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Development of neutron instrumentation for modern neutron sources in NRC “Kurchatov Institute” - PNPI

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NRC «Kurchatov Institute» - Petersburg Nuclear Physics Institute named by B.P.Konstantinov (NRC “Kurchatov institute” – PNPI), Gatchina, Russia
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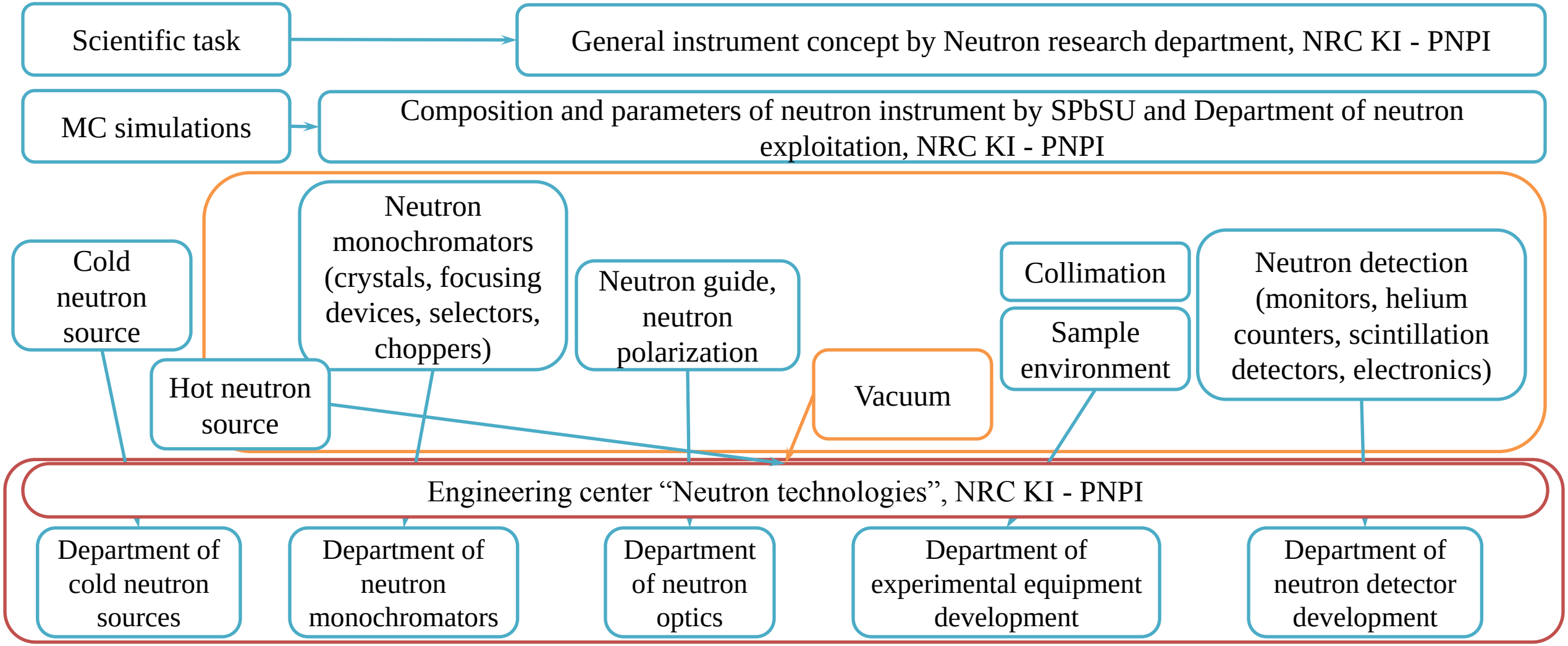
Prototype development



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Neutron detectors and profile monitors

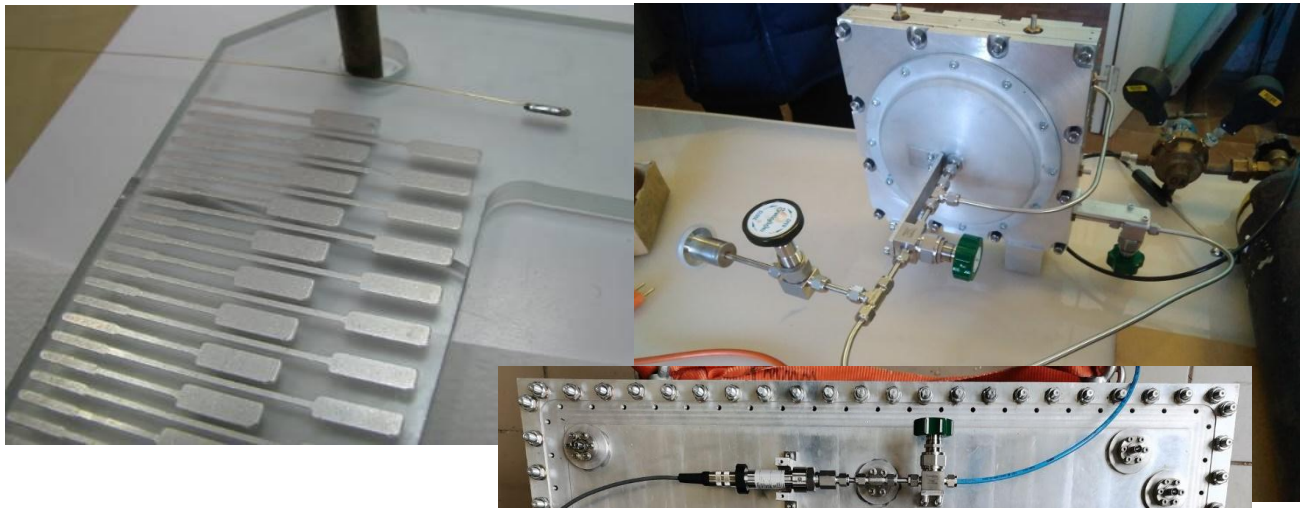
The neutron monitor has been developed on the basis of delay line based MWPC neutron detector:

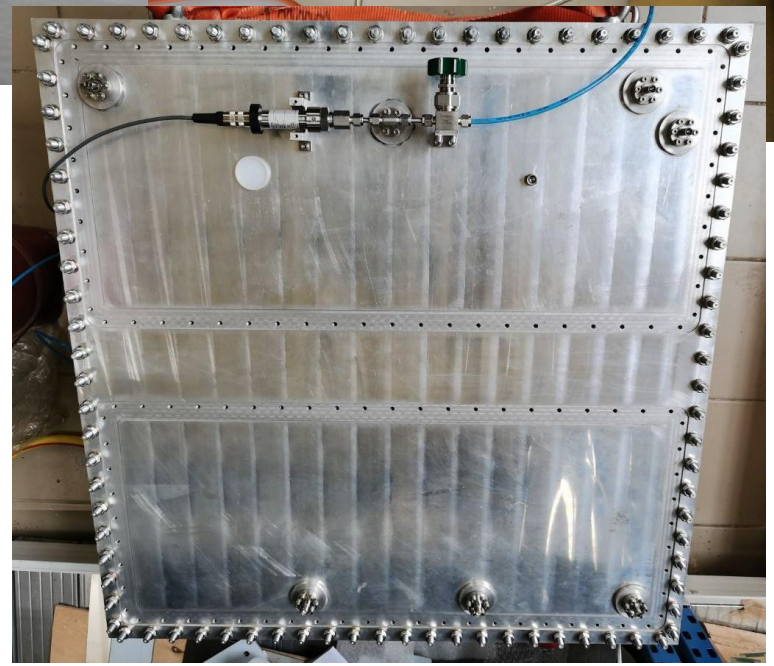
- Sensitive area: 100-600x100-600 mm^2
- Spatial resolution: 2x2 (3x3) mm^2
- Gas pressure: 1-5 bar
- Count rate: 150 kHz per pixel / 150 kHz overall.
- Efficiency:

