POTENTIAL FOR HIGH-ENERGY PHYSICS AT THE OAK RIDGE NATIONAL LAB'S SPALLATION NEUTRON SOURCE

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Oak Ridge's Spallation Neutron Source (SNS) is the highest power pulsed proton source in the world currently providing a time averaged 1.4 MW of 1.0 GeV protons to a liquid mercury neutron production target. The proton beam consists of 1.5×10^{14} protons in an $800ns$ long bunch, at a repetition rate of 60 Hz. The SNS typically runs for more than 4000 hrs each year, with $> 90\%$ reliability. Neutrons are produced at the center of a heavily shielded target monolith and thermalized by a collection of moderators.

Over the next decade SNS is poised to expand the opportunities available for HEP with the Proton Power Upgrade (PPU), and Second Target Station (STS) projects. The PPU currently underway at the SNS, will increase the power of the accelerator from 1.4 MW to 2.8 MW through a 30% increase in the beam energy to 1.3 GeV and a 50% increase in the number of protons per pulse with an early completion date in 2024 [1]. The total power of the accelerator will ultimately be shared between the existing First Target Station (FTS) and the planned Second Target Station (STS). Initially following the PPU the FTS will accept 2.0 MW of 1.3 GeV beam at the present intensity and repetition rate of 60 Hz. Upon completion of the STS, the power on the FTS will remain 2.0 MW, but will be delivered at a rate of 45 Hz with 25% more charge per pulse. The STS will operate at 700 kW with a repetition rate of 15 Hz, taking every 3^{rd} pulse from the accelerator. Both targets will operate at 1.3 GeV, with $< 1\ \mu s$ long pulse structure [2].

The COHERENT collaboration has already taken advantage of the unique opportunity afforded by the SNS beam to measure the coherent elastic neutrino-nucleus interaction with a relatively small 14.6 kg sodium-doped CsI scintillator [3]. Deployed parasitically to the neutron production program COHERENT has made excellent use of available space within the SNS target building. But HEP stands to gain considerably by a closer collaboration with SNS to build custom facilities. While the STS project will rely on the upgraded SNS accelerator facility, the target hall itself

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is a green-field project which is currently in the early stages of development having recently completed a DOE Independent Project Review seeking CD-1 approval. Construction is planned to start in FY26, with a project early completion date slated for FY32. A close collaboration of HEP with the STS project now would ensure that facilities designed with the explicit purpose of making the best use of the SNS beam for HEP research.

References

[1] Proton Power Upgrade Conceptual Design Report, 2017 *ORNL/TM-2016/672 PPU-P01-PD0001* available at: https://neutrons.ornl.gov/ppu/documents

[2] Second Target Station Conceptual Design Report, 2020 *S01010000-TR0001, R00* available at: https://neutrons.ornl.gov/sts/documents

[3] Akimov, D et al. "Observation of coherent elastic neutrino-nucleus scattering" *Science*, 15 Sep, 2017, vol 357, Issue 6356, pp.1123-1126