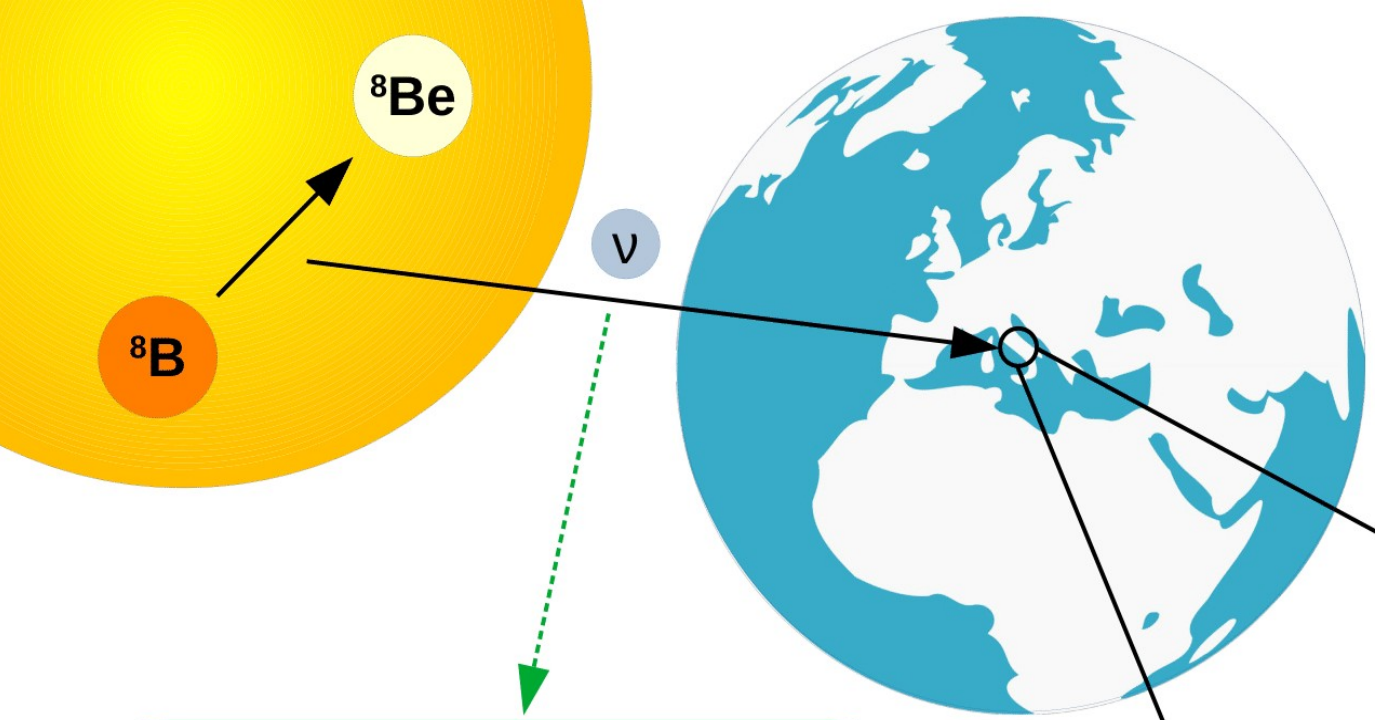
^{8}B solar neutrinos flux



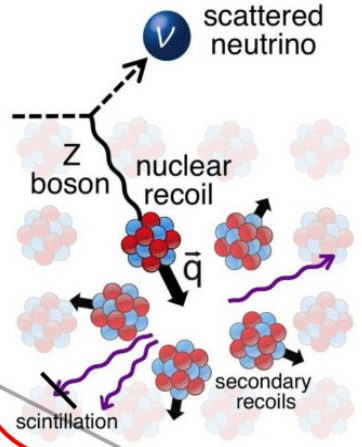
XENONnT

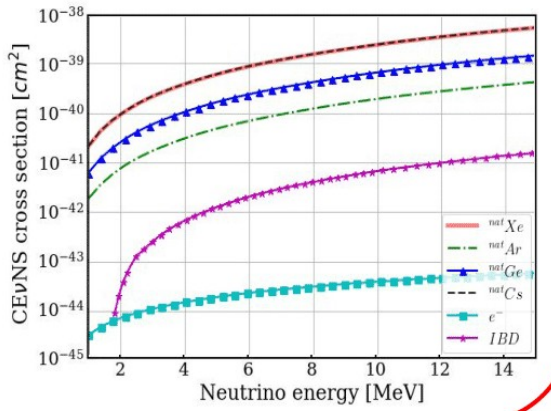



XENONnT
S2
GXE
LXE
S1
ν
ν
e⁻
e⁻
e⁻
E extraction
E drift
time
drift time
(depth)
S2
S1