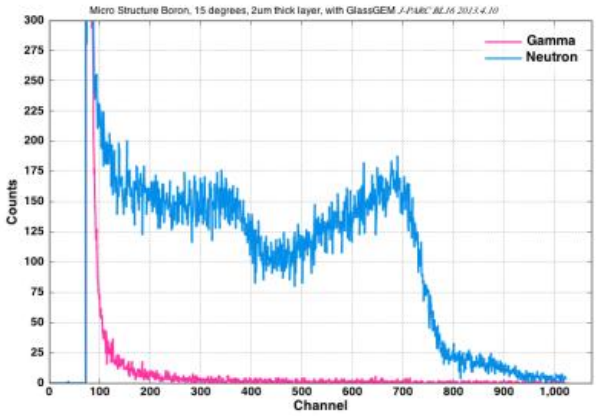
>0.01% for 1 angstrom (N_2)

<70% for 1 angstrom (^3He)

- Transmission: 99% for 1 angstrom (N_2)

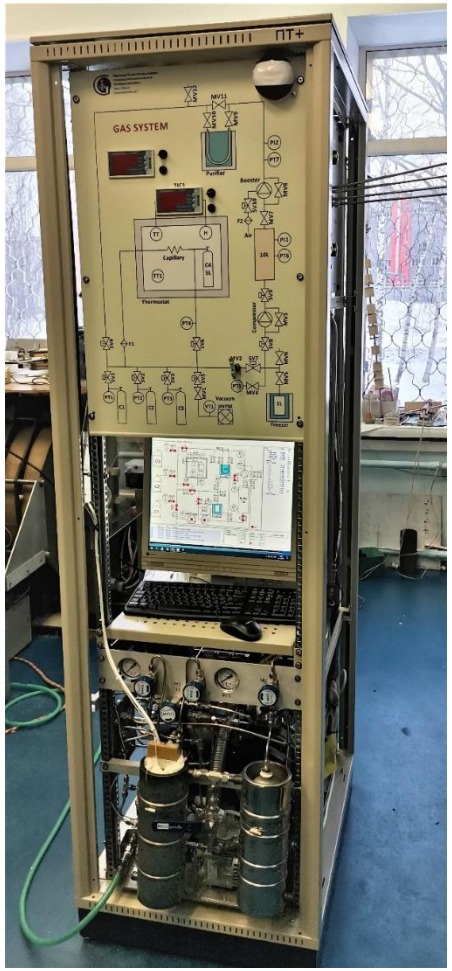


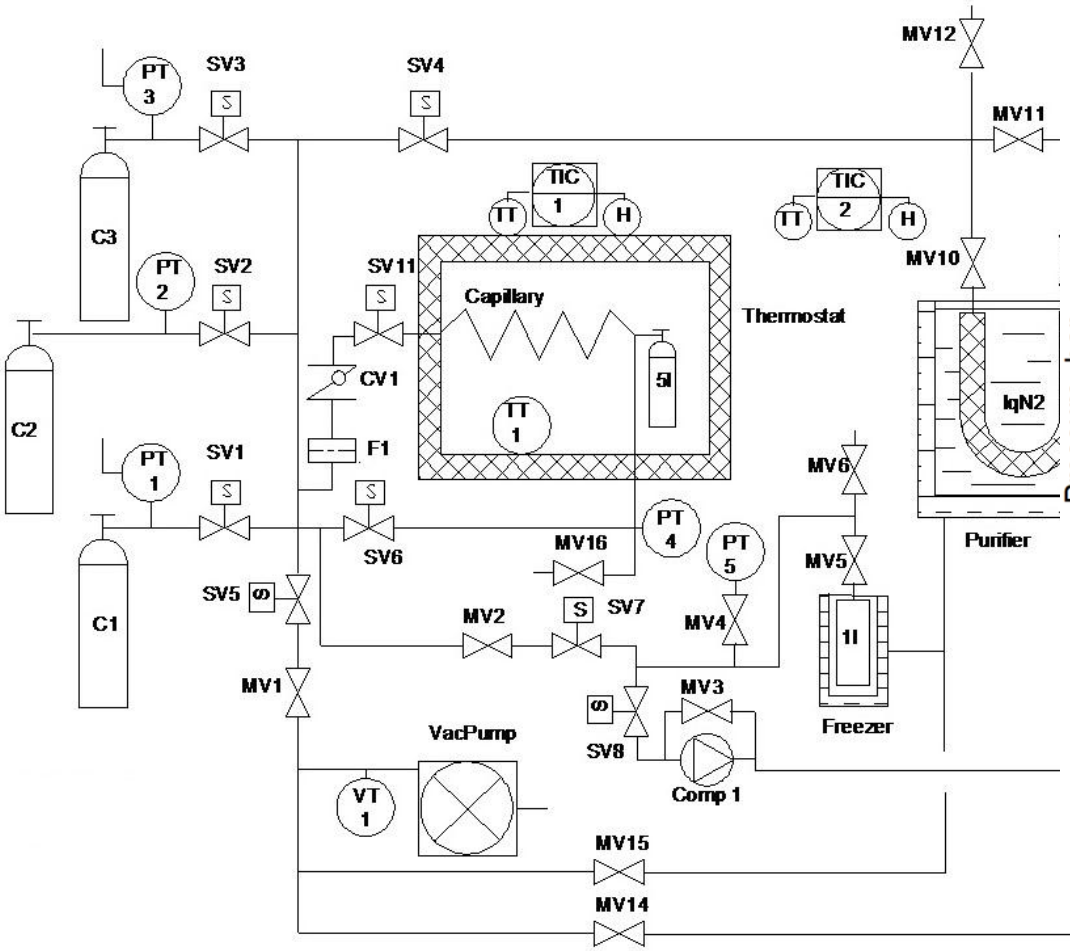


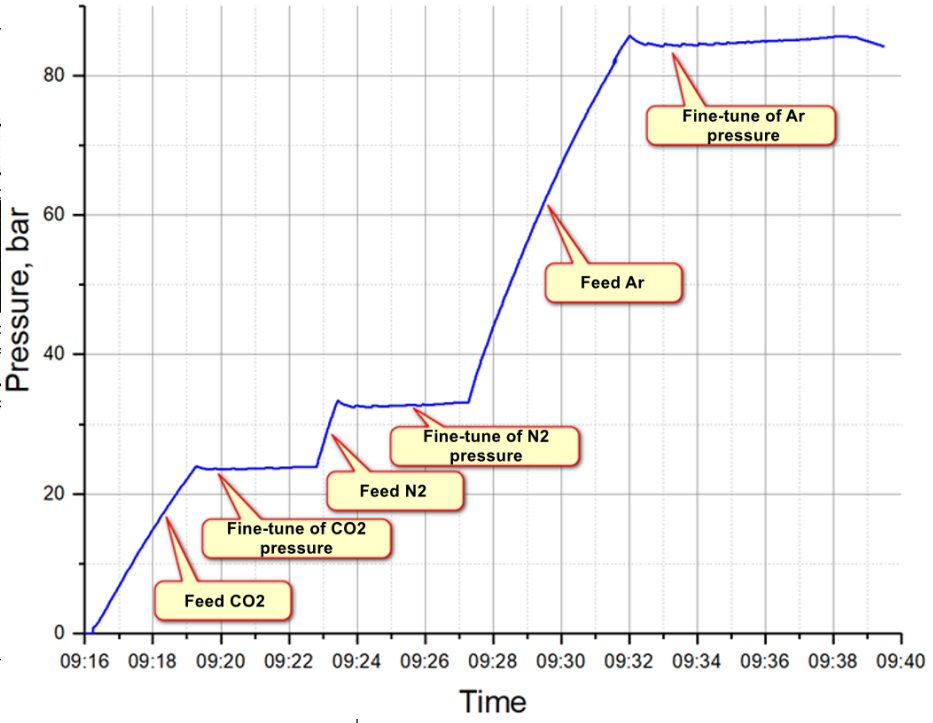


Amplitude spectra for thermal neutrons

Universal gas system with helium-3 separation and purification function







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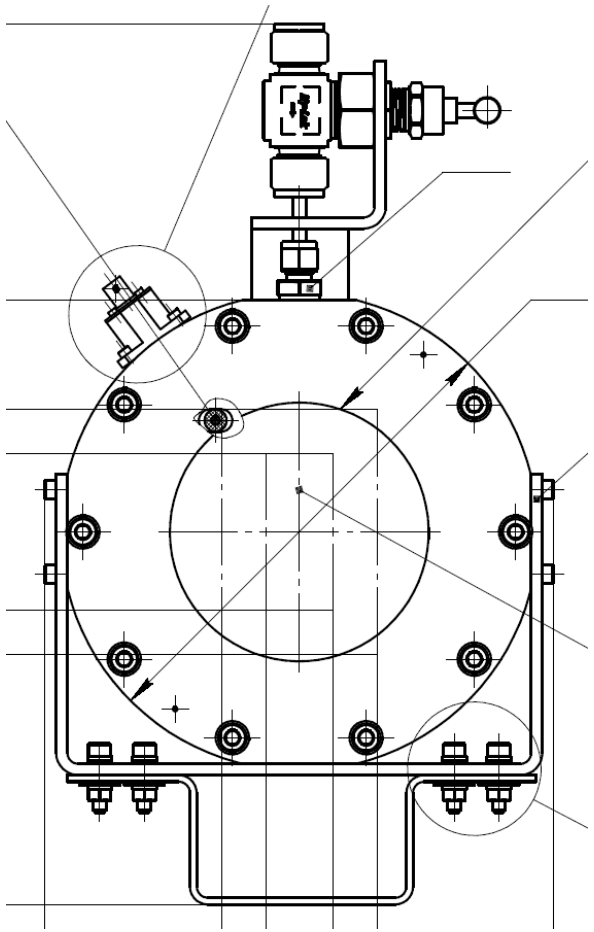
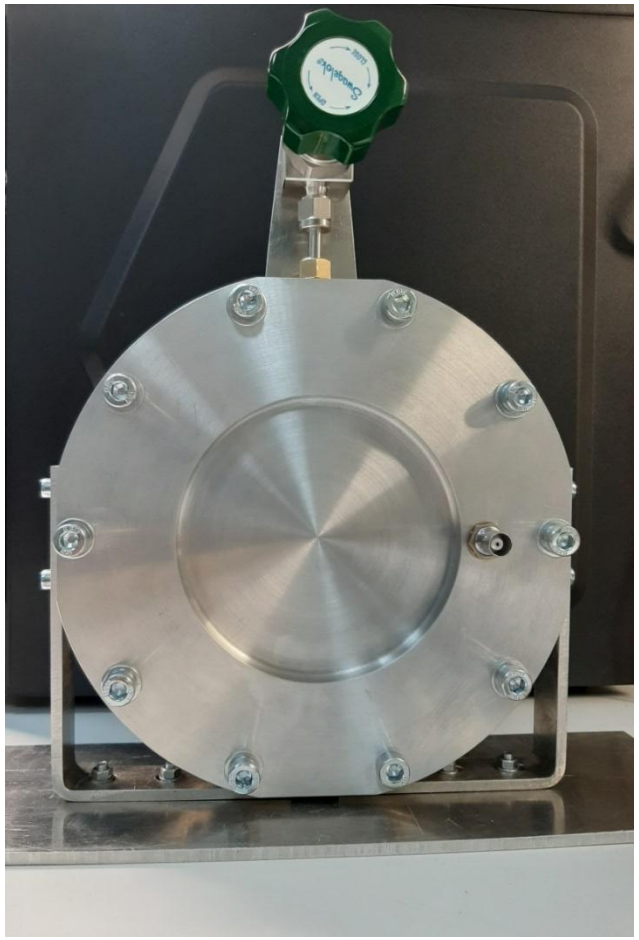
Uranium based neutron monitors

