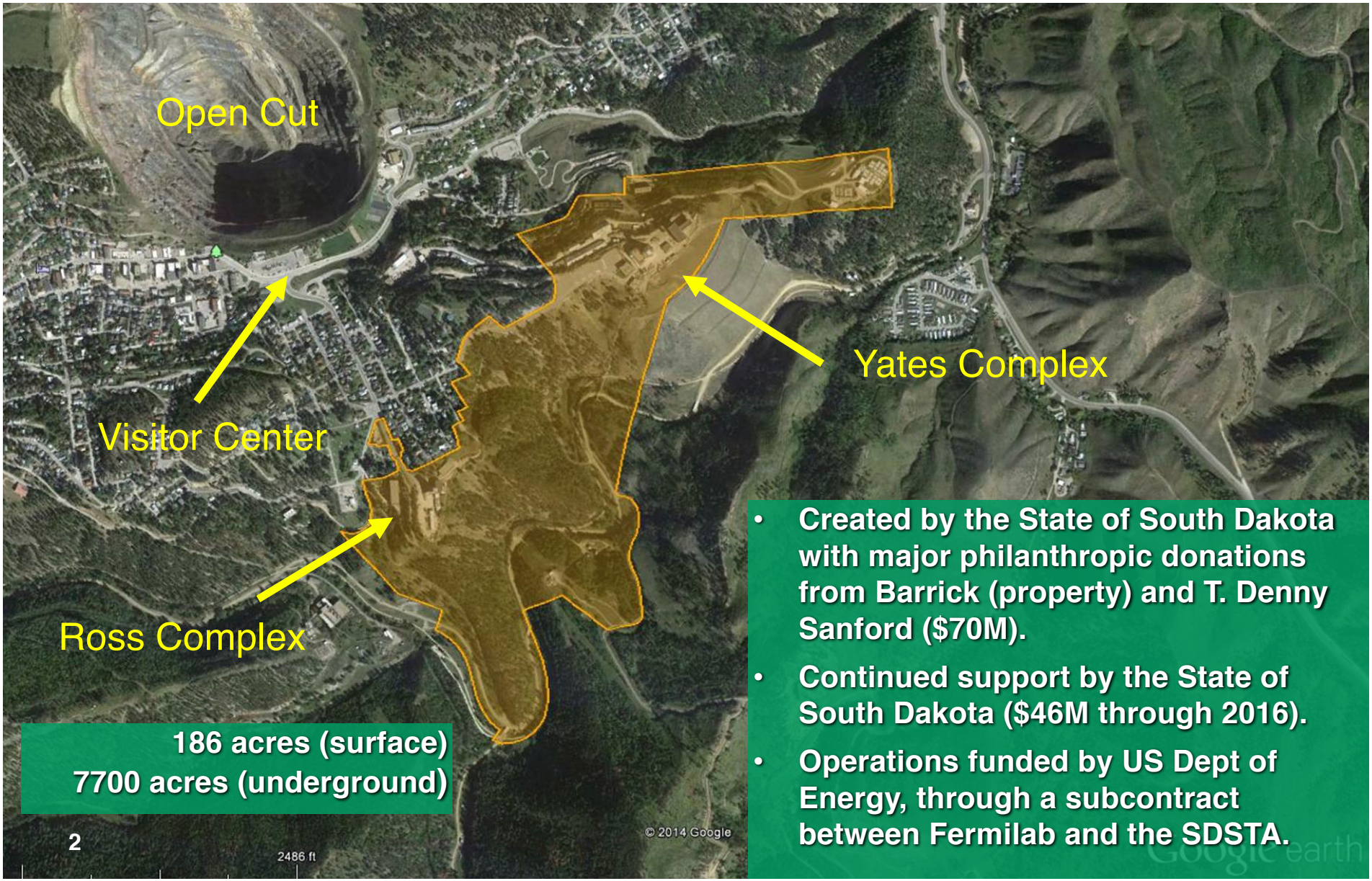
LBNF/DUNE Update Public Meeting
Sanford Lab Update