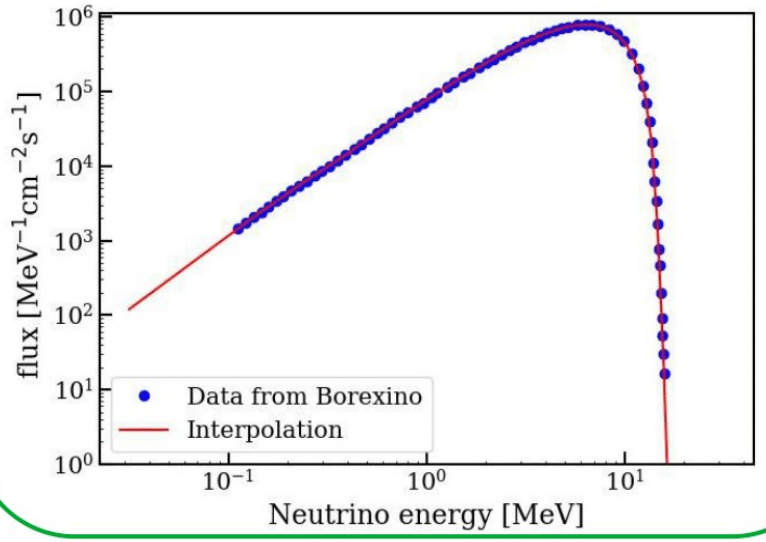


Coherent elastic scattering of neutrinos

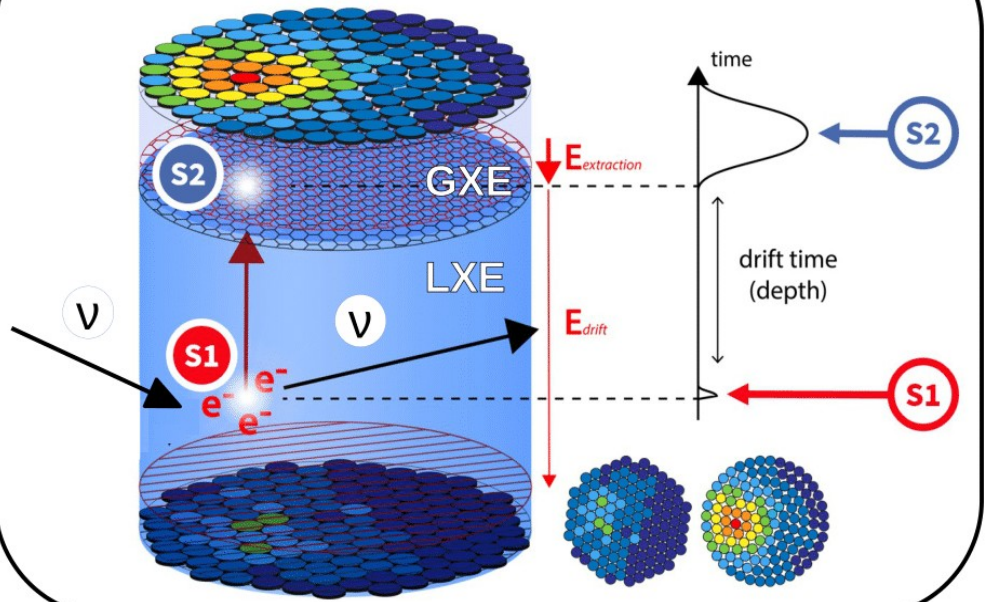




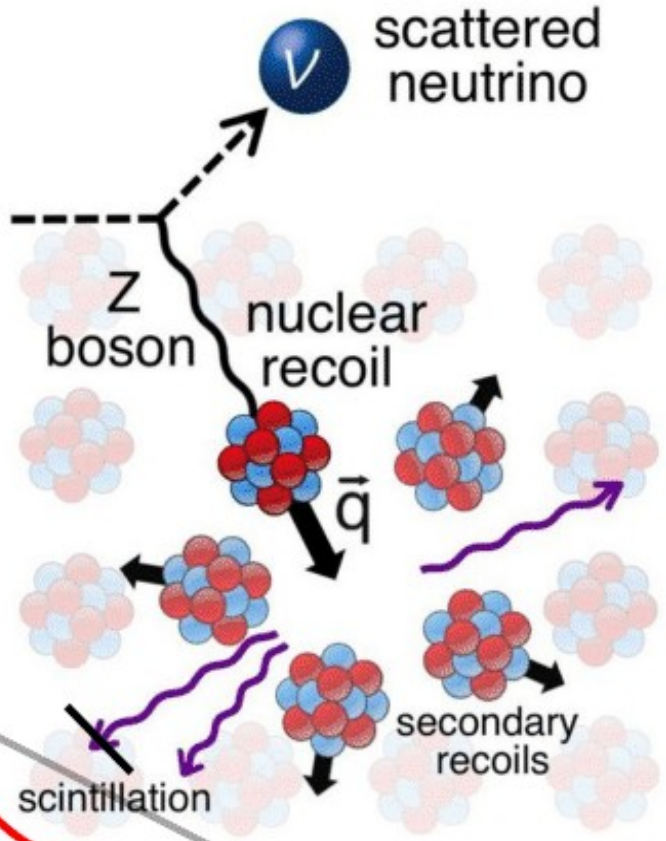
^{8}B solar neutrinos flux

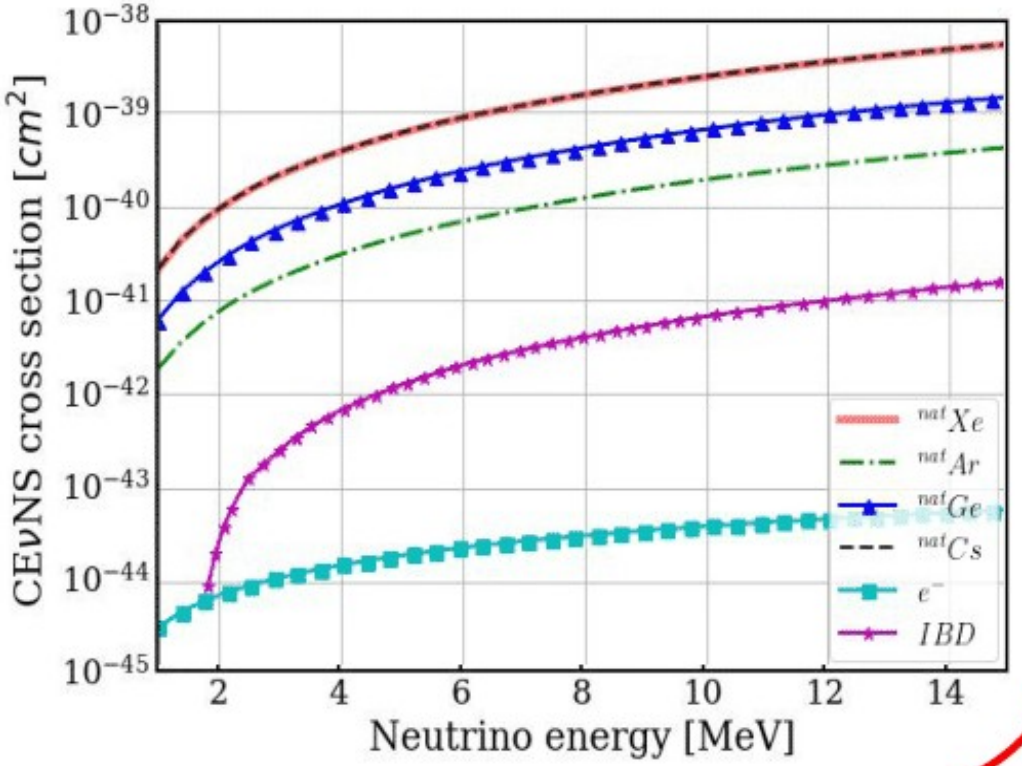


XENONnT