The neutron monitor has been developed on the basis of proportional U-235-based counter:

- Sensitive area: 100x100 mm^2
- Gas pressure: 1 bar
- Count rate: ~1 MHz.
- Efficiency: >0.1% for 1 angstrom.
- Transmission: 98% for 1 angstrom.
- Voltage: ~300 V





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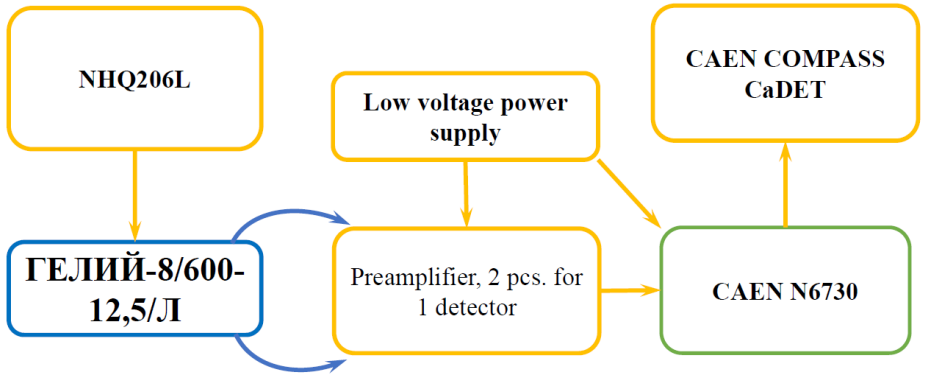
Position-sensitive counters

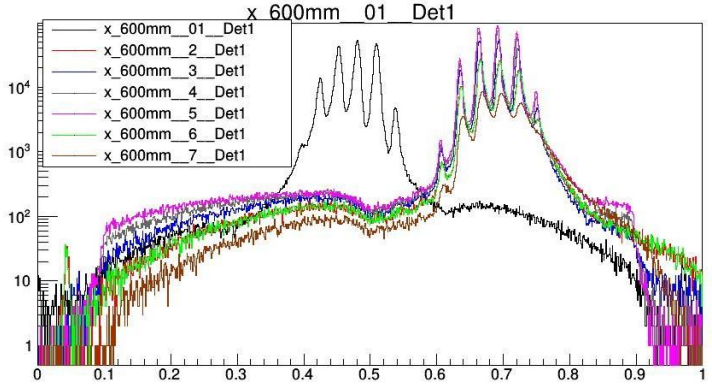
Test scheme 1

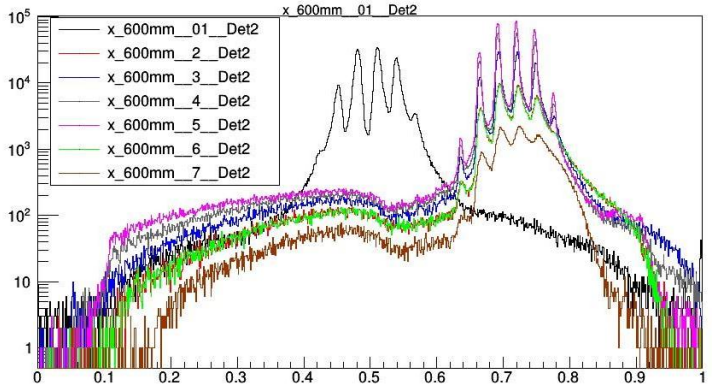


Counter parameters

- Sensitive area: 100-1000*6-30 mm^2
- Pressure: up to 25 bar
- Anode resistance – up to 9.6 kOhms/m

