

Sanford Underground Research Facility

Update on recent activities

Mike Headley
Executive Director
SD Science and Technology Authority



May 31, 2018

Who Am I and Where Have I Been

- Served as SDSTA Executive Director for 5 years and SURF Lab Director for 6 years. Total tenure with SDSTA ~10 years.
- Experience includes 25 years as a senior executive, project manager, and systems engineer working on major space (satellite and ground) systems and underground facility construction, operations, and maintenance for DOE, NSF, USAF, USGS, and State of South Dakota.
 - Systems and facilities supported a wide range of military and science users and national level policy decision makers
 - Projects ranged in cost up to \$6B USD
- Grew up in South Dakota, attended SDSU, served in US Air Force
- Certified as a Project Management Professional (PMP)

Sanford Underground Research Facility

Dedicated facility for underground scientific research

Open Cut

Visitor Center

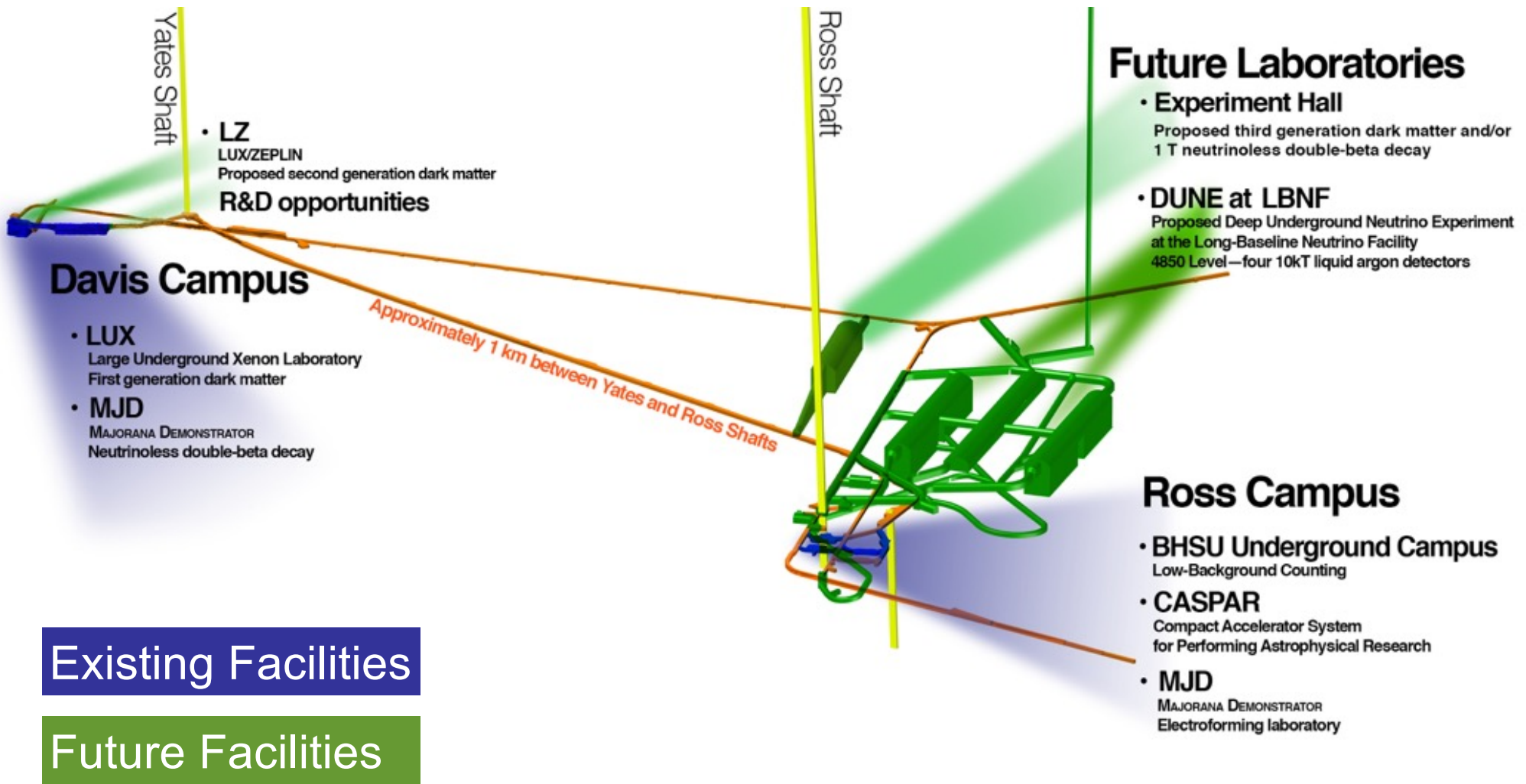
Yates Complex

Ross Complex

223 acres (surface)
7700 acres (underground)

