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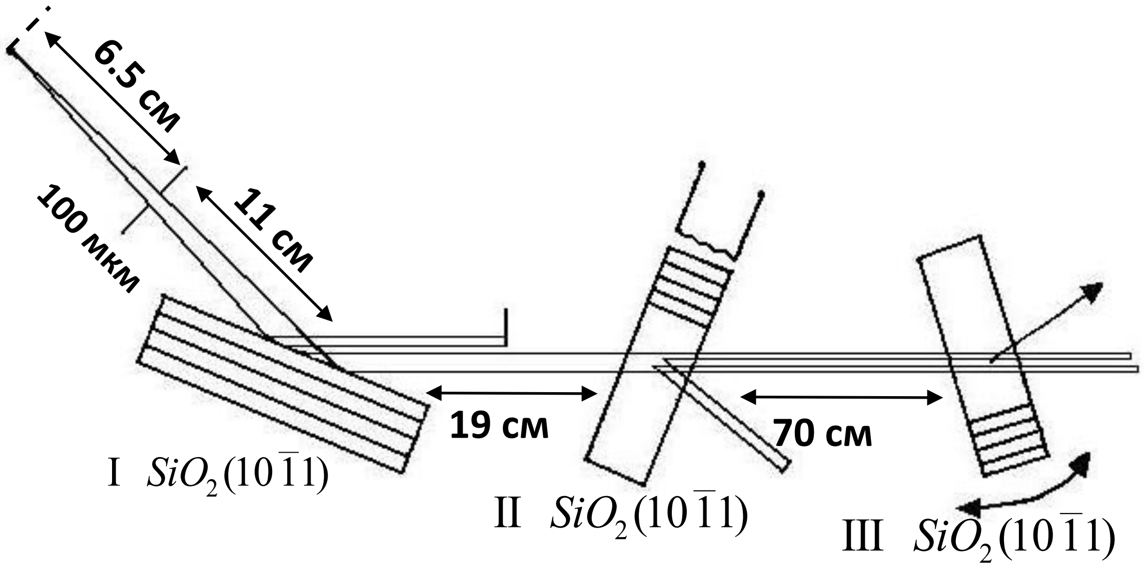
What we have?

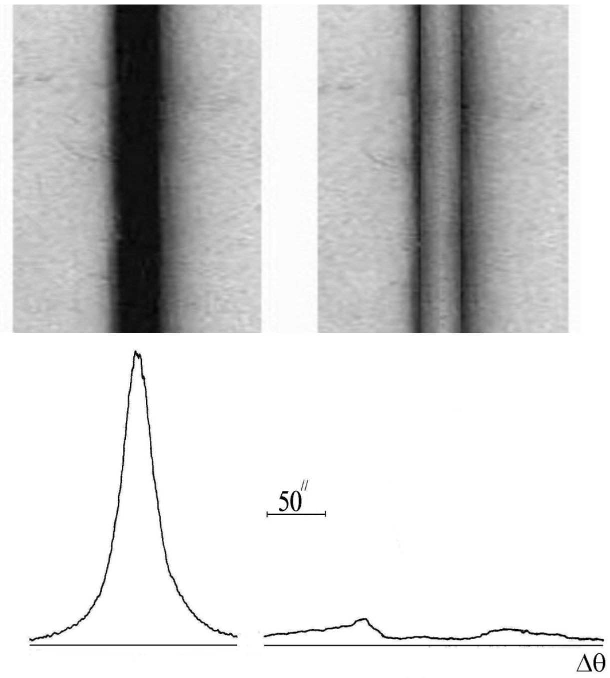
1984 – X-Ray full pumping
1986 - X-Ray diffraction focusing and defocusing in the presence of external excitations
1986- Diffraction of thermal neutrons in piezoelectric single crystals under the influence of external fields.
1987- X-Ray detector based on porous matters
1988 - Information transfer by means of X-Rays
1988 – X-Ray diffraction on SAW.
1989 – Formation of Modulating X-Ray spectroscopy
1989 – Synthesis of profile single crystals
1999 – Suppression of X-Ray linear absorption coefficient.
2000 - Synthesis of new composite porous materials for X-ray detectors
2007 – X-Ray transparence medium
2009 – X-Ray acoustic monochromator
2010 – New X-Ray diffractometer

Full Pumping of X-ray radiation from transition direction to diffraction direction

