Welcome to Second Target Station (STS) SHUG Town Hall

STS Future Science Case, Impact, and Instruments

Co-Chairs: Laura Greene, Alan Tennant, Norm Wagner, Soichi Wakatsuki

OAK RIDGE National Laboratory

THE UNIVERSITY OF TENNESSEE KNOXVILLE

FSU FLORIDA STATE UNIVERSITY

Stanford University

NATIONAL MAGLAB

UNIVERSITY OF DELAWARE

Co-chairs

Alan Tennant

University of Tennessee Professor of Physics

Professor of Materials Science and Engineering

Director, UTK MRSEC

Director, Shull Wollan Center

Project Leader, Quantum Science Center, a DOE National Quantum Information Science Center

Norm Wagner

University of Delaware Robert L Pigford Chair in Chemical & Molecular Engineering

Affiliated Professor, Dept. of Physics & Astronomy

Joint Professor, Biomedical Engineering (BME)

Professor, Biomechanics & Movement Science (BIOMS)

Director, Center for Neutron Science (CNS)

Soichi Wakatsuki

Professor of Photon Science at Stanford SLAC

Professor, Structural Biology

Member, Bio-X

Member, Maternal & Child Health Research Institute (MCHRI)

Faculty Fellow, Sarafan ChEM-H

Laura Greene

Chief Scientist, National High Magnetic Field Laboratory

Maria Krafft Professor of Physics, Florida State University

Research Professor, University of Florida

PCAST Member

Focus Area Chairs, Co-Chairs, and Members

Quantum Materials

Collin Broholm (Chair), JHU

Mingda Li, (Co-chair), MIT

Alan Tennant, UTK
Laura Greene, Maglab
Yishu Wang, UTK
Alex Hoffmann, UIUC
Joel Moore, UC Berkeley
Rob McQueeny, Ames
Xiaojian Bai, LSU
Pengcheng Dai, Rice University
Henrik Ronnow, EPFL
John Tranquada, BNL
Mansai Mandal, MIT
Kiran Mak, MIT
Eduardo Fradkin, University of Illinois
Satoru Nakatsuji, University of Tokyo
Vivien Zapf, LANL
David Mandrus, UTK

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Mark Lumsden (Technical Advisor/Note Taker),ORNL
Yaohua Liu (Technical Advisor/Note Taker),ORNL

Soft Matter and Polymers

Nitash Balsara (Chair),UCB

Narita Sinha (Co-Chair), PSU

Norman Wagner, U of Delaware
YZ, University of Michigan
Yun Liu, NIST
Amy Xu, LSU
Yanfei Yu, University of Massachusetts Amherst
Roger Pynn, Indiana University
Michael Bockstaller, Carnegie Mellon University
Peter Olmsted, Georgetown U
Emanuela Del Gado, Georgetown U

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Changwoo Do (Technical Advisor/Note Taker),ORNL
Eugene Mamontov (Technical Advisor/Note Taker),ORNL

Materials and Engineering

Steve Zinkle (Chair), UTK

Janelle Wharry (Co-Chair), Purdue

Adrian Brugger, Columbia
Shenyang Huang, GE
Suresh Babu, UTK
Don Brown, LANL
Zhenzhen Yu, CO School of Mines
Matt Steiner, U of Cincinnati
Kevin Field, U of Michigan
Les Butler, LSU
Srikanth Pilla, U of Delaware

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Saurabh Kabra (Technical Advisor/Note Taker),ORNL
Ke An (Technical Advisor/Note Taker), ORNL

Chemistry and Environmental Science

Jacob Jones (Chair), NC State

Craig Brown (Co-Chair), NIST

Kate Page (Co-Chair), UTK
Angela Pitenis (Co-Chair), UCSB
Eric Pierce, ORNL
Efrain Rodriguez, University of Maryland
Roberto Car, Princeton
Theodore Betley, Harvard University
Angus Wilkinson, Georgia Tech
Mohammad A. Omary, U of North Texas
Manal A. Rawashdeh-Omary, Texas Woman's U
George Nelson, UAH
Jie Xu, Arizona State University
Olivier Delaire, Duke University
Theo Siegrist, FSU
Karena Chapman, Stony Brook University
Alison Altman, Texas A&M University
Robert Schurko, FSU and National MagLab
Abel Chuang, UC Merced
Tomislav Friscic, University of Birmingham (UK)
Russell Hemley, University of Illinois, Chicago

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Christina Hoffmann (Technical Advisor/Note Taker),ORNL
John Ankner (Technical Advisor/Note Taker),ORNL

Biological Materials, Systems & Human Health

Eddie Snell (Chair), HWI

Jonathan Nickels (Co-Chair), U Cincinnati

Soichi Wakatsuki, Stanford University
Margaret Stroupe, FSU
Andrzej Joachimak, ANL
Yimin Mao, University of Maryland
Mark Wilson, University of Nebraska
Abhishek Singharoy, Arizona State
Drew Marquardt, University of Windsor
Thomas Cleveland, NIST
Gloria Borgstahl, U of Nebraska
Ichiro Tanaka, Ibaraki University
Kalina Hristova, Johns Hopkins
Steven Damo, Fisk University

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Flora Meilleur (Technical Advisor/Note Taker),NCSU/ORNL
Shuo Qian (Technical Advisor/Note Taker),ORNL

STS was conceived as a visionary source: A decade ago

”The STS upgrade is ‘***absolutely central***’ to US science.”

