

# Sanford Underground Research Facility

Markus Horn on behalf of SURF

Building on rich legacies, the Sanford Underground Research Facility (SURF) has been operating for over a decade as a facility dedicated to supporting underground research in rare-process physics, as well as offering research opportunities in other disciplines.

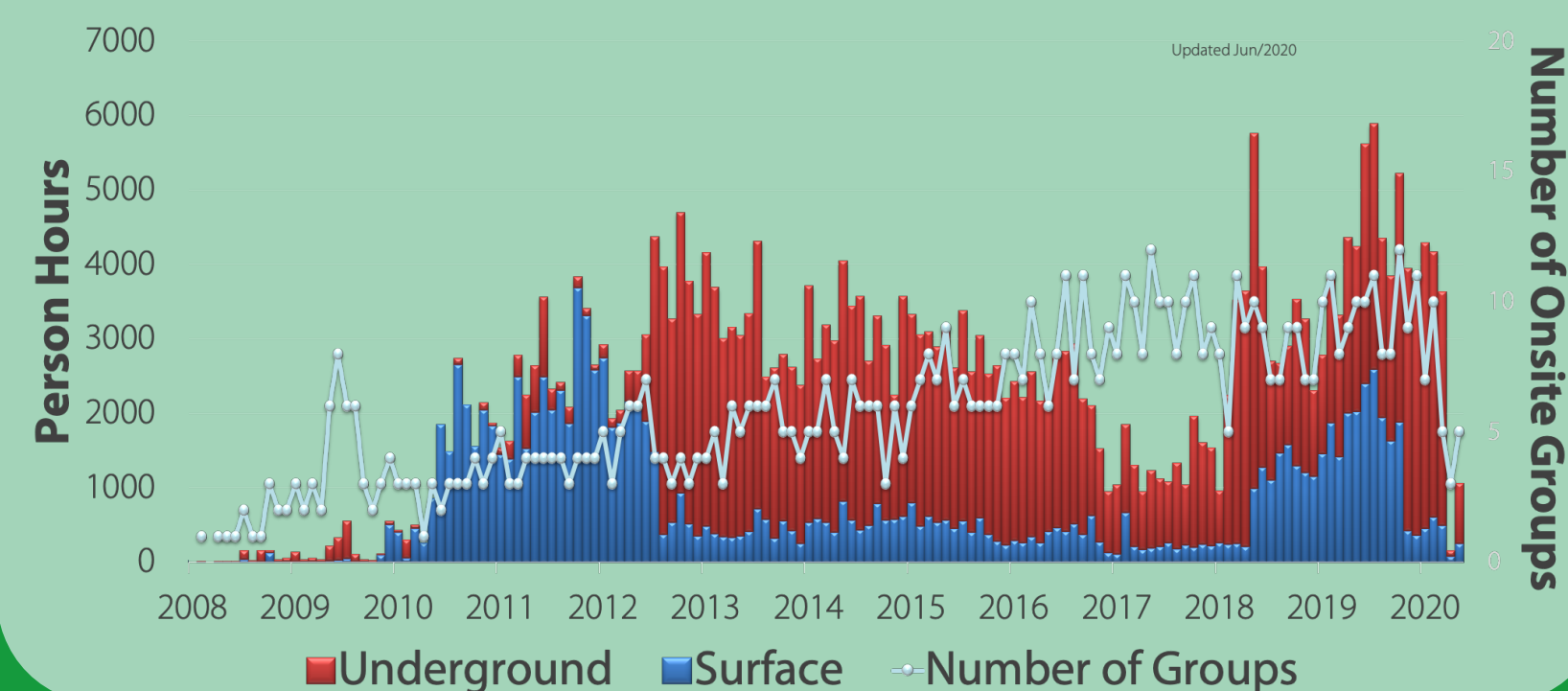
Laboratory facilities include a Surface Campus as well as two main campuses at the 4850-foot level (4300 m.w.e.) that host a range of significant physics experiments: the LUX-ZEPLIN (LZ) dark matter experiment, the MAJORANA DEMONSTRATOR neutrinoless double-beta decay experiment and the CASPAR nuclear astro-physics accelerator. Furthermore, the BHUC laboratory dedicated to critical material assays for current and future experiments has been operating since Fall 2015.

Plans to accommodate the Fermilab-led international Deep Underground Neutrino Experiment (DUNE) at the Long Baseline Neutrino Facility (LBNF) are well advanced, and initial construction has commenced. SURF is a dedicated research facility with significant expansion capability, and applications from other experiments are welcome.



