Xenoscope – A full-scale vertical demonstrator for DARWIN

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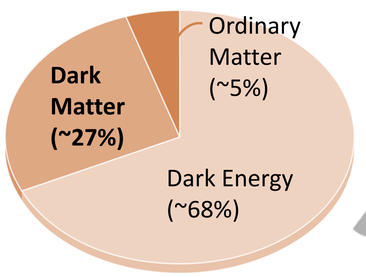
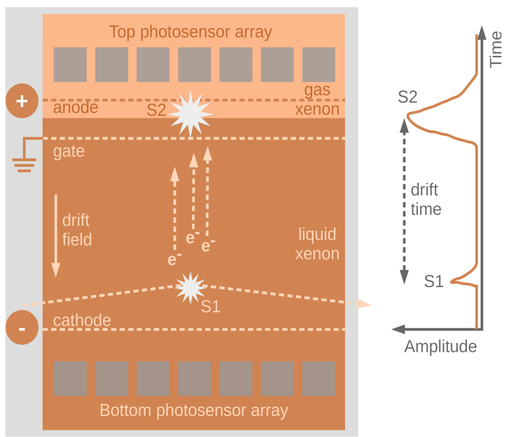
Dark matter and direct detection

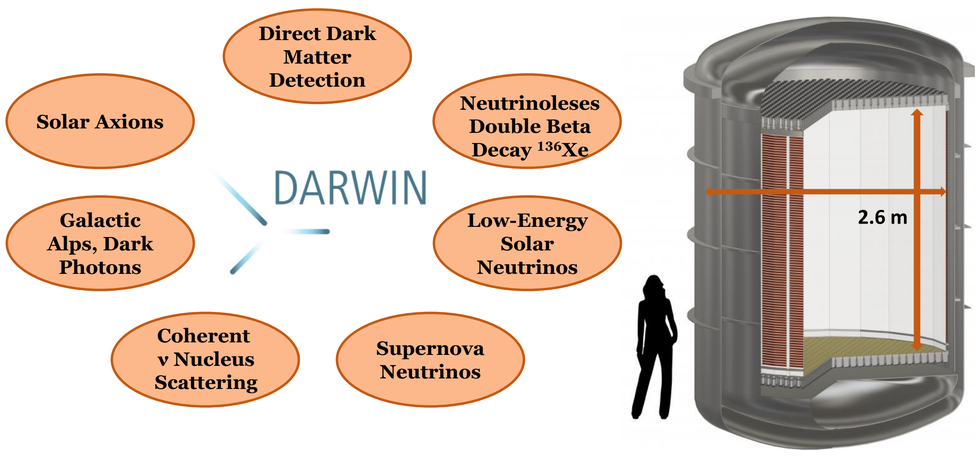
Observations





Direct Detection

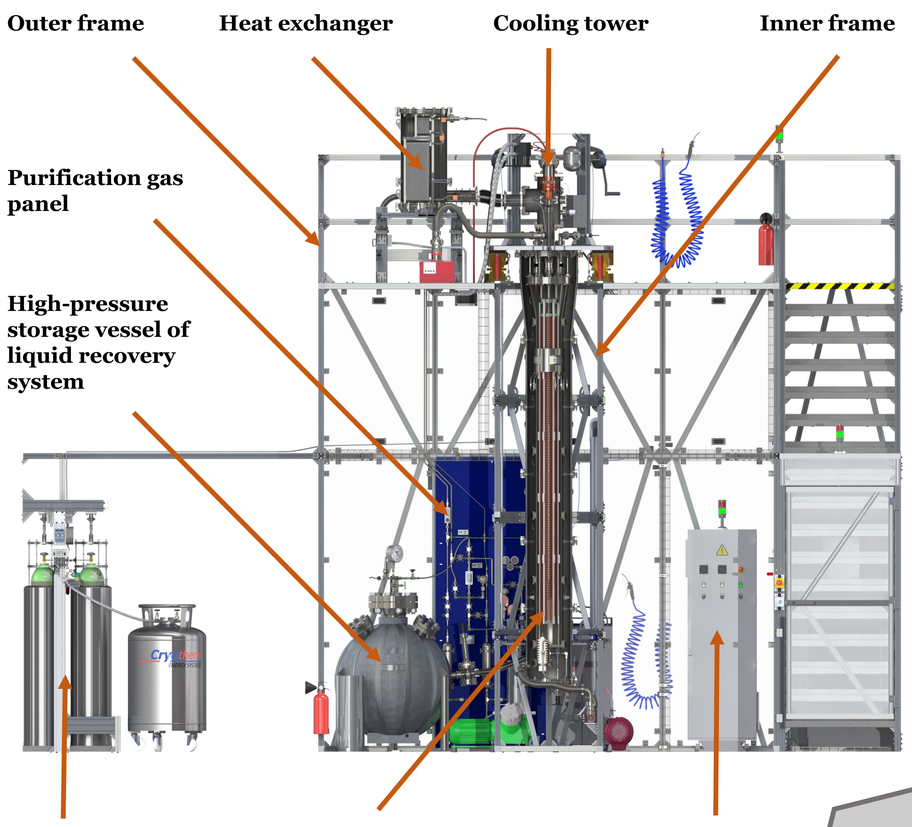
DARWIN – the next generation dark matter and neutrinos observatory

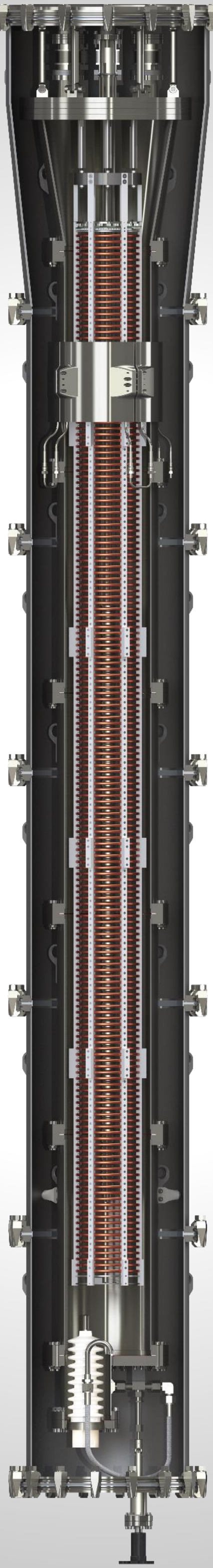


Dual-phase time projection chamber with 50 tonnes of liquid xenon (40 t active) to, among others, probe the WIMP phase space down to the irreducible neutrino background.

The Xenoscope R&D Platform

Design, build and operate a full-height LXe TPC as a prototype for the DARWIN observatory, with the main goals to address the key requirements for drifting electrons over 2.6 m and to determine the required fast recirculation and purification rate of LXe.