Coherent elastic scattering of neutrinos

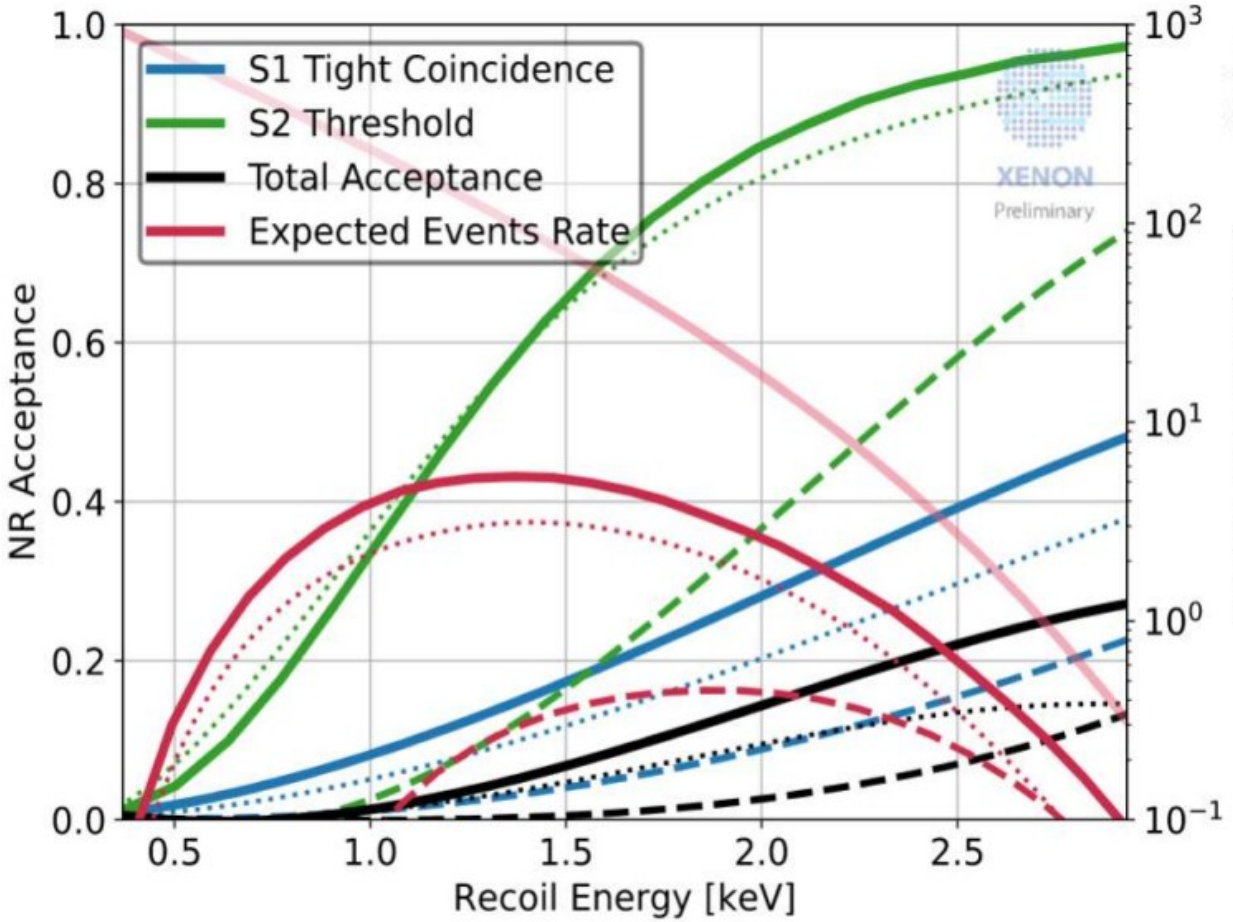




Detection efficiency

- Driven by **2-fold PMT coincidence for S1** (2 photons) & **S2 threshold** (100 PE)

- **Emission models** for low nuclear recoils (Light Yield & Charge Yield) from data fitting with NESTv2 parametrisation & morph parameters for yield fluctuation quantification



Expected Differential Rate

$$\frac{dR}{dE_r} = \mathcal{N} \int_{E_\nu^{min}} \Phi(E_\nu) \frac{d\sigma(E_r E_\nu)}{dE_r} dE_\nu$$