Experimental setup

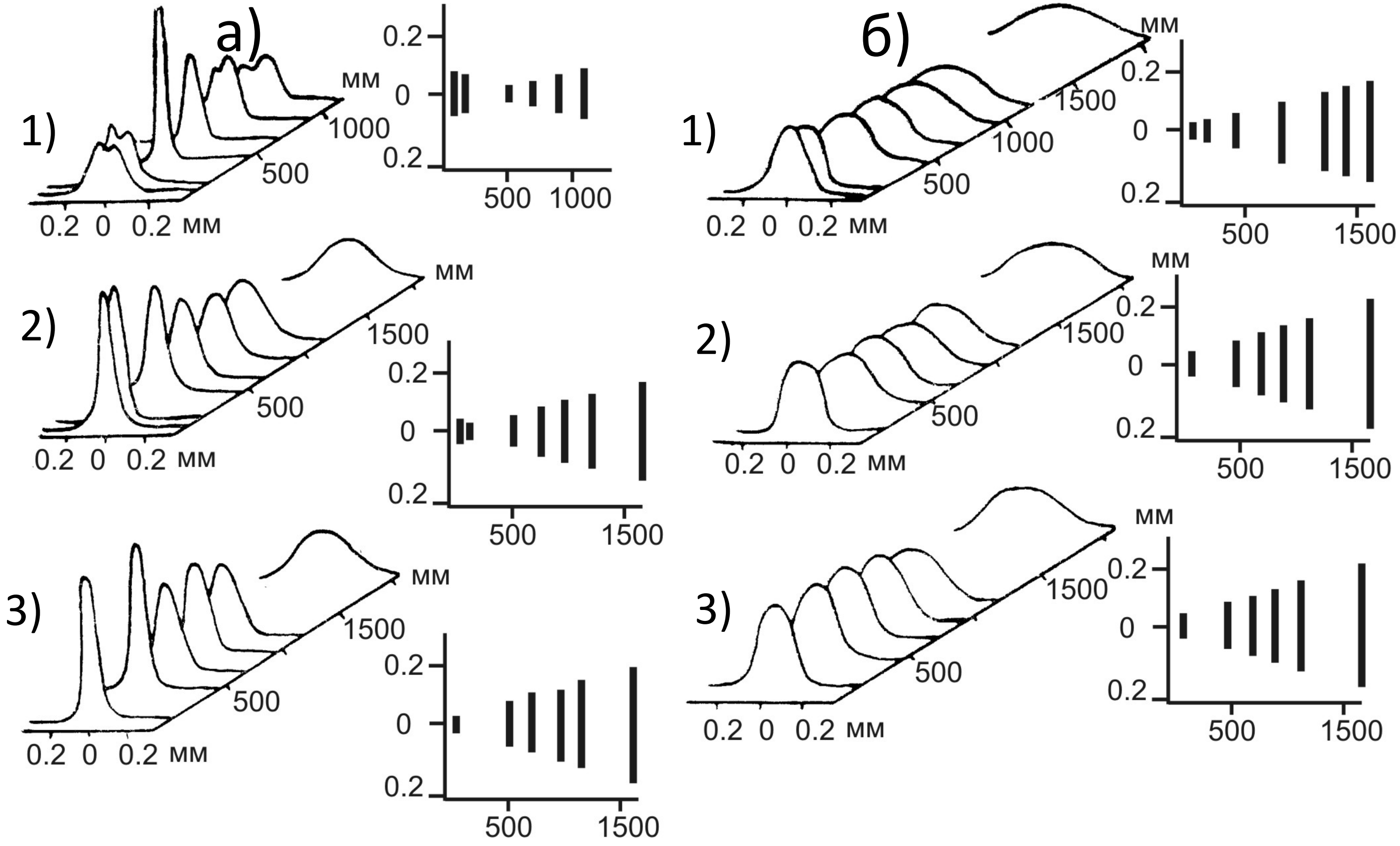


Experimental results



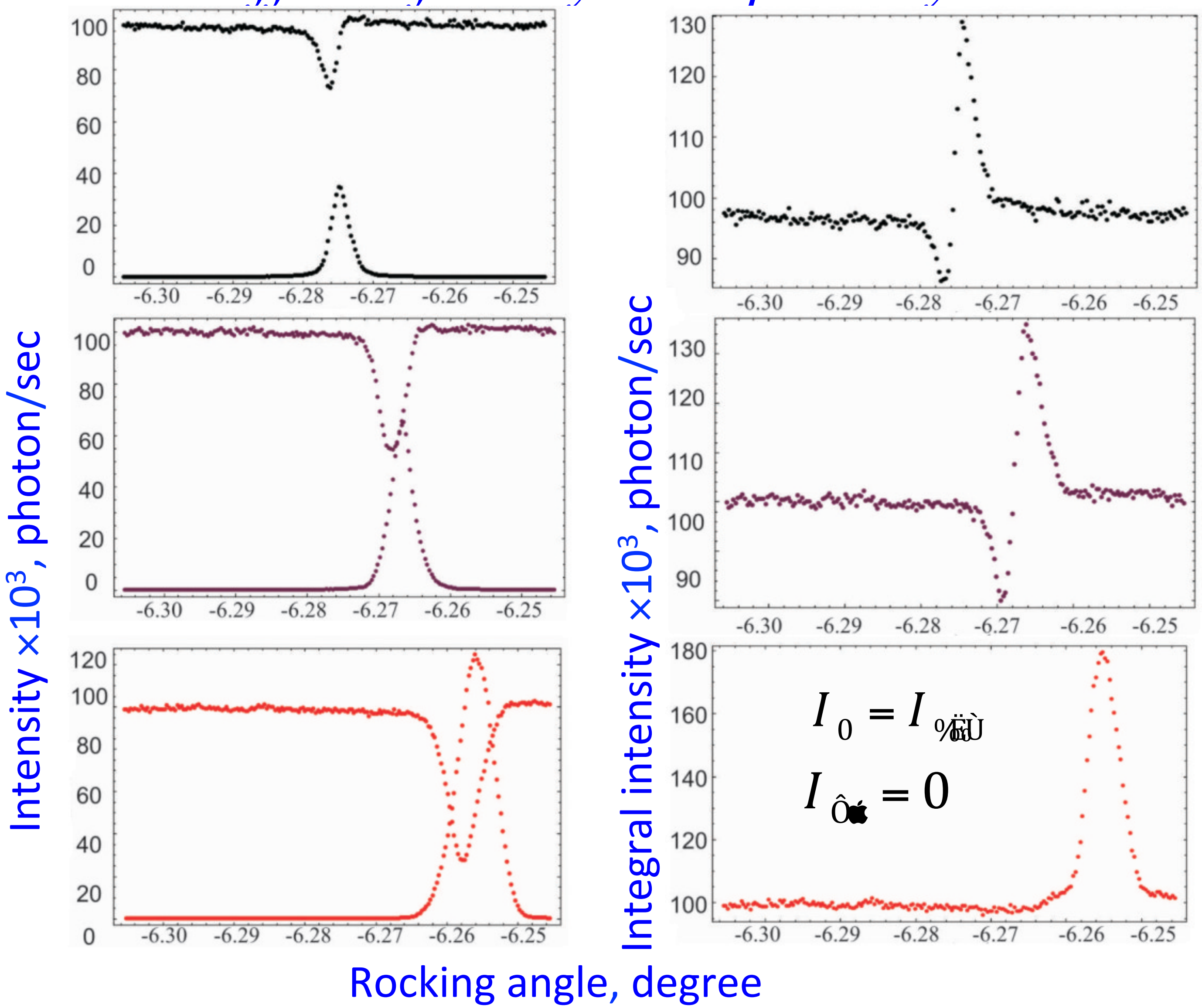
I-crystal-monochromator,
II-sample,
III- crystal -analyser.

Focusing and defocusing of X-ray beams by means of acoustic fields



a) focusing
b) defocusing.

Effect of X-ray transparency



Rocking curves of X-cut Quartz single crystal

What we have obtained during 2012 ?

Monochromatization of neutron beams
Thermal neutrons detector based on new synthesis composite porous materials
Formation of periodic structures

