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C2Po3D-01: Design, manufacturing & commissioning of the high brightness liquid para-hydrogen moderator for the European Spallation Source

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The European Spallation Source (ESS) in Lund, Sweden, is designed to become the most powerful accelerator driven spallation neutron source in the world. ESS is currently under construction, and the first beam on target is planned for the second half of 2025, with first user operation expected to start in 2026. As a key component of the neutron production, which was developed, built and tested at Central Institute of Engineering, Electronics and Analytics –Engineering and Technology (ZEA-1) of Forschungszentrum Juelich GmbH, the cryogenic moderator slows down high-energy neutrons released from the spallation target. To gain maximum neutron brightness for condensed and soft matter research, an optimized low dimension liquid para-hydrogen moderator has been developed. Hydrogen with a pressure around 1 MPa, a temperature around 20 K and a para-hydrogen fraction of at least 0.995 will be utilized to interact with neutrons in a unique moderator vessel arrangement. This paper describes the engineering design, manufacturing and commissioning of the low dimension liquid para-hydrogen moderator for the ESS.

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