Oscillating sample for an experiment on the investigation of neutron wave interaction with matter moving with extreme acceleration.

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The experiment on the investigation of interaction of neutron wave with matter moving with extreme acceleration [1]

Motivation of the experiment is:
Test of the effective potential model for matter moving with acceleration above the certain critical value

$$W >> \frac{4Eb}{ma^2} = W_c$$

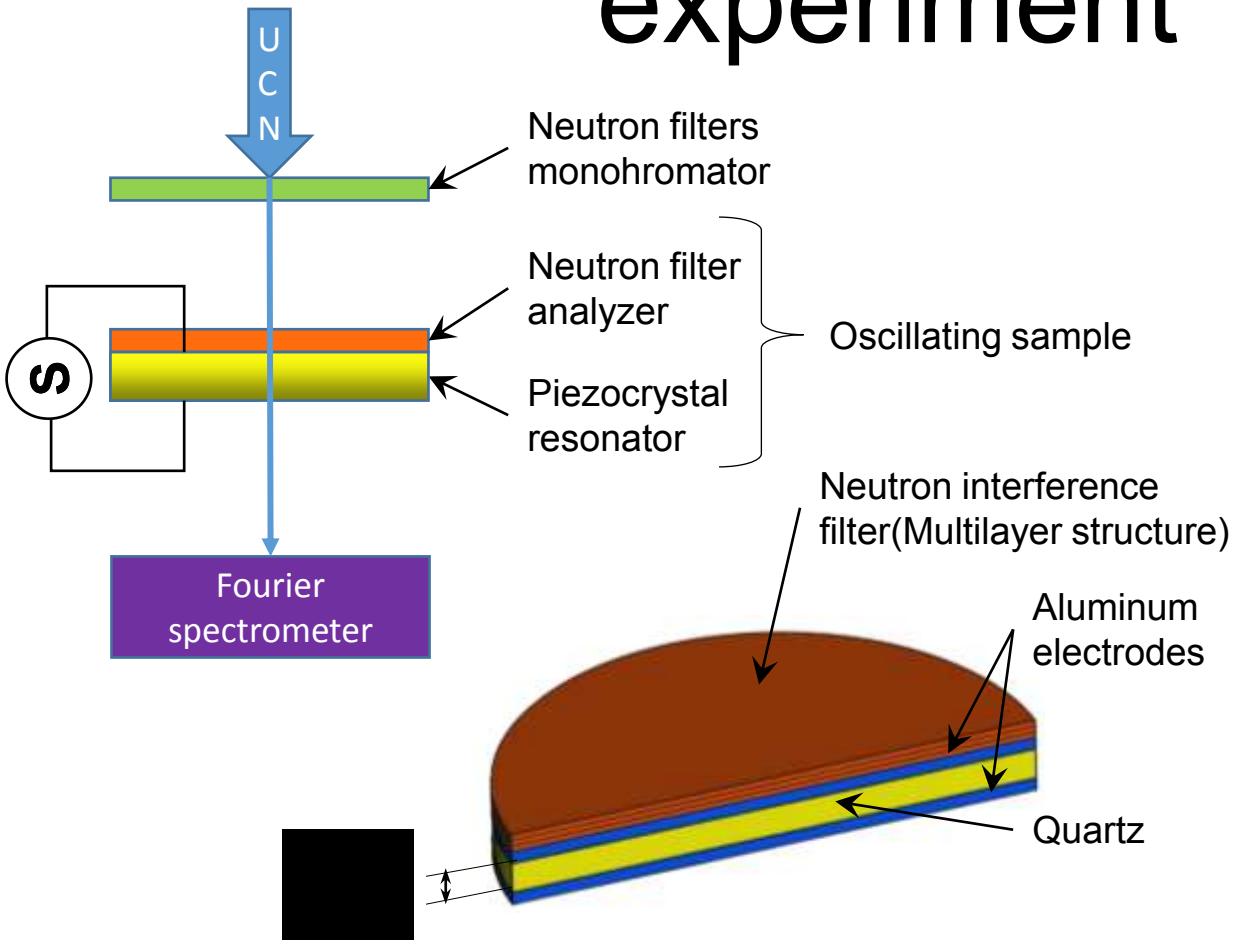
where E is the neutron energy, b is the scattering amplitude, m is the neutron mass and a is the interatomic distance.