Monochromatization of Diffracted Neutrons by the Acoustic Superlattice

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Experimental setup

Угол дифракции $\theta=30^0$, $2\theta = 60^0$

Длина волны тепловых нейтронов $\lambda=3.3435$Å

Отражающие атомные плоскости $(10\bar{1}1)$ SiO_2

Толщина кристалла 5мм, резонансная частота 576кГц

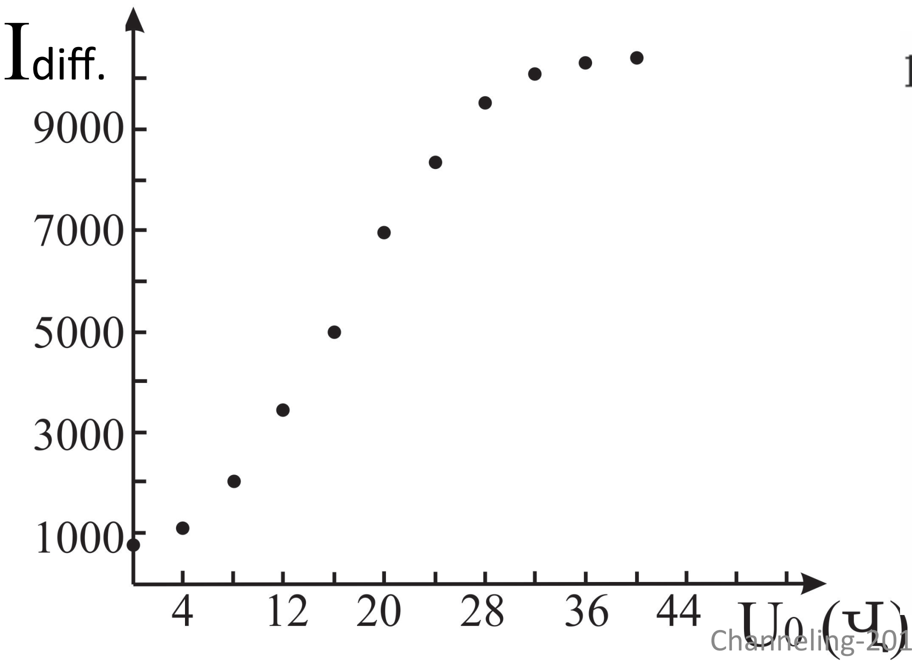
Experimental and Theoretical Results

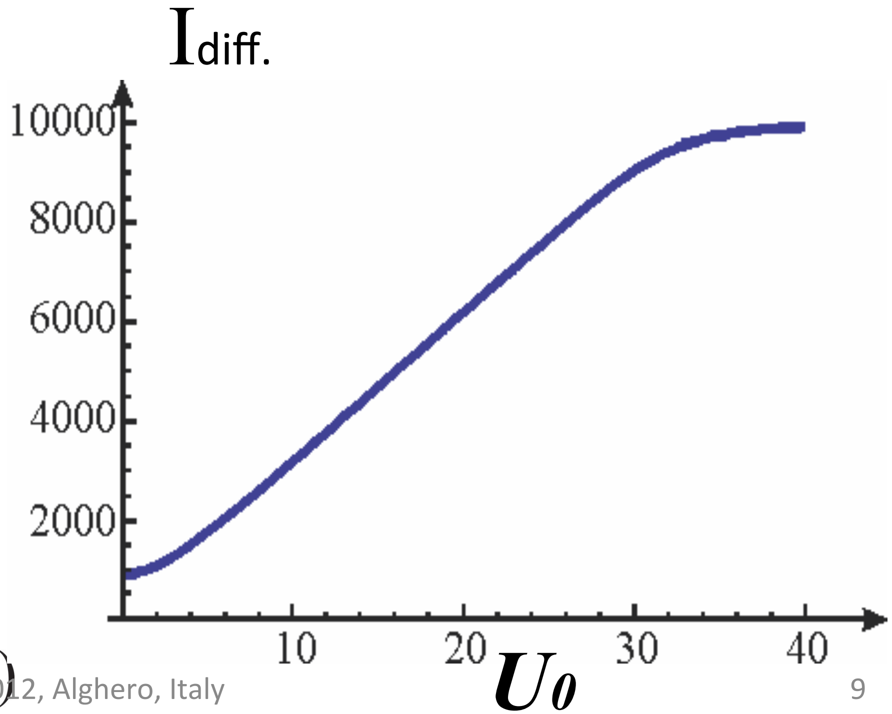
The integral intensity of thermal neutrons reflection in the presence of acoustic waves.

$$I_h = \frac{I_0}{2}\left(1 - \frac{\alpha^2 - U_0^2}{\sqrt{(1+(\alpha+U_0)^2)(1+(\alpha-U_0)^2)}}\right)$$

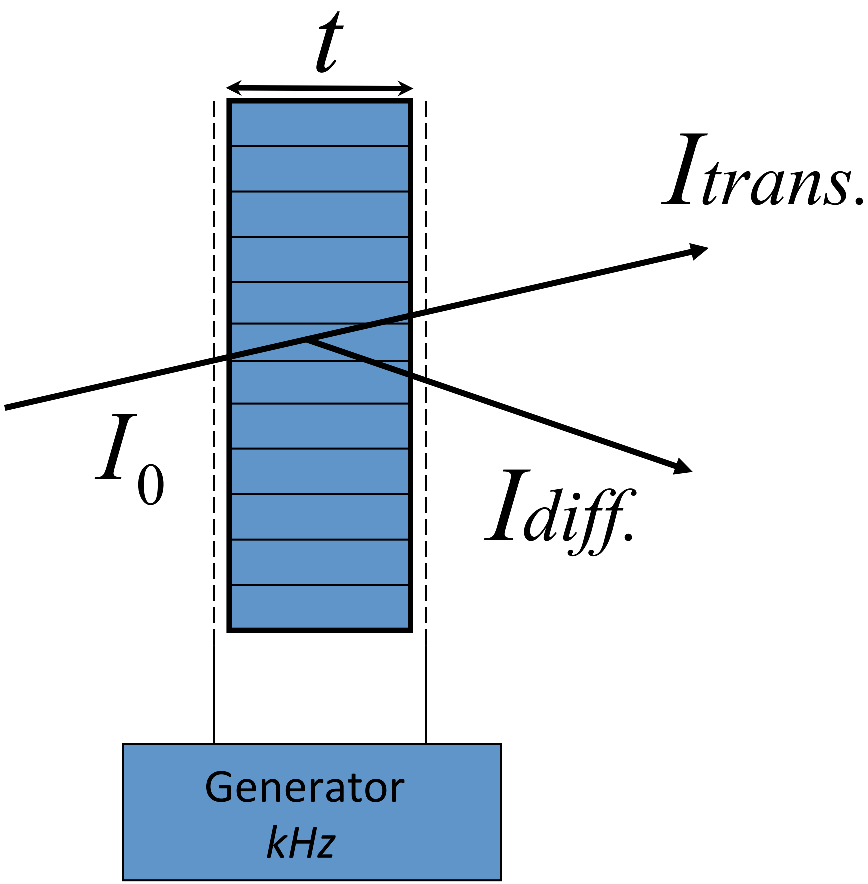
where α –is an immeasurable value and characterizes the deviation from Bragg angle.

U_0 –is the amplitudes of acoustic wave oscillations





The Coherence of Thermal Neutrons for Full Pumping

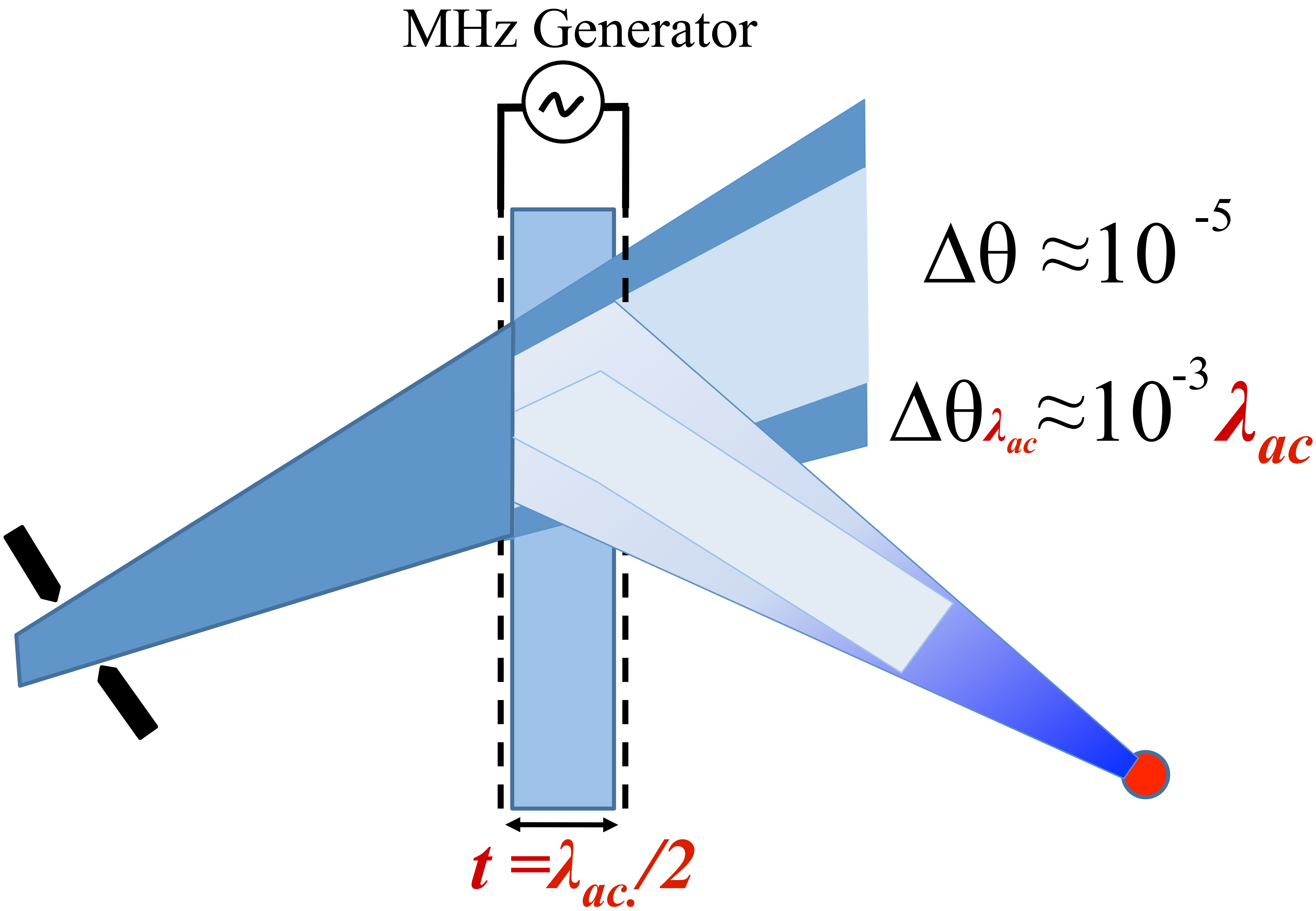


1) $I_o > I_{trans.} + I_{diff.}$

2) $t = \lambda_{ac.}/2$

$I_0 = I_{diff.}$

$I_0 = 0$


MHz Generator
$\Delta\theta \approx 10^{-5}$
$\Delta\theta_{\lambda_{ac}} \approx 10^{-3}\,\lambda_{ac}$
$t = \lambda_{ac}/2$