“...significant scientific/technical issues that must be resolved before construction can be initiated…long-versus a short-pulse source…”

2013 BESAC facilities prioritization review

A short pulse, high brightness, broad dynamic range, cold source is needed to address emerging challenges in world-leading science

2024 Basic Energy Sciences Advisory Committee (BESAC)

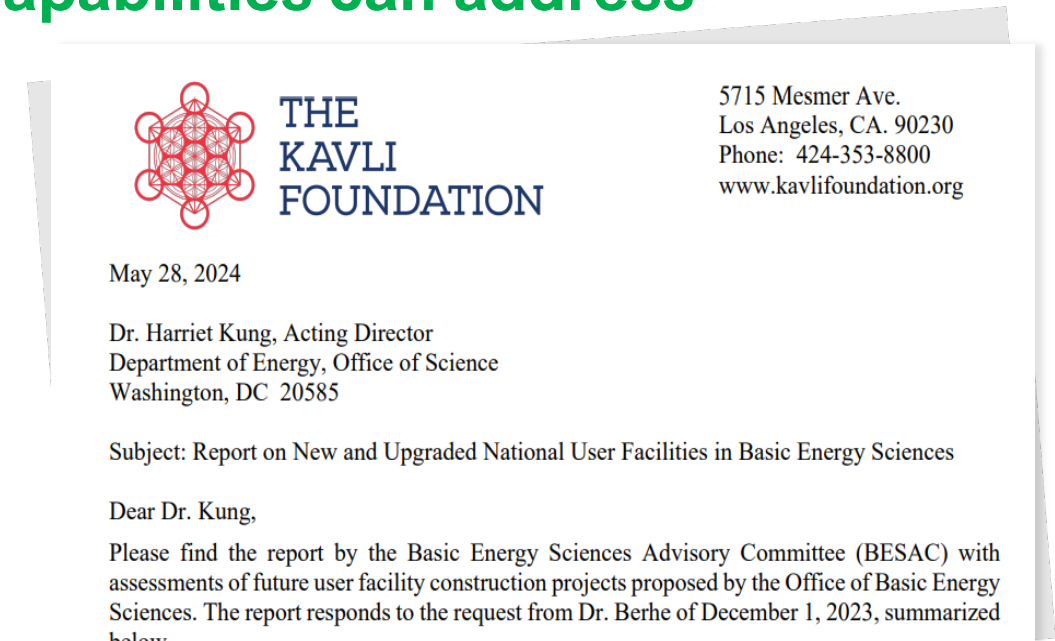
Second Target Station (STS) at the Spallation Neutron Source will be the **world's brightest source of cold neutrons** (up to 100x brighter than existing facilities) and **represents a transformative technological advance**

- As such, it is viewed as having the potential to be **absolutely central** to future world-leading science, with the potential to enable discovery science and technologies, in the fields of **quantum materials for computing and sensors, biological and soft materials for science, energy, national security, and medicine**.

  The science case must be more fully developed to specify the currently inaccessible grand challenges that the new capabilities can address

- STS will be **ready to proceed** to CD-2 once the science case is refined and the instrument suite redefined to support the science.

Development of the *science case* is essential



THE KAVLI FOUNDATION

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May 28, 2024

Dr. Harriet Kung, Acting Director
Department of Energy, Office of Science
Washington, DC 20585

Subject: Report on New and Upgraded National User Facilities in Basic Energy Sciences

Dear Dr. Kung,

Please find the report by the Basic Energy Sciences Advisory Committee (BESAC) with assessments of future user facility construction projects proposed by the Office of Basic Energy Sciences. The report responds to the request from Dr. Berhe of December 1, 2023, summarized

Process

Initiated **national engagement** process with a three-hour hybrid community session:

- **June 28** at the Second Target Station and Instrumentation Workshop on in Knoxville, a satellite meeting of the American Conference on Neutron Scattering (ACNS).
- Approximately 100 participants.
- Presented the case for the STS and outlined a multi-stage process for gathering community input consisting of the following steps:

1. Host a national workshop by the end of August to gather initial insights.
2. Formulate preliminary conclusions and recommending possible instrument suites to meet emerging needs.
3. **Hold a town hall for additional community feedback: This event.**
4. Compile all input into a **final report for the Department of Energy.**

Workshop

The Second Target Station (STS) Project is a major DOE-BES project that will add a new target and instrument station to the Spallation Neutron Source at Oak Ridge National Laboratory. STS will provide new capabilities to characterize materials with neutrons.

