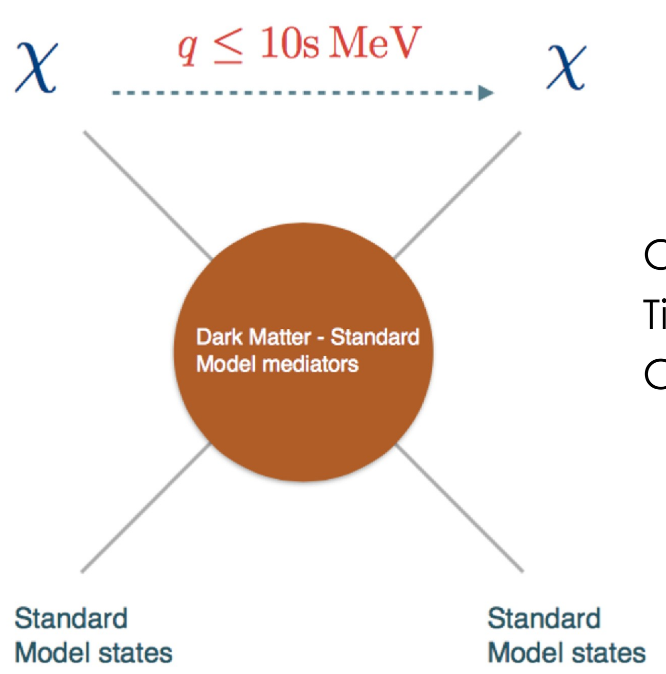
The Search for Dark Matter in XENON1T

The XENON Collaboration

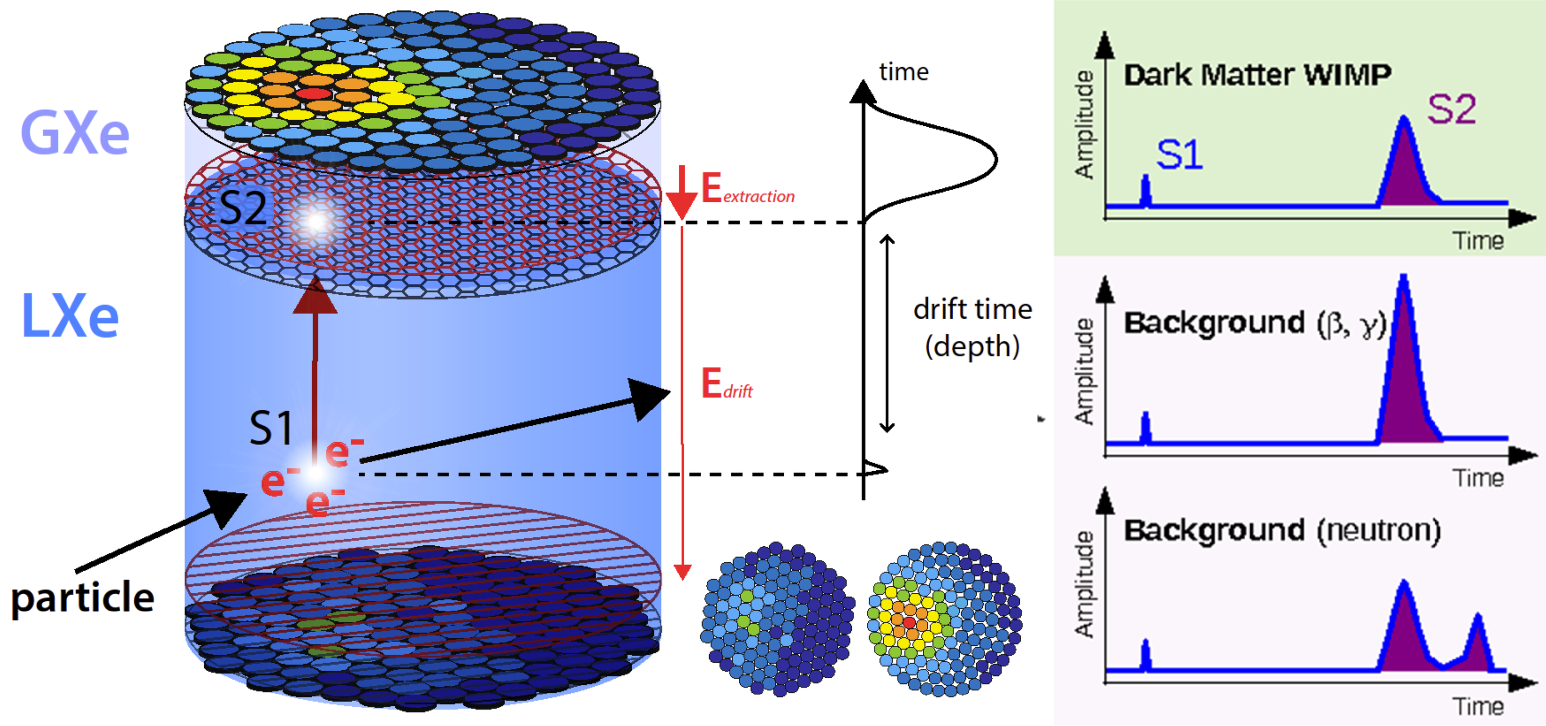
Astroparticle Physics Group of Prof. Laura Baudis, University of Zurich (2017)