## SCIENCE SUPPORT

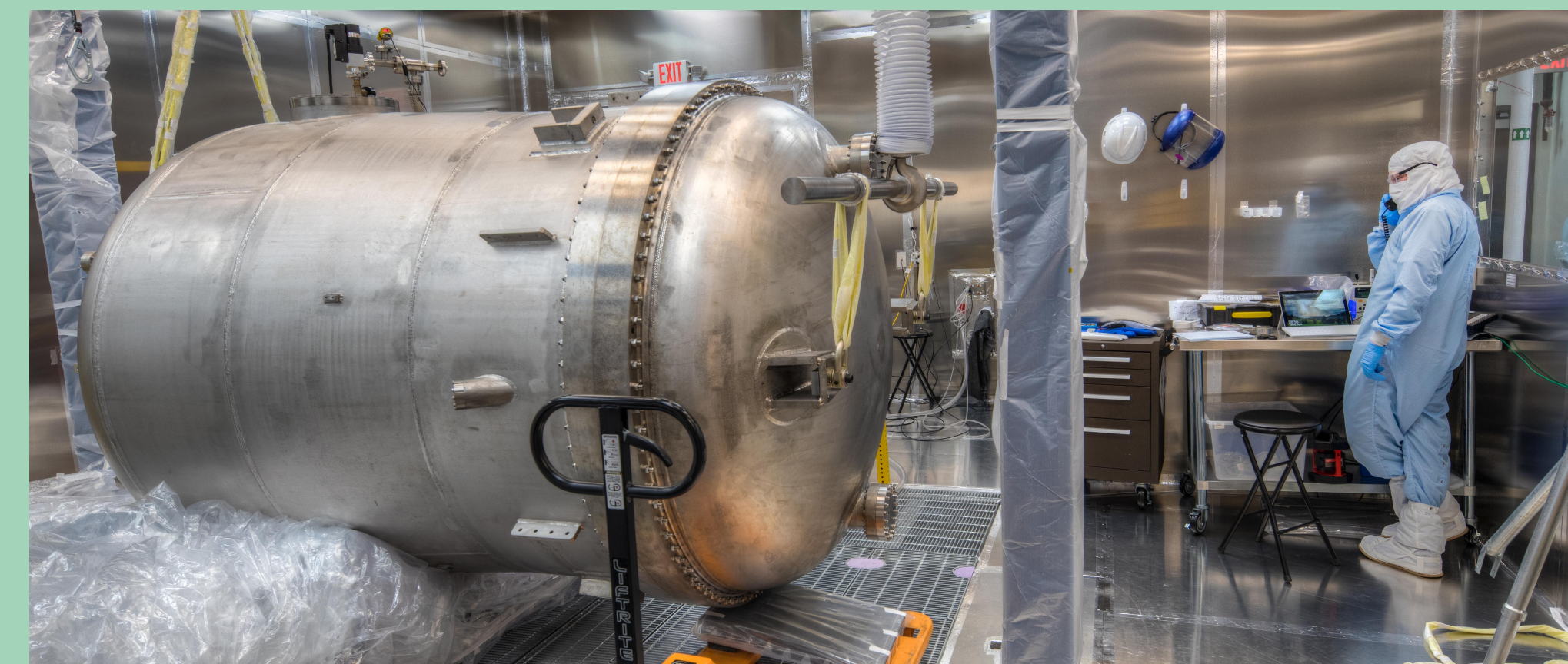
- Expanding community of researchers from multiple disciplines, incl. biology & geology
- SURF staff (~165 people) for 24h-operations, facility maintenance & science support
- 29 expts, ~400 current active users from 82 institutions in 9 countries



YATES

## SURFACE LABORATORY

- Surface Laboratory newly renovated and extended, incl. low-Rn cleanroom and a Rn-reduction system (~300 m<sup>3</sup>/hr)
- Currently used by the LZ exp. for detector assembly (pictured)



## BHUC

Black Hills State University Underground Campus

- Sanford Lab's low-background counting facility housing a total of 6 ultra-sensitive low background counters used to assay materials