Target density | **^{8}B flux** | **SM CEvNS Cross section**

$$E_\nu^{min} = \sqrt{\frac{m_N E_r}{2}}$$

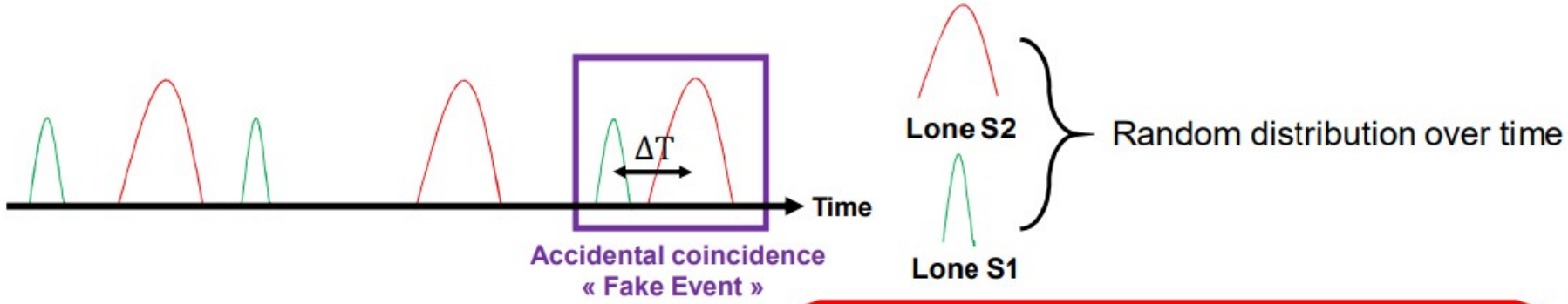
Minimal neutrino energy to induce a specific nuclear recoil energy

Detection efficiency plot

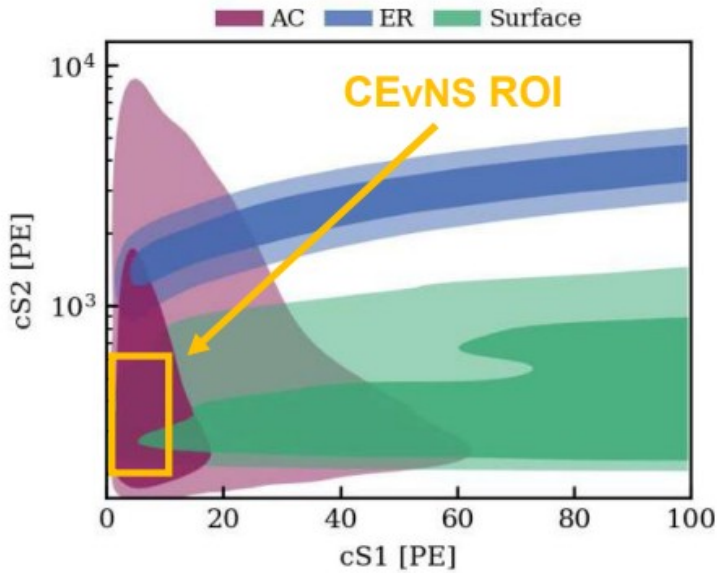
- *Full line* ⟶ *CEvNS (nT)*
- *Dashed line* ⟶ *Standard (nT)*
- *Dotted line* ⟶ *CEvNS (1T)*

Accidental coincidences (AC)

- **Random pairing of lone S1 & S2 signals** by the Event Builder



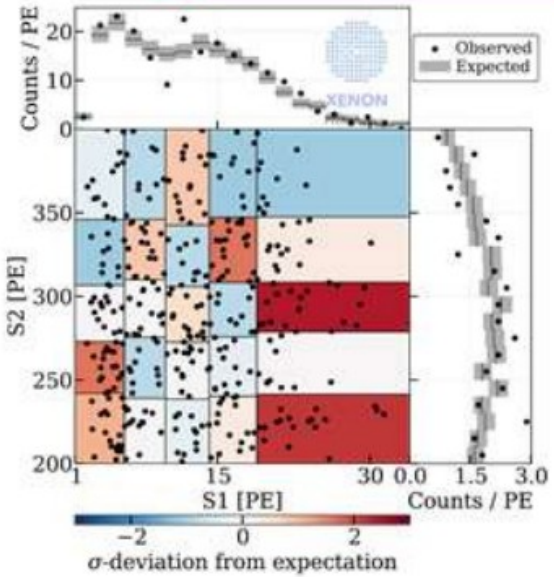
- **Main background for CEvNS searches**



