First Dark Matter Search Results from the LUX-ZEPLIN (LZ) Experiment

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(Dated: July 7, 2022)

The LUX-ZEPLIN (LZ) experiment is a dark matter detector centered on a dual-phase xenon time projection chamber operating at the Sanford Underground Research Facility in Lead, South Dakota, USA. This Letter reports results from LZ's first search for Weakly Interacting Massive Particles (WIMPs) with an exposure of 60 live days using a fiducial mass of 5.5 t. A profile-likelihood analysis shows the data to be consistent with a background-only hypothesis, setting new limits on spin-independent WIMP-nucleon cross-sections for WIMP masses above 9 GeV/c^2. The most stringent limit is set at 30 GeV/c^2, excluding cross sections above 5.9×10^{-48} cm^2 at the 90 % confidence level.

There is abundant astrophysical evidence for the existence of dark matter [1–4], a nonrelativistic and nonbaryonic matter component of the universe that has so far eluded direct detection through interaction with ordinary matter [5]. Weakly Interacting Massive Particles (WIMPs), which obtain their relic abundance by thermal freeze-out through weak interactions [6], are postulated in a wide variety of viable extensions to the Standard Model of particle physics [7–9]. They are a leading candidate to explain dark matter, despite strong constraints from many searches completed and ongoing at colliders [10–14], with telescopes [15–21], and in underground laboratories [22–29]. This Letter reports the first search for dark matter from the LUX-ZEPLIN (LZ) experiment, with the largest target mass of any WIMP detection experiment to date.

The LZ experiment [30, 31] is located 4850 ft underground in the Davis Cavern at the Sanford Underground Research Facility (SURF) in Lead, South Dakota, USA, shielded by an overburden of 4300 m water-equivalent [32]. It is a low-background, multi-detector experiment centered on a dual-phase time projection chamber (TPC) mounted in a double-walled titanium cryostat [33] filled with 10 t of liquid xenon (LXe). The TPC is a vertical cylinder approximately 1.5 m in diameter and height, lined with reflective PTFE, and instrumented with 494 3-inch photomultiplier tubes (PMTs) in two arrays at top and bottom. Energy depositions above approximately 1 keV in the 7 t active xenon region produce two observable signals: vacuum ultraviolet (VUV) scintillation photons (S1) and ionization electrons that drift under a uniform electric field to the liquid surface, where they are extracted and produce secondary scintillation in the xenon gas (S2). The ratio of S2 to S1 differentiates interactions with a xenon nucleus (producing a nuclear recoil, or NR) from interactions with the atomic electron cloud (producing an electron recoil, or ER).

The TPC is surrounded by two detectors, which provide veto signals to reject internal and external backgrounds. A LXe "skin" detector between the TPC field cage and the cryostat wall is instrumented with 93 1-inch and 38 2-inch PMTs. The outer detector (OD) is a near-hermetic system of acrylic tanks containing 17 t of gadolinium-loaded (0.1 % by mass) liquid scintillator [34] to detect neutrons. The entire LZ detector system is in a tank filled with 238 t of ultra-pure water to shield from the ambient radioactive background, and 120 8-inch PMTs are submersed in the water to record OD and water Cherenkov signals.

The data reported here were collected from 23 Dec 2021 to 11 May 2022 under stable detector conditions. The cathode and gate electrodes [35] established a drift field of 193 V/cm, determined by electrostatic simulation to vary by 4 % over the volume considered in this analysis. The gate and anode electrodes established a gas extraction field of 7.3 kV/cm at radial position $r = 0$. Twelve TPC and two skin PMTs developed malfunctioning connections or excessive noise during commissioning and were disabled prior to the run. The temperature and pressure of the LXe were stable to within 0.2%, at 174.1 K (at the TPC bottom) and 1.791 bar(a). The liquid level was stable to within 10 µm, measured by precision capacitance sensors. The full xenon complement of 10 t was continuously purified at 3.3 t/day through a hot getter system, and the observed electron lifetime against attachment on electronegative impurities was between 5000 µs and 8000 µs, much longer than the 951 µs maximum drift time in the TPC.