Resolution up to 2 mm





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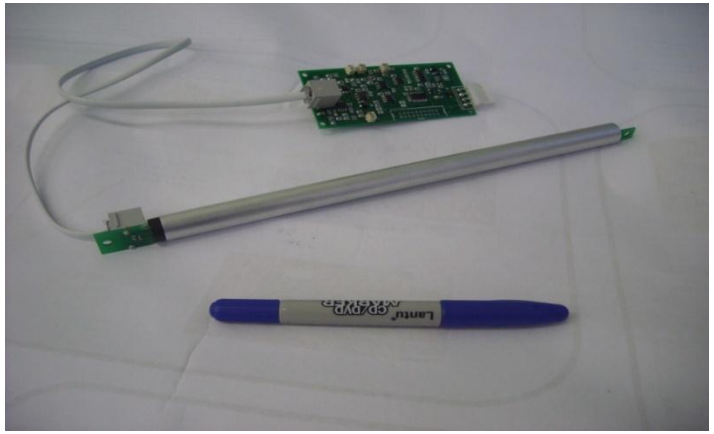
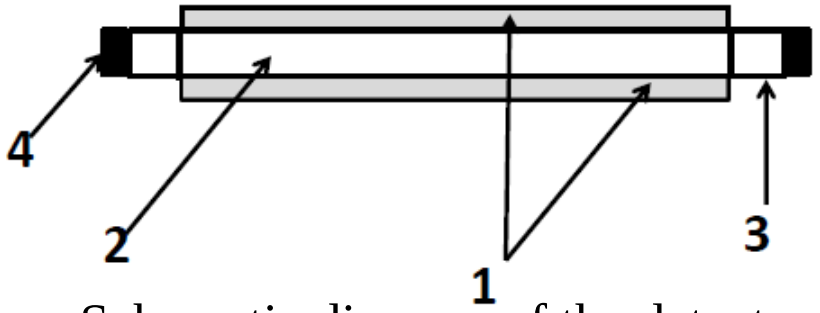
ZnS (Ag) / Li^6F based counters





Schematic diagram of the detector.
1- ZnS(Ag)/LiF scintillator, 2- light guide, 3- focusing prism of the light guide, 4- avalanche photodiode.

Parameters of the counters:

- Sensitive area (5-300)x(2-50) mm^2
- Efficiency 75% for 1.8 angstrom
- Gamma sensitivity < 10^{-5}
- Count rate – 1 MHz per counter

- Low dark noise
- Possible assembling with lack of the blind area
- Do not require high voltage

The detector system for powder neutron diffractometer has been developed and manufactured to be installed on IR-8 reactor in Moscow in 2020. The detector system consist of 160 SiMP-based counters with sensitive area 5x50 mm^2.

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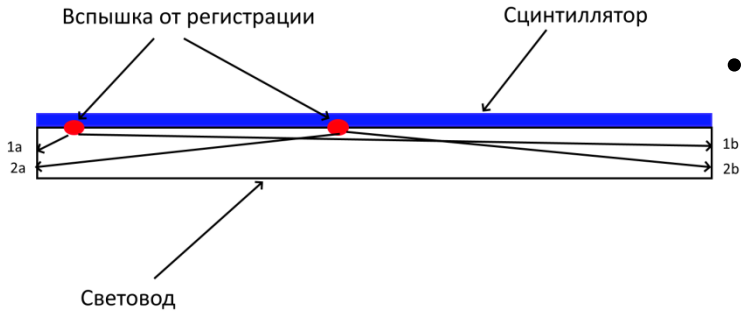
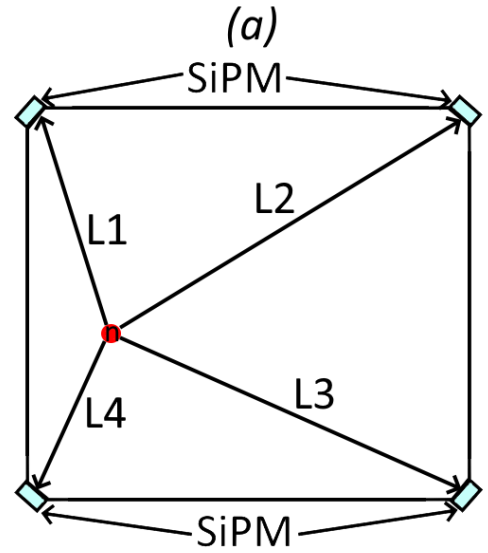
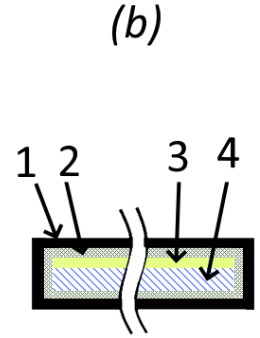
ZnS (Ag) / Li^{6}F based counters

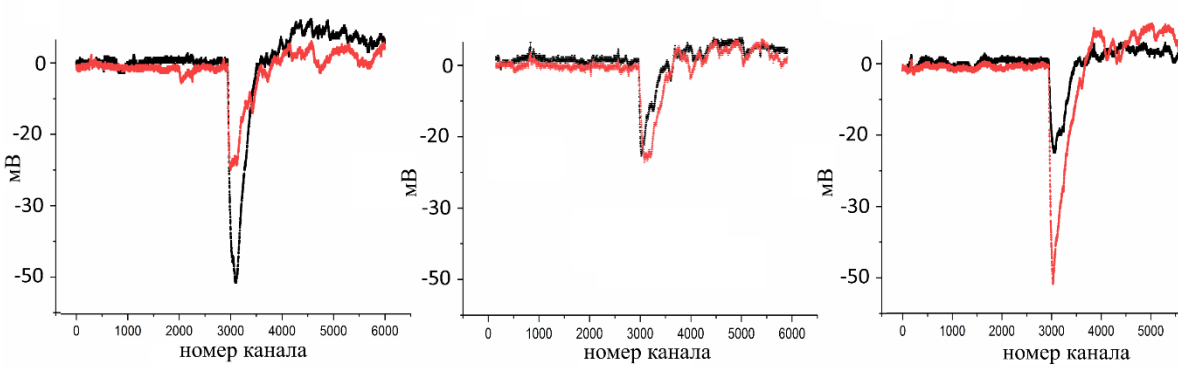


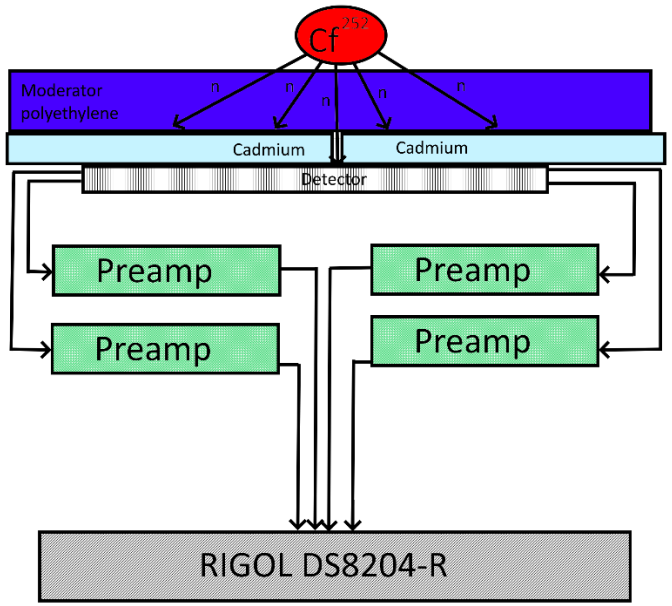
Parameters of the counters:

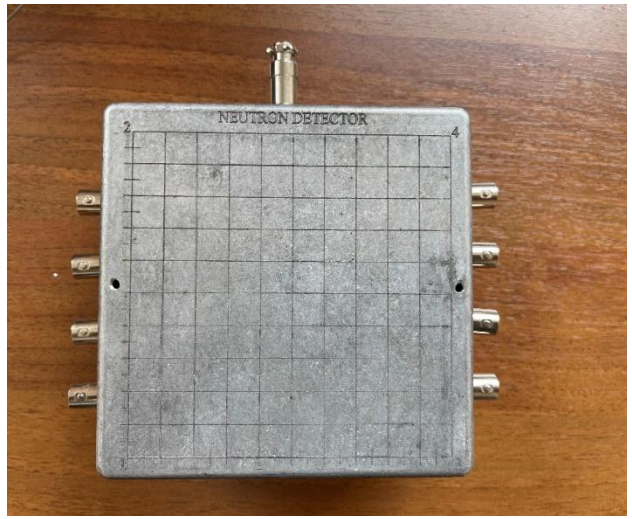
- Sensitive area (5-300)x(5-300) mm^2
- Efficiency 75% for 1.8 angstrom
- Position resolution – 5 mm.











