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The HighNESS Project at the European Spallation Source

The European Spallation Source (ESS), presently under construction, in Lund, Sweden, is a multi-disciplinary international laboratory that will operate the world's most powerful pulsed neutron source. By the year 2027, a suite of 15 instruments will be served by a high-brightness moderator system positioned above the spallation target. However, the existing ESS infrastructure, encompassing the proton linac, target station, and instrument halls, possesses the capability to incorporate a second neutron source positioned beneath the spallation target.

Backed by 3MEuro Research and Innovation Action within the EU Horizon 2020 program, a design study (HighNESS) has operated over the past three years. The study's primary objective was to design a secondary neutron source beneath the spallation target. Distinguished from the first source situated above the target and optimized for high cold and thermal brightness, this new source will deliver heightened intensity (the total number of neutrons from the moderator). Additionally, there will be a shift towards longer wavelengths within the Cold (4-10 Å), Very Cold (10-100 Å) (VCN), and Ultra Cold (> 500 Å) (UCN) neutron spectral ranges. The high-intensity neutron beams offered by the project will open up new possibilities in neutron scattering, particularly in imaging and Small Angle Neutron Scattering (SANS), as well as enable pioneering experiments in fundamental physics, such as the search for neutron to antineutron oscillations.

As the HighNESS initiative approaches its culmination, I will present several key aspects, including the final design of the second cold neutron source, different options for Ultra-Cold Neutrons (UCNs) and Very Cold Neutrons (VCNs) sources, the proposed neutrons scattering instrument concepts, and the neutron-to-antineutron oscillations experiment at the ESS.

Primary author: SANTORO, Valentina (ESS)

Presenter: SANTORO, Valentina (ESS)

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