A new UCN switch for the nEDM experiment at PSI

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Abstract

Together with the PSI nEDM collaboration we developed a new UCN switch for the nEDM experiment located at the Paul Scherrer Institut in Villigen, Switzerland. The switch incorporates five positions for filling and emptying of the EDM precession chamber. Further it serves a throughgoing position, one monitoring and one pumping position. The actuators are state-of-the-art piezo devices, which feature a high precision, non-magnetic behaviour and good vacuum compatibility. The component was installed in December 2010 at PSI.

Figure 1 shows the new switch which was installed in December 2010 at PSI. The interior parts of the switch are shown in Figure 2. Using a rotating principle, five positions are implemented on a rotor plate in a cylindrical vacuum chamber (called switch box) underneath the nEDM experiment [1]: (1) filling of

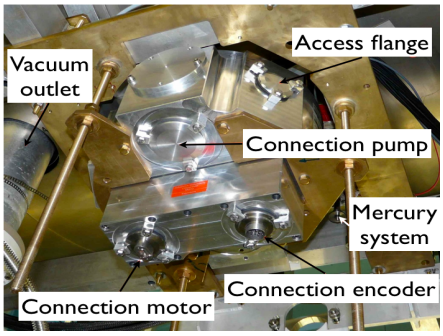

Figure 1: UCN switch underneath the nEDM experiment.

the EDM precession chamber; (2) emptying of the entrance guide directly towards the detector (for monitoring and to clean the entrance guide for the subsequent counting period); (3) emptying of the precession chamber to the detector; (4) through-going position to serve a test beam position; (5) position for vacuum pumping of the precession chamber. The switch box itself is fitted with severel access flanges for additional pumping, optical control and pressure sensors. The UCN-guiding components of the interior parts were coated with Ni/Mo.

The design respects the access to the mercury system of the nEDM co-magnetometer as well as to the vacuum outlets of the apparatus (s. fig 1). The actuator rod for the shutter of the UCN precession chamber (not visible) is located above the switch box.

The actuators of the switch were realized by a set of high precision piezo-motors shown in Figure 3. The piezo motors drive the axes of the switch rotor via tips attached to ceramic rings around the rotor axes. The position of the switch is controlled by an encoder unit and a scale on the axes, see Figure 3. All components feature a high-vacuum compatibility and an inherently

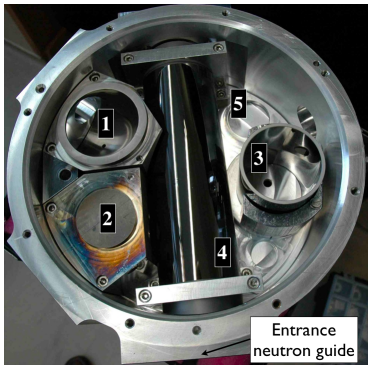

Figure 2: Interior parts of the UCN switch.

non-magnetic characteristic. The maximum switching time between the positions is 1 s. The precision of positioning is < 0.1 mm.

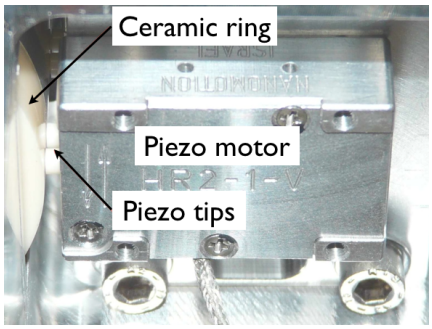

Figure 3: The piezo actuators of the UCN switch.

The guiding of the neutron spin through the switch will be realized by a superposition of exterior magnetic field coils directly attached to the switch box.

[1] I. Altarev et al., *Towards a new measurement of the neutron electric dipole moment*, Nucl. Instr. Meth. A 611 (2009) 133

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