The LZ Dark Matter Experiment

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SDSM&T
On Behalf of the LZ Collaboration
April 9 2016
The LZ Collaboration

- MEPhI (Russia)
- Edinburgh University (UK)
- University of Liverpool (UK)
- Imperial College London (UK)
- STFC Rutherford Appleton, and Daresbury, Laboratories (UK)
- University College London (UK)
- University of Oxford (UK)
- University of Sheffield (UK)
- LIP Coimbra (Portugal)
- CUP (Korea)
- University of Alabama
- University at Albany SUNY
- Berkeley Lab (LBNL)
- UC Berkeley
- Brookhaven National Laboratory
- Brown University
- University of California, Davis
- Fermi National Accelerator Laboratory
- Lawrence Livermore National Laboratory
- University of Maryland
- Northwestern University
- University of Rochester
- University of California, Santa Barbara
- University of South Dakota
- South Dakota School of Mines & Technology
- South Dakota Science and Technology Authority
- SLAC National Accelerator Laboratory
- Texas A&M
- Washington University
- University of Wisconsin
- Yale University

31 Institutions internationally
Dark Matter

- Considerable gravitational evidence
- Leading candidate is new particle: WIMP
- Look for (rare) interaction with nucleus
LZ Detector

Z position from S1 – S2 timing
X-Y positions from light pattern

Reject gammas by S2/S1 ratio
Expect > 99.5% rejection

Image by CH Faham (Brown)
LZ Detector

- Inner Cryostat
- Top PMT Array
- TPC (Sensitive Volume)
- Outer Cryostat
- Bottom PMT Array
LZ Detector

- LUX Water Tank
- High-Voltage Feedthrough \( \geq 100 \text{ kV} \)
- LXe TPC
- Ti Cryostat
- 25 Tonnes Scintillator Veto
- Passive Water Shielding
LZ Located at SURF

Located in the Davis Cavern 4850' level in Homestake Mine, SD

LUX to be removed in early 2017
Water tank will remain
Projected Sensitivity

After 1000-day exposure

- LZ projected
- 90% CL Median CDR
- 90% CL Median (Baseline)
- 90% CL Median (Goal)

Zeplin III (2011)
LUX (2015)
LUX 300d projected

ν-N coherent scattering

1 event
ν-N coherent, 3σ significance
1000 Tonne-years
<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Activity</th>
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<tbody>
<tr>
<td>2012</td>
<td>March</td>
<td>LZ (LUX-ZEPLIN) collaboration formed</td>
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<tr>
<td>2012</td>
<td>May</td>
<td>First Collaboration Meeting</td>
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<tr>
<td>2012</td>
<td>Sept</td>
<td>DOE CD-0 for G2 dark matter experiments</td>
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<td>2013</td>
<td>Nov</td>
<td>LZ R&amp;D report submitted</td>
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<td>2014</td>
<td>July</td>
<td>LZ Project selected in US and UK</td>
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<td>2015</td>
<td>April</td>
<td>DOE CD-1/3a approval - similar in UK</td>
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<td>Beginning procurements(Xenon, PMT, cryostat)</td>
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<td>2016</td>
<td>April</td>
<td>DOE CD-2/3b approval; baseline; all fab starts</td>
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<td>2017</td>
<td>June</td>
<td>Begin preparations for surface assembly at SURF</td>
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<td>2018</td>
<td>July</td>
<td>Begin underground installation</td>
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<td>2019-2020</td>
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<td>Begin commissioning</td>
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Summary

• LZ Project progressing on-schedule
  – Long lead-time item procurement underway: Xenon, PMTs, Cryostat, etc.
  – Materials screening programme well underway
  – Preparing now for CD-2 Review

• Expecting to begin Dark Matter search around 2020
Thank you!
Backup Slides....
LZ Detector

- Inner Cryostat
- Top PMT Array
- TPC (Sensitive Volume)
- Outer Cryostat
- Bottom PMT Array
Skin Veto

- Thin layer of LXe between TPC, cryostat walls
  - Called “skin”
- Instrumented with 192 PMTs to provide Veto signal
Expected Fiducial Volume

No Veto: 2.8 Tonne
Skin Veto: 4.1 Tonne
+ Scintillator Veto: 5.6 Tonne