Mike Headley
SDSTA Executive Director and Sanford Lab Director
13 March 2017

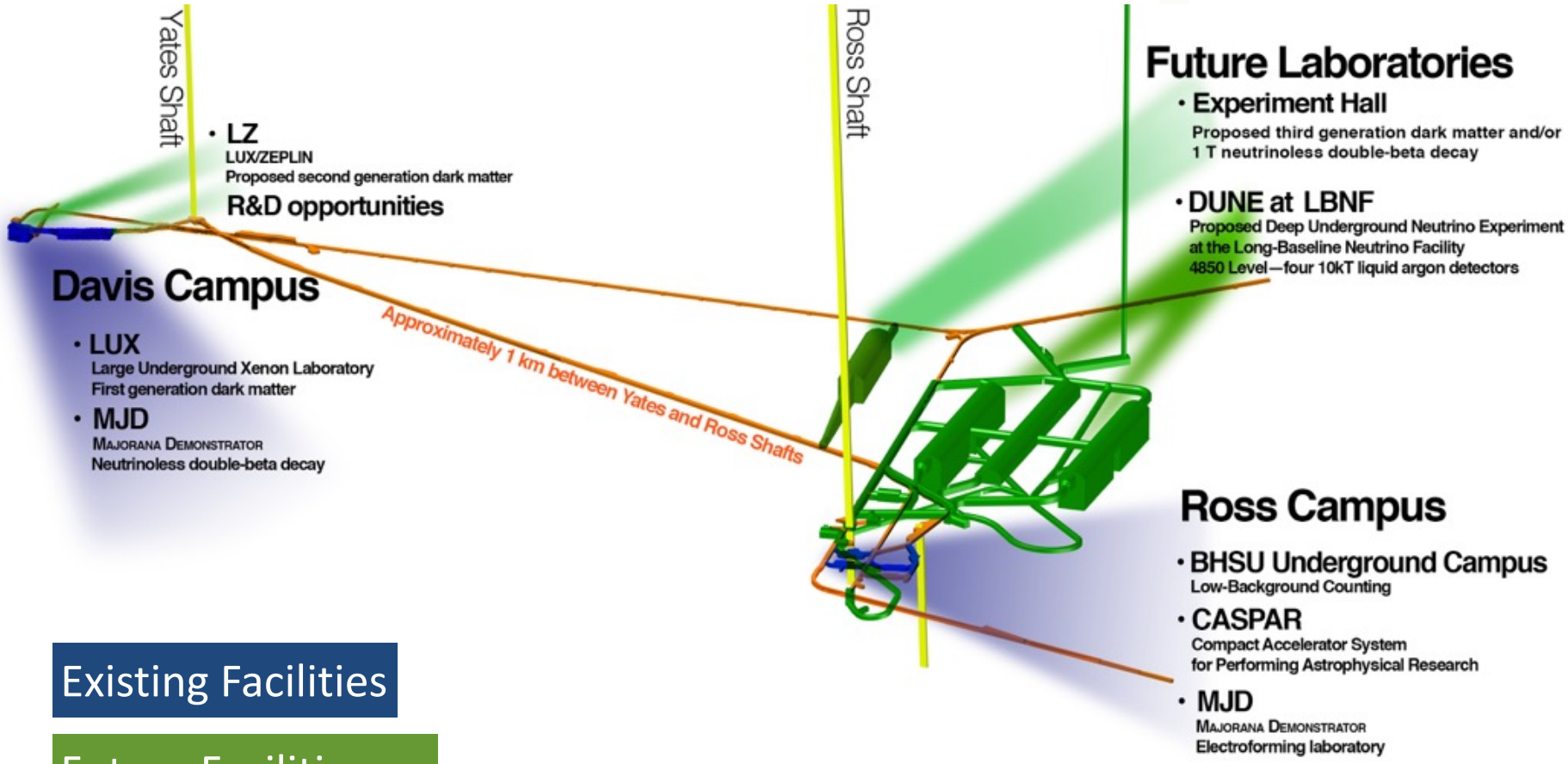
Sanford Underground Research Facility

Dedicated facility for underground scientific research



- Created by the State of South Dakota with major philanthropic donations from Barrick (property) and T. Denny Sanford ($70M).
- Continued support by the State of South Dakota ($46M through 2016).
- Operations funded by US Dept of Energy, through a subcontract between Fermilab and the SDSTA.

