IRRADIATION FACILITY OF THE IBR-2 REACTOR AS A MULTI-OPERATED INSTRUMENT FOR RESEARCHES OF MATERIALS OF TOKAMAKS, COLIDERS, DETECTORS, CHOPPERS AND NEUTRON GUIDES

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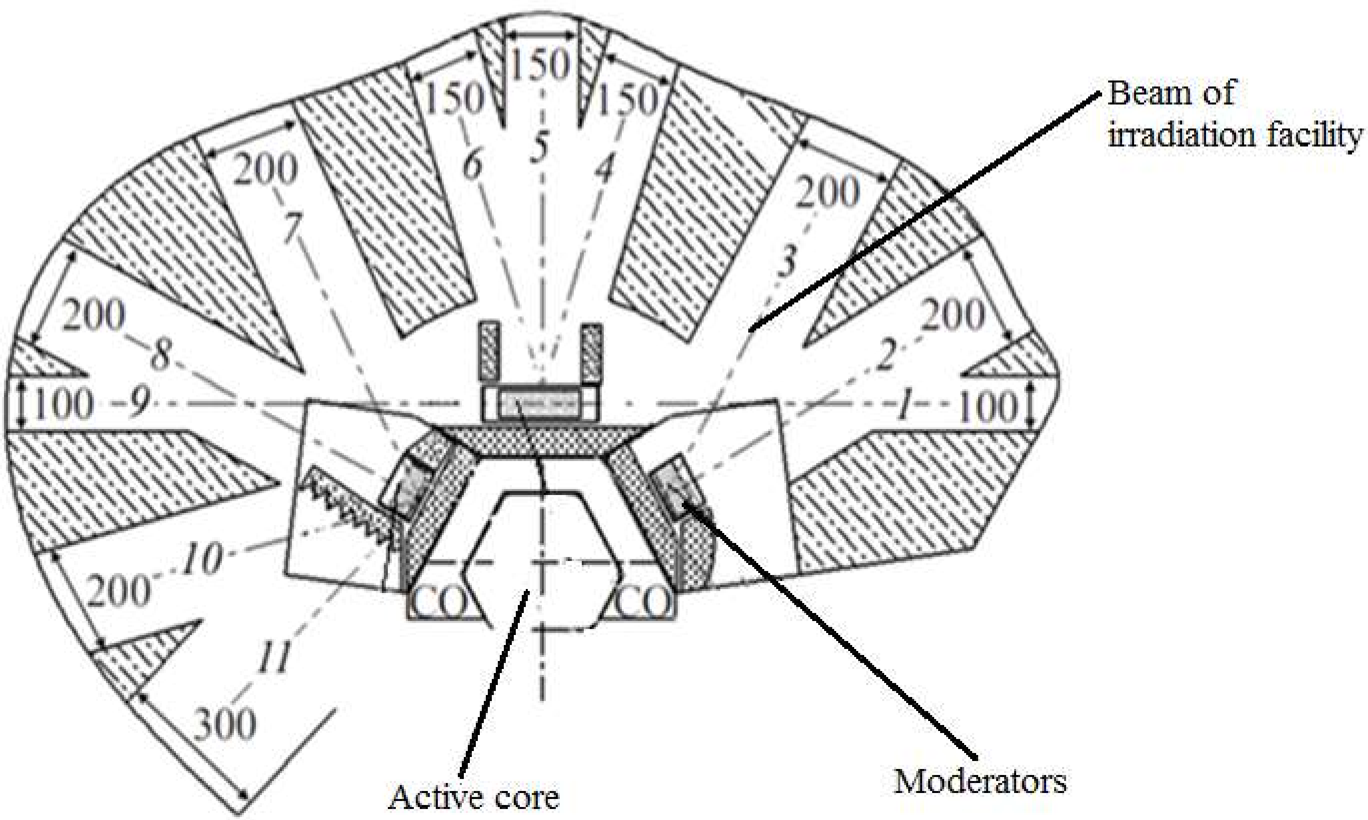
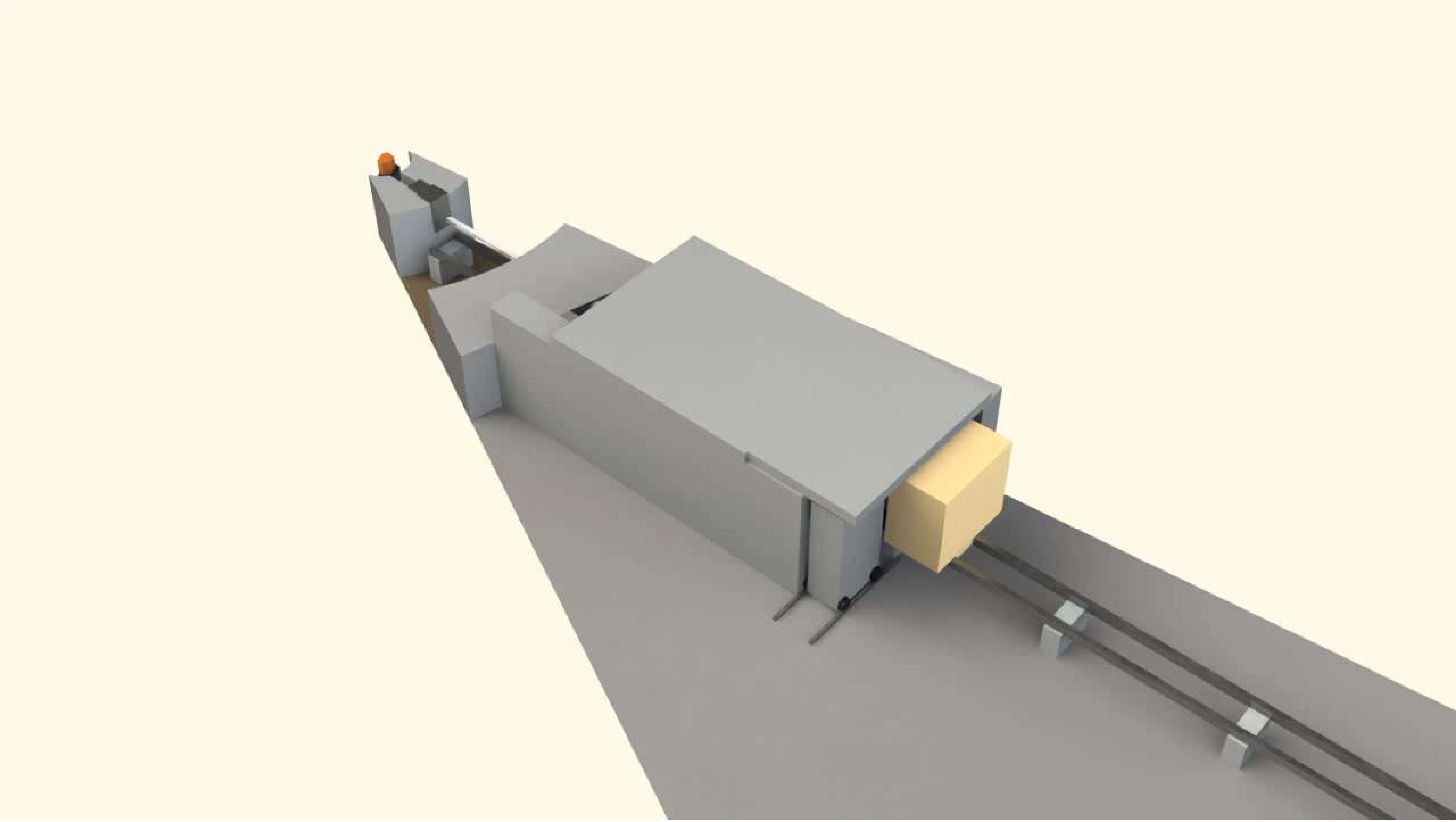
Plan of the talk

1. Facility for radiation investigation: principle of work
2. Neutron spectrum from the reactor IBR-2
3. What kind of experiments can we do?