The goals for this workshop are to identify Grand Challenges for the nation in the coming decades, which then can refine the STS science cases that STS will uniquely address. There will be opportunities to re-define the initial instrument suite to optimize highest priority science. Those instruments are part of the STS project. The workshop is the first step towards addressing recommendations from the recent Basic Energy Science Advisory Committee report on new and upgraded BES scientific user facilities (https://science.osti.gov/-/media/bes/besac/pdf/Reports/Report-to-BESAC-on-New-and-Upgraded-National-User-Facilities-2024-05-28Final.pdf).

Following the workshop, a virtual public town hall is planned to share the findings with the community, which will also provide opportunities for feedback. A final report is anticipated to be completed by the end of 2024.

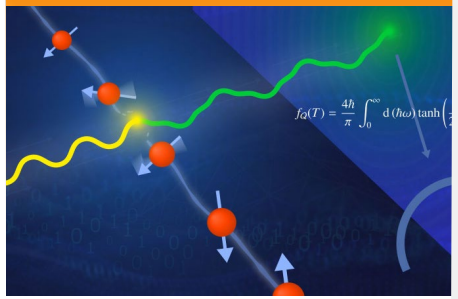
Questions that should be discussed at the workshop and addressed in the report include:

- What are the emerging and future grand challenges for the nation over the next 10-20 years focusing on the following five science areas?
  - Quantum Materials
  - Soft Matter & Polymers
  - Materials & Engineering
  - Chemistry & Environmental Science
  - Biological Materials, Systems & Human Health
- How can neutrons uniquely address these grand challenges as compared to other techniques including but not limited to X-rays, electrons, or NMR?
- What are unique science cases connected to the identified grand challenges?
- What instrument suite is required to deliver the science?

Website: https://conference.sns.gov/event/458/

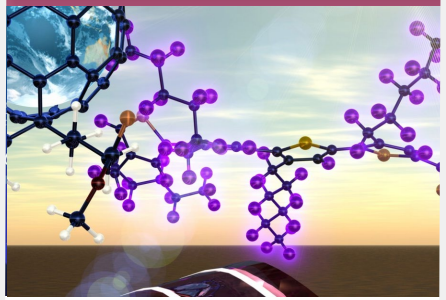
Breakouts on 5 key science areas where neutrons play a unique role

Quantum materials



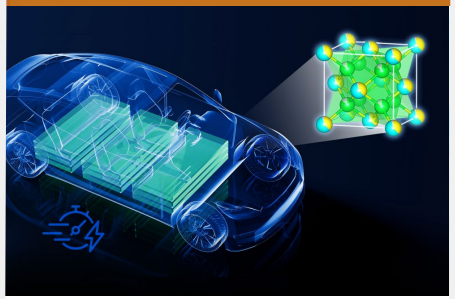
Neutrons reveal entangled magnetic states of quantum spin liquids

Soft matter and polymers



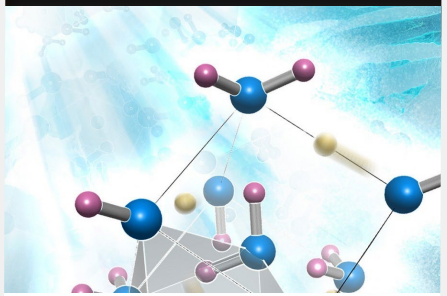
Neutrons uncover molecular structures and dynamics in soft matter and polymers

Materials and engineering



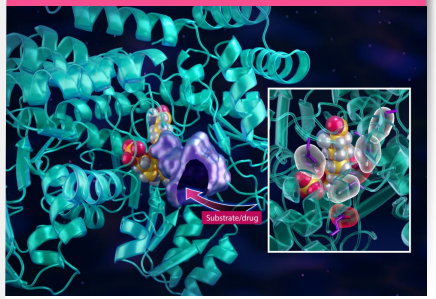
Neutrons penetrate materials without causing damage, allowing atomic-level analysis

Chemistry and environmental science



Neutrons identify light elements and track chemical reactions non-destructively

Biological materials and systems



Neutrons show interactions of molecules, revealing dynamic biological system processes

Key outcome of the workshop

The scientific case for STS has significantly evolved over the past decade, reflecting shifts in science priorities, the increasing impact of artificial intelligence (AI) on experimental and theoretical science, and the urgency of societal problems that neutrons uniquely address.

This evolution has generated *significant new science cases and applications which are the basis of this Town Hall*

Your input is valuable and needed!

- Create a **compelling case**
- Complete for end **December 2024**
- Goes to **DOE for consideration**
- Operating source **2034**

Thank you for contributing your time and expertise to our nation's scientific future!