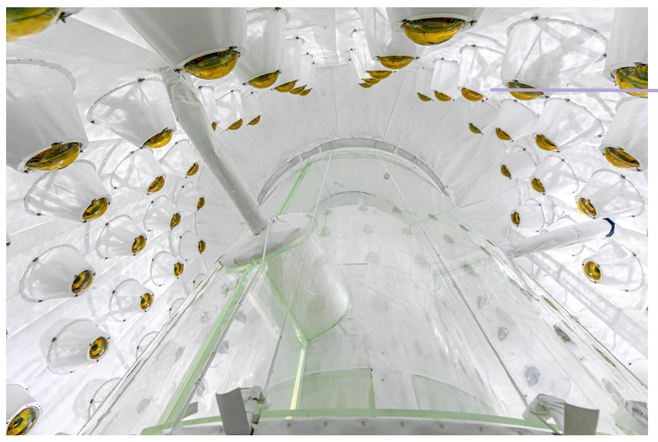
# The LUX-ZEPLIN (LZ) Experiment: Searching for direct evidence of dark matter

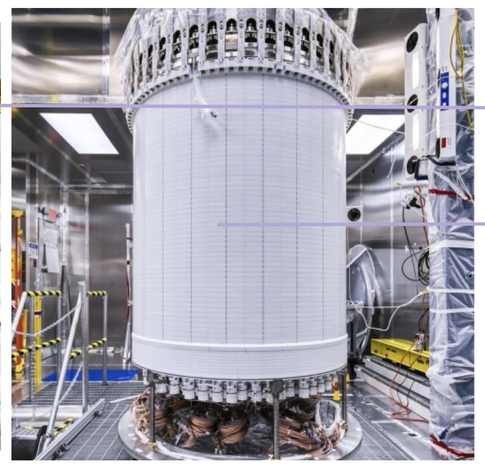
The LUX-ZEPLIN (LZ) Collaboration

## 26 % of the Energy in the Universe

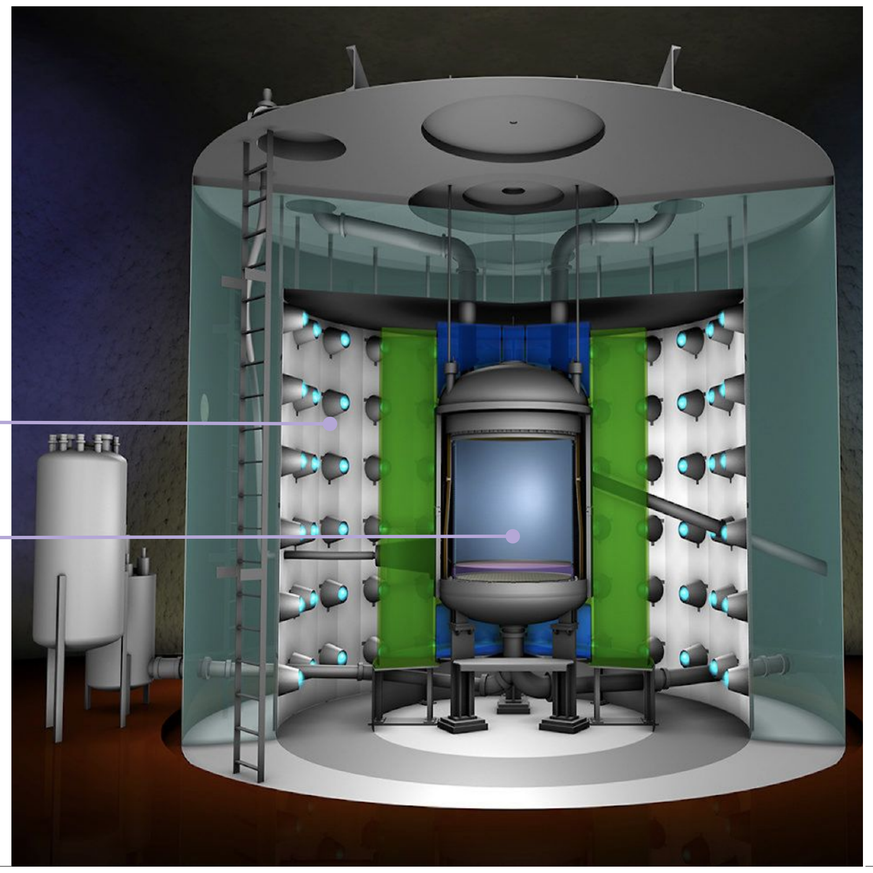
Astronomical observations have indicated a considerable amount of dark matter in our universe, but nobody has been able to directly observe any dark matter yet. LZ is an experiment looking for dark matter particles, in particular Weakly Interacting Massive Particles (WIMPs) among other candidates.