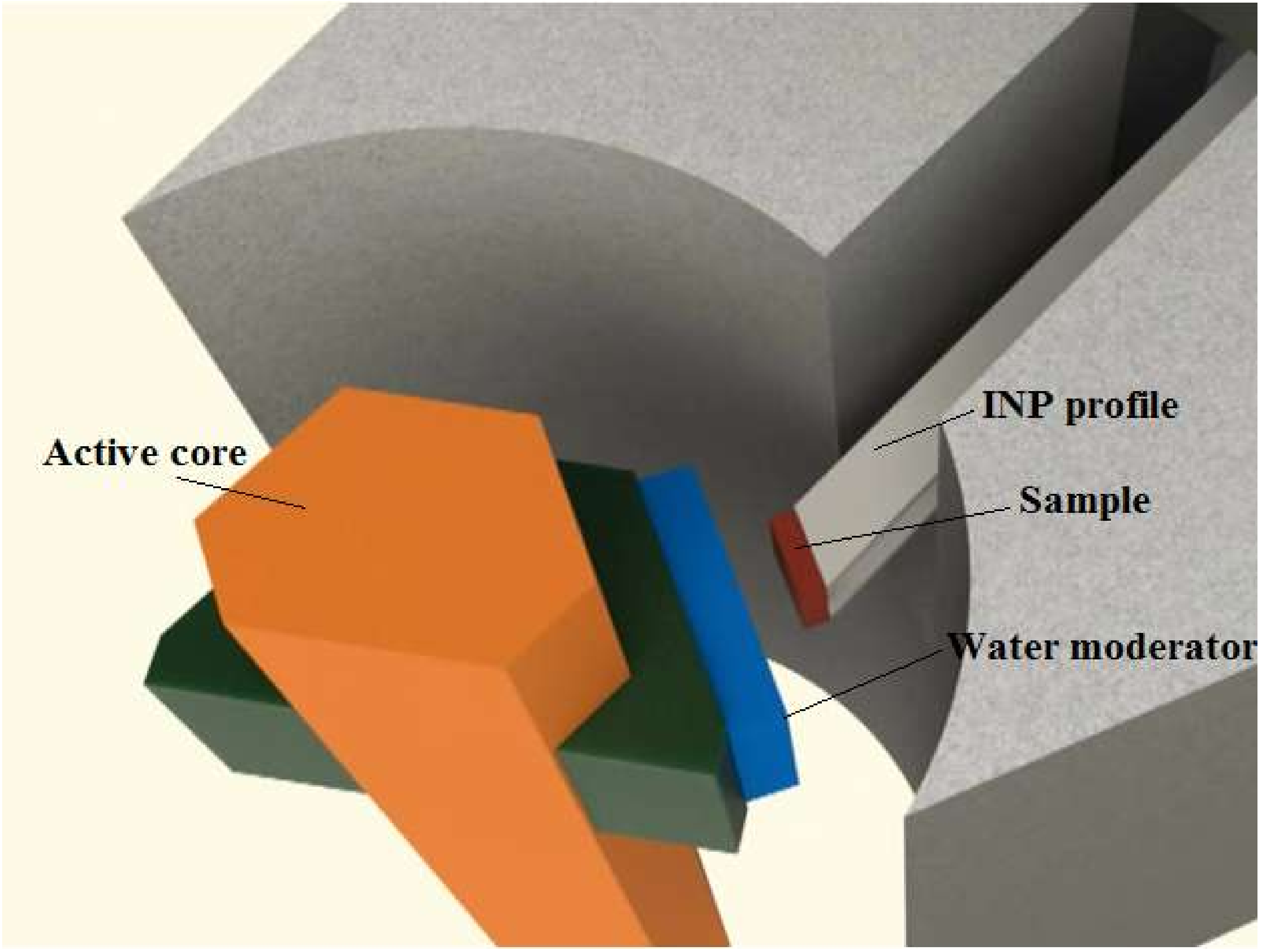
Experimental beamline of the irradiation facility