The data acquisition (DAQ) system records events triggered by a digital filter sensitive to S2 signals in the TPC, reaching full efficiency for S2 pulses with 6 extracted electrons at a typical rate of 5 Hz. A time window of 2 ms before and 2.5 ms after each trigger is recorded, constituting an event. Zero-suppressed waveforms from all PMT channels, including low- and high-gain amplification paths for TPC and OD PMTs, are recorded for every trigger with single photoelectron efficiencies averaging 94 %, 86 %, and >95 % for the TPC, skin, and OD PMTs, respectively.

Event properties are reconstructed through analysis of the PMT waveform shapes, timings, and distributions. Raw waveform amplitudes are normalized by the PMT and amplifier gains and summed separately within the TPC, skin, and OD. Integrated waveform area is reported in photons detected (phd) at each PMT, accounting for the double photoelectron effect in response to VUV photons [36, 37]. Pulse boundaries are identified on the summed waveforms using filters tuned for prototypical pulse shapes in each detector. Pulses in the TPC are further classified as S1 or S2 based on their hit pattern and pulse shape. S1 pulses are required to have signals above the electronic noise threshold in at least 3 PMTs. The time ordering of the most prominent S1 and S2 pulses in each event is then used to identify single-scatter (one S1 preceding one S2) and multi-scatter (one S1 preceding multiple S2s) events. The transverse (x, y) location of events is determined by the PMT hit pattern of S2 light from the extracted electrons, using the MERCURY algorithm [38]. The algorithm was tuned using uniformly distributed radioactive sources in the TPC and has a 1σ resolution of 4 mm for S2 signals of 3000 phd. The resolution worsens by approximately a factor of two near the TPC wall due to asymmetric light collection at the TPC edge. The location along the cylinder (z) axis is inferred from the drift time, and has a 1σ resolution of 0.7 mm for events near the cathode electrode.

LZ uses radioactive sources to correct for spatial variation in response across the TPC and to calibrate the detector response to ER and NR events. ER calibration events are obtained using dispersed sources ^{83m}Kr and ^{131m}Xe before and during the WIMP search and tritiated methane (CH_3T) post-search. The tritium source is important for understanding the response to low energy ER events, the most prominent background component in the run. Localized NR calibration events are created using a deuterium-deuterium (DD) generator that emits monoenergetic 2.45 MeV neutrons [39–41] along a conduit through the water tank and AmLi sources [42] deployed between the walls of the cryostat vessels.

Using the dispersed sources, the S1 signal is normalized to the geometric center of the detector, using a correction in x, y, and drift time; this normalized value is called S1c. The S2 signal is normalized to a signal at the radial center and top (shortest drift time) of the detector; this normalized value is called S2c. The size of the S1 corrections is on average 9 % and comes primarily from variations in light collection efficiency and PMT quantum efficiency. The size of the S2 corrections is on average 11 % in the (x, y) plane and comes primarily from non-operational PMTs and extraction-field non-uniformity caused by electrostatic deflection of the gate and anode electrodes. The S2 correction in z is due to electron attachment on impurities and averages

7 %. Corrected parameters are uniform across the TPC to within 3%.

To reproduce the TPC response to ER and NR events, detector and xenon response parameters of the NEST 2.3.7 [43] ER model are tuned to match the median and widths of the tritium calibration data in $\log_{10}$S2c-S1c space, and to match the reconstructed energies of the ^{83m}Kr (41.5 keV), ^{129m}Xe (236 keV), and ^{131m}Xe (164 keV) peaks. The photon detection efficiency g_1 is determined to be 0.114 ± 0.002 phd/photon and the gain of the ionization channel g_2 to be 47.1 ± 1.1 phd/electron [44]. The tritium data are best modeled with the NEST recombination skewness model [45] disabled, and comparisons between the tuned model and tritium data using several statistical tests show consistency throughout the full tritium ER distribution [46–49]. The ER model includes effects from electron capture decays [50]. The parameters of the ER model were propagated to the NEST NR model and found to be in good agreement with DD calibration data, matching NR band means and widths to better than 1 % and 4 % in $\log_{10}$S2c, respectively. Figure 1 shows the tritium and DD neutron data compared to the calibrated model.