Area of main backgrounds in S2 vs S1 space

$$N_{AC} = \int R_{S1}(t) \times R_{S2}(t) \times \Delta T \times dt$$

- N_{AC}: AC rate
- $R_{S1}(t)$: Lone S1 rate
- $R_{S2}(t)$: Lone S2 rate
- ΔT: Max electron drift time

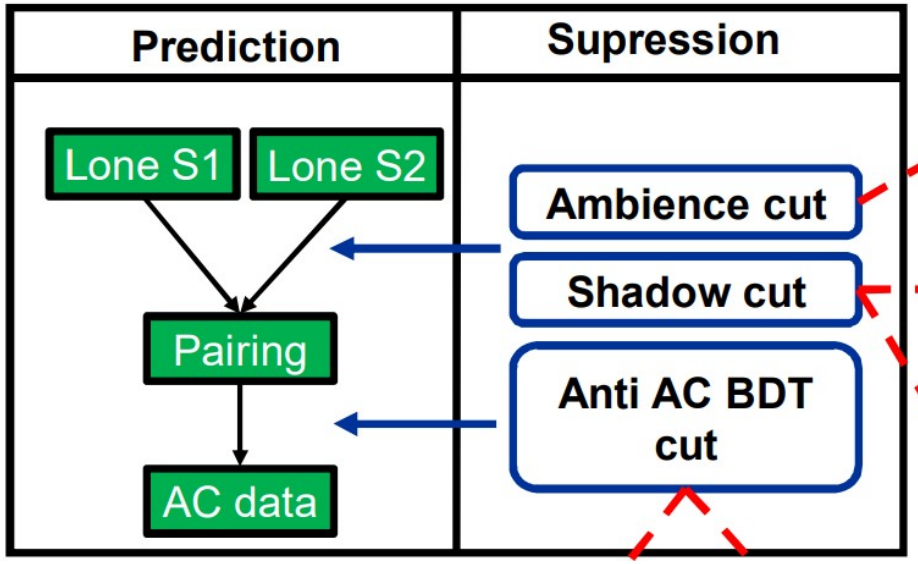


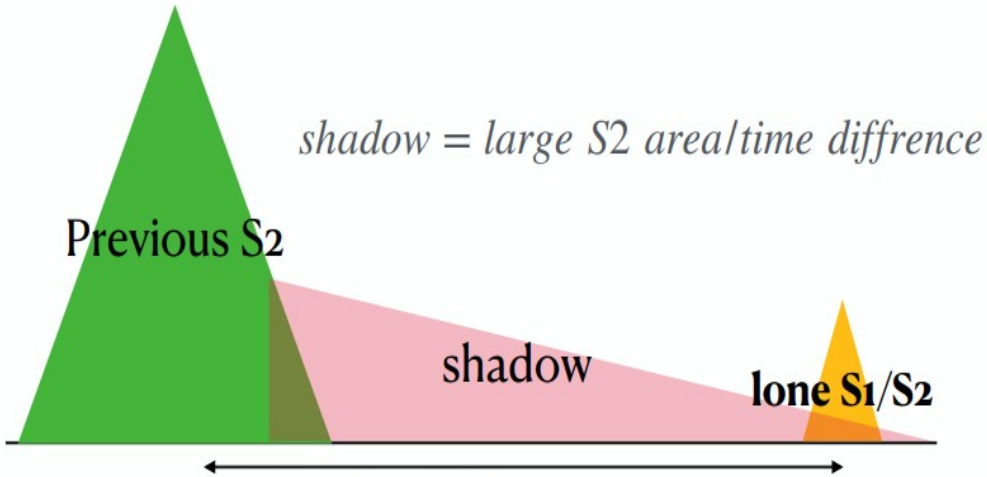
AC background is nicely understood in first science run of XENONnT
5% precision