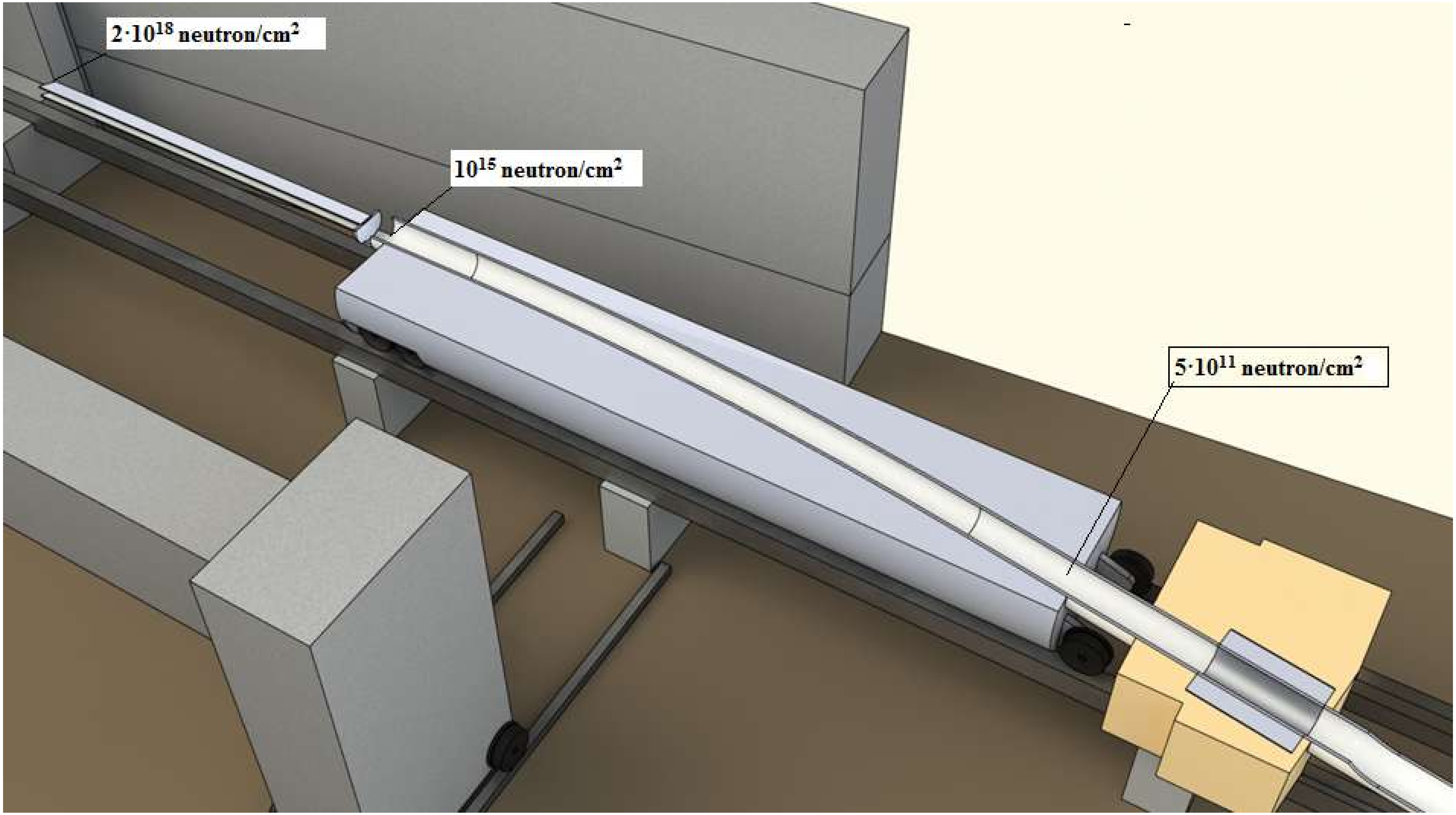
Irradiation facility



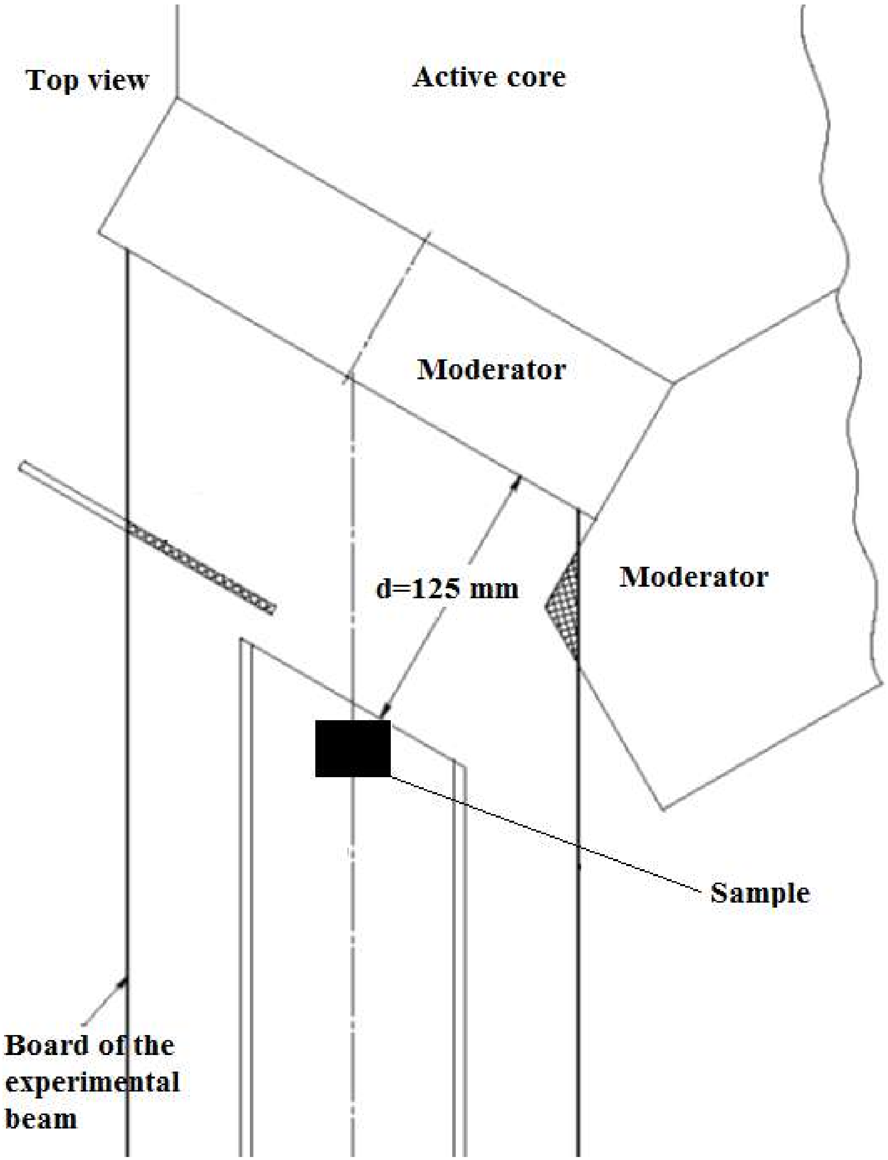
Irradiation facility

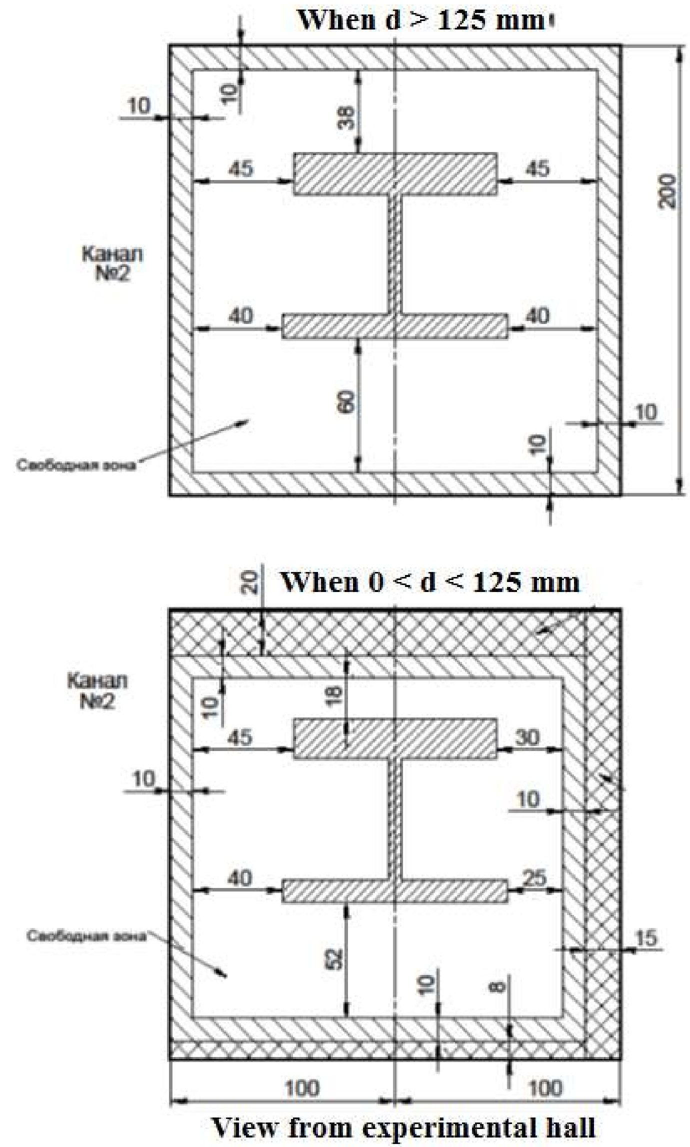


What neutron fluences do we have?