Direct Detection of Dark Matter

Direct detection experiments aim to observe the recoil of a target nucleus—in this case, xenon—that is induced by a collision with a dark Weakly Interacting Massive Particle (WIMP). Such an observation requires large, highly sensitive detectors with ultra-low background contributions from cosmic, environmental, and internal sources. XENON1T, located at the Laboratori Nazionali del Gran Sasso, is currently the world's most sensitive operational detector.



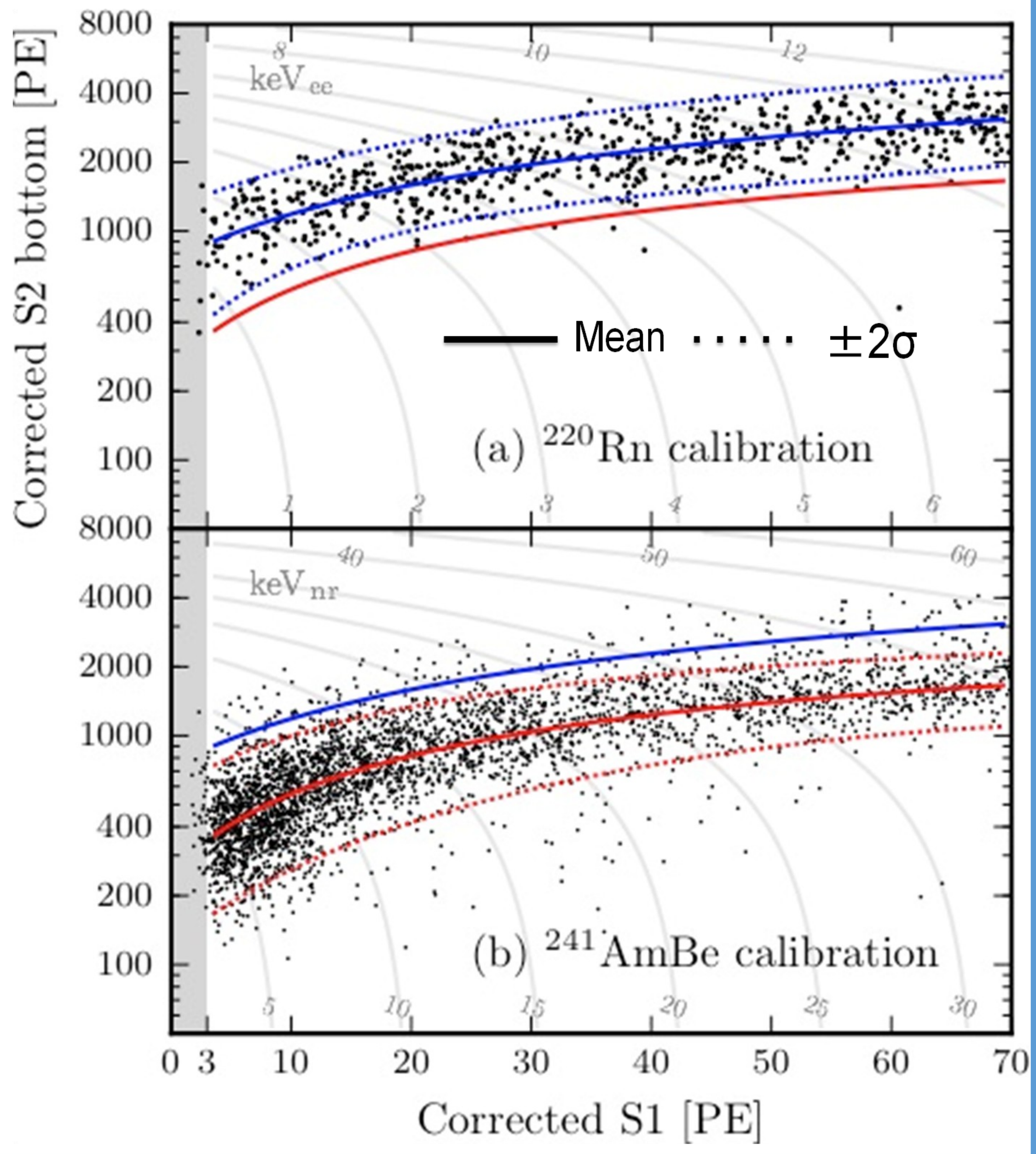
The Detection Principle & Calibration



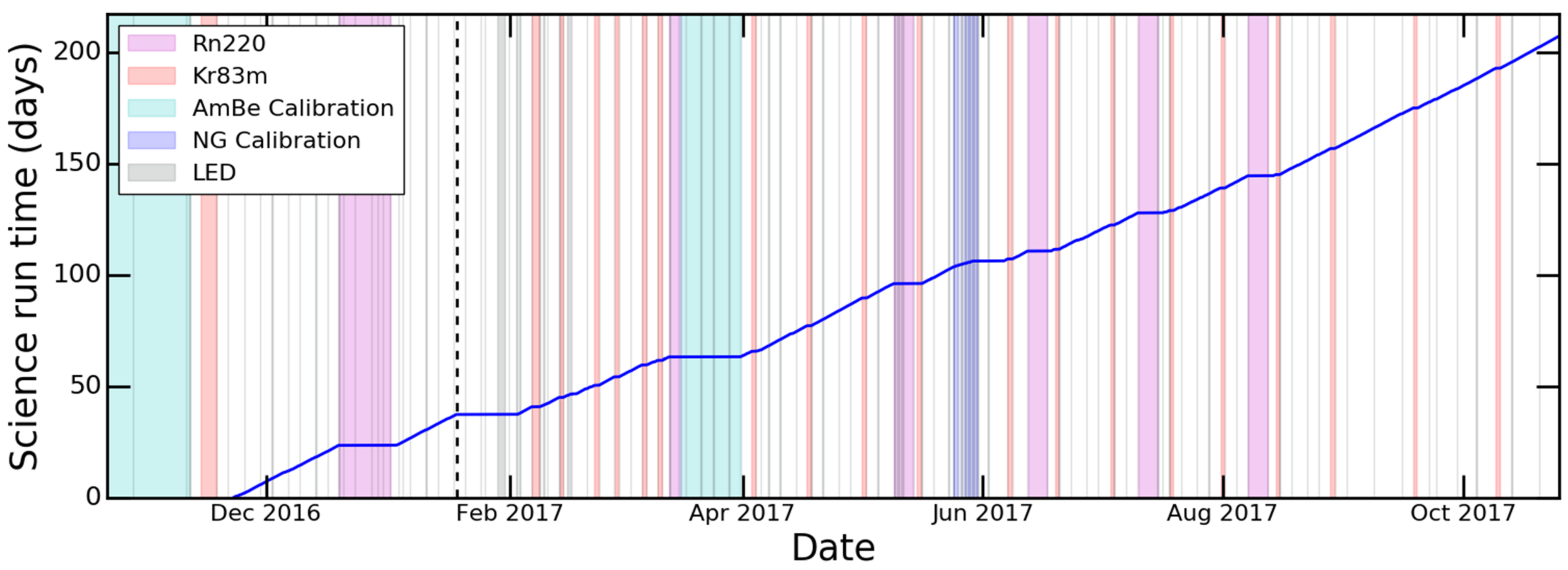
Our liquid-gas Time Projection Chamber holds 3.2 tonnes of ultra-pure xenon. The energy and 3D position of a xenon atom's recoil are reconstructed with 248 Photomultiplier tubes.