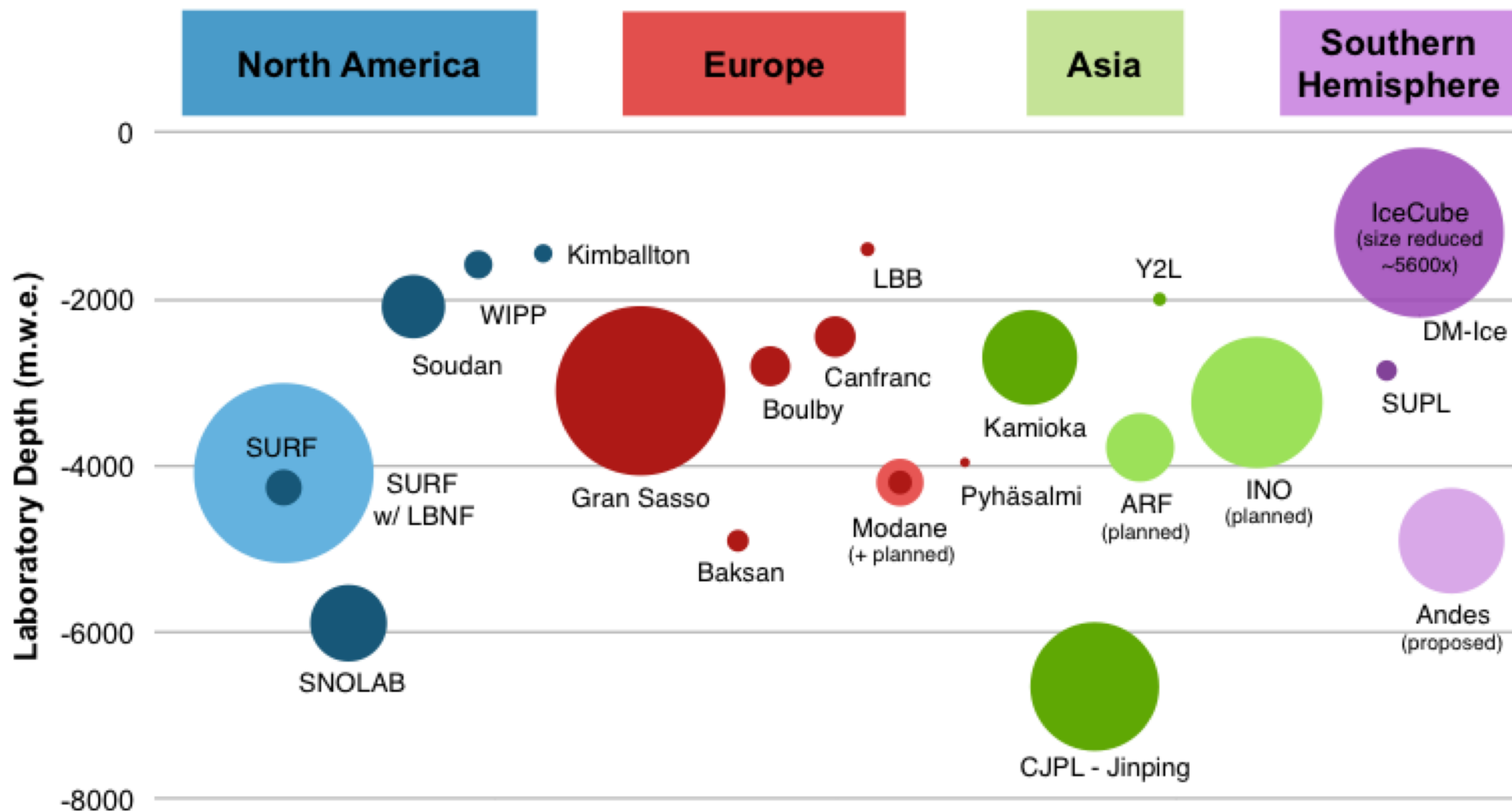
- Created by the State of South Dakota with major philanthropic donations from Barrick (property) and T. Denny Sanford (\$70M)
- Strong S. Dakota support (\$80M)
- Operations funded by US Dept of Energy, through a subcontract between Fermilab and the SDSTA

4850L Science Facilities



Global Underground Physics Laboratories

Circle area represents volume of science space



Current Underground Physics Program

MAJORANA DEMONSTRATOR (MJD):

- Studying the neutrino's mass and the matter/antimatter imbalance in the universe. Proving the techniques needed for a tonne-scale experiment.
- 2 cryostats with 44 detectors (40kg Ge) assembled. Physics data collection is underway.
- March 2018 - Paper published in *Physical Review Letters* documenting MJD exceeded background radiation reduction goals.
- Planning is underway for LEGEND experiment – initially a 200kg target at Gran Sasso in Italy.



Current Underground Physics Program

Compact Accelerator System for Performing Astrophysical Research (CASPAR):

- Studying nuclear reactions in stars resulting in the generation of elements heavier than Fe.
- NSF and SD funded
- SDSM&T faculty and students leading assembly and commissioning process.
- “First beam” achieved in July 2017. First physics data occurring in 2018.



