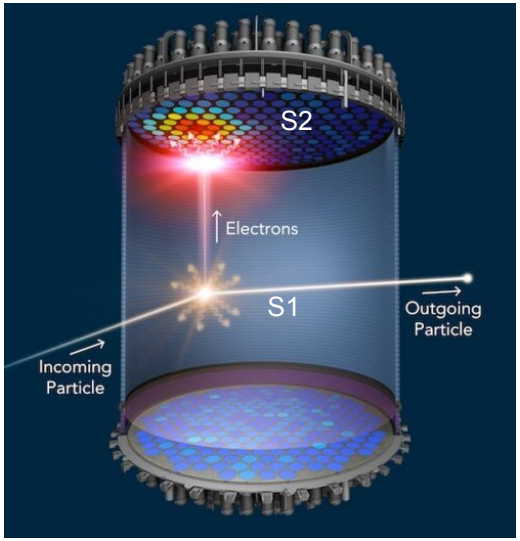
XLZD Discovery Requirements: Background Studies

Rory Matheson XLZD Collaboration

The XLZD Detector

- XLZD will be a 60-100 tonne, dual-phase, liquid xenon dark matter detector.
- Its primary goal will be to search for Weakly Interacting Massive Particles (WIMPs).

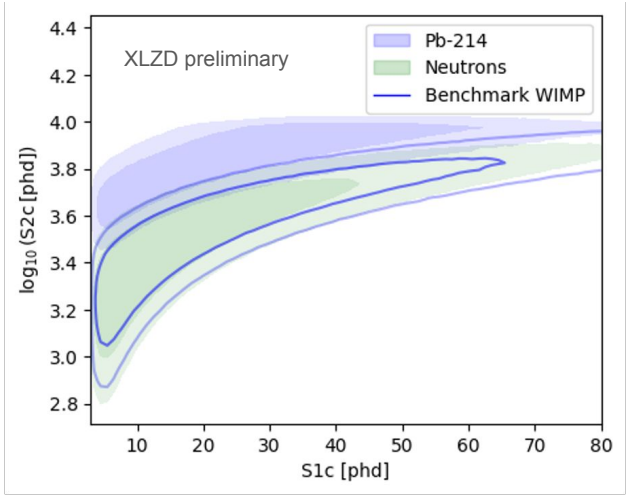
- Investigations into detector requirements will allow optimal decisions on detector designs to be made.

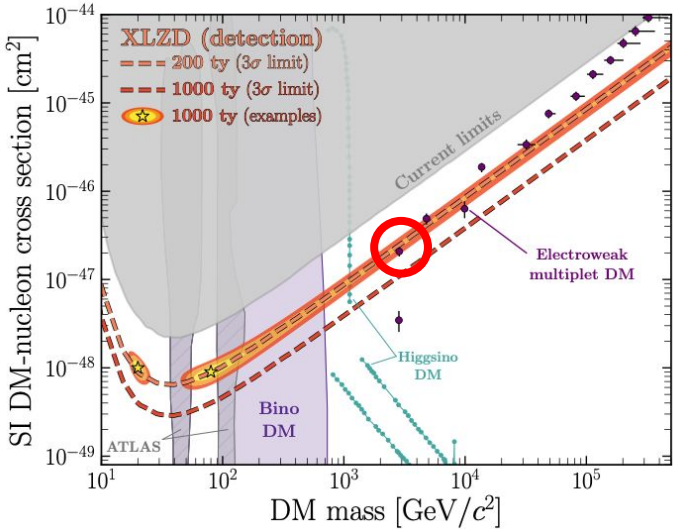


See Henrique's talk on XLZD at Boulby.

Aims + Motivation

- To investigate the effect that prominent radioactive backgrounds had on WIMP-discovery.
- To investigate the neutron background.