The critical acceleration for UCNs [2]:

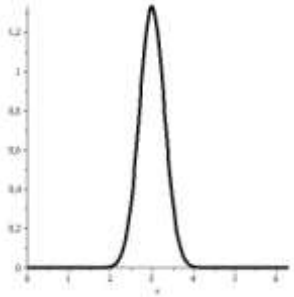
$$W_c = 10^5 m/s^2$$

1. A.I. Frank, D.V. Kustov, G.V. Kulin el al., *JOP: Conf. Series* **746** (2016)
2. Frank A.I., *JETP Lett.* **100** (2014) 613

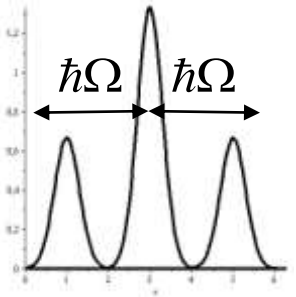
Scheme of the proposed experiment



UCN spectra after transmission through first filter

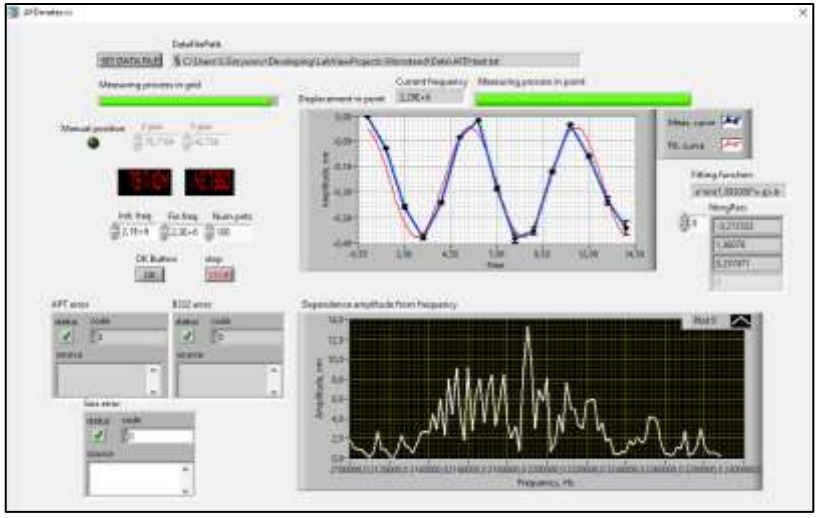


Splitting of UCN spectra after transmission through filter oscillating in space



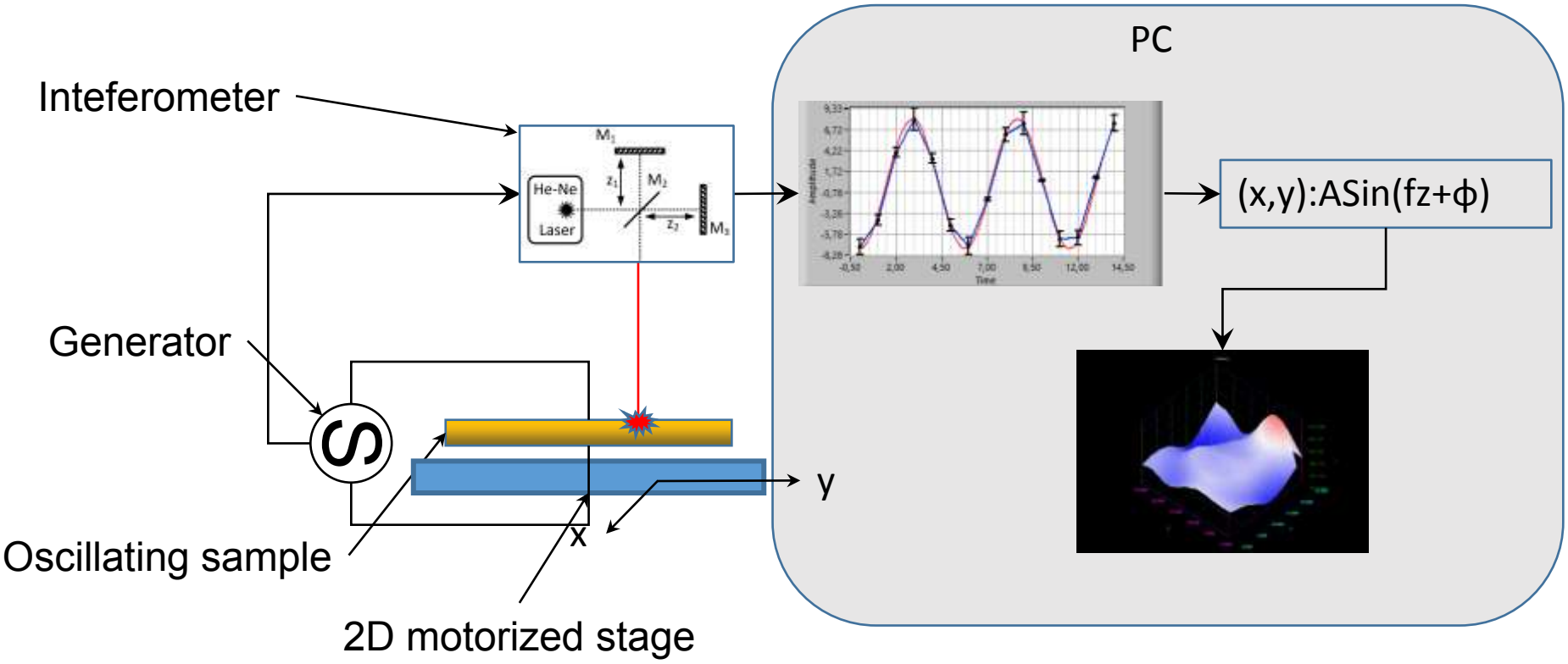
The sample surface must oscillating uniformly!