Black Hills State University (BHSU) Underground Campus (BHUC):

- Low background counting to characterize radiopurity of detector components.
- SD funded. Some support via SURF Services.
- Installed 4 low background counters.
- Near term activities focused on the LZ dark matter experiment equipment.
- Providing opportunities for undergraduates in physics and other science disciplines.

LUX-ZEPLIN (LZ) Dark Matter Experiment

LZ will be located in the Davis Cavern on the 4850 foot level



LZ Cryostat

- LZ collaboration includes over 250 members at 37 institutions.
- 10,000 kg Xe (3,500 gallons). 30x larger, 100x more sensitive than LUX experiment.
- Using existing Surface Laboratory and 4850L Davis Campus facilities.
- Project is in construction.
- Surface facility upgrades completed. LZ cryostat arrived May 14, 2018.
- Davis Campus construction started Jan 2018. Planned to complete in late May.
- Experiment installation in 2018-19.
- Operate for 5 years starting in 2020.

LZ cryostat arrived!



Educational Opportunities for K-12 Students

School Presentations

Elementary

- A Day in the Life...
- Particle Accelerators

Middle School

- Career Opportunities
- Dark Matter

High School

- Neutrinos

Curriculum Units

Early Elementary

- Creature Features
- Between a Rock and a Dark Place

Elementary

- Exploring Unseen
- Force Be With You
- There & Back Again

Middle School

- Seismic Science
- Search Dark Matter
- Waterworks

High School

- Perplexing Puddles
- Star-Stuff

Field Trips

Opportunities to visit the lab are limited. School visits available:

- Fall
- Spring

E&O Curriculum Units



E&O Student Impact - Numbers in Review

- 2017-2018 School Year
 - Students at field trips - 709
 - Students at classroom talks - 6,675
 - Students using curriculum units - 2,043
- Summer 2017
 - Teachers at summer workshops - 54
- Since 2015
 - Students at field trips - 1,886
 - Students at classroom talks - 24,467
 - Students using curriculum units - 6,306



Neutrino Day X - July 14, 2018

Activities at several locations in Lead – 8:30AM to 5:30PM

NEUTRINO DAY



2018



- 10th anniversary
- More than 1200 people yearly
- Hands-on activities, demonstrations and displays for kids of all ages
- Videoconferencing with scientists underground at SURF and Fermilab
- Hoistroom tours
- Great speakers!

Economic Impacts in South Dakota

Through September 2017 (end of U.S. Federal FY2017)

Spending in South Dakota to date	\$185 million
FY18 total budget (all sources & activities)	\$22.9 million
FY18 SURF Operations budget (DOE funds)	\$14.6 million
Annual payroll budget in SD (FY18)	\$13.3 million
Annual non-payroll budget in SD (FY18)	\$6.7 million
Jobs in South Dakota	158
Active research groups	23
Research groups with SD members	18



LBNF/DUNE Economic Impacts

South Dakota

\$952 million

Total economic output

\$340 million

Income for South Dakota households

Illinois

\$1,204 million

Total economic output

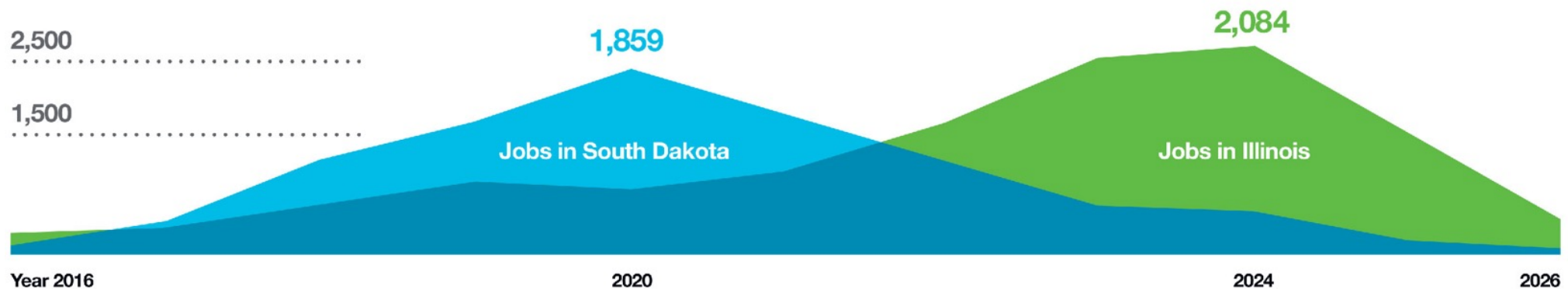
\$593 million

Income for Illinois households

90% of economic output is in the 13-county western South Dakota region

94% of economic output is in the 9-county Chicago metro region

Jobs created, 2016–2026*



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Thank You!