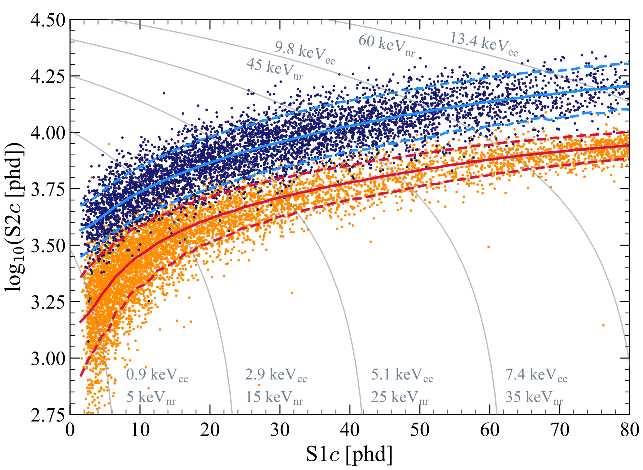

FIG. 1. Calibration events in $\log_{10}$S2c-S1c for the tritium source (dark blue points, 5343 events) and the DD neutron source (orange points, 6324 events). Solid blue (red) lines indicate the median of the ER (NR) simulated distributions, and the dotted lines indicate the 10 % and 90 % quantiles. Thin grey lines show contours of constant electron-equivalent energy (keV$_{\text{ee}}$) and nuclear recoil energy (keV$_{\text{nr}}$).

The WIMP signal considered in this analysis is expected to produce low-energy, single-scatter NR signals uniformly distributed in the TPC, with no additional signals in the TPC, skin, or OD. The following strategy is used to obtain a clean sample of such events: exclude time periods of elevated TPC activity or electronics interference; remove multi-scatter interactions in the TPC; remove events outside an energy region-of-interest (ROI); remove events due to accidental coincidence of S1 and S2 pulses; remove events with coincident signals in the TPC and skin or OD; remove events near the TPC active volume boundaries. Methods of bias mitigation that involve obscuring the data, such as blinding the signal region, or adding fake events ("salting"), were avoided to allow control over larger sources of systematic errors that may be presented by a new detector. To mitigate bias in this result, all analysis cuts were developed and optimized on sideband selections and calibration data.

The search data set totals 89 live days after removing periods for detector maintenance and calibration activity, as well as a 3 % loss due to DAQ dead time and a 7 % loss to periods excised due to anomalous trigger rates. Because dual-phase xenon TPCs experience elevated rates of activity after large S2 pulses [25, 28, 51, 52], a time hold-off is imposed to remove data taken after large S2s and after cosmic-ray muons traversing the TPC. These omissions result in a final search live time of 60 ± 1 d where a WIMP interaction could be reconstructed. In future searches, the hold-off can be relaxed by optimization with respect to analysis cuts and detector operating conditions.

The ROI is defined as S1c in the range $3 - 80$ phd, uncorrected S2 greater than 600 phd (>10 extracted electrons), and S2c less than 10^5 phd, ensuring that signal efficiencies are well understood and background ER sources are well calibrated by the tritium data. Events classified as multiple scatters in the TPC are removed, as are events with poor reconstruction due to noise, spurious pulses, or other data anomalies.

A suite of analysis cuts targets accidental coincidence events, henceforth called "accidentals", where an isolated S1 and an isolated S2 are accidentally paired to mimic a physical single-scatter event. Isolated S1s can be generated from sources such as particle interactions in charge-insensitive regions of the TPC, Cherenkov and fluorescent light in detector materials, or dark-noise pile-up. Isolated S2s can be generated from sources such as radioactivity or electron emission from the cathode or gate electrodes, particle interactions in the gas phase or in the liquid above the gate electrode, or drifting electrons trapped on impurities and released with $\mathcal{O}(100\,\text{ms})$ time delay [52]. Analysis cuts to remove accidentals target individual sources of isolated S1s and S2s using the expected behavior of the S1 and S2 pulses with respect to quantities such as drift time, top-bottom asymmetry of light, pulse width, timing of PMT hits within the pulse, and hit pattern of the photons in the PMT arrays. The cuts remove >99.5 % of accidentals, measured using single-scatter-like events with unphysical (>951 µs) drift time (UDT) and events generated by random matching of isolated S1 and S2 populations.

