

First operation of the ultracold neutron source at the Paul Scherrer Institute

The UCN source team has demonstrated excellent functioning of all major subsystems of the new facility. Ultracold neutrons have been produced for the first time from this source and under full load. The performance was found as expected under the operational conditions.



The construction of the PSI source for ultracold neutrons (UCN) has been completed. The new UCN source is the second spallation target station driven by the PSI ring cyclotron and designed to take macro-pulses of up to 8s of the full proton beam intensity (590MeV, >2mA). Neutrons are thermalized in a heavy water moderator, cooled down and converted to UCN in solid deuterium. The license to start full commissioning arrived on December 16. Between December 16 and 22, the source

has been operated with the aim and duty to demonstrate the principle functioning of all major subsystems. Different modes of operation have been tested starting with 5ms short pulses ramping from 100 μ A to 1.8mA (operational limit of the accelerator at the time of testing), followed by continuous 10 μ A beam for mapping of the radiation field and dose rates around the biological shielding, especially in the experimental areas, and finally going to longer pulses starting from 500 μ A for 2s up to 1.8mA for 8s. The test of the whole accelerator chain and beam diagnostics was very successful and the desired pulses were reliably delivered. Long intense pulses of the 1MW beam always had 5ms pilot pulses running a few seconds ahead and guaranteeing the perfect adjustment of the proton beamline. The heavy water system, including cooling of the spallation target and target window, had been tested before at the end of 2009 and again performed reliably as expected. The cryogenic system of the source behaved extremely well in its first cool down ever. The moderator vessel was cooled to below 5K without any problem. The moderator cooling was very satisfactory, also loaded with deuterium and in-beam. During all times, the ultracold neutron performance of the source was monitored with in-situ detectors and detectors at the end of the beam lines. The UCN storage of the source and the guides behaved as expected. Due to the scheduled accelerator shutdown, the deuterium crystal had to be frozen under suboptimal conditions (no para-to-ortho conversion, fast freeze out). In this respect, the UCN production rate was within expectation and considerably increasing in the warm-up phase towards liquefaction, demonstrating the potential for improvement. The experiments can now expect the predicted UCN intensity once a good ortho-deuterium crystal can be exposed after the accelerator shutdown in April 2011. As a last highlight, the neutron electric dipole moment experiment could successfully detect its first UCN, both from direct beam and after storage.

On behalf of the UCN source team
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