High Speed Detector of Thermal Neutrons

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H.R.Muradyan, E.A.Mkrtchayn, S.A.Mirakyan

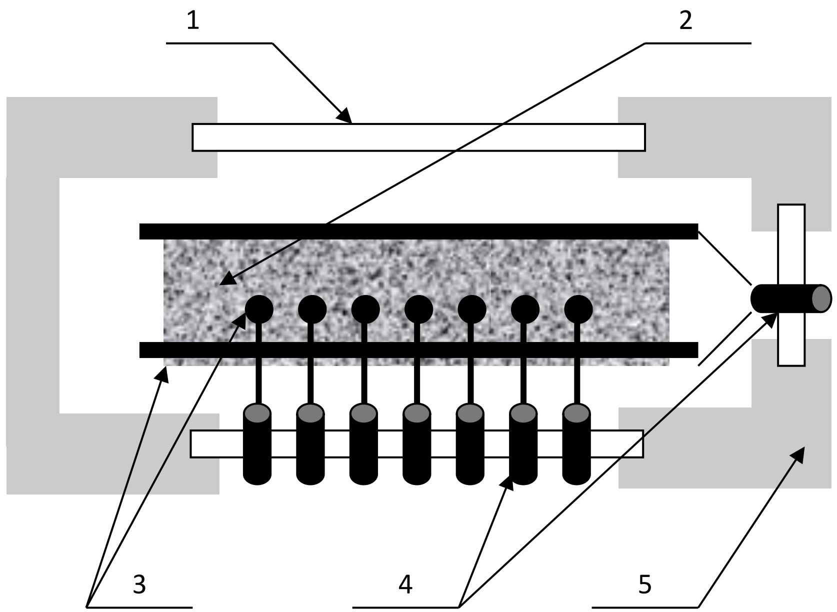

Figure1 schematic view of the detector based on porous composite materials (2) placed in the special vacuum chamber of stainless steel (5) with a window (1). (3) and (4) electrode contacts for applying electric field .

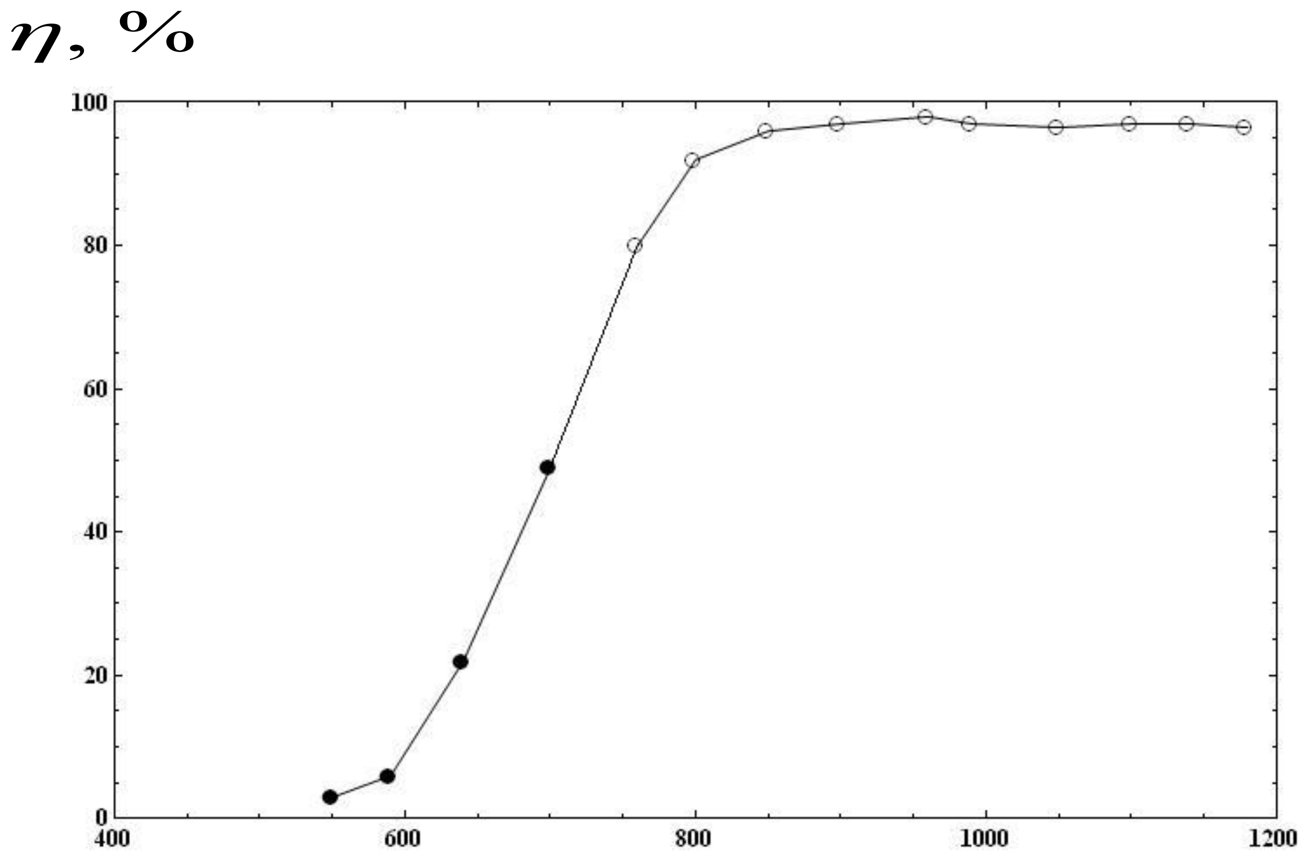

Figure.2 Registration efficiency η_{α} dependence on the operating voltage U.