Development of a linear position-sensitive counter

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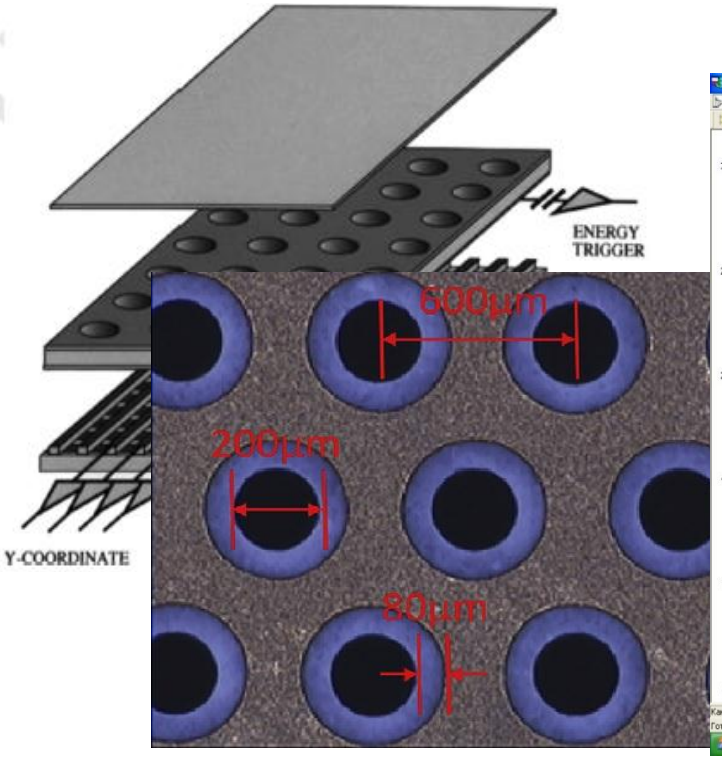
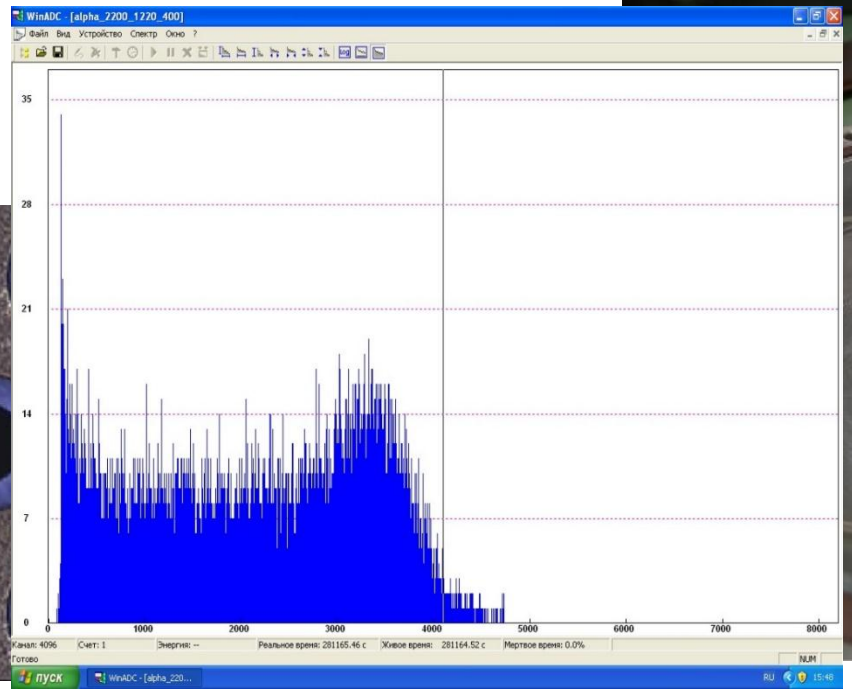
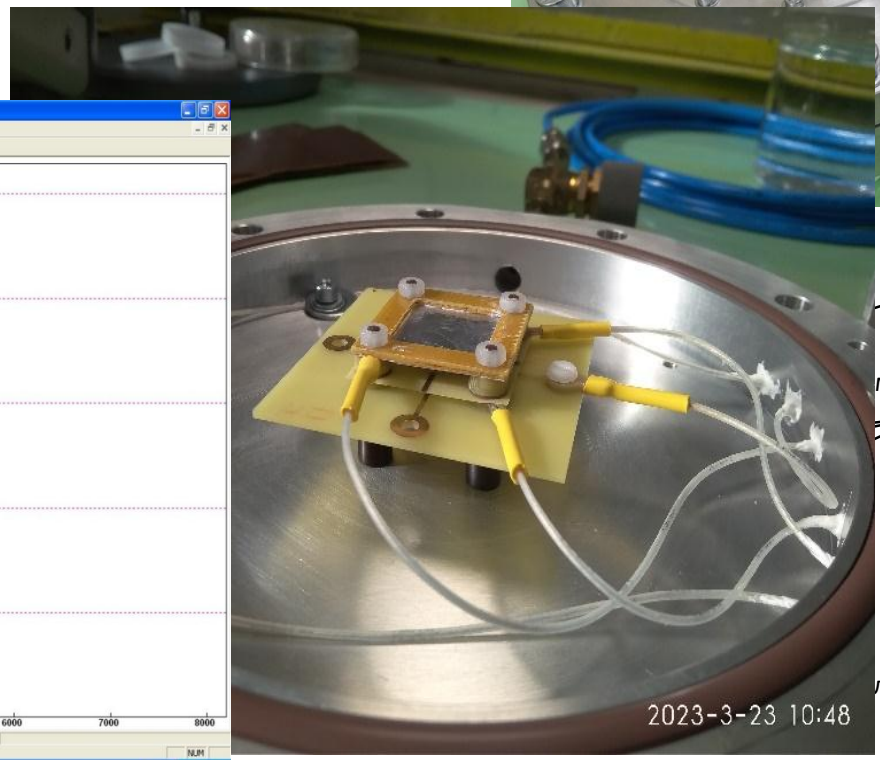
Gas discharge detector with solid state converter

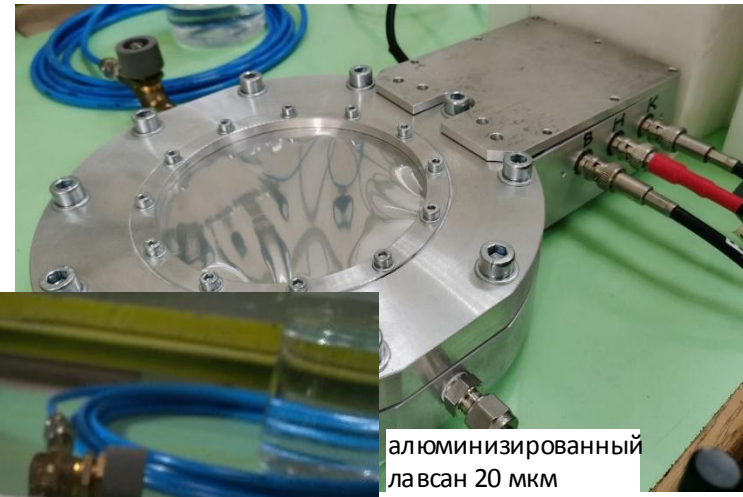
Development, creation and testing of a prototype of a recording gas-discharge module with a solid-state converter with an active area not less than 100×100 mm^2.

Provision of spatial resolution in X, Y, Z coordinates not worse than 1.5×1.5×0.05 mm^3.