Data-driven signal efficiencies for the trigger, reconstruction, and analysis cuts are shown in Fig. 2. The DAQ trigger efficiency is determined from DD data by comparing the external trigger of the generator against

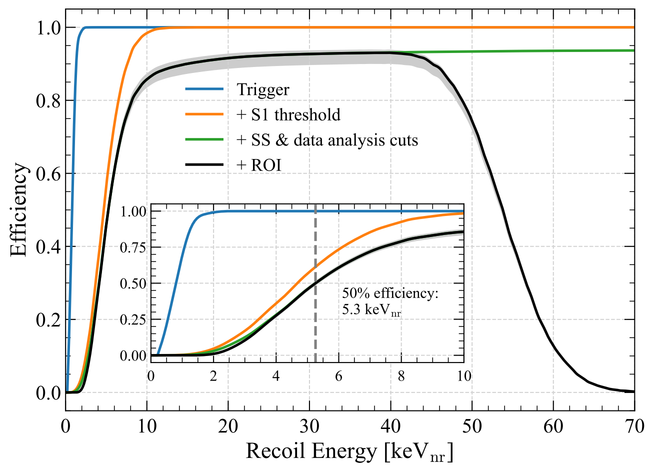

FIG. 2. Signal efficiency as a function of NR energy for the trigger (blue), the 3-fold coincidence and >3 phd threshold on S1 (orange), single-scatter (SS) reconstruction and analysis cuts (green), and the search ROI in S1 and S2 (black). The inset shows the low energy behavior, with the dotted line at 5.3 keV$_{nr}$ marking 50 % efficiency. The error band (gray) is assessed using AmLi and tritium data as discussed in the text.

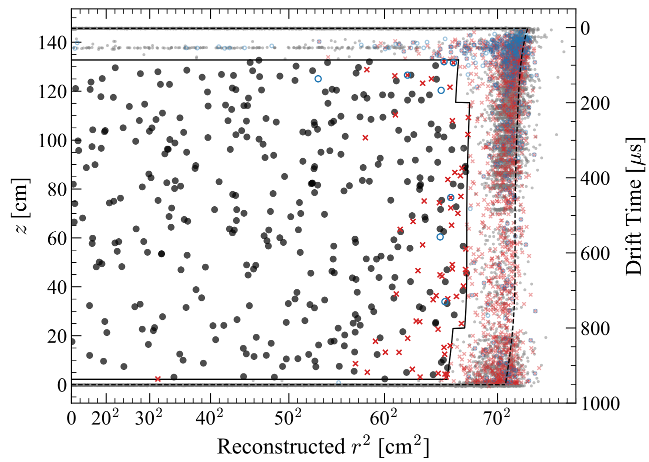

FIG. 3. Data in reconstructed r^2 and z after all analysis cuts. Black (grey) points show the data inside (outside) the FV. Red crosses and blue circles show events vetoed by a prompt LXe skin or OD signal, respectively. The solid line shows the FV definition, and the dashed line shows the extent of the active TPC. Field non-uniformities cause the reconstructed r position of the active volume boundary to vary as a function of z. Events with drift time of approximately 50 µs are from recoils in the gas which produce S1 and S2 pulses with a fixed time separation.

the TPC S2 trigger logic. The reconstruction efficiency for low-energy NR events is evaluated by comparing the reconstruction results against a large set of events manually identified as single-scatter in DD data. Analysis cut efficiency is not determined directly from neutron calibration data as they do not cover the spatial extent of the TPC and are contaminated by a high rate of single photons and electrons. Instead, the efficiency throughout the full analysis volume is evaluated using tritium data for analysis cuts targeting S1 pulses and the combination of tritium and AmLi data for those targeting S2 pulses. Composite NR-like waveforms are generated using tritium single scatters with their S2 pulses replaced by smaller pulses from other tritium or AmLi events (an "AmLi-tritium" dataset). The uncertainty on the NR signal efficiency is the larger of the $\pm 1\sigma$ statistical fluctuation of the AmLi-tritium dataset and the difference between the AmLi-tritium dataset and a pure AmLi dataset. The uncertainty is 3 % for nuclear recoil energies >3.5 keV$_{nr}$, increasing to 15 % at 1 keV$_{nr}$.

Events with coincident activity in the TPC and skin or OD are removed to reduce backgrounds producing γ-rays and neutrons. To mitigate backgrounds associated with γ-rays, events with a prompt signal in the OD (skin) within ±0.3 µs (±0.5 µs) of the TPC S1 pulse are removed. Neutrons can thermalize in detector materials and those that capture on hydrogen or gadolinium in the OD can be tagged by an OD pulse of greater than ∼200 keV within 1200 µs after the TPC S1. A selection on large skin pulses in the same time window additionally tags γ-rays returning to the xenon from an OD capture process. AmLi calibration sources produce neutrons that scatter in both the TPC and the OD and are used to determine a neutron tagging efficiency for TPC single-scatters of 88.5 ± 0.7 %, with a false veto rate of 5% dominated by accidental activity in the OD during the coincidence window.

