

LBNF/DUNE Informational Meeting

Sanford Lab Update

Jaret Heise

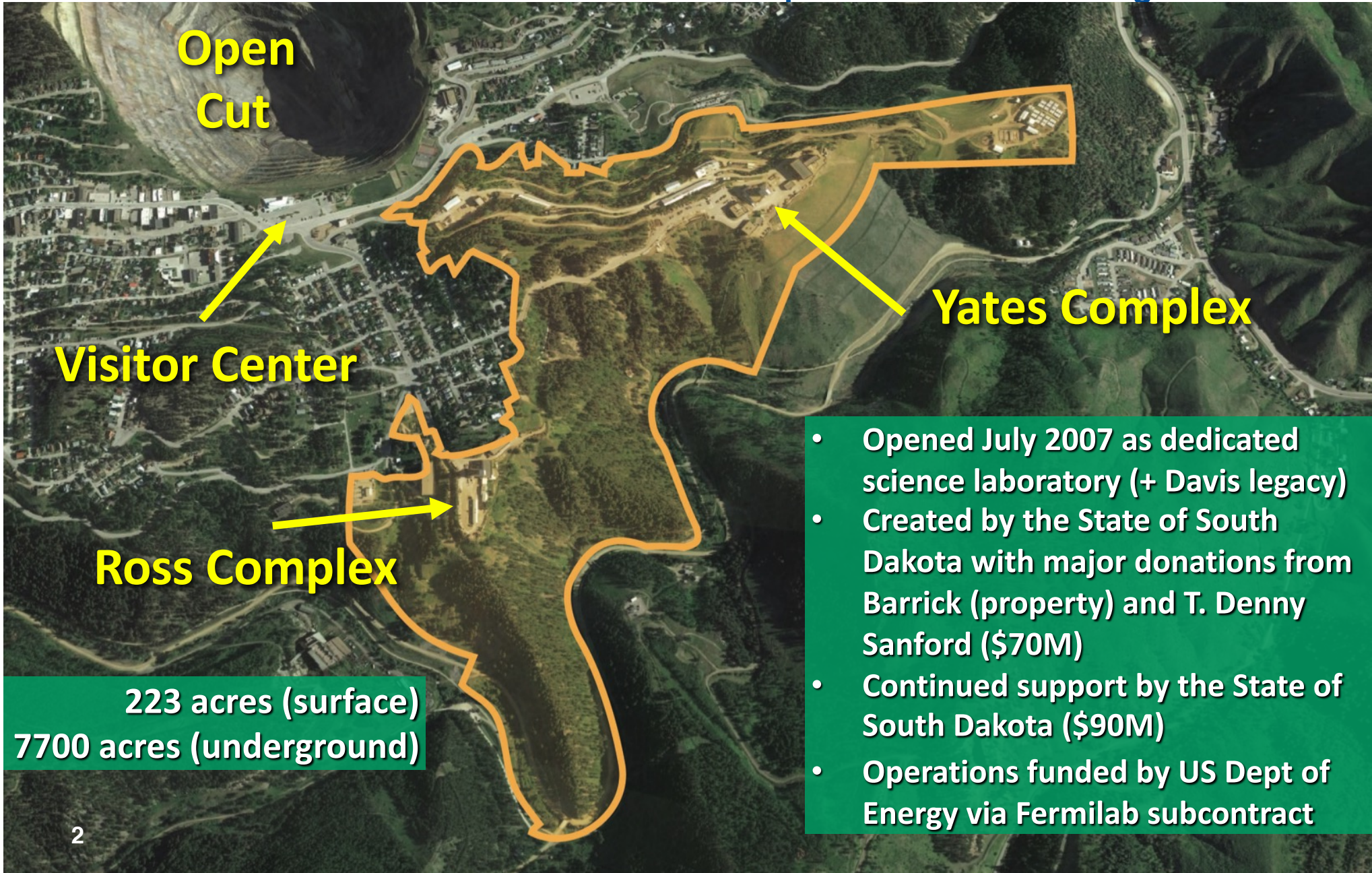
Sanford Lab Science Director

16 January 2019

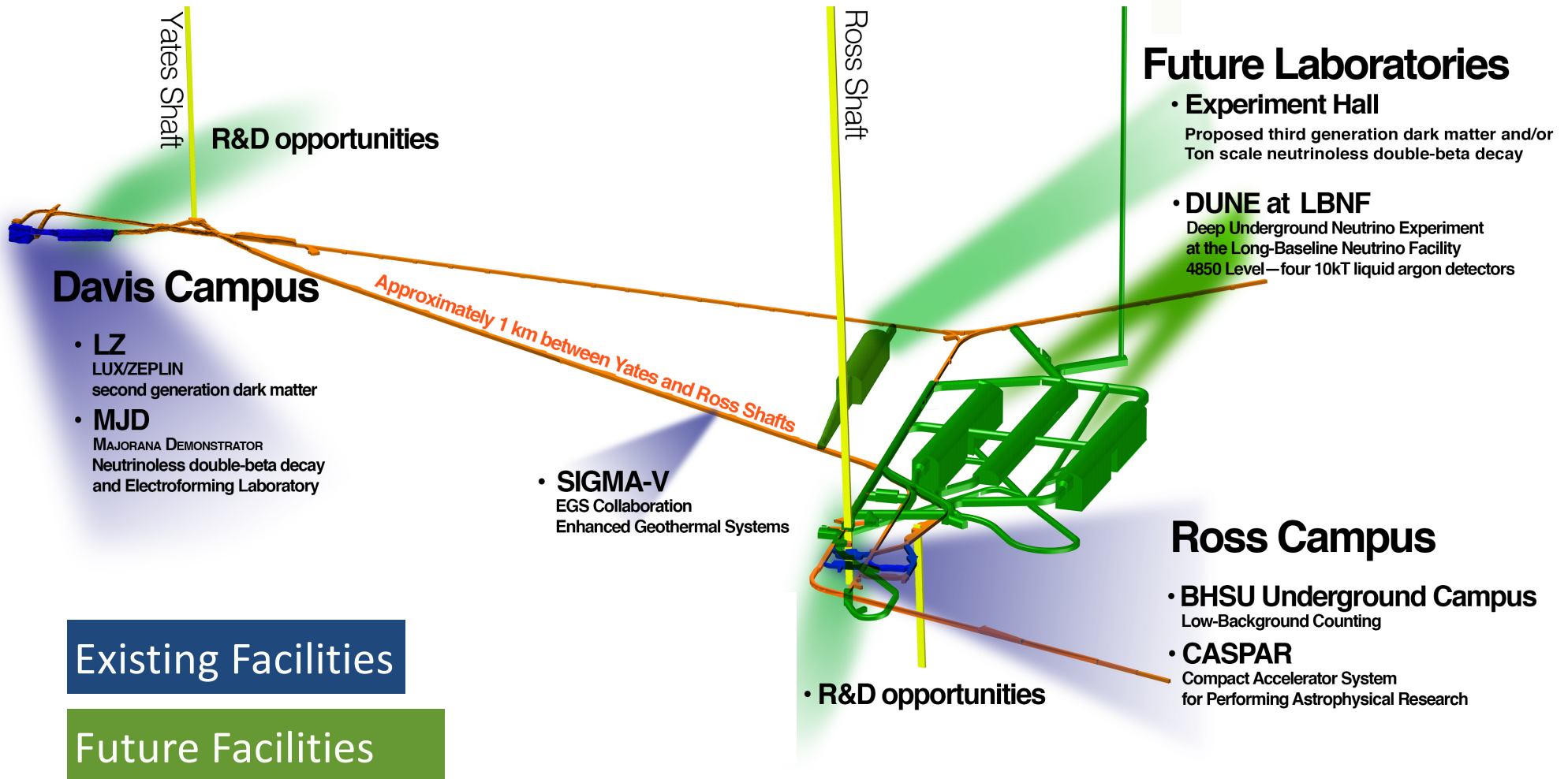


Sanford Underground Research Facility

Nation's underground laboratory to advance compelling multidisciplinary research in a safe work environment and to inspire and educate through science



4850L Science Facilities



Current Underground Science Program Physics (4850L Davis Campus)

MAJORANA DEMONSTRATOR:

- Studying **neutrino mass** and the **matter/antimatter** imbalance in the universe using 45 kg germanium inside lead + copper shield. Proving techniques and technologies for ton-scale experiment.



MAJORANA DEMONSTRATOR:

- **Status:** Physics data collection with 2 cryostats underway, operation expected through 2020. Production resumed for world's purest copper for next-generation experiment.

Current Underground Science Program Physics (4850L Davis Campus + Surface Laboratory)

LUX-ZEPLIN (LZ):

- Direct search for **dark matter** using 10 tonnes xenon within ultra-pure titanium cryostat, submerged in ultra-pure water shield + new liquid scintillator.