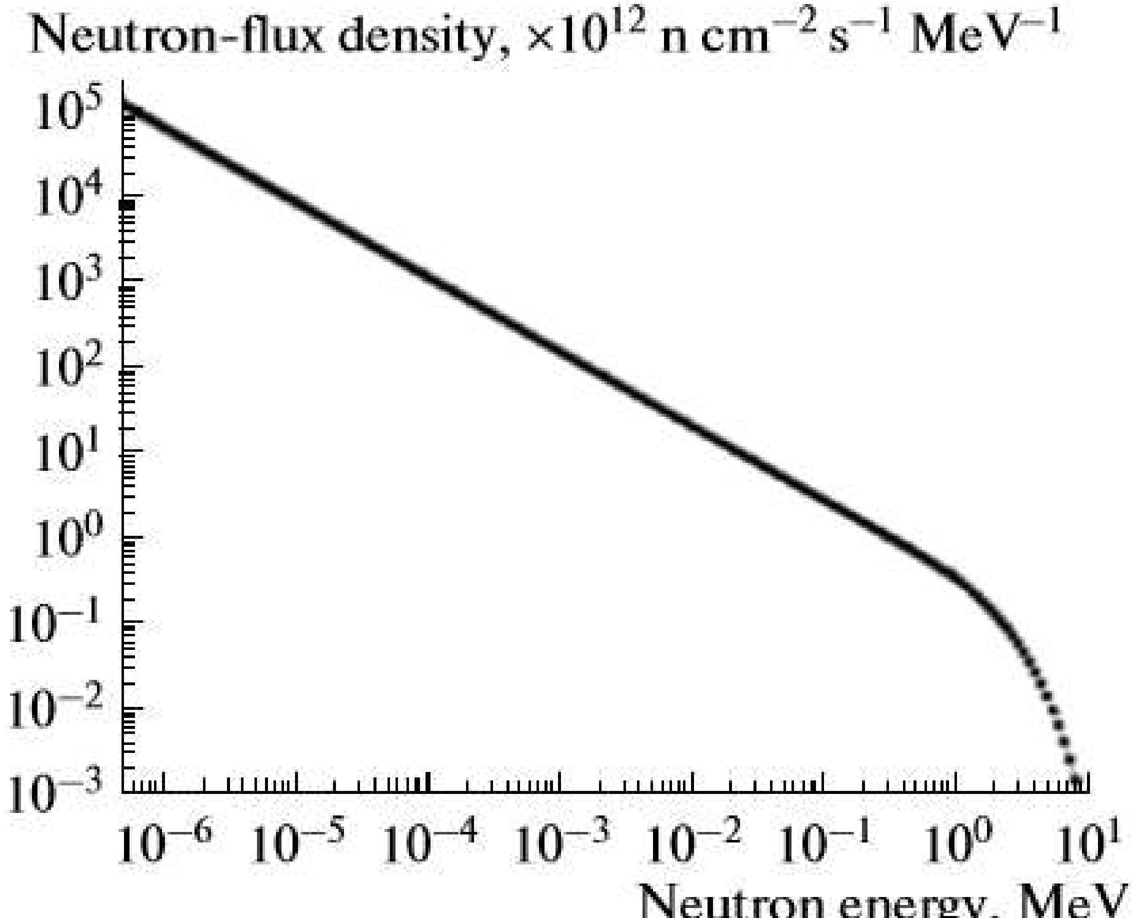


What size of samples we can irradiate?