Finally, events outside a central fiducial volume (FV) are removed to reject external and other backgrounds which concentrate near the TPC boundaries, as shown in Fig. 3. Events at high radius have reduced position reconstruction resolution, due to reduced S2 light collection efficiency and charge-loss effects within a few millimeters of the PTFE wall. The radial extent of the FV and the S2 threshold are chosen simultaneously to eliminate events leaking into the FV due to poor position reconstruction resolution. Radially, the FV terminates at 4.0 cm in reconstructed position from the TPC wall, with small additional volumes removed in the top (5.2 cm for drift time <200 µs) and bottom (5.0 cm for drift time >800 µs) corners to account for increased rates of background in those locations. Events within 6.0 cm of the (x, y) positions of two ladders of TPC field-cage resistors embedded in the TPC wall are also removed. Vertically, events with drift times <86 µs and >936.5 µs are rejected, corresponding to 12.8 cm and 2.2 cm from the gate and cathode electrodes, respectively. The xenon mass in the FV is estimated to be 5.5 ± 0.2 t using tritium data and confirmed by geometric calculation.

Figure 4 shows the distribution in $\log_{10}$S2c-S1c of the 335 events [53] passing all selections, along with con-

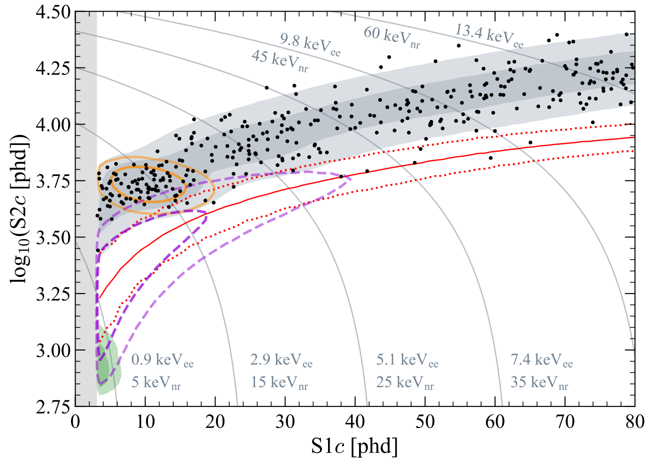

FIG. 4. WIMP-search data (black points) after all cuts in $\log_{10}$S2c-S1c space. Contours enclose 1σ and 2σ of the following models: the best-fit background model (shaded grey regions), the ^{37}Ar component (orange ellipses), a 30 GeV/c^2 WIMP (purple dashed lines), and ^{8}B solar neutrinos (shaded green regions). The red solid line indicates the NR median, and the red dotted lines indicate the 10 % and 90 % quantiles. Model contours incorporate all efficiencies used in the analysis. Thin grey lines indicate contours of constant energy.

tours representing a 30 GeV/c^2 WIMP, a flat NR distribution, and the background model. The signal model assumes spin-independent scattering from WIMPs with an isotropic Maxwell–Boltzmann velocity distribution, parameterized as in Ref. [54], with inputs from Refs. [55–60]. The WIMP model has an approximately exponentially decreasing energy spectrum with shape that depends on the mass of the WIMP [55].

The background model in this analysis consists of nine components, grouped according to their spectra in the ROI or the uncertainty on their rate. Table I lists the expected number of events from each component.

The dominant ER signal in the search comes from radioactive decay of impurities dispersed in the xenon. ^{214}Pb from the ^{222}Rn decay chain, ^{212}Pb from ^{220}Rn, and ^{85}Kr have broad energy spectra that are nearly flat in energy across the ROI and are summed into an overall β background. The concentrations of ^{214}Pb and ^{212}Pb are determined by fitting to energy peaks outside the ROI. The xenon was purified of krypton above ground using gas chromatography [61], and an *in situ* mass spectroscopy measurement of 144 ± 22 ppq $^{\mathrm{nat}}$Kr (g/g) informs the ^{85}Kr rate estimate. The β component is further combined with a small (<1 %) and similarly flat ER contribution from γ-rays originating in the detector components [62] and cavern walls [63]. Solar neutrinos are also predicted to contribute a nearly flat ER spectrum in the ROI, with a rate calculated using Refs. [54, 64–66]. As the prediction is very precise, neutrinos are kept separate from the detector β background in this model.