алюминизированный
лавсан 20 мкм

напыление карбида
бора 1 мкм

мкм

медная позолоченная
металлизация 15 мкм

лит 1500 мкм

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X-Ray laboratory of EC “NT”
Powder X-Ray diffractometer and X-Ray reflectometer

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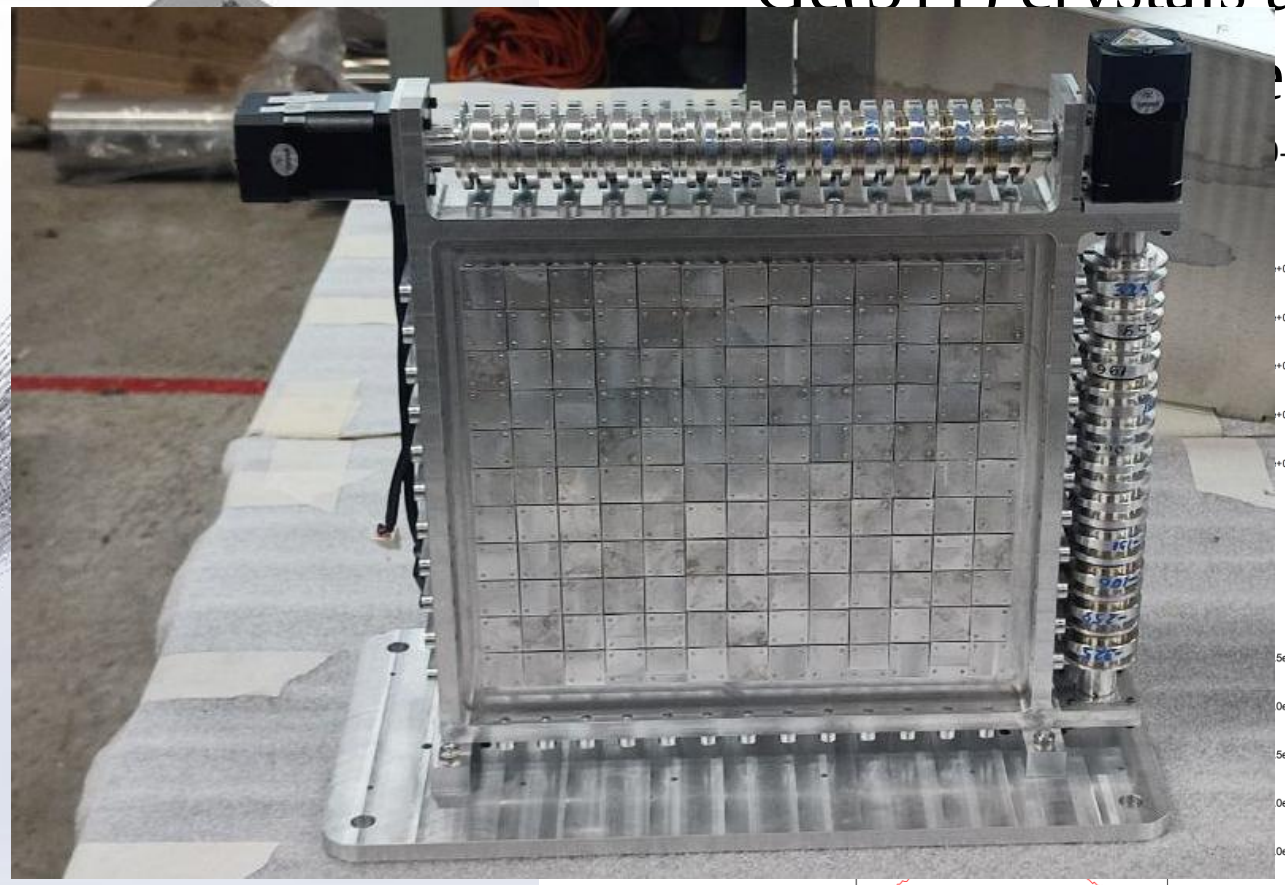
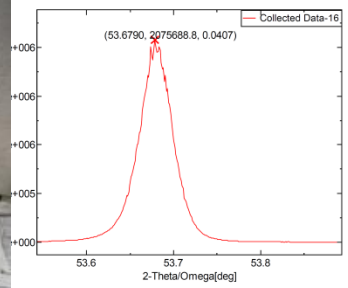
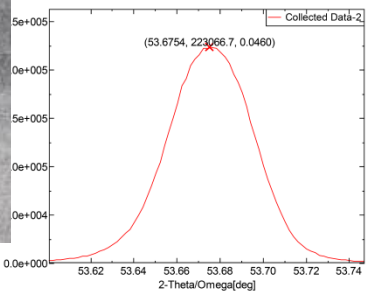
Monochromators for neutron radiation

Ge(311) crystals and focusing

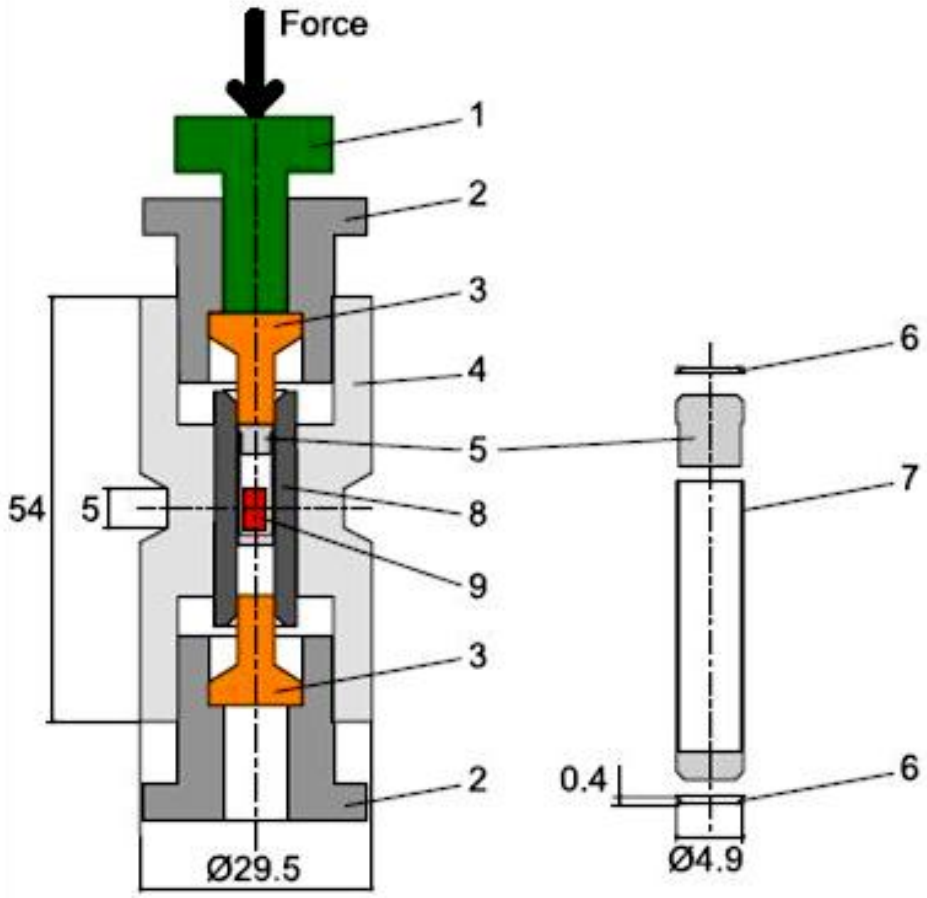




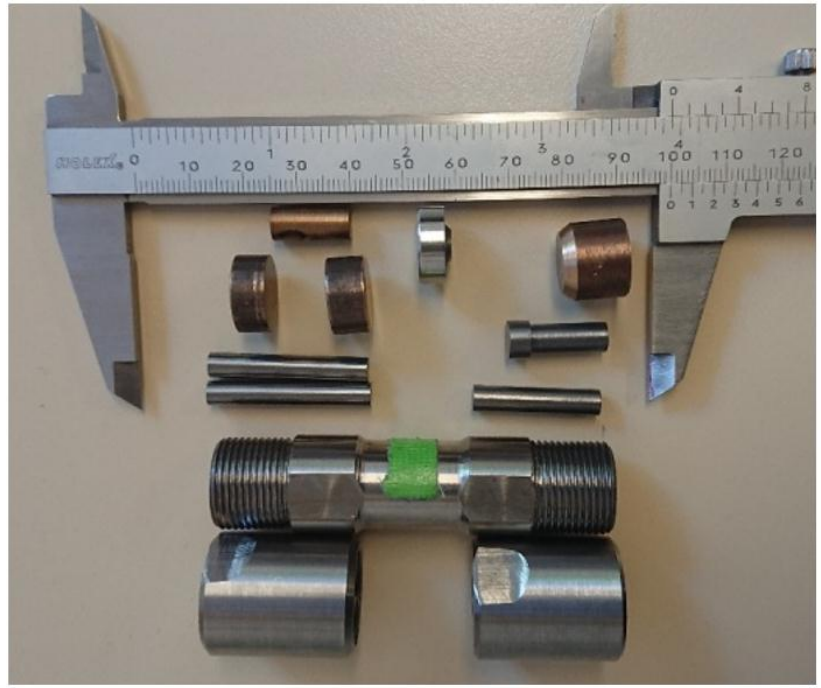
θ-2θ scan, FWHM=82.8



High-pressure chambers



Magnetic and non-magnetic high-pressure chambers for neutron and synchrotron experiments
Maximal pressure level varies with respect to the type of the chamber and reaches 500 kBar