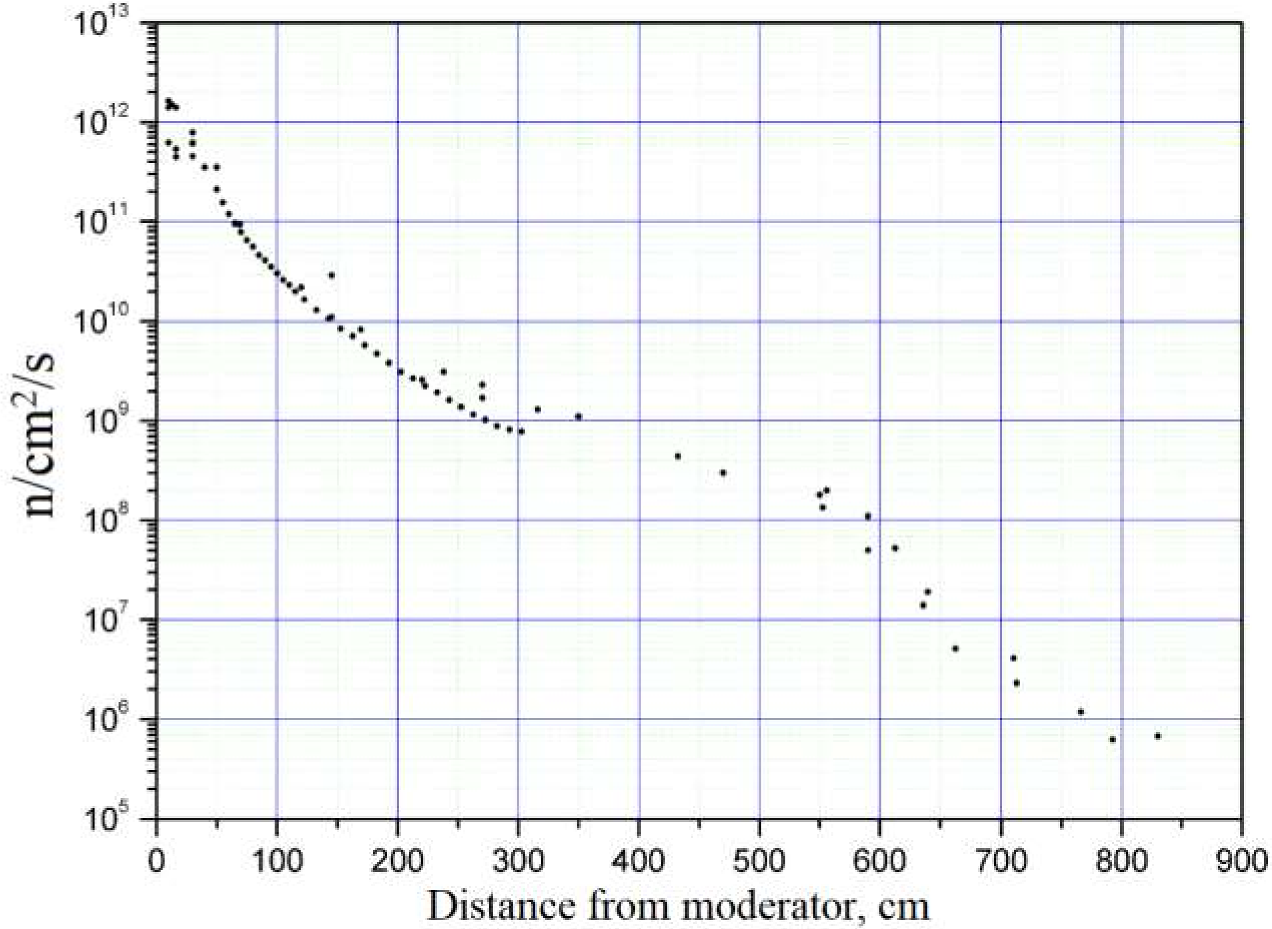




Neutron spectrum of the reactor

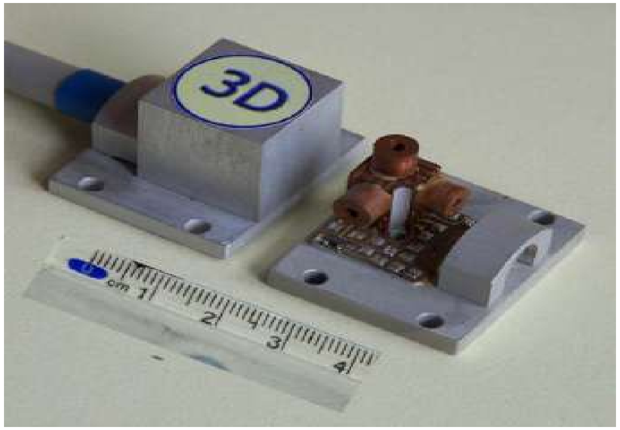


Dependence of neutron density flux from distance from moderator: fast neutrons



Experiments

Irradiation of heads with metal Hall sensors samples for ITER and DEMO tokamaks projects and NICA



Now we get a fluence near 10^{20} n/cm^2 and metal sensors feel themselves very well

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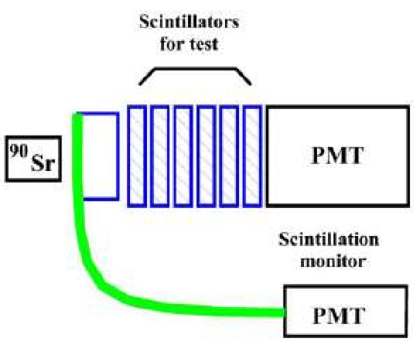
1. **Experimental evaluation of stable long term operation of semiconductor magnetic sensors at ITER relevant environment / I. Bolshakova [et al.] // Nuclear Fusion. – 2015. – Vol. 55. – №8. – P. 083006-083016 (Impact factor – 4,04)**
2. **Metal Hall Sensors for the new generation fusion reactors of DEMO scale / I. Bolshakova et al // Nuclear fusion 57(11), June 2017**
3. **Graphene and prospects of radiation-hard Hall sensors / I.A. Bolshakova et al. // 2017 IEEE 7th International Conference on Nanomaterials: Applications & Properties (NAP – 2017). –Zatoka, Ukraine, 2017 – 03CBN15-3 – p. 1-4**
4. **Metal Nanofilms for Magnetic Field Sensors / A. Vasiliev et al. // 2017 IEEE 7th International Conference on Nanomaterials: Applications & Properties (NAP – 2017). –Zatoka, Ukraine, 2017 – 04NESP18-1 – p. 1-4**

Experiments

With LHC, CERN

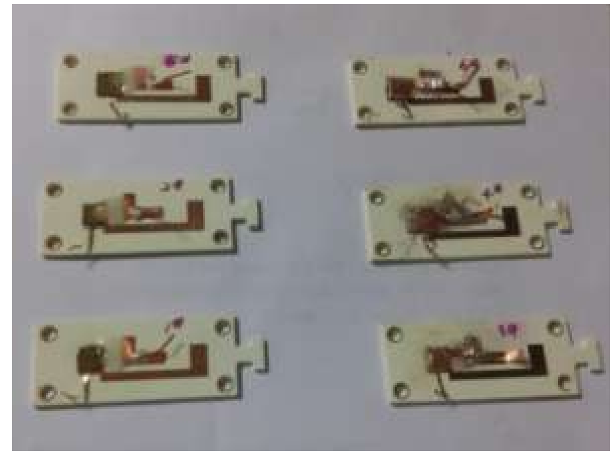
mini Fcal, Detector Atlas, LHC

Electronic boards G10, FR4, Rogers, Arlon и полиимида.



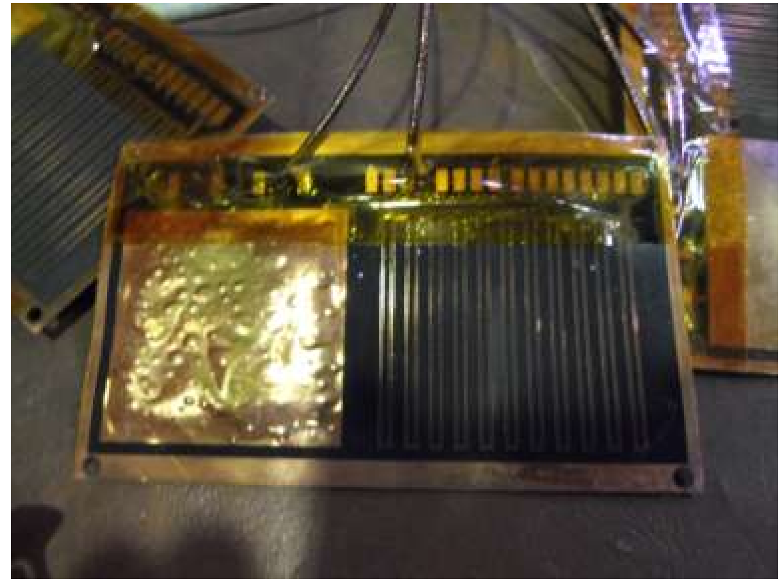
plastic SCSN-81 scintillator
CMS Hadron Calorimeter