Scanning laser vibrometer



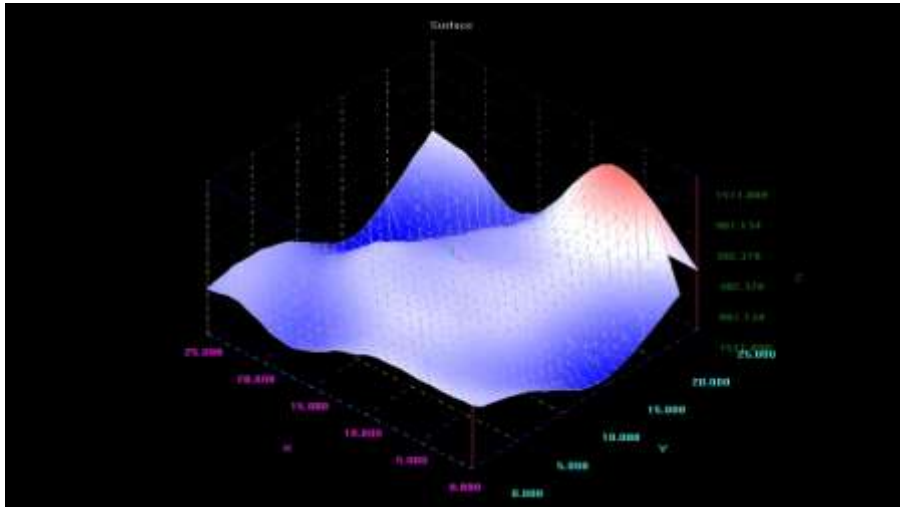
- Time resolution is 12,5MS/sec
- Distance resolution is 0,1nm
- Position resolution is defined by the laser spot. It is about 0.1mm