4850L Science Facilities



Existing Facilities

Future Facilities

Current Underground Science Program
Physics (4850L Davis Campus)

MAJORANA DEMONSTRATOR:

- Studying the neutrino's mass and the matter/antimatter imbalance in the universe. Proving techniques for a larger experiment.
- **Status:** 2 cryostats with 44 detectors (40kg Ge) assembled. Commissioning and testing underway. Physics data in mid-2017.

Large Underground Xenon (LUX):

- Direct detection of dark matter.
- **Status:** Data taking completed in May 2016. Remains most sensitive DM experiment in world. Decommissioning underway in prep for the LUX-ZEPLIN (LZ) next generation experiment.

Current Underground Science Program
Physics (4850L Ross Campus)

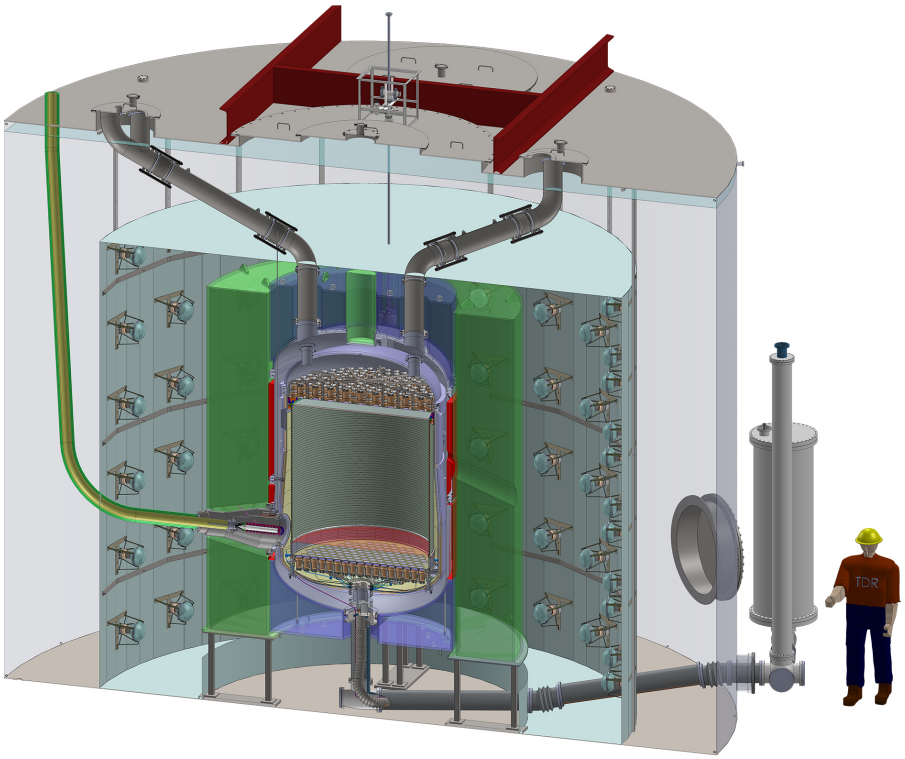
Compact Accelerator System for Performing Astrophysical Research (CASPAR):

- Studying nuclear reactions in stars resulting in the generation of elements heavier than Iron.
- **Status:** SDSM&T faculty and students leading onsite activities. Beamline components assembled, commissioning underway. Operations planned mid-2017.

Black Hills State University (BHSU) Underground Campus:

- Low background counting to characterize radiopurity of detector components.
- **Status**: Installed 4 low background counters. Completed counting activities for the first 45 LZ photo multiplier tubes. Providing opportunities for undergraduate students.