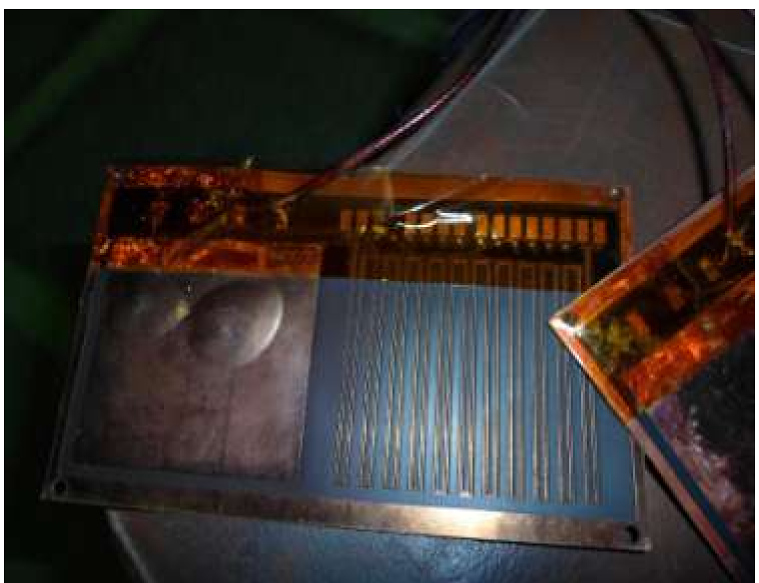
DD modules



Scintillators, LHC

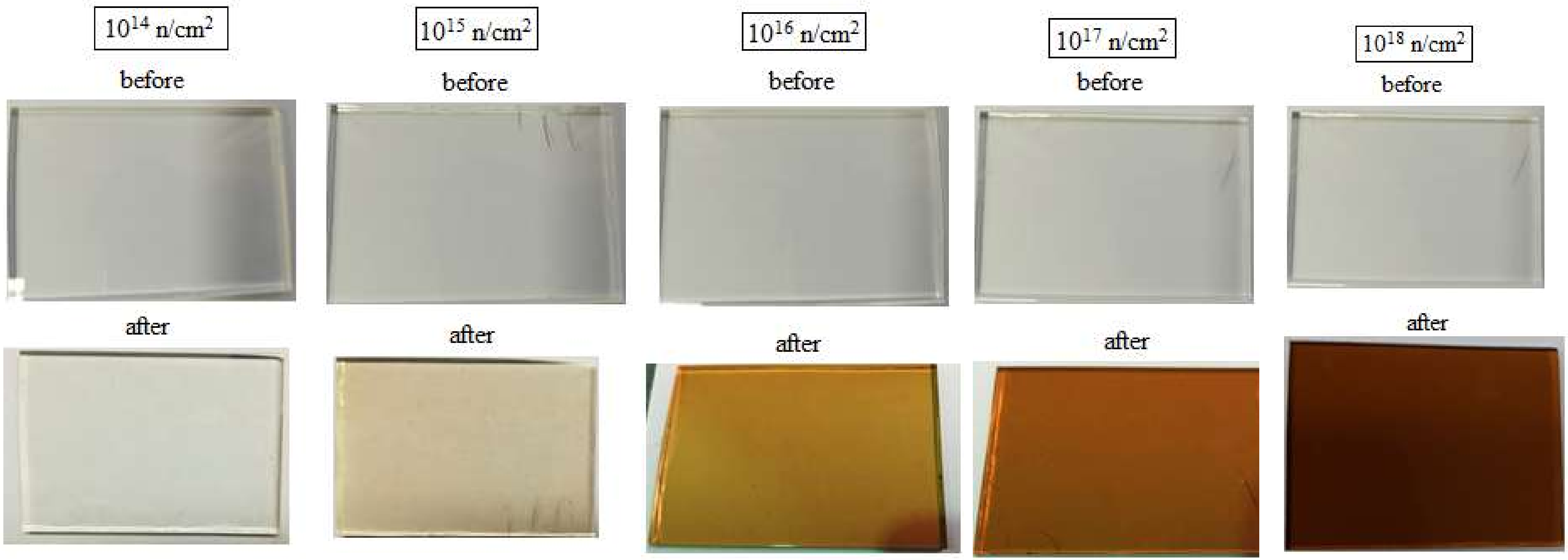
Electronic boards for ATLAS, CERN





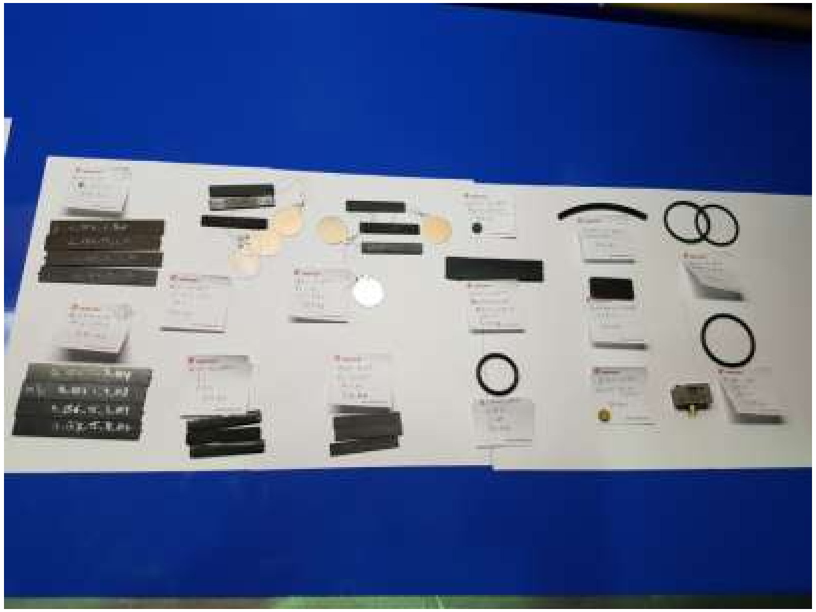
Electronic boards: G10, FR4, Arlon 85N, poliamid (copton), Rogers 4450B. Fast neutron fluence (E_n>0.4 MeV) ~ $4 \cdot 10^{17}$ n/cm^2.