Scheme of the vibrometer

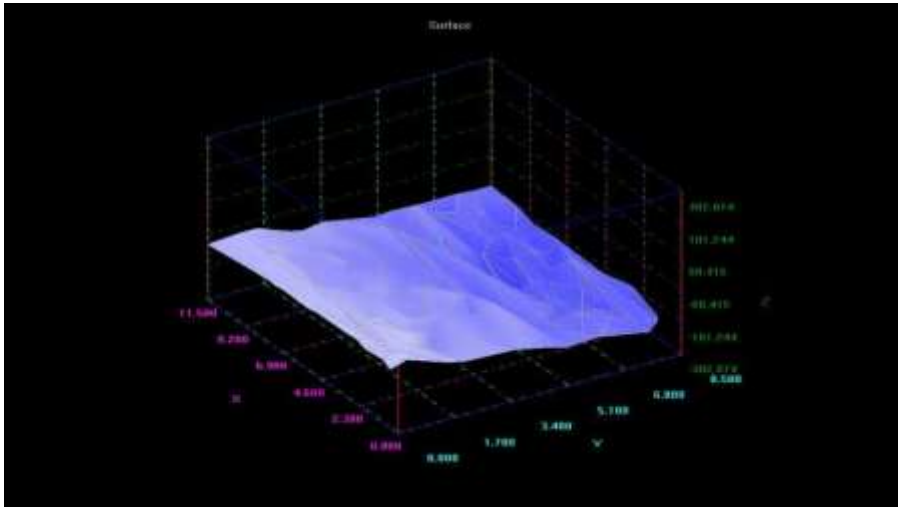


Measurement of test samples using the vibrometer

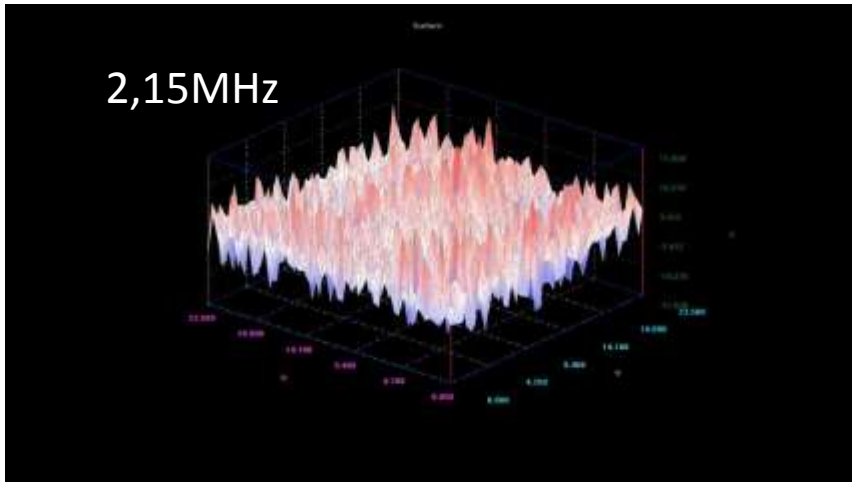
An acoustic speaker (1kHz)

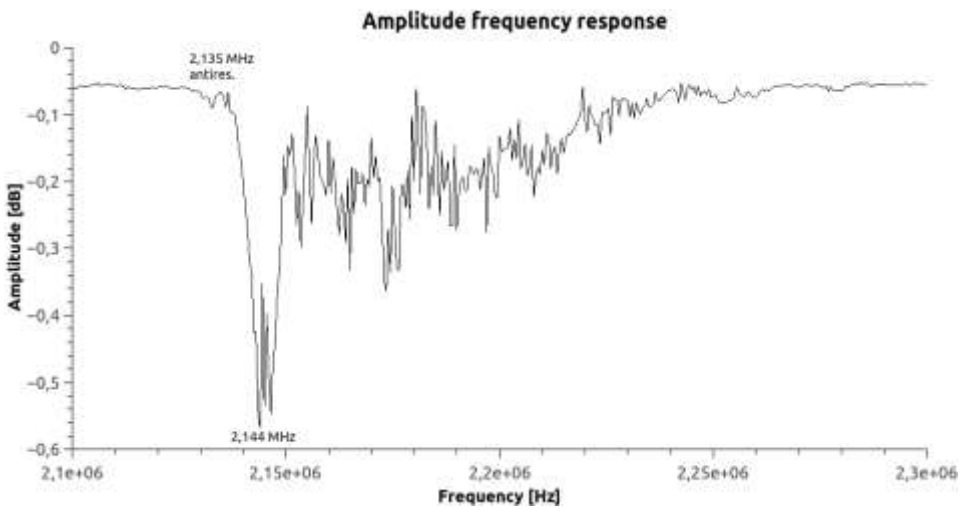


A piezoceramic membrane (3kHz)

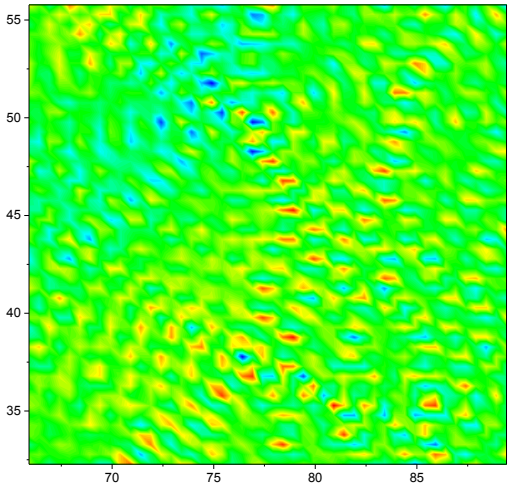


Surface oscillation of a quartz resonator (x-cut)