A Rn-220 source is dissolved directly in the liquid xenon volume to accumulate its daughter particle Pb-212, which populates the Electronic Recoil band with low -energy beta particles. In contrast, an external AmBe source generates low-energy neutrons that populate the Nuclear Recoil band.

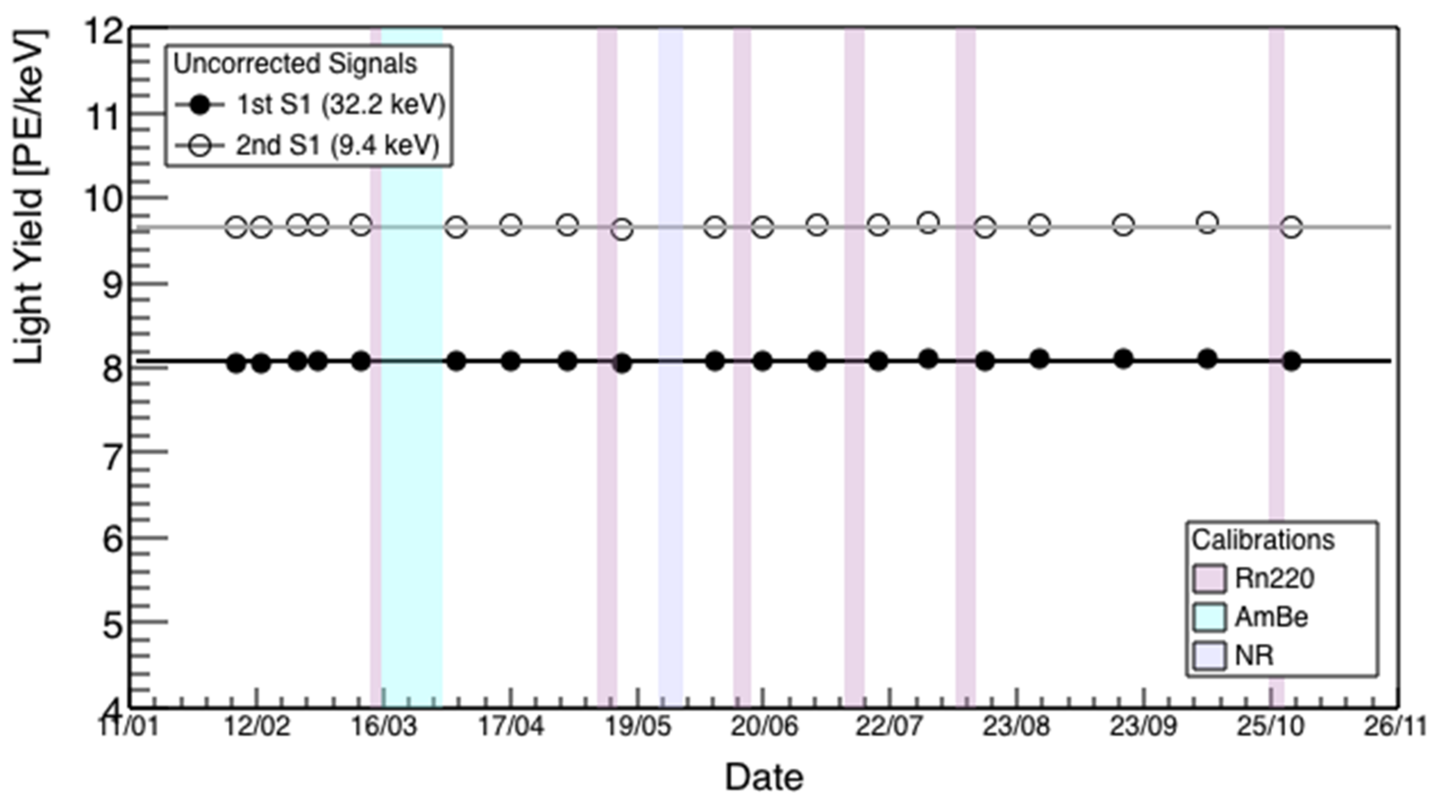
Electronic and Nuclear recoils may be distinguished according to their charge-to-light ratio.