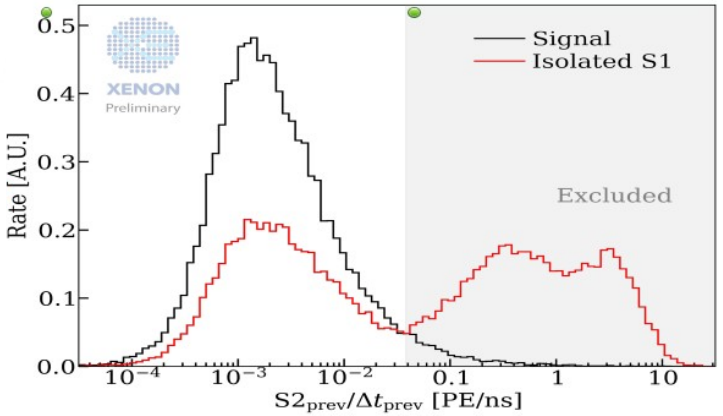
Expected AC data vs true data (Ar37)

Data selection

- Minimum cutlist: Muon & Neutron Veto, …
- ROI cuts: Two fold coincidence & S2 Threshold
- Anti AC cuts: Data-driven method
- Wall background: Fiducial cut
- S1 & S2 quality cuts



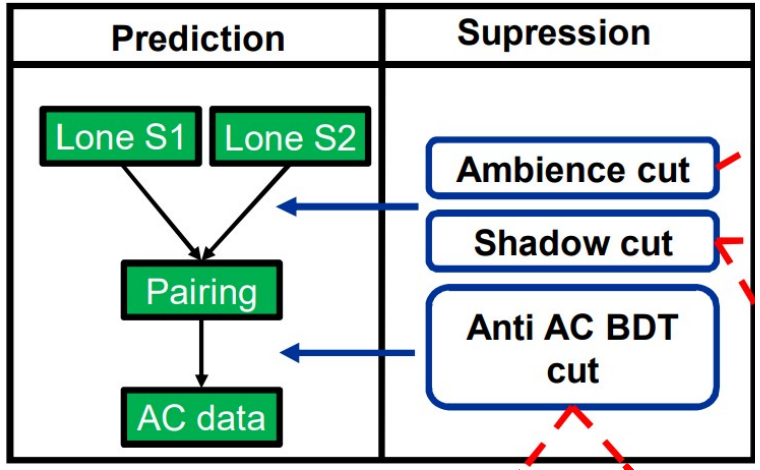


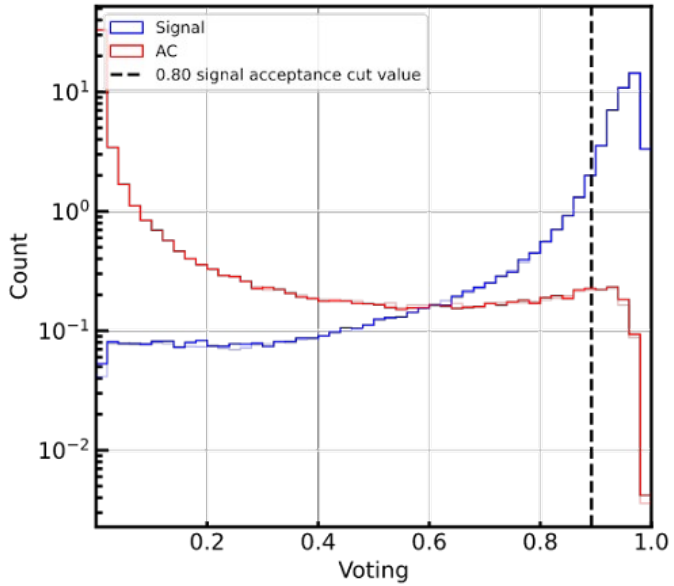


Shadow cut efficiency

Data selection

- Anti AC cuts: Data-driven method





Trained IA with simulated CEvNS & AC data (5 parameters of events)

BDT cut suppress the AC background by **two orders of magnitude**, signal acceptance at ~ 80%

Conclusions & Outlook

- **Current estimation of signal and backgrounds (Detector efficiency & Cuts) in [ty]**

^{8}B CEvNS	AC	NR	ER
4.84	10.6	0.01	0.04

- XENONnT CEvNS study is very advanced on first science run (SR0) but still a lot of work to do on the current science run (SR1)

- XENONnT CEvNS analysis will be more sensitive and with more exposure than XENON1T

STAY TUNED !