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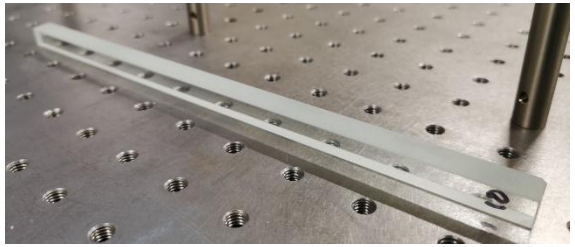
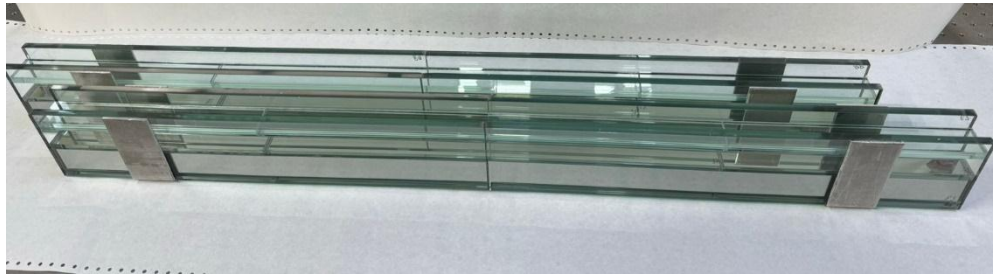
Areas of activity of “Neutron Technologies” LLC, subsidiary of NRC «Kurchatov Institute» - PNPI

“Neutron Technologies” LLC was established in 2018 in Gatchina, Leningrad region, Russia.

Core activity:

- neutron guides of various geometries;
- mirror and super mirror reflective coatings (m<3);
- research equipment and its components;
- components for neutron optics of different levels of complexity;
- neutron monochromators based on single crystals;
- detectors for thermal neutrons (gas and with solid-state converters);
- signal readout electronics and signal processing electronics;
- flippers and components for magnetic systems;
- neutron polarizers and analyzers (m<2.5, P<98%, R>82%);





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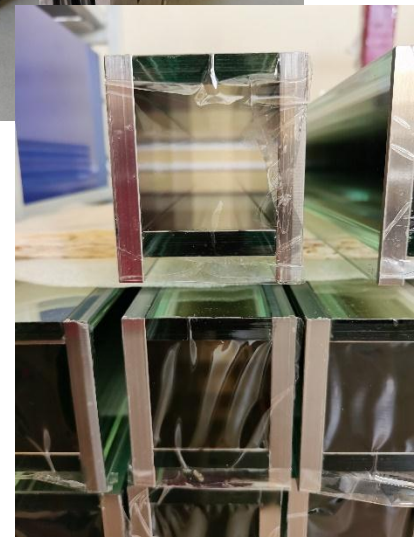
Areas of activity of “Neutron Technologies” LLC, subsidiary of NRC «Kurchatov Institute» - PNPI

Services:

- development of design documentation for technological products;
- full range of engineering services from project development to its launch and reaching design characteristics with a full cycle of testing;
- manufacture of equipment for cold neutron sources;
- glass substrates production.



Distinctive Features of “Neutron Technologies” LLC:

- possibility to manufacture products with limited or no production in Russia;
- development of production for import substitution and reduction of dependence on imports;
- experience in manufacturing of scientific and technical products used in physics research instruments;
- experience in project implementation from the development of design documentation to the finished product.

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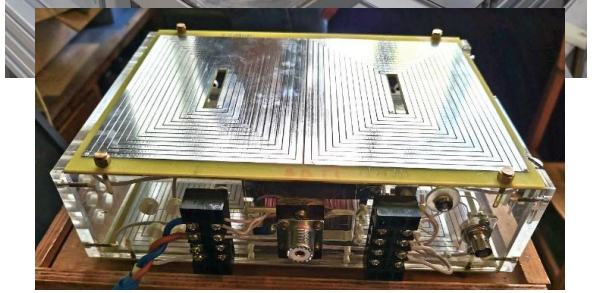
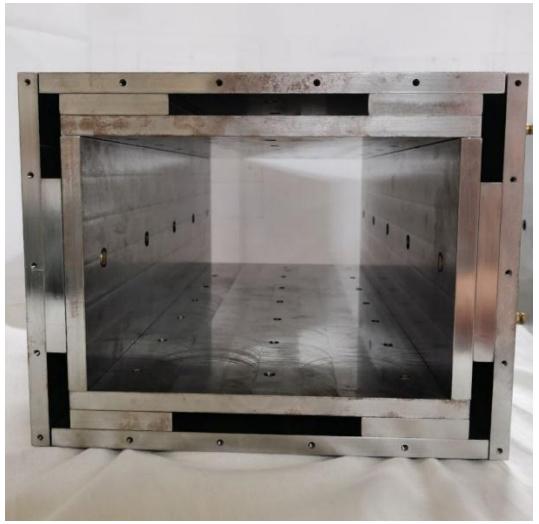
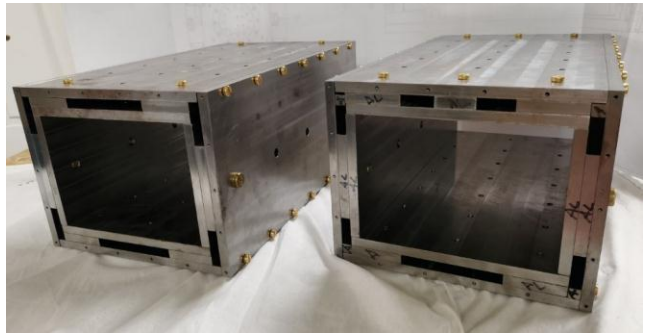
Manufacture of adiabatic radio frequency **spin flippers and electronic equipment for their control, as well as components of magnetic systems (coils, magnets, permanent magnets).**