LUX-ZEPLIN (LZ) Dark Matter Experiment
LZ will be located in the Davis Cavern on the 4850 foot level



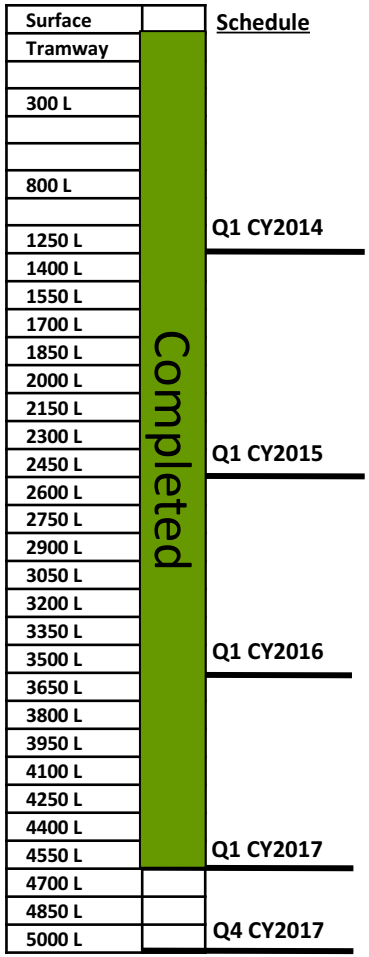
LZ Detector and Shielding

- LZ collaboration includes ~220 members at 36 institutions.
- 10,000 kg Xe (3,500 gallons). 30x larger, 100x more sensitive than LUX.
- Using existing Surface Laboratory and 4850L Davis Campus facilities.
- Experiment and facility design work underway. Project has been “baselined” for construction.
- Facility modifications are underway on the surface and are planned for 2018 underground in Davis Campus.
- Experiment installation underground planned for 2018-19.
- Operate for 5 years starting ~2020.

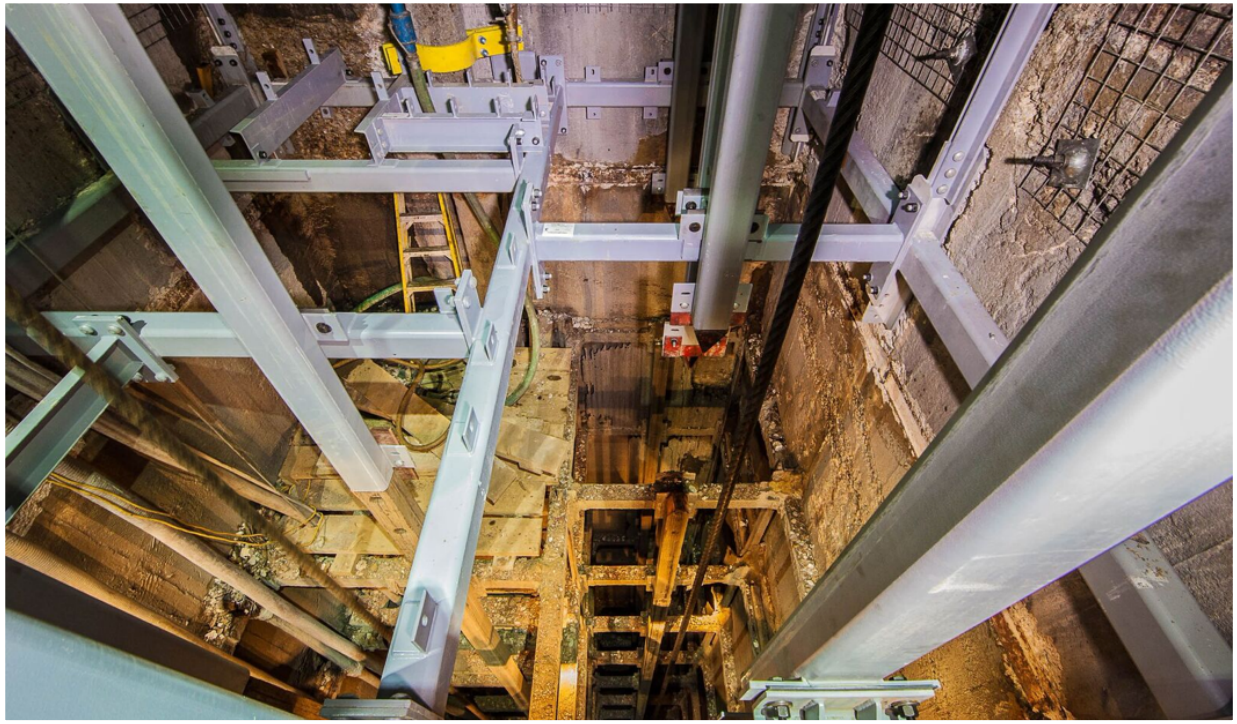
LZ Surface Construction
Surface facility construction to complete in May 2017