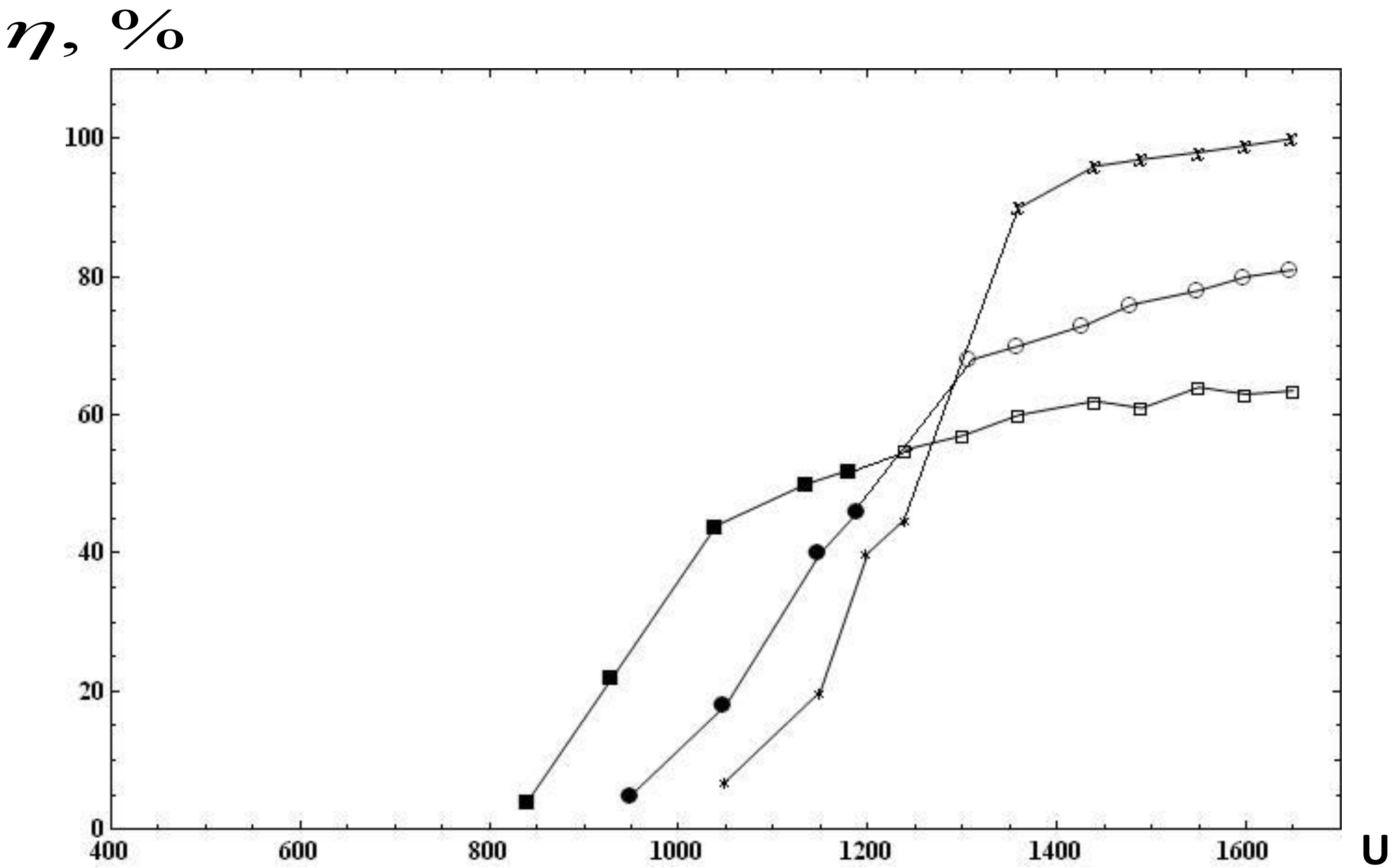

Figure 3. E_e~1 MeV electron registering efficiency with three different detectors.

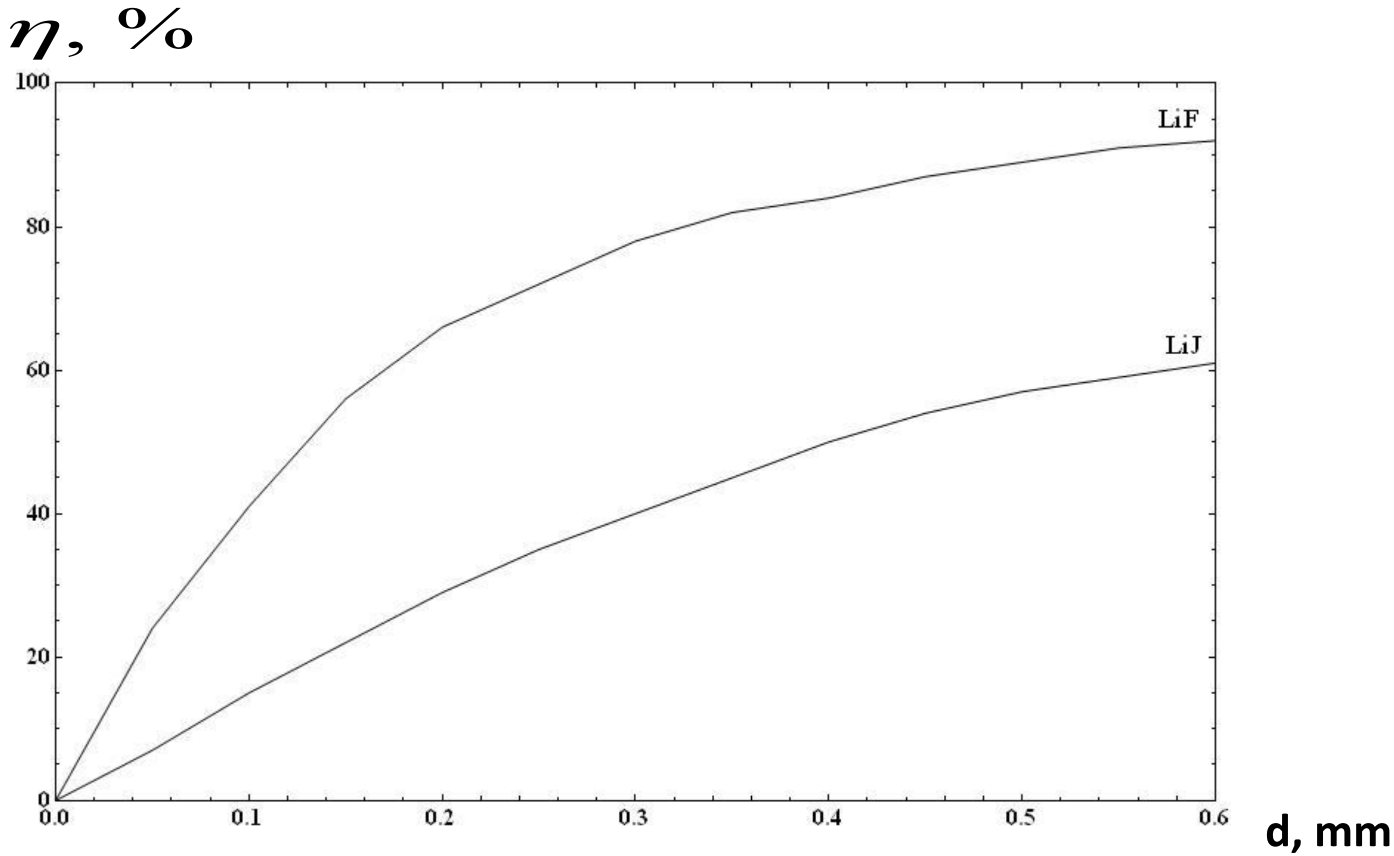

Figure.4 Dependence of thermal neutron absorption efficiency with energy E_n = 0.025 eV from the thickness of LiF and LiJ.