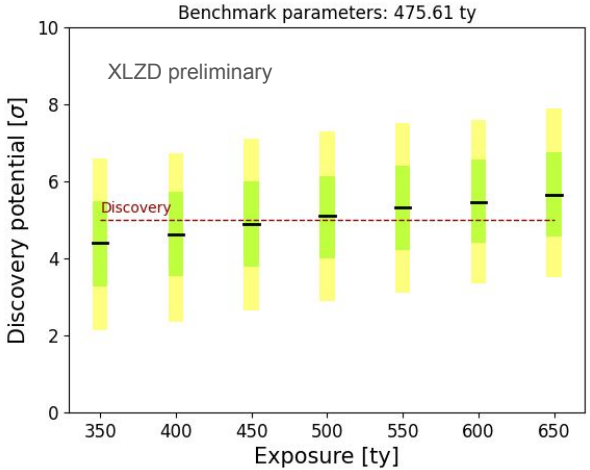


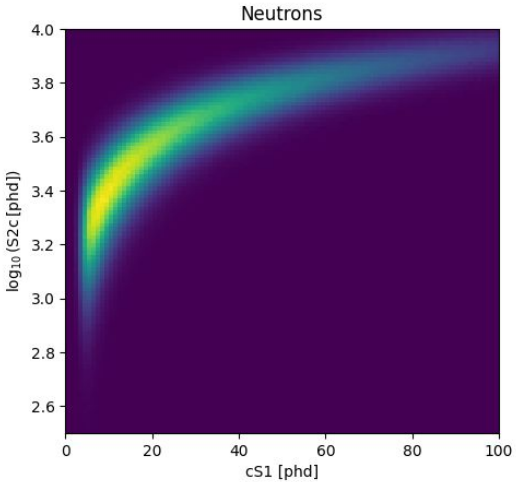
arXiv:2410.17137

- A 2827 GeV 'benchmark' WIMP was selected ($\sigma = 2.05 \times 10^{-47}$ cm^2).

Method

- Template spectra were produced for various background concentration levels.
- Statistical inferences were run and test statistics produced using the Profile Likelihood Ratio (PLR) method.



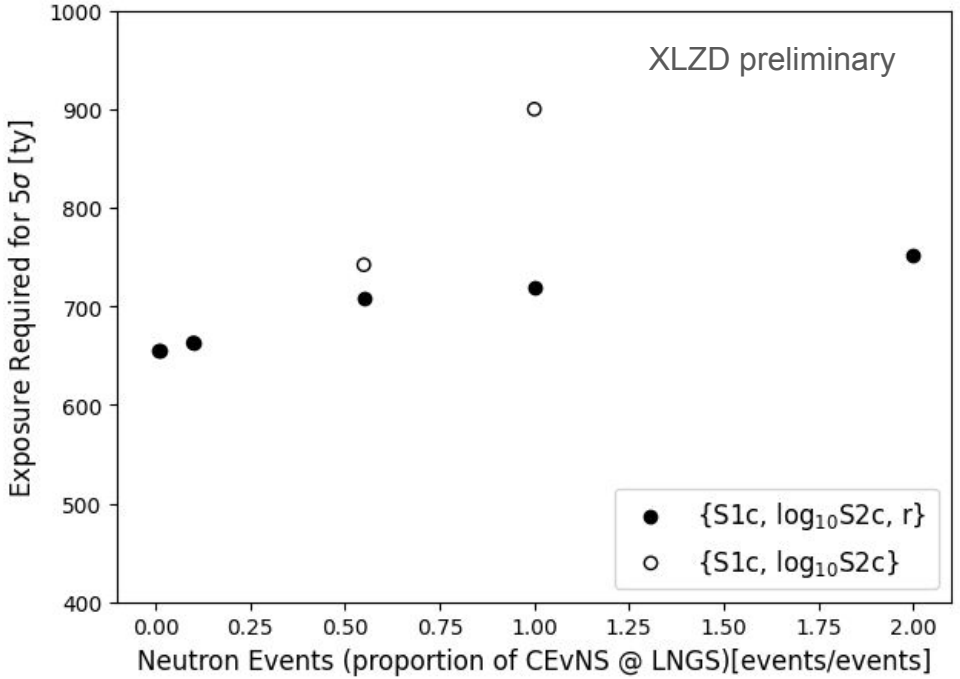


- The exposures required for a 5 σ discovery were found at each background concentration.

Software: Flamedisx

Results

- Considering radial dependency drops the exposure required at higher neutron rates.
- The large volume of XLZD provides effective shielding from neutrons.



*This rate includes the capabilities of the outer detector.

Conclusions

- We have the framework to estimate the exposure required for a 5 σ WIMP discovery (of given mass).
- This work is just beginning… There are many more aspects of the detector we can investigate.
- It's exciting to see the potential of the new detector in WIMP-discovery!!

Credit to all those involved!

ROYAL HOLLOWAY UNIVERSITY OF LONDON

Thanks for listening