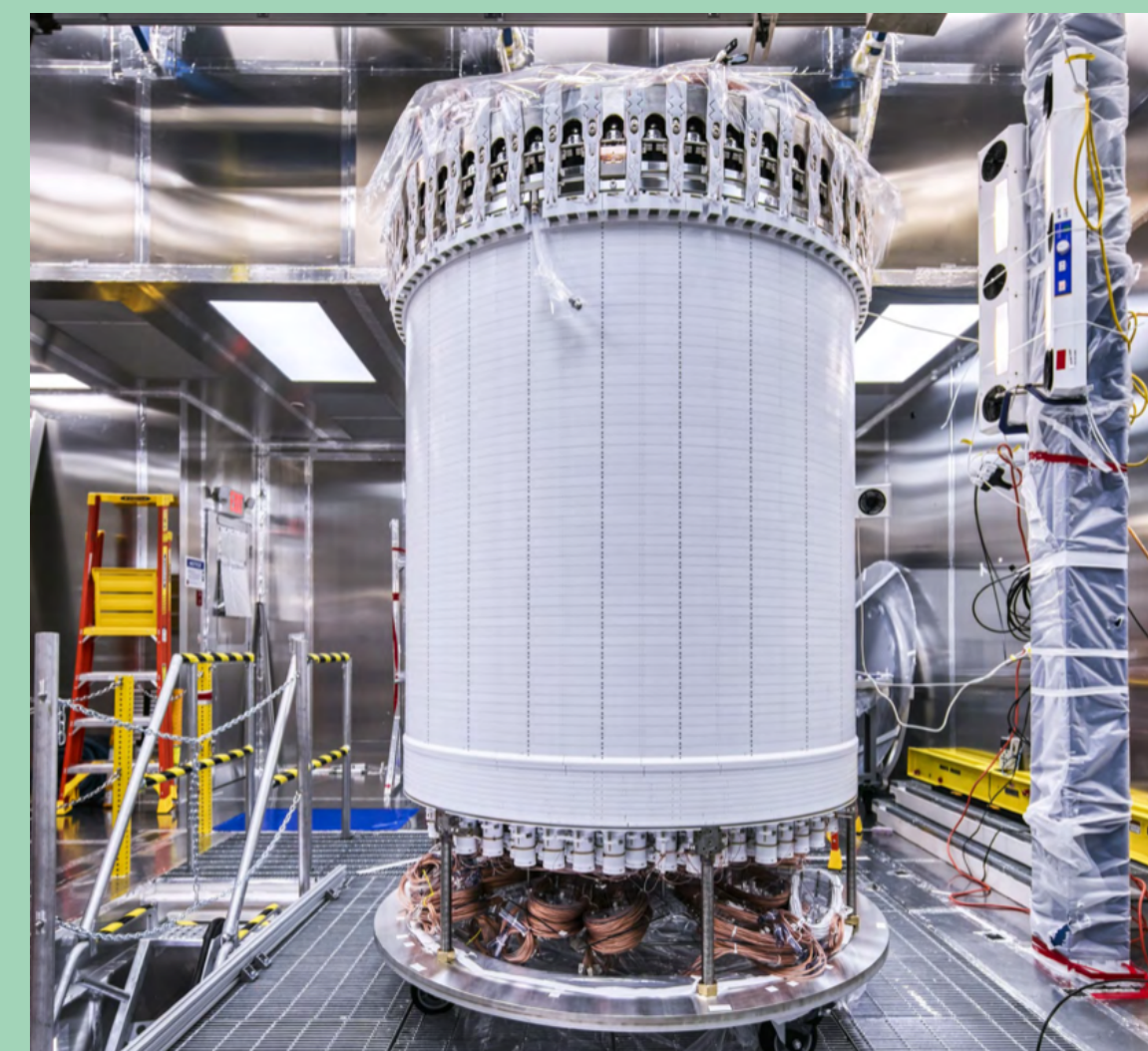


## DAVIS CAMPUS

### LUX-ZEPLIN

Direct detection Dark Matter experiment

- 10t liquid Xenon Time-Projection-Chamber
- Ultra-pure titanium cryostat, water & Gd-loaded liquid scintillator (LAB) veto/shield
- Construction started early 2017
- Assembly of TPC on surface, delivered underground Oct/2019
- Production physics data expected 2020, ~5 yrs operations



### CASPAR

Compact Accelerator System for Performing Astrophysical Research

- Study of stellar nuclear fusion reactions, esp. neutron production for slow neutron-capture nucleosynthesis
- Beam operation since May 2017



ROSS

## ROSS CAMPUS

(Site of future excavations)

## MAJORANA DEMONSTRATOR

- Neutrinoless double-beta decay experiment using 44 kg Ge in two cryostats, 30 kg enriched <sup>76</sup>Ge inside Cu/Pb/HDPE shield (~72 tons) with active muon veto
- Production physics data since 2015, currently also R&D for tonne-scale Ge-based experiment (LEGEND)



## LBNF/DUNE

Long-Baseline Neutrino Facility / Deep Underground Neutrino Experiment

- DOE project led by Fermilab. Significant international contributions (incl. CERN, STFC-UK)
- LBNF: provides facilities at two locations "Near Site": Fermilab, Batavia, IL – facilities to create a neutrino beam "Far Site": SURF, Lead, SD – facilities to support neutrino detectors
- DUNE: large liquid argon detectors to study neutrino oscillations, supernovae neutrinos and nucleon decay
- Design includes three neutrino detectors and a 4<sup>th</sup> chamber for new opportunities
- Construction started Jan/2019 (KAJV), excavation to last ~3-4 yrs
- First detector construction starts ~2024, operating ~2026 with expected data taking for 20-30 yrs