Ross Shaft Refurbishment Update

4,679 feet down from surface (90% complete overall)



- Ross Shaft constructed in 1930s. Rehabilitation initiated in August 2012 to modernize the shaft for LBNF construction.
- SDSTA self-performing the project. Includes removal of old shaft steel and installation of ~6M pounds of new steel. Set to finish Q4 CY2017.
- Project total cost $32.2M: $5.95 in SD appropriated funds, $11.6M in U.S. DOE federal funds, and $14.6M in Sanford private funds.



Sanford Lab 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

Elementary
- Exploring Unseen
- Force Be With You

Middle School
- Seismic Science
- Search Dark Matter

High School
- Perplexing Puddles
- Star-Stuff

In Development
- There & Back Again
- Waterworks

Field Trips

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

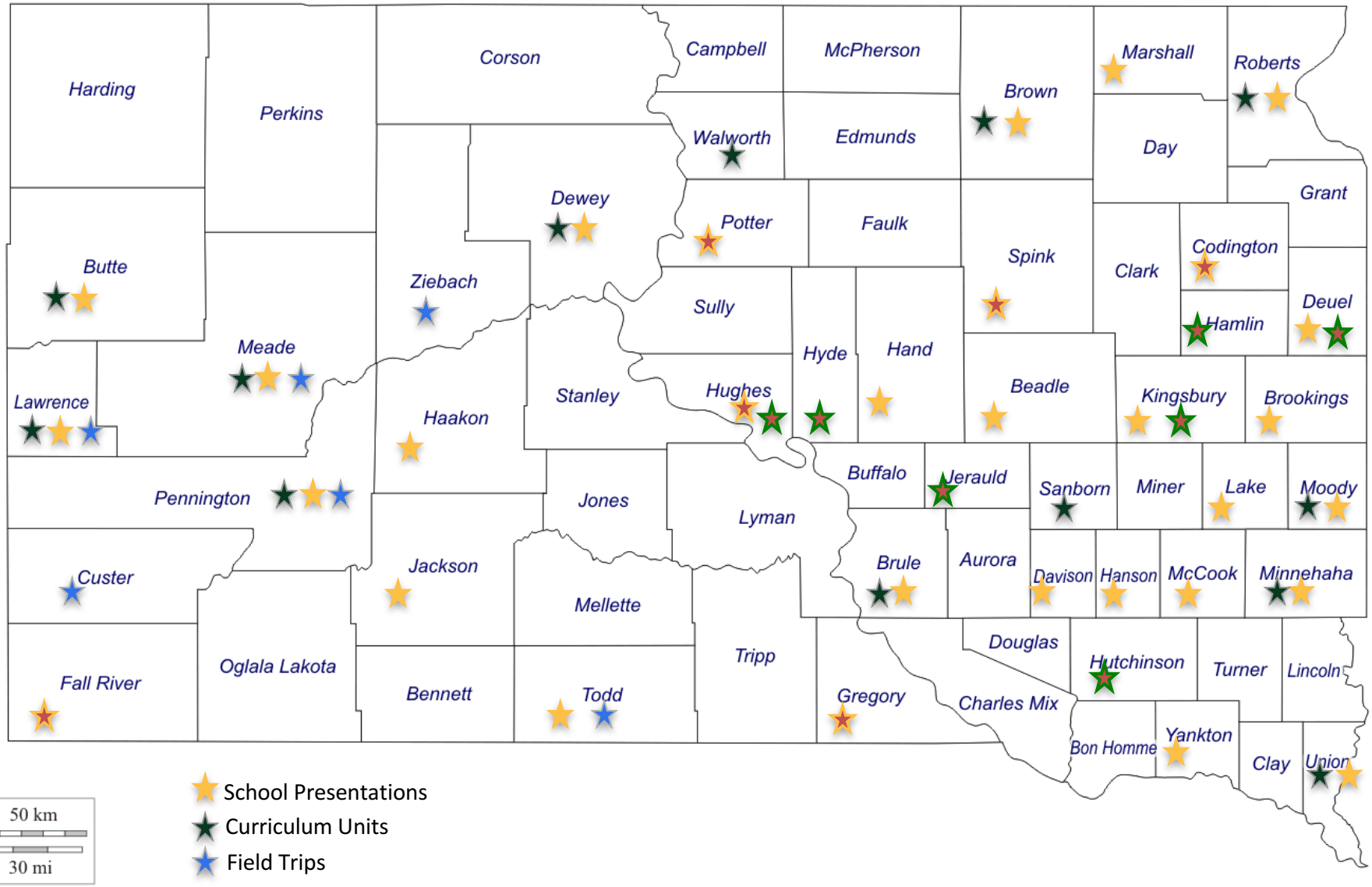
Sanford Lab Education and Outreach Impacts