Outer Detector

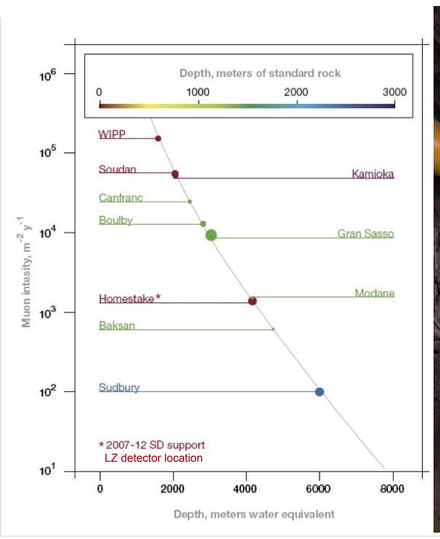


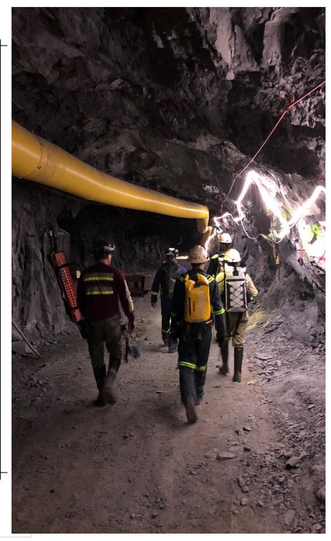
Time Projection Chamber



## 4850 Feet below the Surface

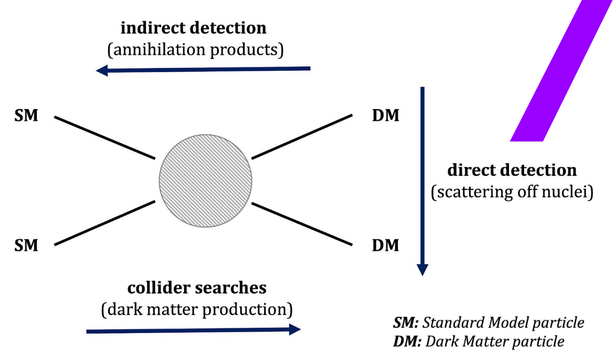
The LZ detector is located at the Sanford Underground Research Facility (SURF) in Lead, South Dakota, USA. Along with the water tank embedding the xenon detector, the rock between the experiment level and the surface level provides shielding from backgrounds, such as gammas and neutrons.