Data Acquisition & Detector Stability



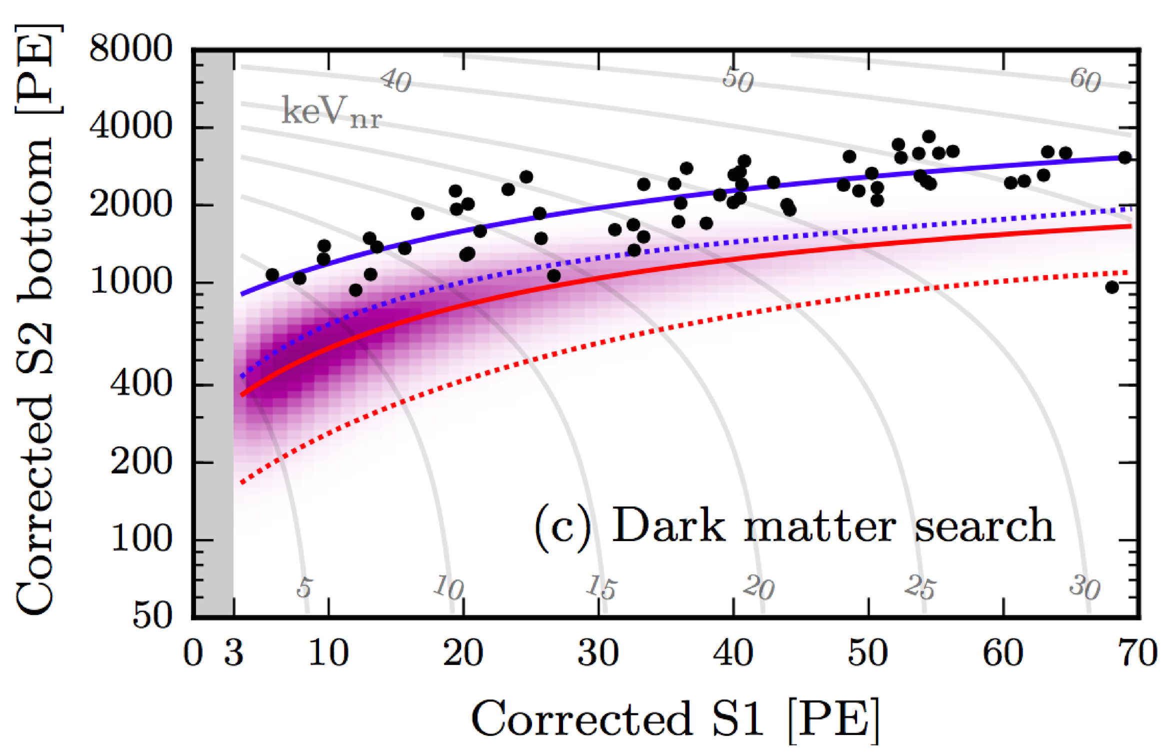
Our Data Acquisition system collects science data with 99% efficiency. Since late 2016, we have accumulated 34.2 (Run 0) and ~200 (Run 1) live days of data.