K-12 students served from September 2015 to February 2017

	School Presentations	Curriculum Units	Field Trips
Number of Students	14,064	2,231	944
Number of Classrooms	1004	159	67

- Before 2015, Sanford Lab's E&O Program focused primarily on field trips.
- The total number of K-12 students participating in programming from 2008 to the end of February 2017 is 23,352.

Sanford Lab Education and Outreach Activities in South Dakota

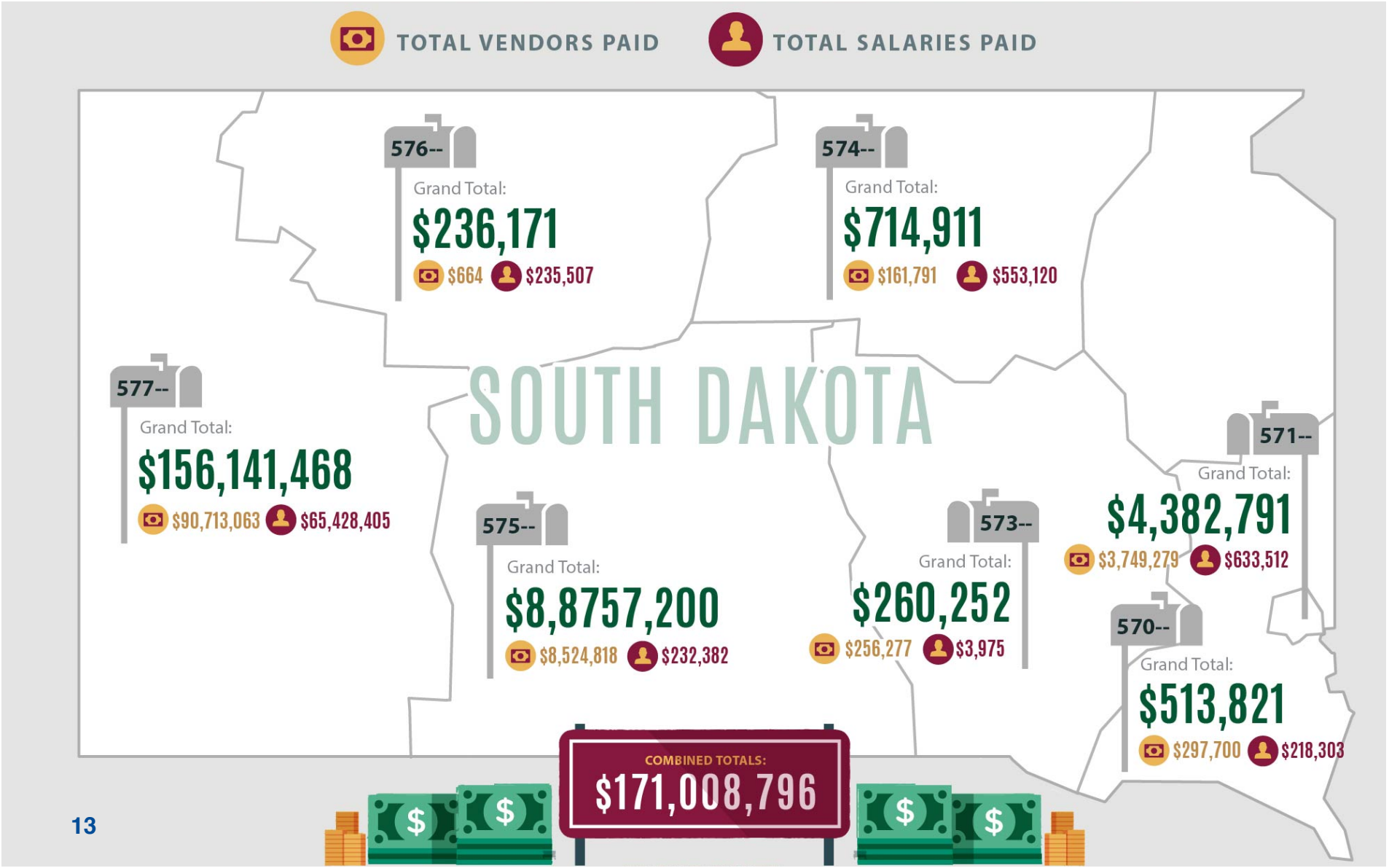


Economic Impacts in South Dakota
Through Year End CY2016

Spending in South Dakota to date	**$171M**
Annual total budget (all sources & activities)	$23.4M
Annual SURF operations budget (DOE funds)	$14.75M