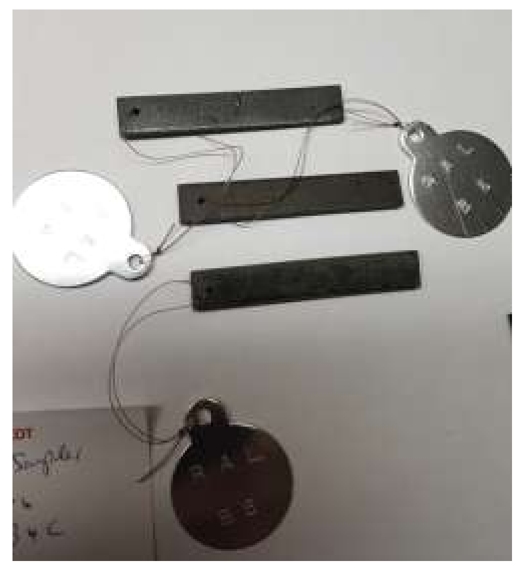
First results of neutron guide glasses irradiation



Glass						
K208	SiO_2	B_2O_3	K_2O	NaCl	Al_2O_3	CeO_2
%	76,92	10,56	9,59	0,97	1,38	0,58

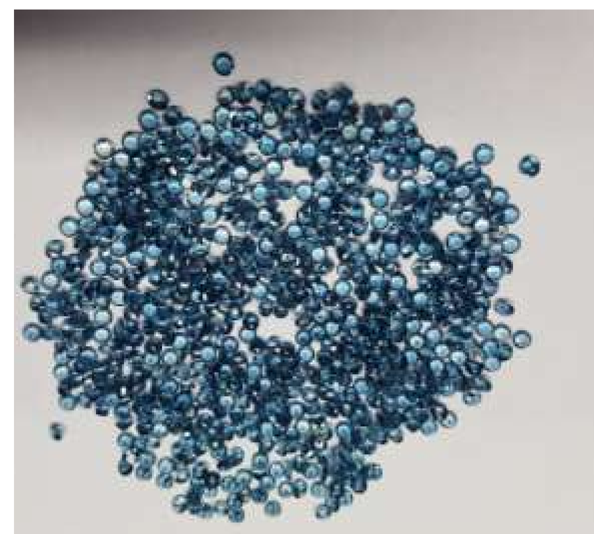
ESS Beam Choppers’ materials





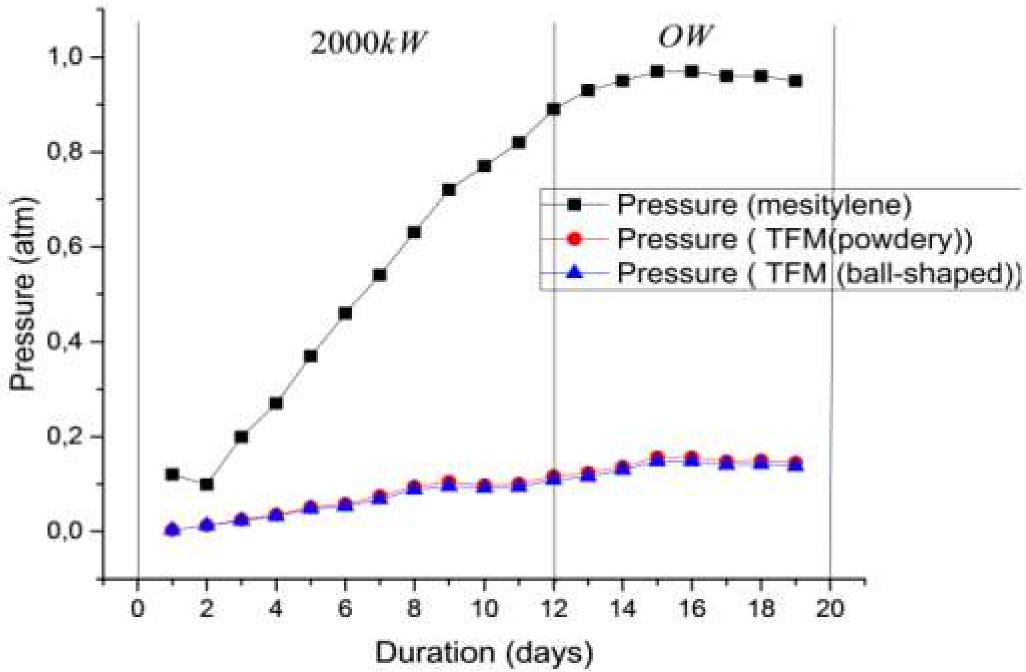
Radiation coloring of Topaz

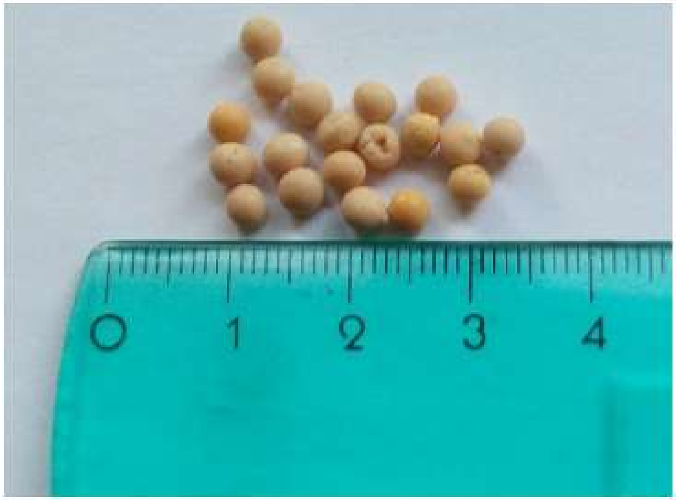
Blue topaz is very popular in the gold work as jewelry. Yet, naturally occurring blue topaz is quite rare. For that reason, on the facility for the radiation research colorless topazes are irradiated up to fast neutron fluence of 10^{18} n/cm^2 to produce a more desired darker blue. The photo of topaz after the irradiation is shown in figure