LUX-ZEPLIN (LZ):

- **Status:** Detector assembly underway on surface, detector underground in 2019, data starting 2020 for ~5 years. 100x more sensitive than LUX, expect to reclaim title as world's most sensitive dark matter detector!

Current Underground Science Program Physics (4850L Ross Campus)

Compact Accelerator System for Performing Astrophysical Research (CASPAR):

- Studying nuclear reactions in stars resulting in the **synthesis of elements** heavier than iron.



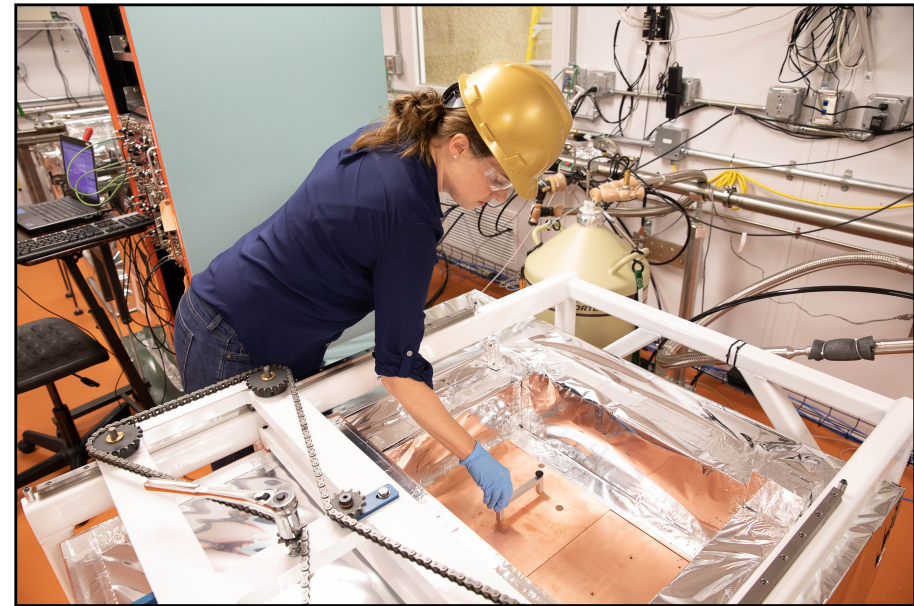
Compact Accelerator System for Performing Astrophysical Research (CASPAR):

- **Status:** SDSM&T faculty and students leading onsite activities. “First beam” achieved in July 2017, first physics data collected in 2018, program to continue beyond 2022.

Current Underground Science Program Physics (4850L Ross Campus)

Black Hills State University (BHSU) Underground Campus:

- Low background counting to characterize **radiopurity** of detector components (less than parts per *billion*, new system possibly as low as parts per *trillion*).



Black Hills State University (BHSU) Underground Campus:

- **Status:** 6 low background counters operating. Counting activities focused on LZ near term. Providing opportunities for undergraduates in physics and other science disciplines.

Current Underground Science Program Geology (4850L West Drift)

Stimulation Investigations for Geothermal Modeling Analysis & Validation (SIGMA-V):

- Studying enhanced rock pressurization techniques applicable to **geothermal energy**. Modeling for Dept of Energy FORGE project. Geothermal has potential to heat 100 million homes in the U.S.



Stimulation Investigations for Geothermal Modeling Analysis & Validation (SIGMA-V):

- **Status:** 8x holes drilled, significant number of monitoring instruments installed, flowing water to test heat extraction. Investigating additional site on 4100L. 8 U.S. national laboratories involved. Program completion ~2020.

Sanford Lab Educational Opportunities for K-12 Students

School Presentations

Elementary

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

Middle School

- Career Opportunities
- Dark Matter
- Hot Rocks

High School

- Neutrinos
- Water – Where Does it go?