TABLE I. Number of expected events from various sources for the 60 d×5.5 t exposure, before and after the combined fit of the background model plus a 30 GeV/c^2 WIMP signal to the selected data. ^{37}Ar and detector neutrons have non-gaussian prior constraints and are totaled separately. Values at zero have no lower uncertainty due to the physical boundary.

Source	Expected Events	Best Fit
β decays + Det. ER	218 ± 36	222 ± 16
ν ER	27.3 ± 1.6	27.3 ± 1.6
^{127}Xe	9.2 ± 0.8	9.3 ± 0.8
^{124}Xe	5.0 ± 1.4	5.2 ± 1.4
^{136}Xe	15.2 ± 2.4	15.3 ± 2.4
^{8}B CEνNS	0.15 ± 0.01	0.15 ± 0.01
Accidentals	1.2 ± 0.3	1.2 ± 0.3
Subtotal	276 ± 36	281 ± 16
^{37}Ar	[0, 291]	$52.1^{+9.6}_{-8.9}$
Detector neutrons	$0.0^{+0.2}$	$0.0^{+0.2}$
30 GeV/c^2 WIMP	–	$0.0^{+0.6}$
Total	–	333 ± 17

The naturally occurring isotopes of ^{124}Xe (double electron capture) and ^{136}Xe (double β decay) contribute ER events, and the predictions are driven by the known isotopic abundances, lifetimes, and decay schemes [67–69].

Cosmogenic activation of the xenon prior to underground deployment produces short-lived isotopes that decayed during this first run, notably ^{127}Xe (36.3 d) and ^{37}Ar (35.0 d) [70–72]. Atomic de-excitations following ^{127}Xe L- or M-shell electron captures fall within the ROI if the ensuing ^{127}I nuclear de-excitation γ-ray(s) escapes the TPC. The rate of ^{127}Xe electron captures is constrained by the rate of K-shell atomic de-excitations, which are outside the ROI. The skin is effective at tagging the ^{127}I nuclear de-excitation γ-ray(s), reducing this background by a factor of 5. The number of ^{37}Ar events is estimated by calculating the exposure of the xenon to cosmic rays before it was brought underground, then correcting for the decay time before the search [73]. A flat constraint of 0 to three times the estimate of 97 events is imposed because of large uncertainties on the prediction.

The NR background has contributions from radiogenic neutrons and coherent elastic neutrino-nucleus scattering (CEνNS) from ^{8}B solar neutrinos. The prediction for the CEνNS rate, calculated as in Refs. [54, 64–66], is small due to the S2>600 phd requirement. The rate of radiogenic neutrons in the ROI is constrained using the distribution of single scatters in the FV tagged by the OD and then applying the measured neutron tagging efficiency (88.5 ± 0.7 %). A likelihood fit of the NR component in the OD-tagged data is consistent with observing zero events, leading to a data-driven constraint of $0.0^{+0.2}$ applied to the search. This rate agrees with simulations based on detector material radioassay [62].

Finally, the expected distribution of accidentals is determined by generating composite single-scatter event waveforms from isolated S1 and S2 pulses and applying the WIMP analysis selections. The selection efficiency is then applied to UDT single-scatter-like events to constrain the accidentals rate.

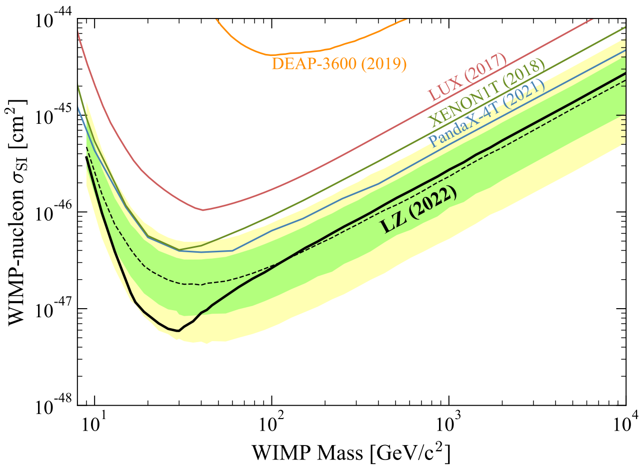

FIG. 5. The 90 % confidence limit (black line) for the spin-independent WIMP cross section vs. WIMP mass. The green and yellow bands are the 1σ and 2σ sensitivity bands. The dotted line shows the median of the sensitivity projection. Also shown are the PandaX-4T [26], XENON1T [25], LUX [28], and DEAP-3600 [74] limits.