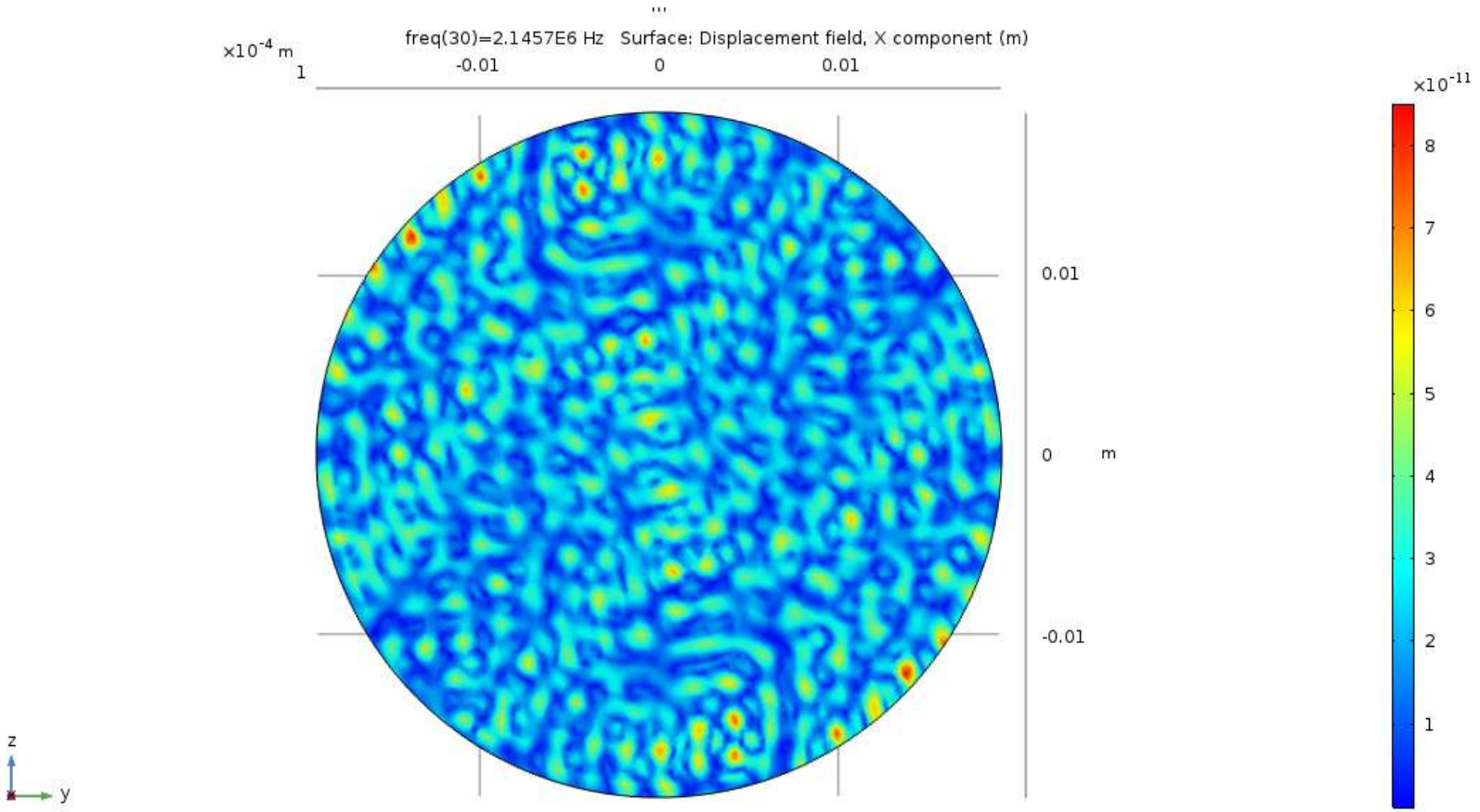




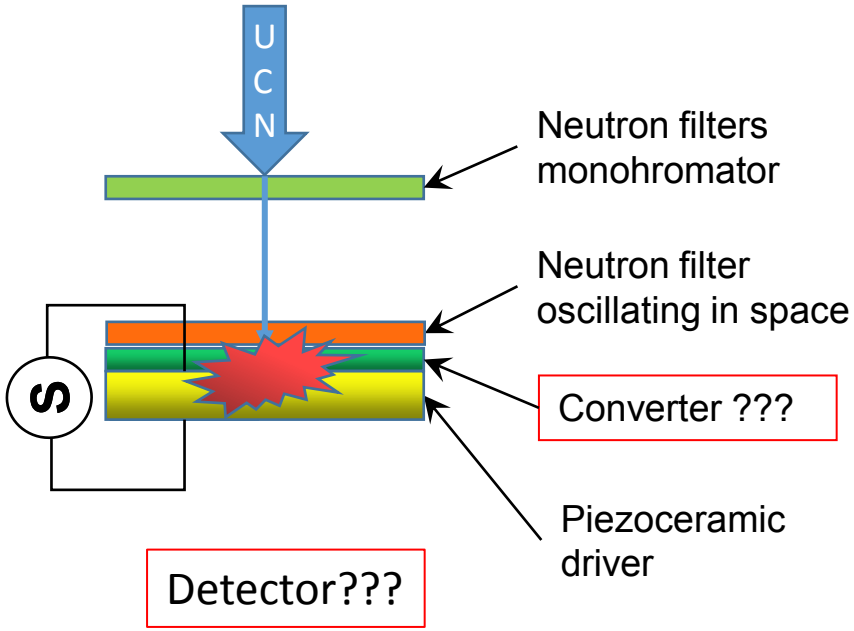
Topogram



Computation of the surface oscillation of the quartz resonator using the Comsol Multiphysics



An alternative scheme of the experiment.



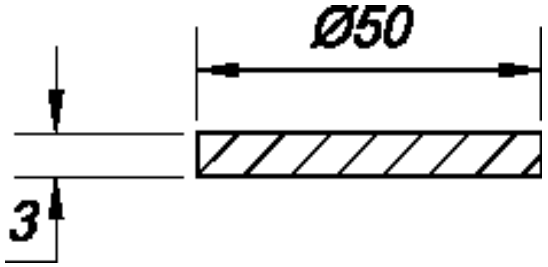
- There is registered the time dependent of the count rate oscillation
- There is used a piezoceramic resonator being nontransparent for the UCNs