Curriculum Units

Early Elementary

- Creature Features
- Between a Rock and a Hard 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

K-12 Student Impact

Students Participating in SURF E&O Programs

Activity	2017-2018	Since 2015
School Assemblies	6,214	25,778
Science Curriculum Units	2,376	8,265
Field Trips to SURF	796	2,305
TOTAL	9,386	36,348

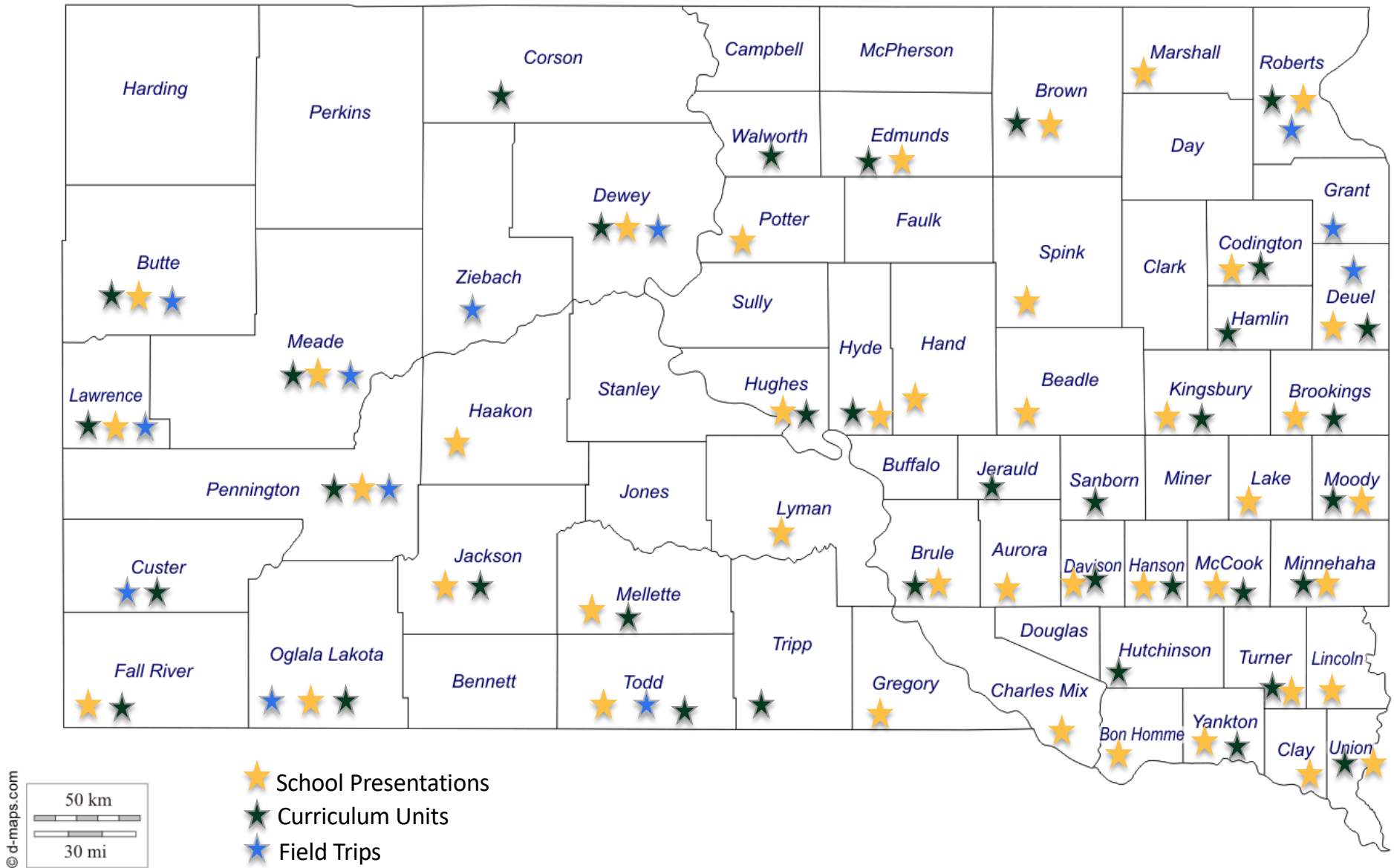
- **20.2%** of students participating are from schools with >10% American Indian population.
- **6.4%** of students participating are from schools with >50% American Indian population.

SURF also hosts summer workshops for teachers



K-12 Student Impact

Students Participating in SURF E&O Programs (2015-2019)



Economic Impacts in South Dakota

Through September 2018 (end of U.S. Federal FY2018)



Spending in South Dakota to date	\$201 million
FY19 total budget (all sources & activities)	\$28.1 million
FY19 SURF Operations budget (DOE funds)	\$18.0 million
Annual payroll budget in SD (FY19)	\$14.6 million
Annual non-payroll budget in SD (FY19)	\$13.5 million
Jobs in South Dakota	180
Active research groups	27
Research groups with SD members	21

Total Spending in South Dakota through Sept 30, 2018

Grouped by 3-digit zip code region