Annual payroll in SD	$13.6M
Annual non-payroll expenses in SD	$5.9M
Jobs in South Dakota	163
Active research groups	24
Research groups with SD members	18

Total Spending in South Dakota through year end 2016

Grouped by 3-digit zip code region.



Economic Impact of the Long-Baseline Neutrino Facility

Economic impact, 2016-2026*

South Dakota

$952 million
Total economic output

$340 million
Income for South Dakota households

Illinois

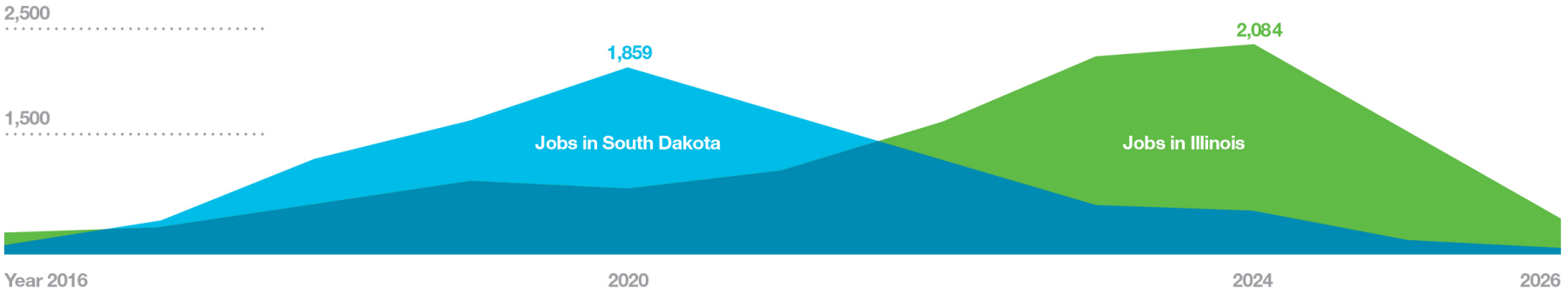
$1,204 million
Total economic output

$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*



Full report available at: http://lbnf.fnal.gov/economic-impact.html