spin flippers





magnetic system



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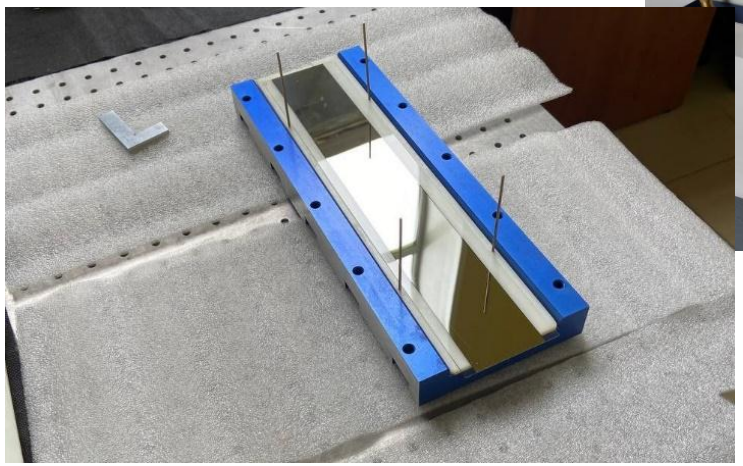
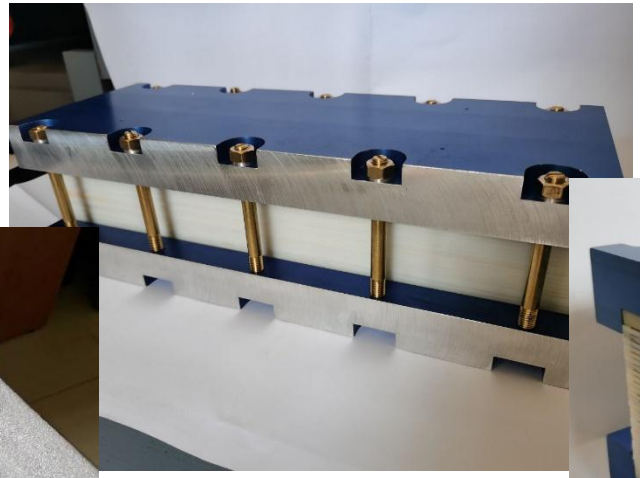
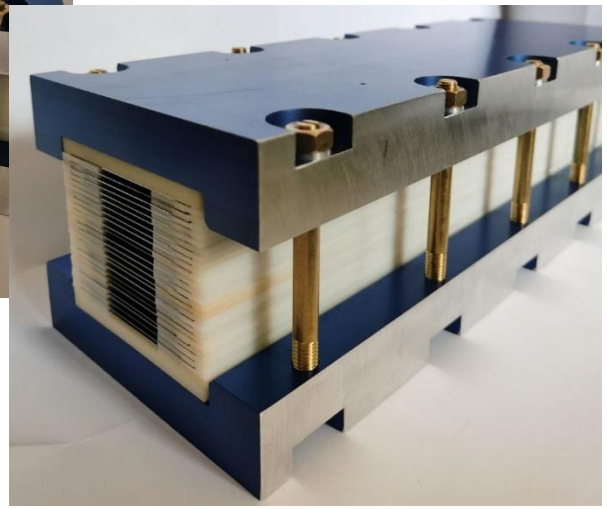
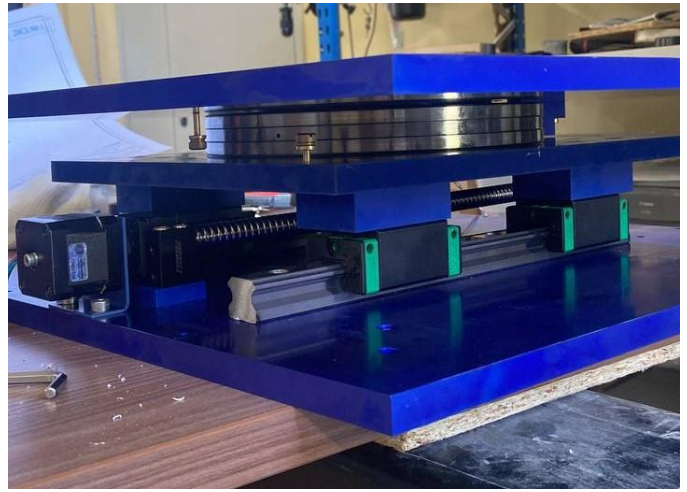
Manufacture of devices for neutron polarization analysis – **neutron polarizers and analyzers**, the key component of which are super mirror polarizing elements.





polarizer





Positioning system

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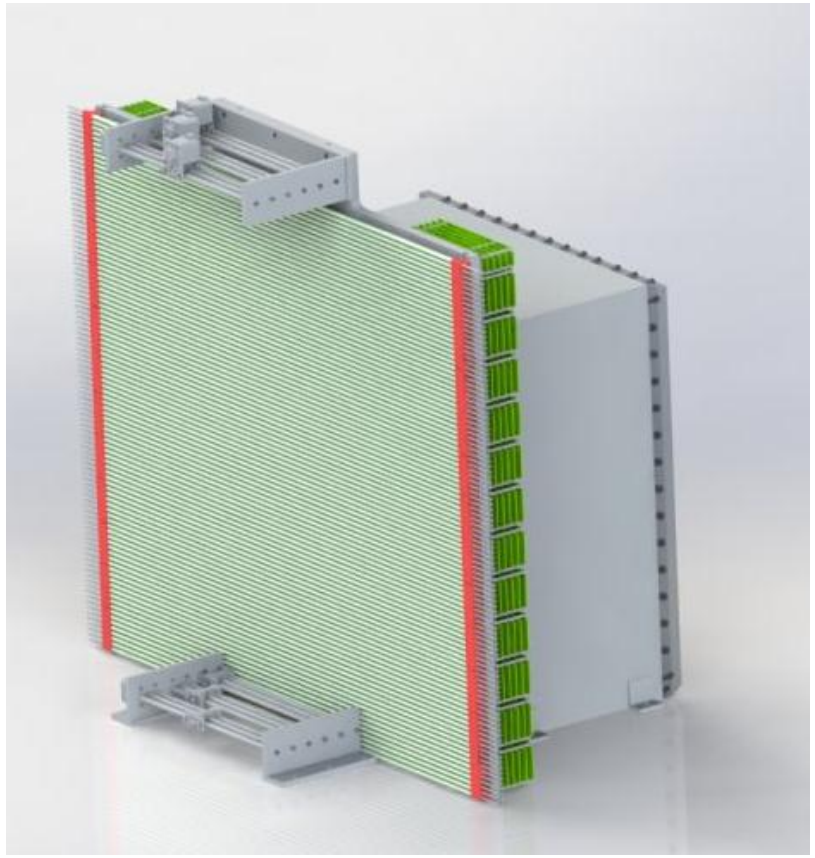
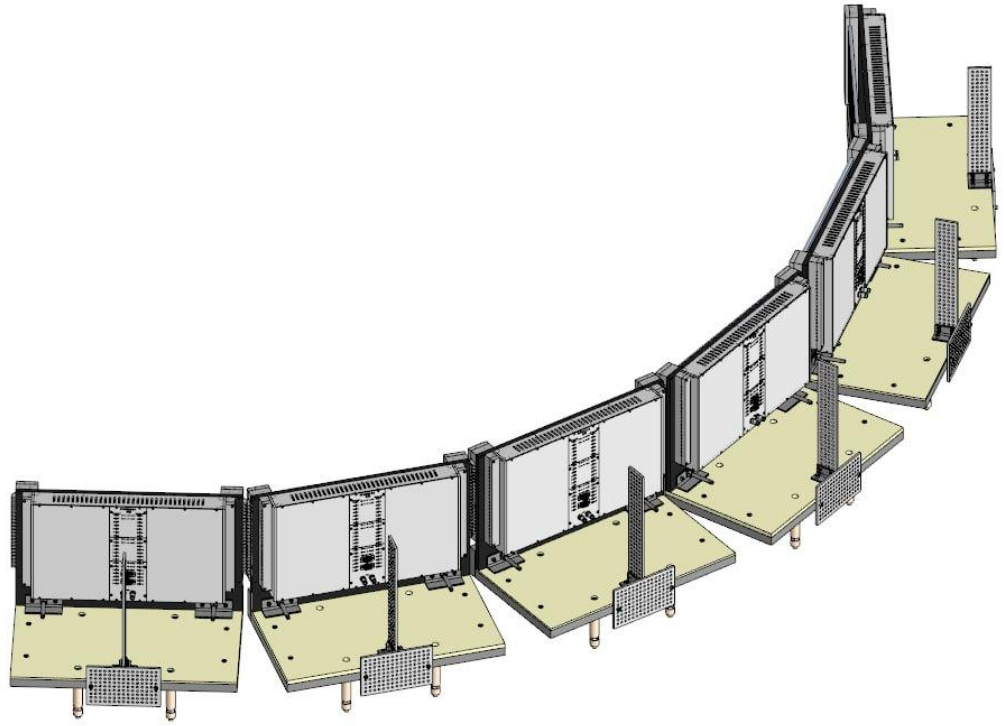
Areas of activity of “Neutron Technologies” LLC, subsidiary of NRC «Kurchatov Institute» - PNPI

Manufacture of neutron detectors for PIK reactor





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Areas of activity of “Neutron Technologies” LLC, subsidiary of NRC «Kurchatov Institute» - PNPI

Manufacture and installation of a neutron guide system for PIK reactor facility

Cold neutron source for IR-8 reactor

Thank you for your attention!

Contacts:
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