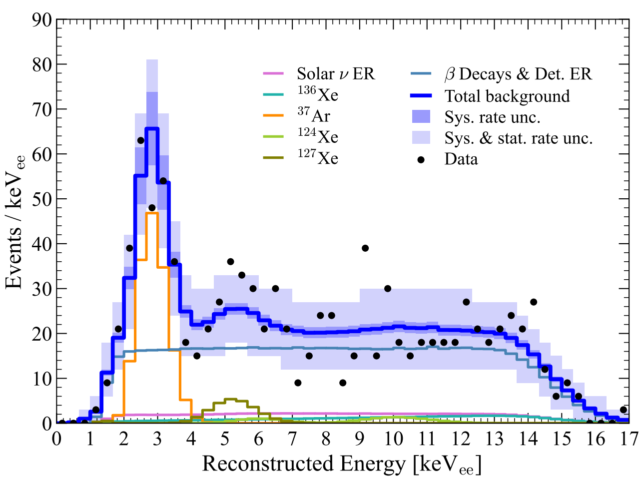

FIG. 6. Reconstructed energy spectrum of the best fit model. Data points are shown in black. The blue line shows total summed background. The darker blue band shows the model uncertainty and the lighter blue band the combined model and statistical uncertainty. Background components are shown in colors as given in the legend. Background components from ^{8}B solar neutrinos and accidentals are included in the fit but are too small to be visible in the plot.

Statistical inference of WIMP scattering cross section and mass is performed with an extended unbinned profile likelihood statistic in the $\log_{10}$S2c-S1c observable space, with a two-sided construction of the 90 % confidence bounds [54]. Background and signal component shapes are modeled in the observable space using the GEANT4-based package BACCARAT [75, 76] and a custom simulation of the LZ detector response using the tuned NEST model. The background component uncertainties are included as constraint terms in a combined fit of the background model to the data, the result of which is also shown in Table I.

Above the smallest tested WIMP mass of $9\,\mathrm{GeV/c^2}$, the best-fit number of WIMP events is zero, and the data are thus consistent with the background-only hypothesis. Figure 5 shows the 90 % confidence level upper limit on the spin-independent WIMP-nucleon cross section σ_{SI} as a function of mass. The minimum of the limit curve is at $m_\chi = 30\,\mathrm{GeV/c^2}$ with a limit of $\sigma_{\mathrm{SI}} = 5.9 \times 10^{-48}\,\mathrm{cm}^2$. For WIMP masses between $19\,\mathrm{GeV/c^2}$ and $26\,\mathrm{GeV/c^2}$, background fluctuations produce a limit which is below a critical discovery power threshold, $\pi_{\mathrm{crit}} = 0.32$, and for these masses the reported limit is set to the limit equivalent to π_{crit} [54]. The background model and data as a function of reconstructed energy are shown in Fig. 6, and the data agree with the background-only model with a p-value of 0.96. A data release for this result is in the Supplemental Materials [77].

The LZ experiment has achieved the highest sensitivity to spin-independent WIMP-nucleon scattering for masses greater than $9\,\mathrm{GeV/c^2}$ due to the successful operation of an integrated detector system containing the largest dual-phase xenon TPC to date. LZ is continuing operations at SURF and will undertake further detector and analysis optimization to search for a broad range of rare-event physics searches, including WIMPs, neutrinoless double-beta decay, solar neutrinos, and solar axions [78–80] over an estimated 1000 day exposure.