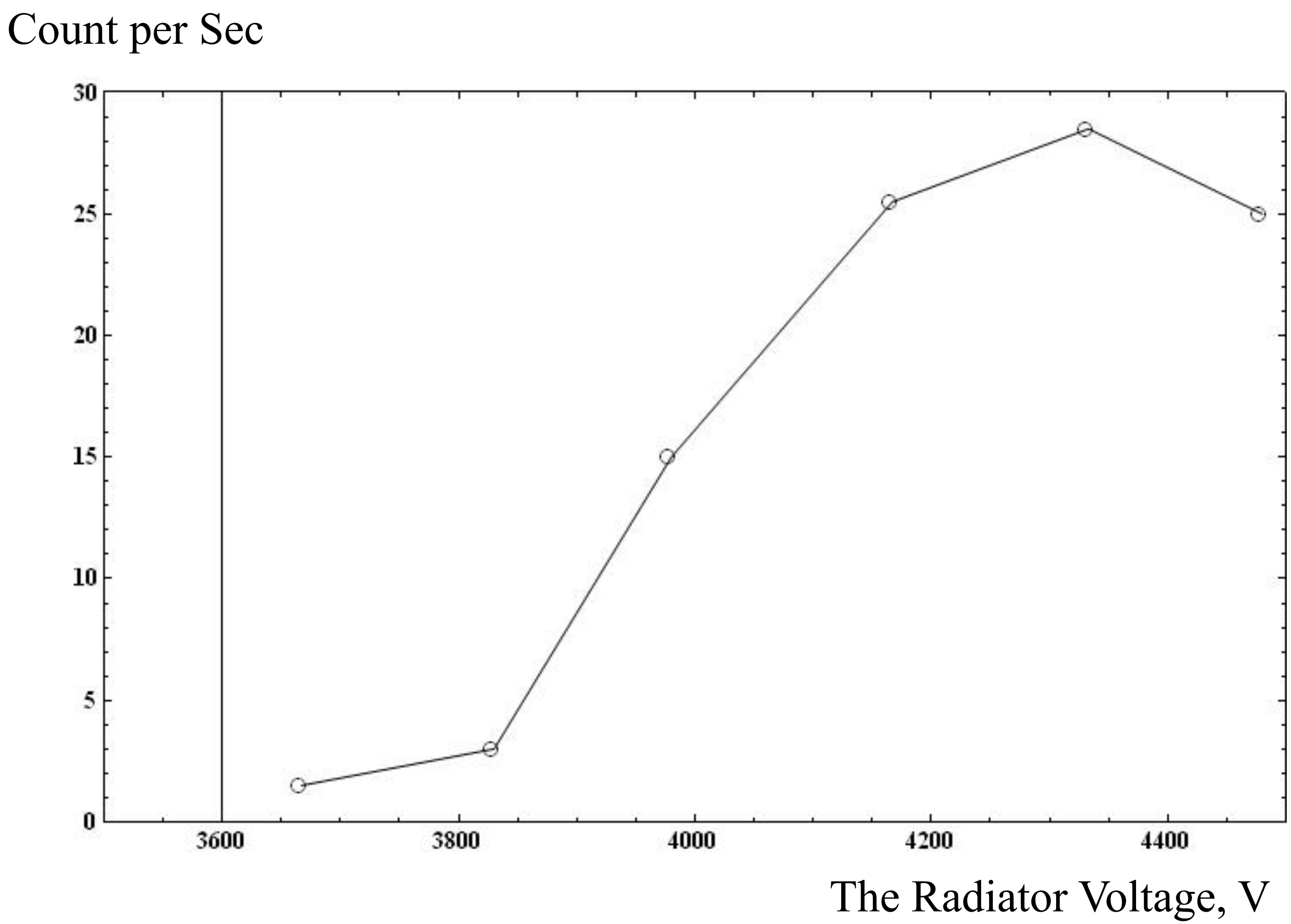

Figure 5. Registration rate dependence from the radiator voltage, $U_{r,}$ for the energy E_n =0,025eV.

FORMATION OF PERIODIC STRUCTURES

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H.R.Muradyan, E.A.Mkrtchayn, S.A.Mirakyan

The Generator of Micro Particles

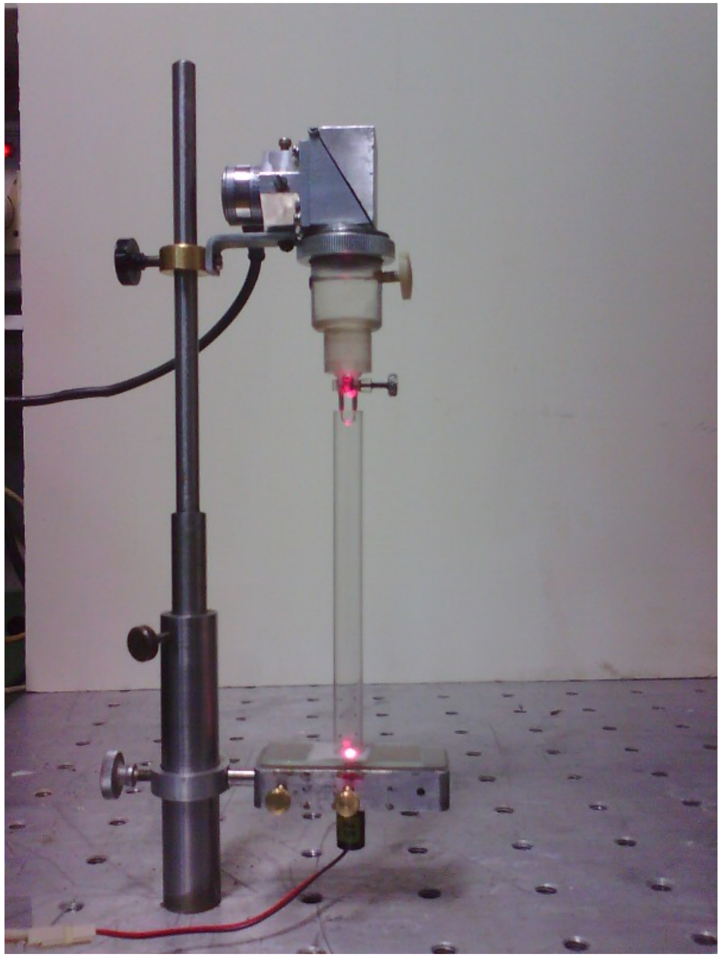

Fig.1 The general view of the generator
with the crystallization chamber.

Crystallization Chamber

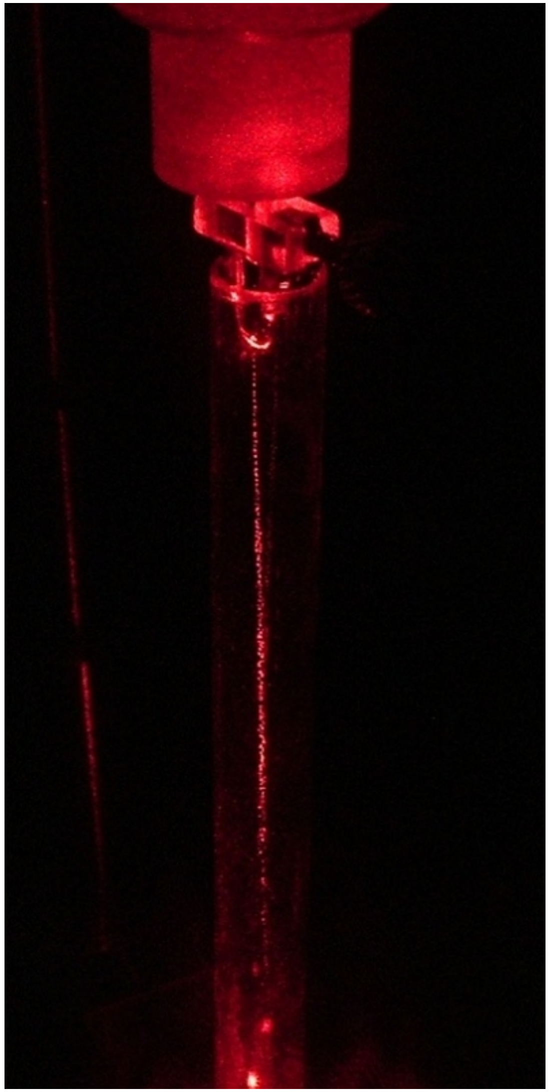

Fig. 2

For micro crystals acquisition, different solutions of water-soluble crystals (NaCl, $LiIO_3$, KDP, etc.) are used. The crystallization of generated droplets is carried out by their evaporation in the crystallization chamber (fig. 2) shaped as a glass tube with temperature and humidity sensors for crystallization conditions control inside the tube. Thus obtained crystals subside on a glass substrate.

