# Progress Report on the Mini-$D_2$ Source for Ultra-Cold Neutrons

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In the beam tube SR-4 of the Munich high-flux reactor FRM-II a source for ultra-cold neutrons (UCN) shall be installed, the Mini-$D_2$ source. It has a small amount of solid $D_2$ at a temperature of $\approx$ 5K, being positioned inside a long evacuated tube near the cold source. Neutrons may be down-scattered in the $D_2$ converter and may be stored in the tube, if their energy is less than the effective potential of the Be on the surface of the walls of this tube (250 neV). Under optimum conditions the total losses due to absorption or up-scattering in wall collisions are small compared to those in the $D_2$ converter. Then a UCN density of $\approx 10^4/\mathrm{cm}^3$ builds up in the storage tube, comparable to the density in the converter. At the end of the storage tube a neutron buffer volume will be installed to improve the maximum UCN density in the attached experiments. By opening a valve at the end of the buffer volume, which is already in the experimental hall, up to $5 \cdot 10^8$ UCN may be supplied to the experiment every few minutes. Operated in continuous mode, the source will provide a UCN flux of about $5 \cdot 10^5$ UCN/cm$^2$s. More details on the Mini-$D_2$ UCN source are given in an internal report [1].

In the year 2004 a test setup to study UCN production has been completed. This setup consists of all the essential parts for producing UCN in the same geometry as it will later be in the Mini-$D_2$ source, such as the UCN converter filled with solid deuterium, the UCN storage tube, the deuterium gas system and the electrical controlling and measuring system. The storage tube is attached to a test cryostat with a small UCN storage volume ($\approx$ 20 liters), witch can be separated from the UCN producing converter with a valve. After a certain storage time the UCN can be detected and counted. With this setup one is able to measure the different effects wich have influence on the UCN production, such as the para-$D_2$ to ortho-$D_2$ ratio in the converter or the temperature of the converter. Also systematic studies of different loss factors in storing the UCN or by transporting them through the storage tube can be done. Furthermore different types of UCN detectors can be installed in this setup and their efficiency can be measured.

The test setup has been mechanically build up during the year 2004 at the Maier-Leibnitz-Laboratory. All parts of the setup have been tested there with respect to their functionality. The deuterium converter has been frozen out at the end of the storage tube. The conversion of the para-$D_2$ content to ortho-$D_2$ has been measured with Raman-spectroscopy. At the end of 2004 the ortho-$D_2$ content was determinated to be at least 98.9%, respectively to 66.7% in the original $D_2$ mixture. After these initial functionality tests, the setup has been moved at the end of 2004 from the MLL to the pulsed TRIGA reactor at Mainz University.

Currently the test setup has been installed in the tangential beam tube "C" of the TRIGA reactor. UCN shall be produced there by reactor pulses of 250 MeV for 30 ms. At the present state several pulses on the $D_2$ converter have been performed. The evaluation of the experimental data is currently underway and will be finished soon.

The test measurements in Mainz will give valuable hints on the moderation of neutrons with a solid deuterium converter. These results will be taken into account for the Mini-$D_2$ setup at the FRM-II.

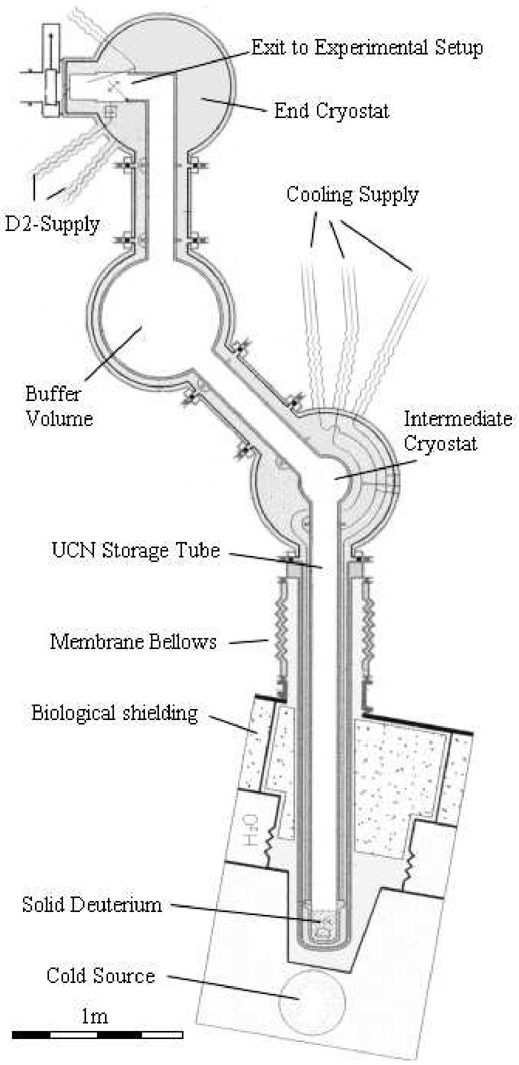


Fig. 1: The Mini-$D_2$ source inside the SR-4 beamtube (schematic)

## References

[1] I. Altarev, F.J. Hartmann, S. Paul, W. Schott, U. Trinks, Internal report TUM-E18, Oct.2000