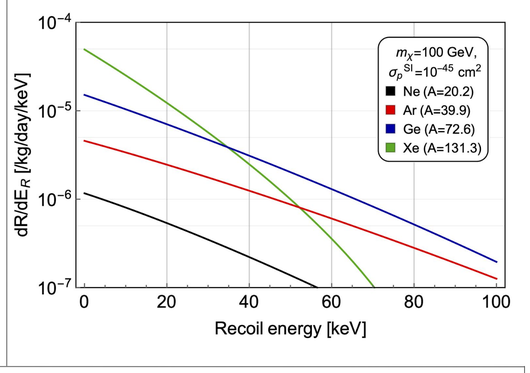


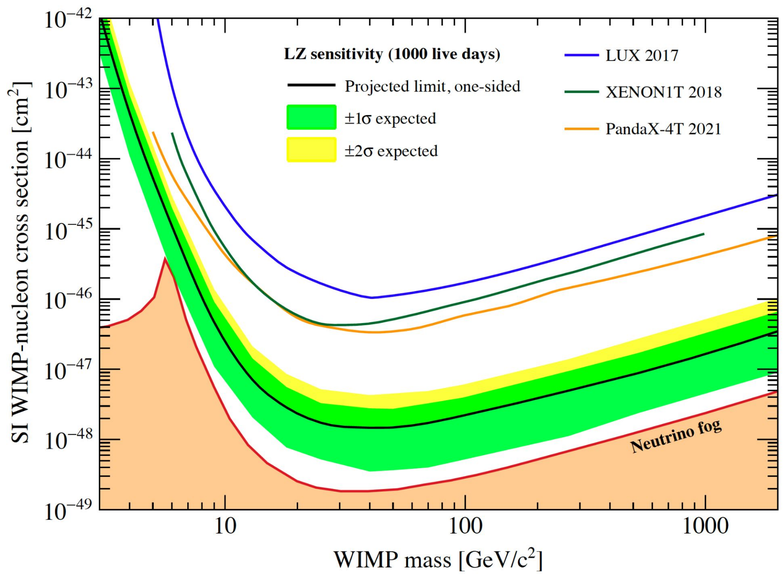



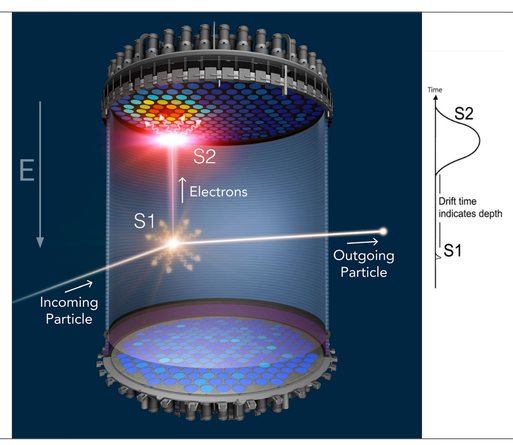
## 7 Tons Active Liquid Xenon

LZ features a dual phase, liquid and gas, xenon time projection chamber (TPC) to perform direct detection of WIMP dark matter. LZ is capable of observing low energy nuclear recoils, the characteristic signature of WIMP scatterings. Xenon was chosen as the target medium because of its properties including high scintillation and ionization yield, stable chemical properties, and no long lived isotope.



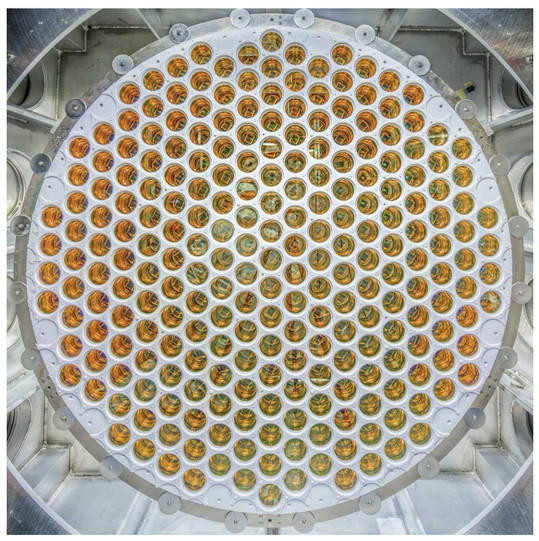




## 2 Signals

A ionizing interaction in the active region of LZ TPC creates electrons and photons. The photons create a prompt signal (S1), observed by photomultiplier tubes (PMTs). The electrons drift up due to the electric field and scatter with the gas xenon particles, creating a secondary signal (S2), again observed by PMTs. We can reconstruct the energy and the three-dimensional location information of the ionizing interaction with the light pattern collected by the PMTs and the delay time between S1 and S2.

## 3 Detector Systems

The LZ detector has three detector systems, TPC, Skin, and Outer Detector (OD). Each detector system collects scintillation signals using PMTs. 494 TPC PMTs and 131 Skin PMTs are in the xenon detector. TPC PMTs are divided into the top array and the bottom array. 120 OD PMTs are installed around the inner surface of the water tank. Skin and OD PMTs tag and veto background events such as neutron events.




## Acknowledgments

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-SC0014223, DE-SC0010813, DE-SC0009999, DE-NA0003180, DE-SC0011702, DESC0010072, DE-SC0015708, DE-SC0006605, DE-SC0008475, 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 U.K. Science & Technology Facilities Council under award numbers, ST/M003655/1, ST/M003981/1, ST/M003744/1, ST/M003639/1, ST/M003604/1, ST/R003181/1 and ST/M003469/1; Portuguese Foundation for Science and Technology (FCT) under award numbers PTDC/FIS-PAR/2831/2020; the Institute for Basic Science, Korea (budget numbers IBS-R016-D1); the GridPP [39, 40] and IRIS Collaborations, in particular at Imperial College London and additional support by the University College London (UCL) Cosmoparticle Initiative.