Summary of Second Target Station (STS) Community Workshop
Date: August 14, 2025
Prepared by: SHUG-EC https://neutrons.ornl.gov/shug/committee

1. Overview

The STS Workshop convened to discuss updates on the Grand Scientific Challenges for the Second Target Station (STS) and to gather community input on the evolving scientific vision, instrumentation suite, and long-term operational strategies. Presentations from Dr. Alan Tennant and Dr. Leighton Coates framed the discussion around the future capabilities of STS in advancing U.S. leadership in neutron science and data-driven discovery.

2. Grand Challenges for STS

Presenter: Dr. Alan Tennant
Dr. Tennant outlined the central mission of STS as bridging the atomic-scale understanding of matter to real-world functional performance—complementary to the First Target Station (FTS) but offering increased flexibility and adaptability. STS will deliver high peak brightness combined with advanced focusing optics, enabling transformative studies across materials, chemical, and biological sciences.

Key enabling themes include:

- **Artificial Intelligence and Automation:** Integration of AI/ML for experiment control, data analytics, and predictive modeling.
- **Multiscale Modeling and Data-Driven Discovery:** Leveraging computational tools to connect atomic to mesoscale processes.
- **Quantum Capabilities:** Recognizing that quantum-enabled instruments and materials platforms will redefine scientific frontiers by the time STS is operational.

Dr. Tennant emphasized that STS must focus not only on “more, bigger, and faster,” but also on genuinely novel scientific directions.

Ten Grand Challenges Identified

The workshop discussed ten overarching “Grand Challenges” intended to shape the STS science agenda:

1. **Quantum materials** that reach fundamental limits for information and energy technologies.
2. **Understanding quantum coherence and dynamics** across diverse material platforms.
3. **Securing U.S. resource independence** through advanced chemistry and sustainable engineering.
4. **Materials and processes for autonomous construction and innovation.**
5. **Elucidating catalytic mechanisms** to transform energy conversion and chemical manufacturing.
6. **Advancing chemical sciences** for a resilient and sustainable future.
7. **Multiscale understanding of non-equilibrium phenomena** in soft matter and polymers.
8. **Mastering hierarchical assembly** and multiscale design principles.

9. **Engineering biological systems** by modeling hydrogen bonding and proton dynamics to understand the principles of life.
10. **Revealing molecular interactions in health and aging** to inform biological and medical sciences.

A draft version of the “Grand Challenges” report has been distributed to SHUG members. Members are encouraged to request a reissue if the document is not accessible via prior communications.

Discussion and Community Input
Key Comment: Dr. Steve Nagler highlighted the urgent need for a national strategy on data accessibility and management. Given that decisions on data infrastructure are progressing rapidly, he proposed that the topic be prioritized for a dedicated Town Hall discussion to ensure community engagement and input before final decisions are made.

3. STS Design and Instrument Suite Update
Presenter: Dr. Leighton Coates
Dr. Coates provided an update on the technical design and instrumentation planning for STS, focusing on aligning instrument development with the Grand Challenge priorities.

Highlights:
- **Instrument Concept Development:** Approximately 16–18 instrument concepts are under evaluation, including both legacy designs and new concepts such as:
    - An **extended-Q total scattering instrument** for atomic-to-mesoscale studies.
    - An **autonomous SANS instrument** designed for rapid, flexible experimentation.
- **Beamline Planning:** STS will feature 21 beam ports, expected to reach full utilization rapidly once operations commence.
- **Timeline:**
    - **2026:** Community input phase for developing and refining instrument proposals.
    - **2027:** Instrument suite selection and prioritization.
    - **2028–2030:** Instrument design and prototyping phase.
    - **2035:** First neutron production at STS.

During Q&A, participants noted that data rates from FTS already pose challenges; the increased data volume anticipated from STS will require substantial advances in data storage, processing, and analysis infrastructure.

Key Takeaways and Next Steps
- STS represents a next-generation neutron science platform integrating quantum-ready instrumentation, AI-assisted experimentation, and data-centric scientific workflows.
- Community engagement in 2026 is essential to ensure alignment between national research priorities and instrument development.
- Data management and availability were repeatedly emphasized as critical to the success of STS, meriting near-term attention and organized discussion forums.

4. Conclusion

The STS Workshop reaffirmed the community's strong enthusiasm for leveraging the unique capabilities of the Second Target Station to tackle transformative scientific challenges. Continued coordination among researchers, SHUG members, and DOE stakeholders will be vital to shape the facility's design, maximize scientific impact, and ensure U.S. competitiveness in neutron science and materials innovation.