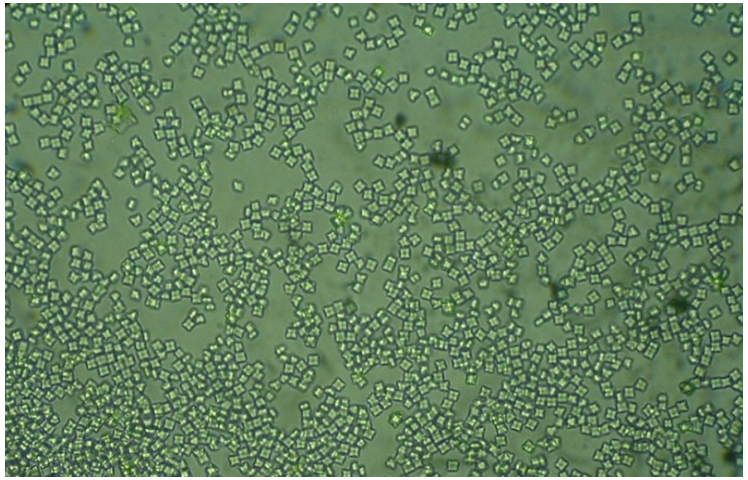

Figure 3

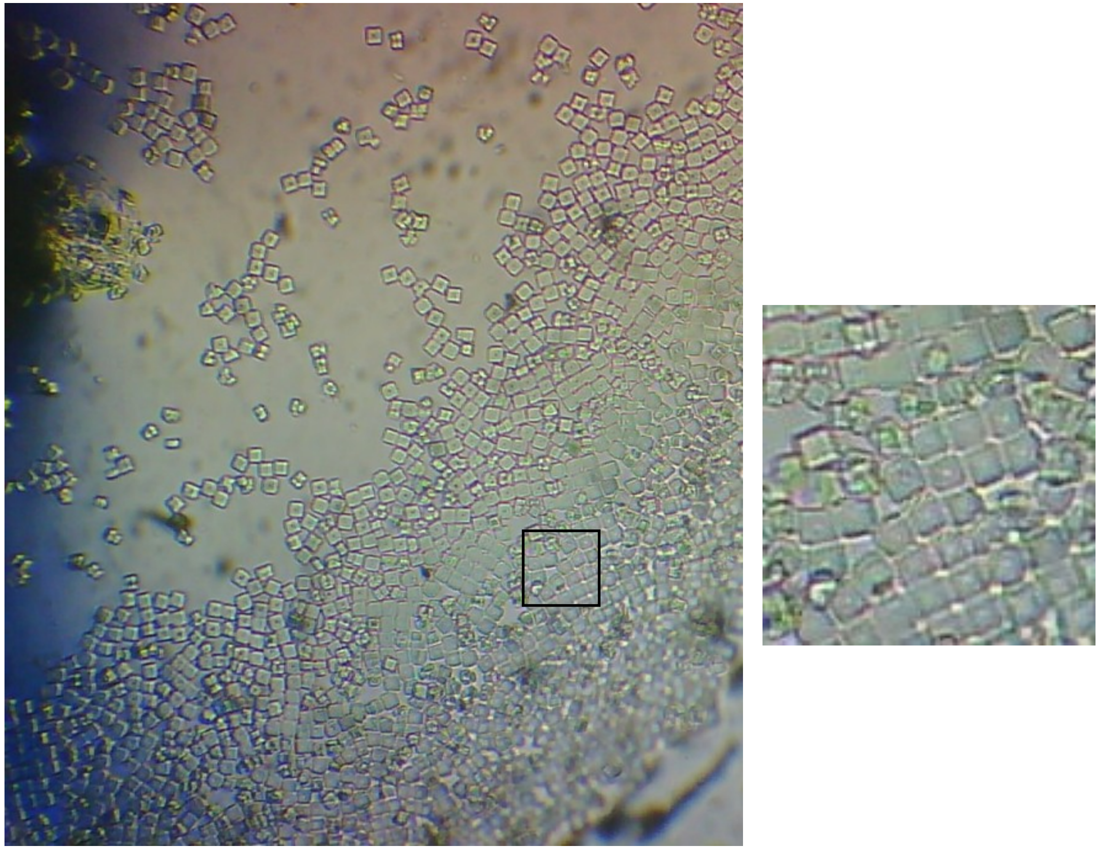

Figure 4

On fig. 3,4 the micro photoes of the crystals are demonstrated. As it is senn on the photoes, the particles have the same size and form. The measurements show that the average quadratic deviation of particles equals about 5%. On the photoes, it is seen the forms of crystal cells (cubic). Such compact packing is the result of particle self-organization in a viscus medium under external influences (electrical, acoustical fields, temperature gradient, etc.).

While laser illumination of such structures, diffraction patterns are seen on the screen (fig. 5a, b).

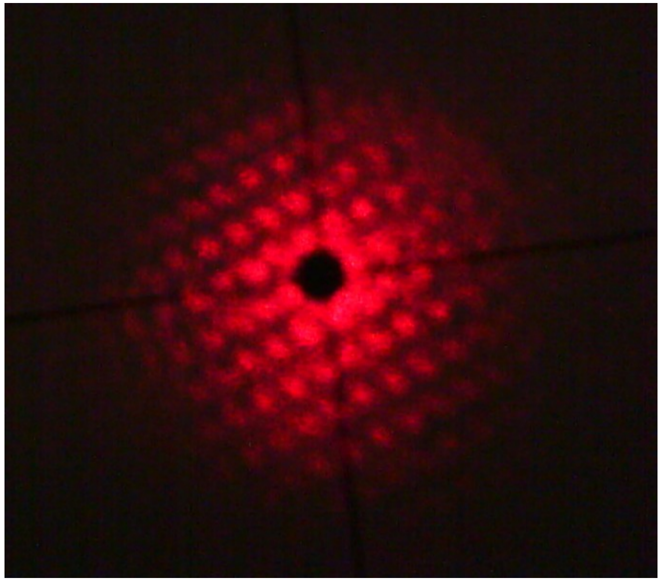

Fig.5.a. Particle average size is 3,4μm.

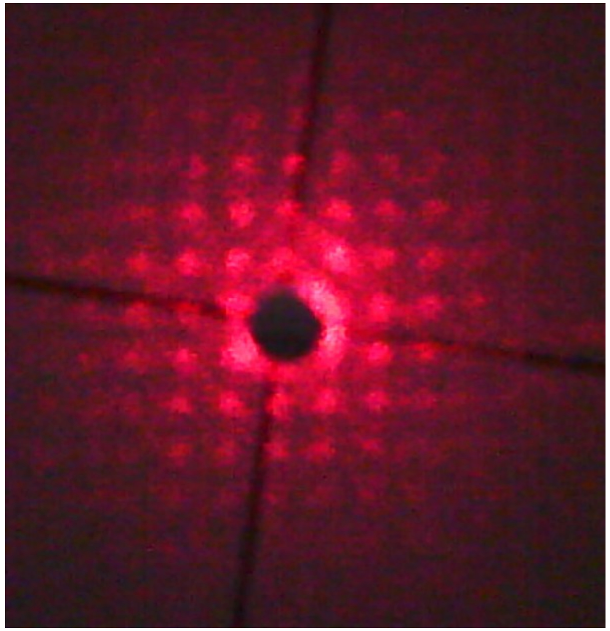

Fig.5.b. Particle average size is 5,5 μm..