Radiation coloring of Topaz

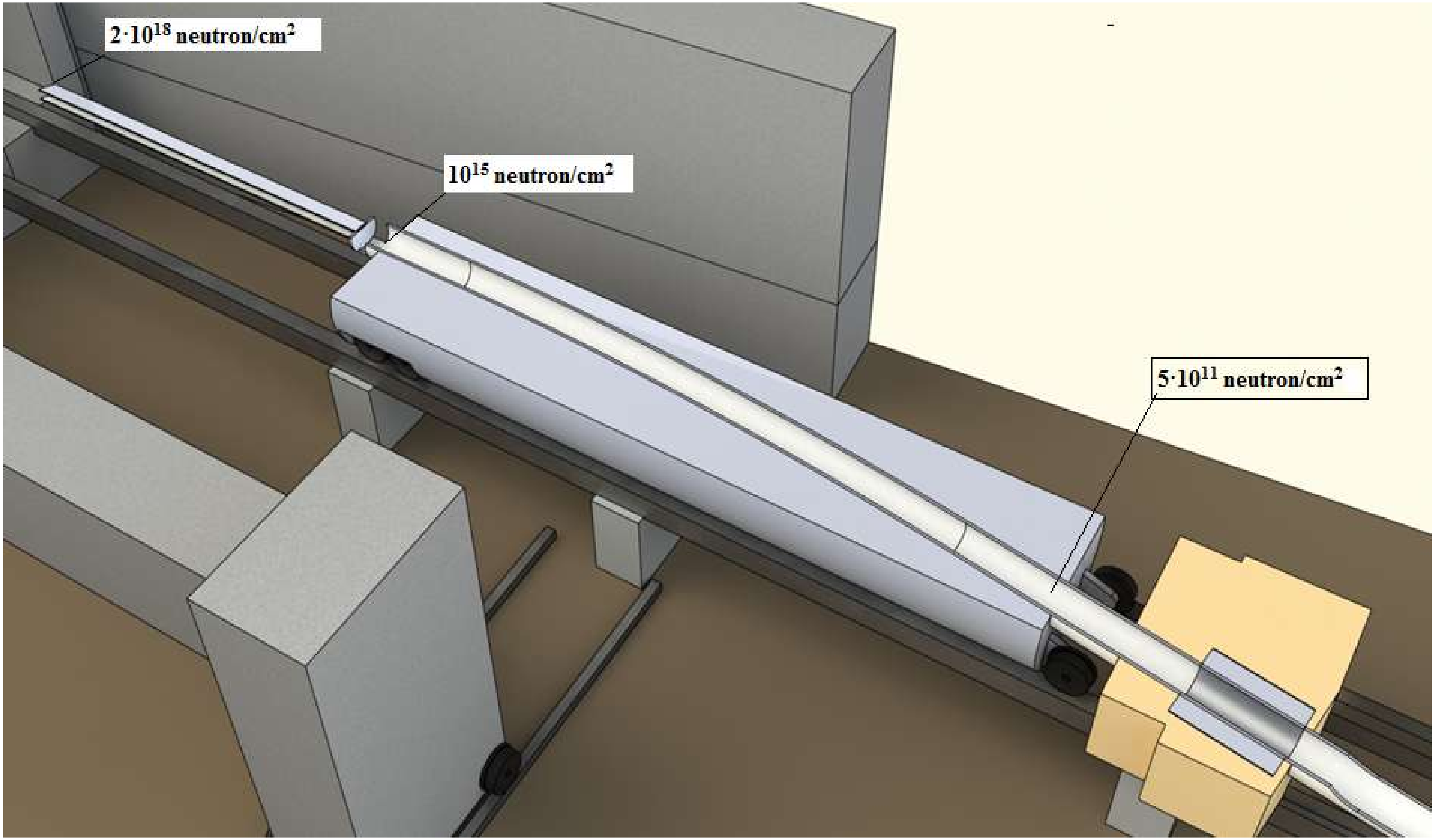
Radiation resistance of materials of cold moderators (at room temperature)



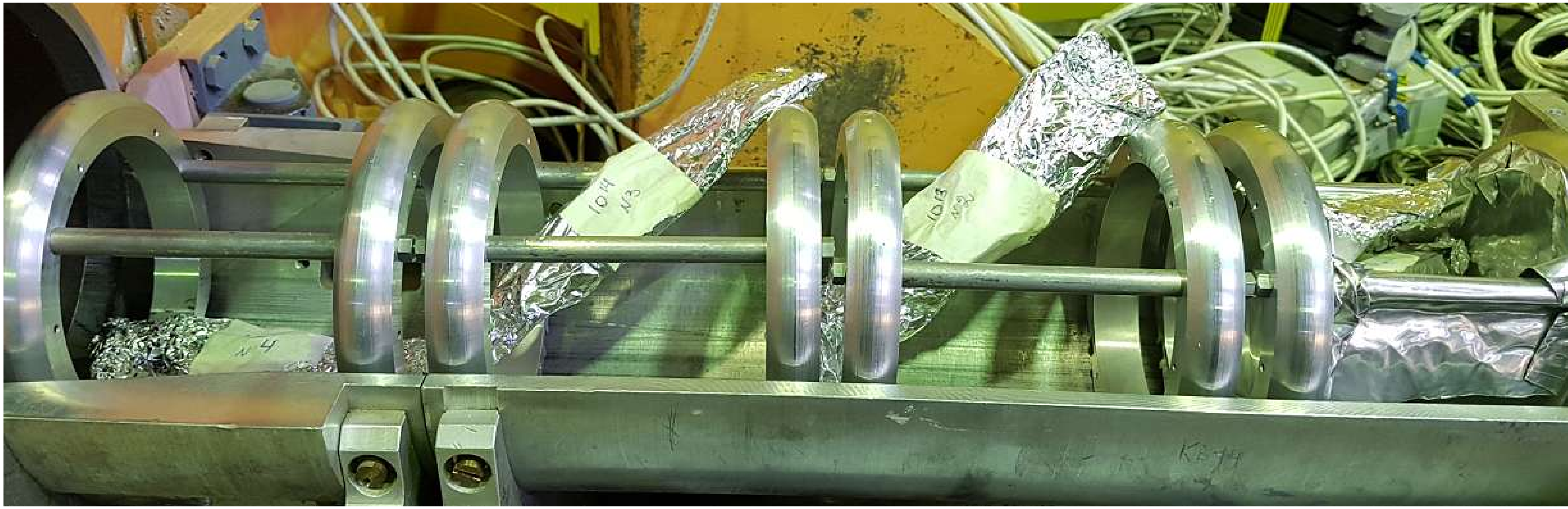


Small fluences for scintillators' irradiation

Small fluences for scintillators' irradiation



Transporting system



List of Publications

- Metal Hall sensors for the new generation fusion reactors of DEMO scale / I. Bolshakova et al // **Nuclear Fusion** 57(11), June 2017.
- Experimental evaluation of stable long term operation of semiconductor magnetic sensors at ITER relevant environment / I. Bolshakova // **Nuclear Fusion** 55(8):083006, August 2015
- Spectrum and density of neutron flux in the irradiation beam line #3 of the IBR-2 reactor / M. Bulavin et al // **Physics of Particles and Nuclei Letters** 12(2):336-343, March 2015
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- Investigation of SCSN-81 scintillator irradiated by neutrons / S. Afanasiev [et al.] // **CMS Internal Note**. – 2013. – v. 2. – P. 1-4.
- Radiation Hardness Investigation of PECVD Silicon Carbide Layers for PV Applications / J. Huran et al. // **40th Photovoltaic Specialists Conference (PVSC).** – Denver, USA, 2014 – pp. 1815-1820
- Graphene and prospects of radiation-hard Hall sensors / I.A. Bolshakova et al. // 2017 IEEE 7th International Conference on Nanomaterials: Applications & Properties (NAP – 2017). –Zatoka, Ukraine, 2017 – 03CBN15-3 – p. 1-4
- Metal Nanofilms for Magnetic Field Sensors / A. Vasiliev et al. // 2017 IEEE 7th International Conference on Nanomaterials: Applications & Properties (NAP – 2017). –Zatoka, Ukraine, 2017 – 04NESP18-1 – p. 1-4
- Light yield and radiation hardness studies of scintillator strips with a filler / A. Artikov et al. // arXiv:1711.11393v1 [physics.ins-det] 30 Nov 2017
- Current experiments at the irradiation facility of the IBR-2 reactor / M. Bulavin and S. Kulikov // Journal of Physics: Conference series (ICANSXXII, 27-31 of March 2017)

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Conclusions

1. **On the basis of experiments on the irradiation facility we can make a prediction for the radiation resistance of different materials in various radiation conditions. We create real radiation conditions.**

2. We look forward to seeing you in Dubna for the experiments at the irradiation facility of the IBR-2 reactor!

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