- Here critical parameter is time resolution of the detector(50 - 100 nsec).

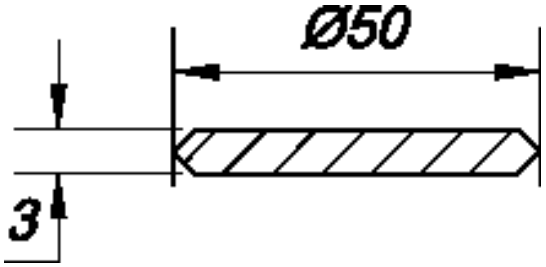
Questions:

- Can the surface of the piezoceramic driver oscillate uniformly [1]?
- How to solve problrem of the detection?

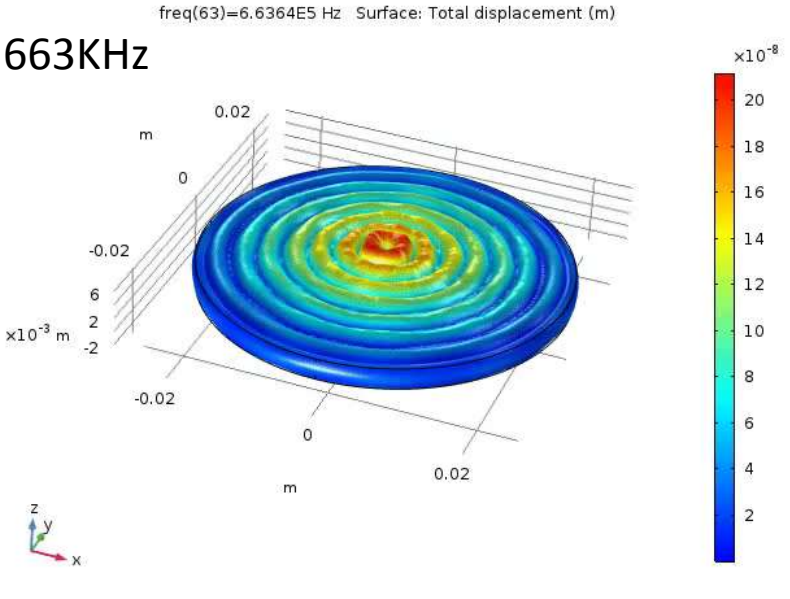
1 J. Felber, Ph.D. thesis, Technische Universität München, 1994.