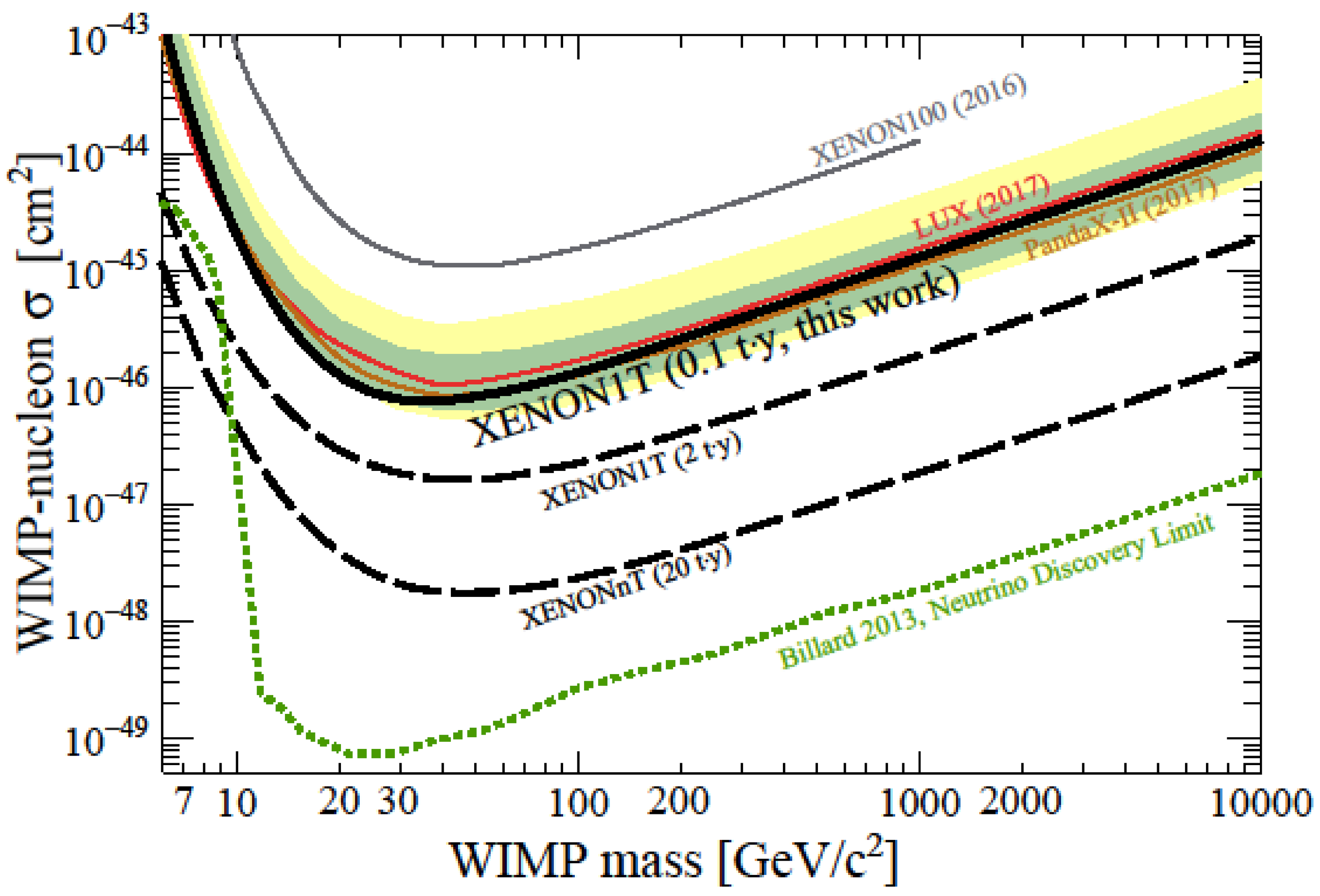
Light yield stability is monitored with the 9.4 and 32.1 keV transitions of Krypton-83m, showing less than 0.5% variation.

Results

We search for Dark Matter in a predefined signal region that is blinded until our event selection and fiducial volume are finalized.Using 34.2 live days of data in a 1042 kg fiducial volume, we find 63 events that satisfy our selection criteria. Based on an extended unbinned profile likelihood analysis, we conclude that the data are consistent with a background-only hypothesis.



We derived the most stringent limits on the WIMP-nucleon cross section for WIMP masses above 10 GeV/c², with a minimum at 7.7x10^{-47} cm².



[1] First Dark Matter Search Results from the XENON1T Experiment, Phys. Rev. Lett. 119, 181301 (2017)

[2] The XENON1T Dark Matter Experiment, arXiv:1708.07051