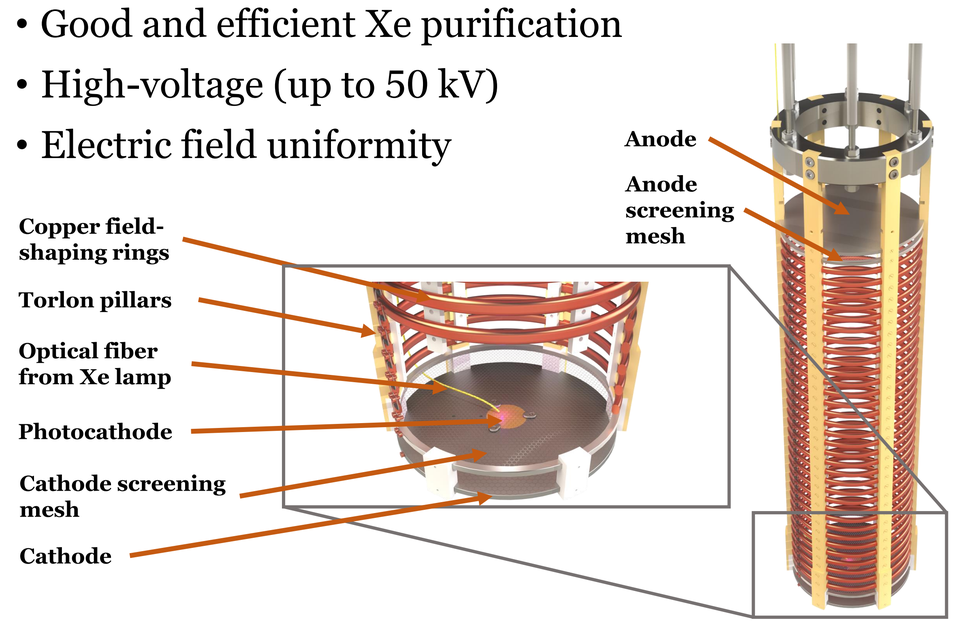




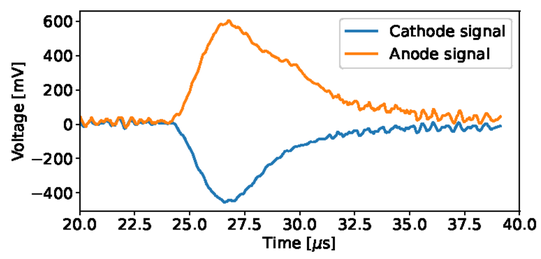
Drifting electrons – Purity Monitor

Electronegative impurities (O_2, N_2, H_2O) in the LXe capture drifting electrons, reducing the size of the charge signals. To achieve 2.6m of drift length and keep a good electron survival probability the system needs:

- Good and efficient Xe purification
- High-voltage (up to 50 kV)
- Electric field uniformity

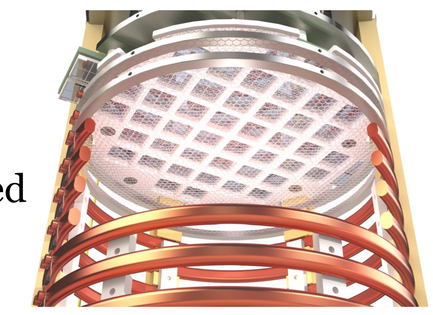


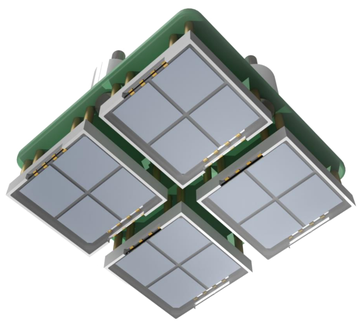
In a purity monitor, the number of electrons produced is controlled (a lamp shines on a photocathode, emitting $O(10^6)$ electrons). Charge signals are collected in the cathode and anode to calculate the electron lifetime.



Next stage – TPC with SiPM array

Once electron drift is achieved and the purification power of the system benchmarked, the main chamber will be converted to a liquid and gas xenon TPC. The proportional scintillation light will be observed by 192 6x6 mm² Silicon Photo-multiplier (SiPM) cells, arranged in tiles of 16.





SiPM main advantages:

- Low material mass and low radioactivity
- Very good single photo-electron resolution
- No HV required
- Stable and durable

Want to know more about it?

Contact us!

darwin-observatory.org

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References:
[1] L. Baudis et al., *Design and construction of Xenoscope – a full-scale vertical demonstrator for the DARWIN observatory*, *JINST* **16** (2021) P08052.
[2] DARWIN collaboration, J. Aalbers et al., *DARWIN: towards the ultimate dark matter detector*, *JCAP* **11** (2016) 017.