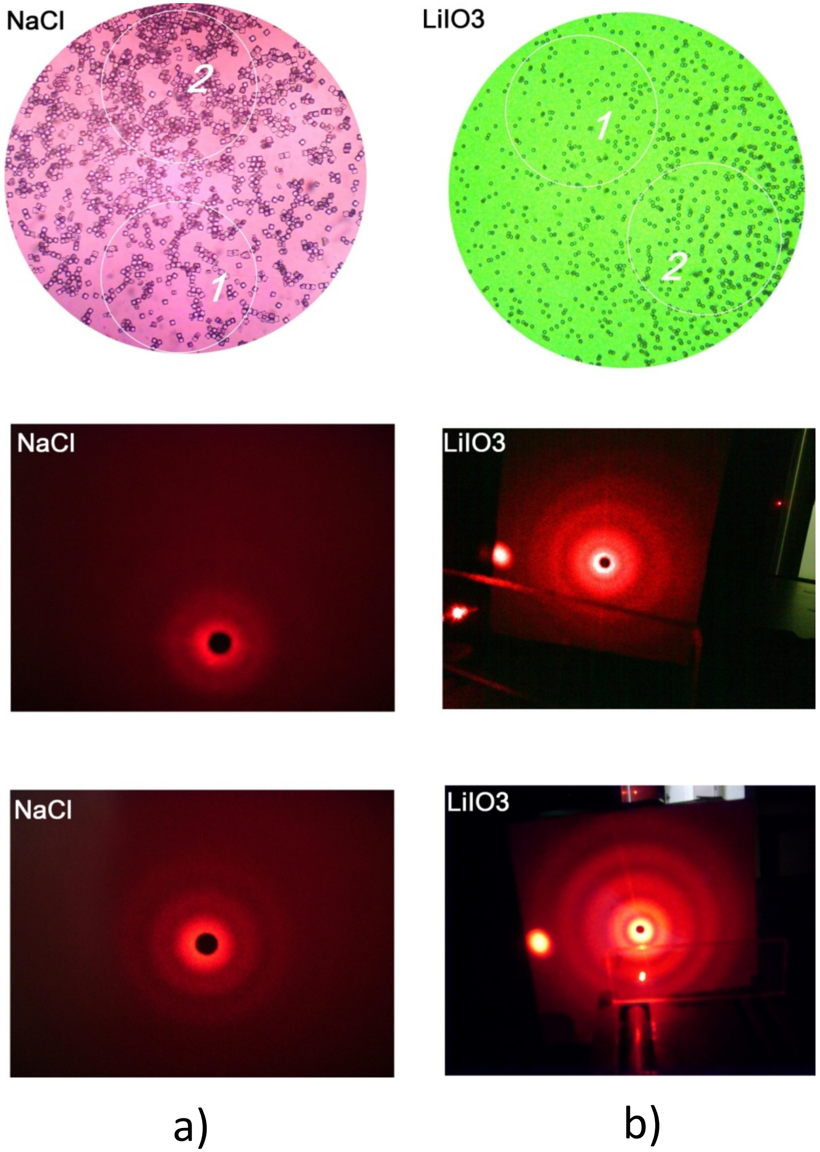

Fig.6

In fig.6.a and 6.b they are presented the photos of micro crystals and their corresponding diffraction patterns for two materials: NaCl and $LiIO_3$ (for obtaining better photos, it is cut a hole near the central bright maximum in the screen). In the photos of micro crystals, the areas with different distribution of the particles are indicated with circles. On the right, they are presented the diffraction for the both materials. As it is seen in the photos, with more numbers of the particles in the illumination zone, they are more diffraction rings on the screen. At the same time, the diameters of the corresponding rings don't change.

In the presented photos the measurement precision is about 10 % (the size of the particles are 2,6±0,2μm for NaCl and 2,3±0,2 μm for $LiIO_3$).

Development of Periodical Microstructures

For ordered distribution of the particles on the substrate, masks with different sizes and periodical holes have been used (fig. 9).

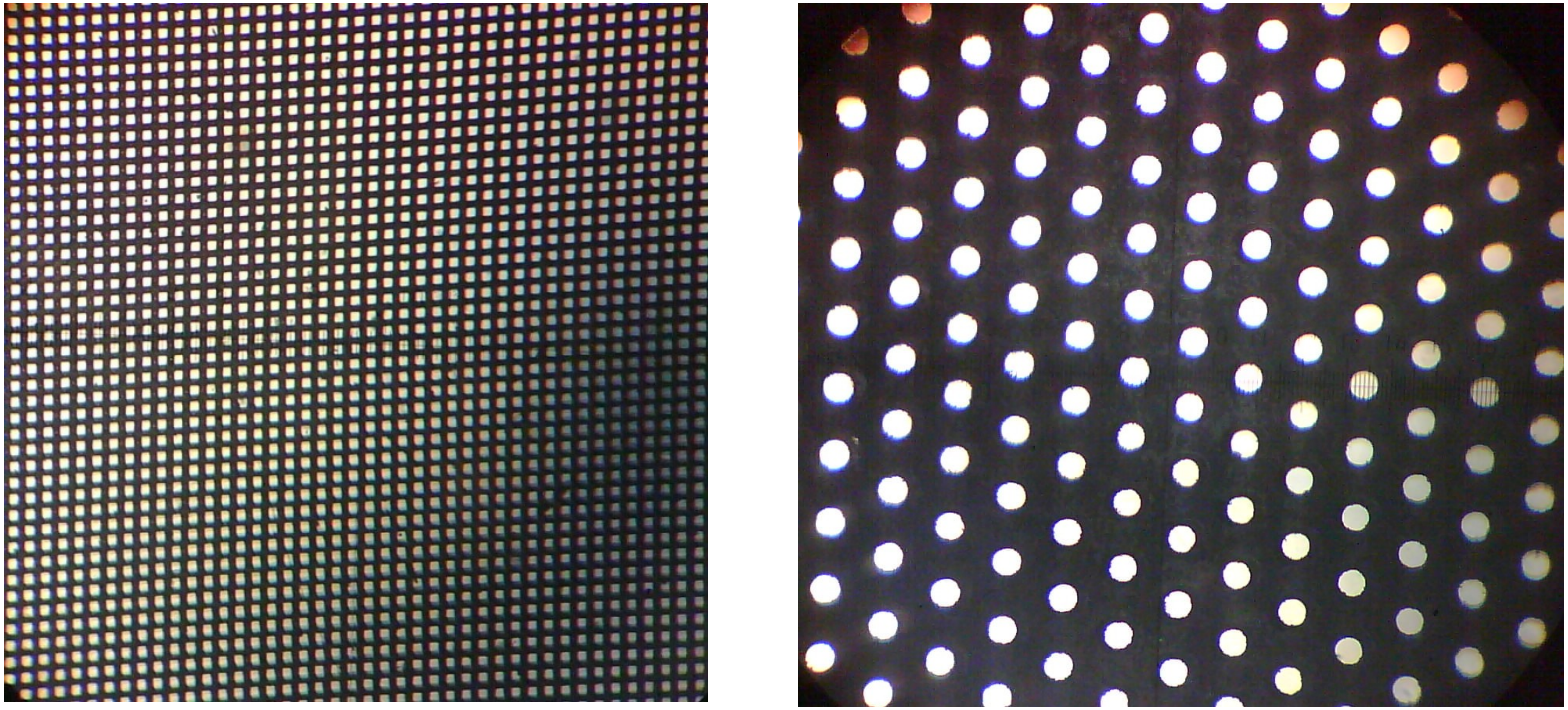

Fig.9. The holes size 40*40 μm, the distance between the holes 80 μm

What we are expecting in near future?

Diffraction of thermal neutrons in single Quartz crystals in the presence of acoustic fields.
Thermal neutrons transparence medium
Thermal neutron diffractometer
Accumulating systems of X-Rays and thermal neutrons
Detectors for elementary particles and gamma quanta with coordinate sensitivity better than 5μm
Alternative sources of electron beams
Alternative sources of energy
Portable X-Ray and thermal neutron diffractometers

Thank you for attention!