Si UCN detector

The coefficient of transmission through the *Al* window of detector equal to 100 μk was selected as the absolute efficiency of the ^{3}He detector, i.e. it is considered that each neutron having passed through the *Al* window of detector is registered. The transmission was measured in the mode of UCN leaving the gravitational spectrometer through the *Al* foil in the horizontal neutron guide. The *X* axis corresponds to the total UCN energy on the foil. The comparison of the relative efficiency of ^{3}He and *Si*-detectors was carried out under similar measuring conditions. A detector with a single *Si* plate was used in the comparison measurements. See page 60. It has the same square as the ^{3}*He* detector. Comparison of detectors efficiency are shown in fig. 1. Subsequent measurements with a detector consisting of two *Si* (the sandwich) plates showed that 15% of neutrons are not registered for the single detector due to loss of α-particles in the converter with thickness of 600 μg/cm^2. The efficiency of the registration of tritons for sandwich type detector (see page 59) is practically perfect due to 4π geometry. Unfortunately, this gain 15% is compensated by losses of UCN in additional *Si* plate. Thus, the both type of detectors have efficiency of UCN detection 80±5% for UCN energy about 200 cm. The UCN spectrum which fall down on the UCN detector in EDM spectrometer (position of detector 120 cm below UCN trap) is started at the energy 120 cm and is stopped at the energy 370 cm. The maximum of this spectrum is at the 270÷300 cm. Thus, the average efficiency of UCN detector is about 80% again.

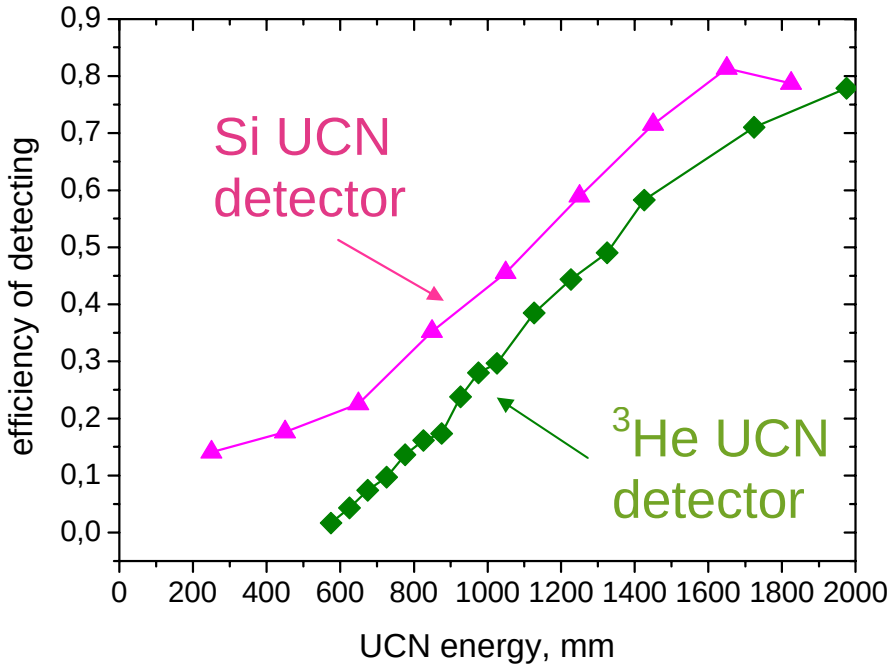

Fig. 1. Comparison of detectors efficiency.

We use as analyzer of UCN polarization the thin layer (1800÷2000)Å of pure iron sputtered on 90μm annealed Al foil. This analyzer was kindly given by Sussex University EDM group.

The ratio of counting rate of top and bottom detectors was measured in experiment. The analyzing power is defined as the following ratio

$$R = \frac{N_{down} - N_{up}}{N_{down} + N_{up}} = \frac{1-r}{1+r},$$

where $r = \frac{N_{up}}{N_{down}}$.

In the ideal case r-ratio have to be equal one for unpolarized UCN beam (H=0) and have to be equal zero for the perfectly polarized UCN beam (H=4T).

In experiment r-ratio for unpolarized beam was found a little bit more than one. It is connected with albedo effect, i.e. the reflection of UCN from *Al* foil and *Si*-detector. The fig. 2 shows energy dependence of analyzing power for analyzing system with vertical UCN guide of 120 cm high. The X-axis in fig. 2 corresponds to UCN energy at the entrance in the vertical guide or UCN energy into the *Be* trap. The maximum of UCN energy in *Be* trap is around 150÷180 cm, therefore the average analyzing power is about 75%.

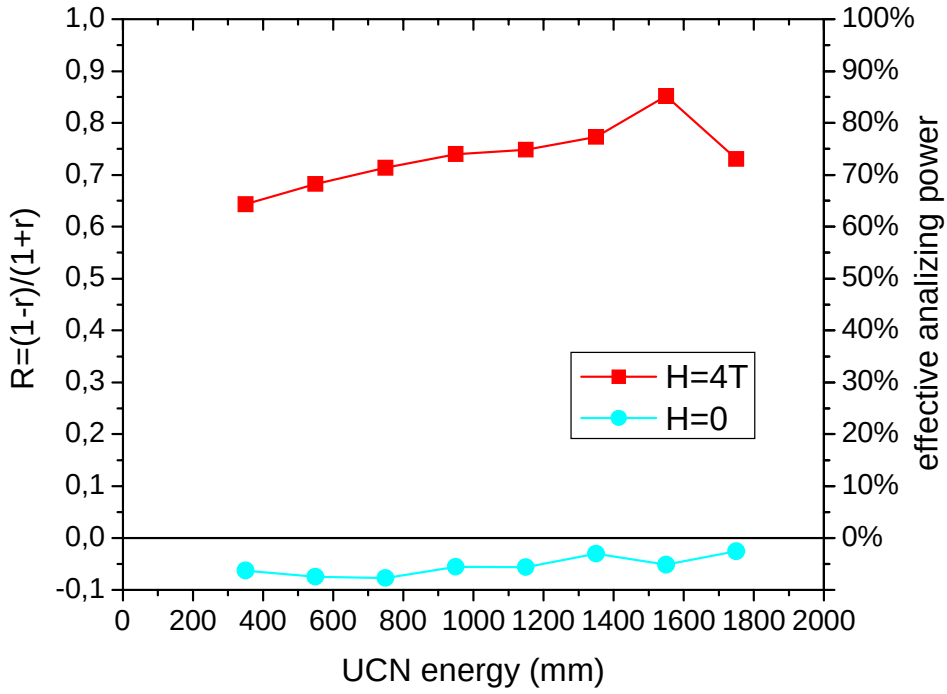

Fig. 2. Energy dependence of analyzing power.

It can be improved by means direct sputtering of pure iron of the surface of *Si* UCN detector. The detector efficiency at lower UCN energy can be increased by means using of the converter $^{6}LiFTi$.