The research supporting this work took place in part at SURF in Lead, South Dakota. Funding for this work is supported by the U.S. Department of Energy, Office of Science, Office of High Energy Physics under Contract Numbers DE-AC02-05CH11231, DE-SC0020216, DE-SC0012704, DE-SC0010010, DE-AC02-07CH11359, DE-SC0012161, DE-SC0015910, DE-SC0014223, DE-SC0010813, DE-SC0009999, DE-NA0003180, DE-SC0011702, DE-SC0010072, DE-SC0015708, DE-SC0006605, DE-SC0008475, DE-SC0019193, DE-FG02-10ER46709, UW PRJ82AJ, DE-SC0013542, DE-AC02-76SF00515, DE-SC0018982, DE-SC0019066, DE-SC0015535, DE-SC0019319, DE-AC52-07NA27344, & DOE-SC0012447. This research was also supported by U.S. National Science Foundation (NSF); the UKRI's Science & Technology Facilities Council under award numbers ST/M003744/1, ST/M003655/1, ST/M003639/1, ST/M003604/1, ST/M003779/1, ST/M003469/1, ST/M003981/1, ST/N000250/1, ST/N000269/1, ST/N000242/1, ST/N000331/1, ST/N000447/1, ST/N000277/1, ST/N000285/1,

ST/S000801/1, ST/S000828/1, ST/S000739/1, ST/S000879/1, ST/S000933/1, ST/S000844/1, ST/S000747/1, ST/S000666/1, ST/R003181/1; Portuguese Foundation for Science and Technology (FCT) under award numbers PTDC/FIS-PAR/2831/2020; the Institute for Basic Science, Korea (budget number IBS-R016-D1). We acknowledge additional support from the STFC Boulby Underground Laboratory in the U.K., the GridPP [81, 82] and IRIS Collaborations, in particular at Imperial College London and additional support by the University College London (UCL) Cosmoparticle Initiative. We acknowledge additional support from the Center for the Fundamental Physics of the Universe, Brown University. K.T. Lesko acknowledges the support of Brasenose College and Oxford University. The LZ Collaboration acknowledges key contributions of Dr. Sidney Cahn, Yale University, in the production of calibration sources. This research used resources of the National Energy Research Scientific Computing Center, a DOE Office of Science User Facility supported by the Office of Science of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231. We gratefully acknowledge support from GitLab through its GitLab for Education Program. The University of Edinburgh is a charitable body, registered in Scotland, with the registration number SC005336. The assistance of SURF and its personnel in providing physical access and general logistical and technical support is acknowledged. We acknowledge the South Dakota Governor's office, the South Dakota Community Foundation, the South Dakota State University Foundation, and the University of South Dakota Foundation for use of xenon. We also acknowledge the University of Alabama for providing xenon.

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Supplemental Materials

DETAILED EVENT RATES

TABLE S1. Number of events remaining after each stage of event selection criteria described in the main text.

Selection description	Events after selection
All triggers	1.1×10^8
Analysis time hold-offs	6.0×10^7
Single scatter	1.0×10^7
Region-of-interest	1.8×10^5
Analysis cuts for accidentals	3.1×10^4
Fiducial volume	416
OD and Skin vetoes	335

TUNED DETECTOR AND XENON RESPONSE MODEL DETAILS

The LZ detector and xenon response models are implemented in a NEST-based application that includes effects such as curved electron drift paths from field non-uniformities, finite position reconstruction resolution in the transverse (x, y) and longitudinal z directions, and position-dependence in S1 and S2 areas. The key numerical parameters of the NEST model are provided in Table S2. Additionally, a header file for NEST 2.3.7 that will reproduce the ER and NR response models used in this analysis is available online at please.insert.a.url. Note that the extraction field number is known to be an effective value due to multiple models for this effect in NEST, and this parameter is tuned such that the extraction efficiency matches the LZ data.

In addition to the parameters below, the width of the predicted ER and NR bands had to be reduced to match LZ calibration data and, as mentioned in the main text, the NEST recombination skewness model was turned off. There are detailed instructions for implementing these changes in the provided header file.

TABLE S2. NEST tuning parameters. Parameters in the top half of the table are input parameters, while bottom half parameters result from NEST calculations.

Parameter	Value
g_1^{gas}	0.0921 phd/photon
g_1	0.1136 phd/photon
Effective gas extraction field	8.42 kV/cm
Single electron	58.5 phd
Extraction Efficiency	80.5 %
g_2	47.07 phd/electron

DATA RELEASE

Selected data from the following plots from this paper are available at please.insert.a.url.

- Figure 2: points representing the total efficiency curve for this analysis (black line).
- Figure 4: points in S1-S2 space representing the data used in the WIMP search (black points).
- Figure 5: WIMP mass points with measured 90% confidence limits and median and 1 and 2 sigma sensitivity bands.