Computation of PZT disks of different profiles in the Comsol Multiphysics

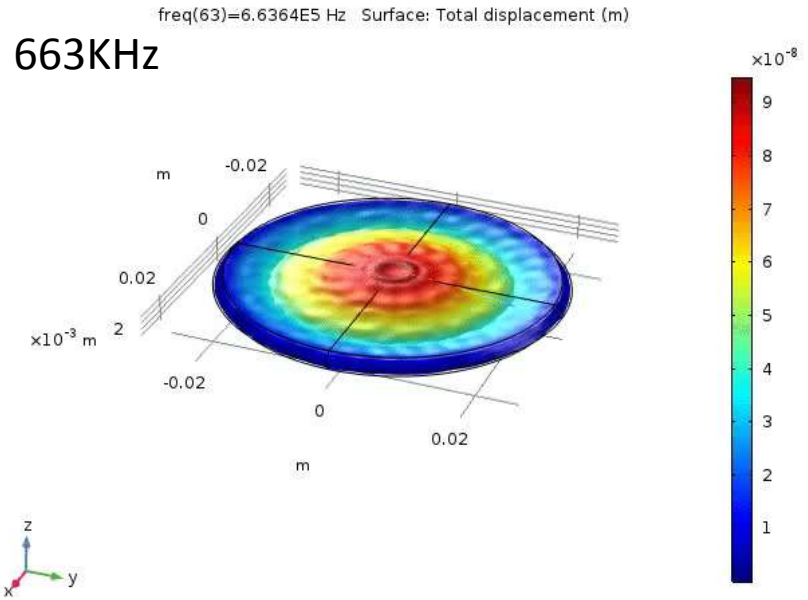




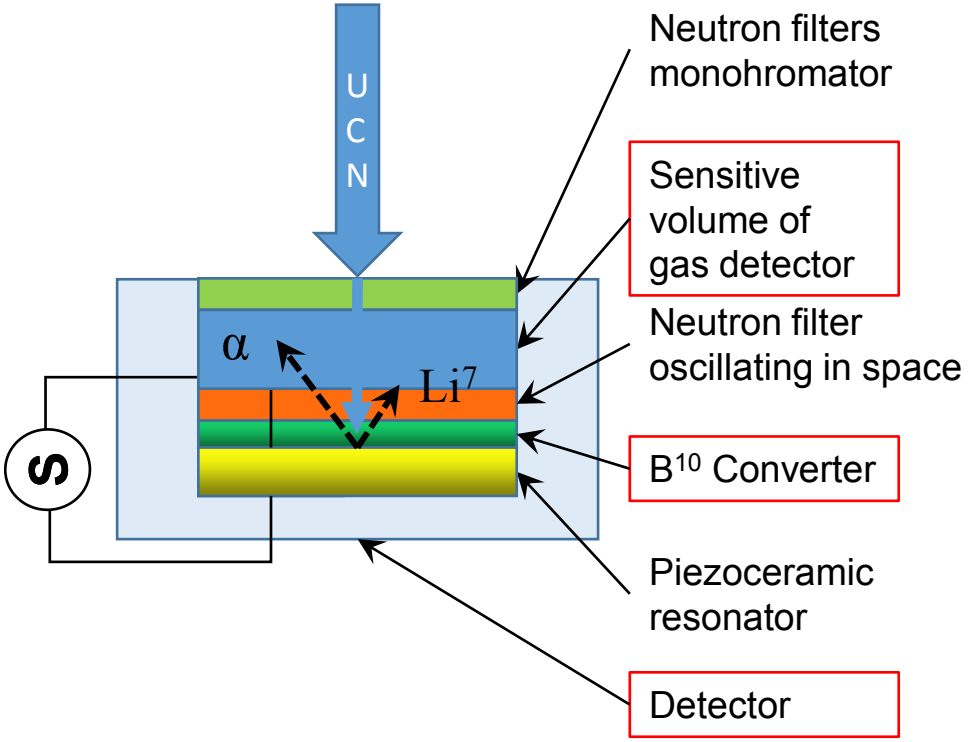
663KHz



663KHz



Registration of UCNs due to the $B^{10}(n,\alpha)Li^7$ reaction



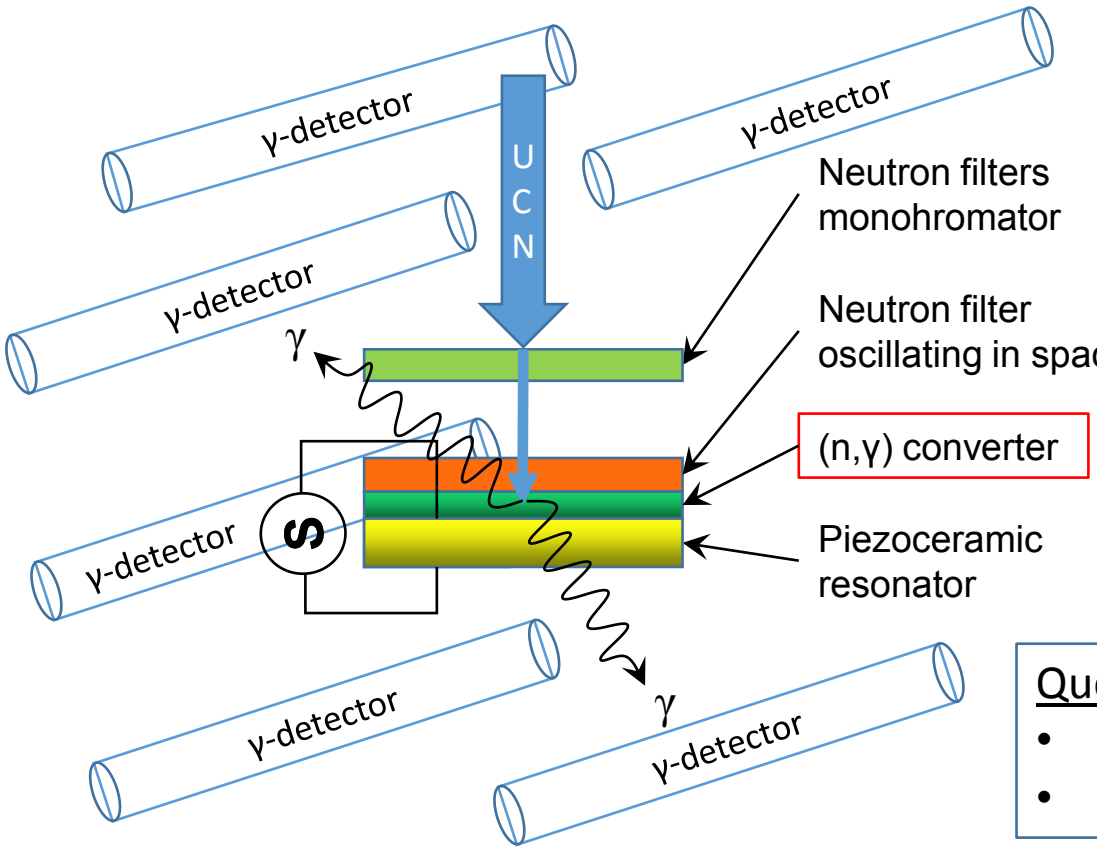
Advantage:

- cooling of the oscillating sample by a gas of the detector

Difficulties:

1. Fast gas α-detector
   - Thin sensitive layer
   - Collection of the first electrons
   - Fast electronic
2. The oscillating sample inside the detector body.

Registration of UCNs due to the (n,γ) reaction



Advantage:
- Well known and developed technology of gamma registration

Disadvantage:
- Low efficiency

Questions:
- Which converter to choose?
- Which scintillator to chose?

Summary

- The scheme of the experiment where UCNs go through the quartz resonator was analyzed
- There was proposed a new scheme of the experiment with using of the piezoceramic resonator
- The computation shows possibility to create uniformly oscillating surface of the resonator.
- Now we are finding an appropriate method for UCNs registration.

Thank you for your attention!