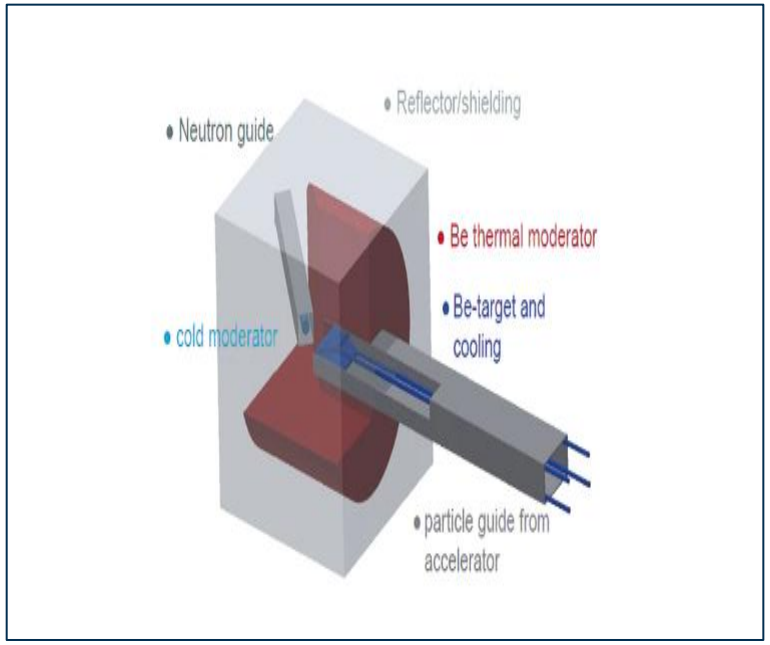

METHANE MODERATOR AT THE JULIC NEUTRON PLATFORM

M. EL BARBARI, JCNS-HBS 24.03.2023

Topics

- High Brilliance Neutron Source HBS
- JULIC Neutron Platform a technology test facility
- December 2022's beam-on-target
- Low Dimensional Cold Moderator LDCM
- Results
- Outlook

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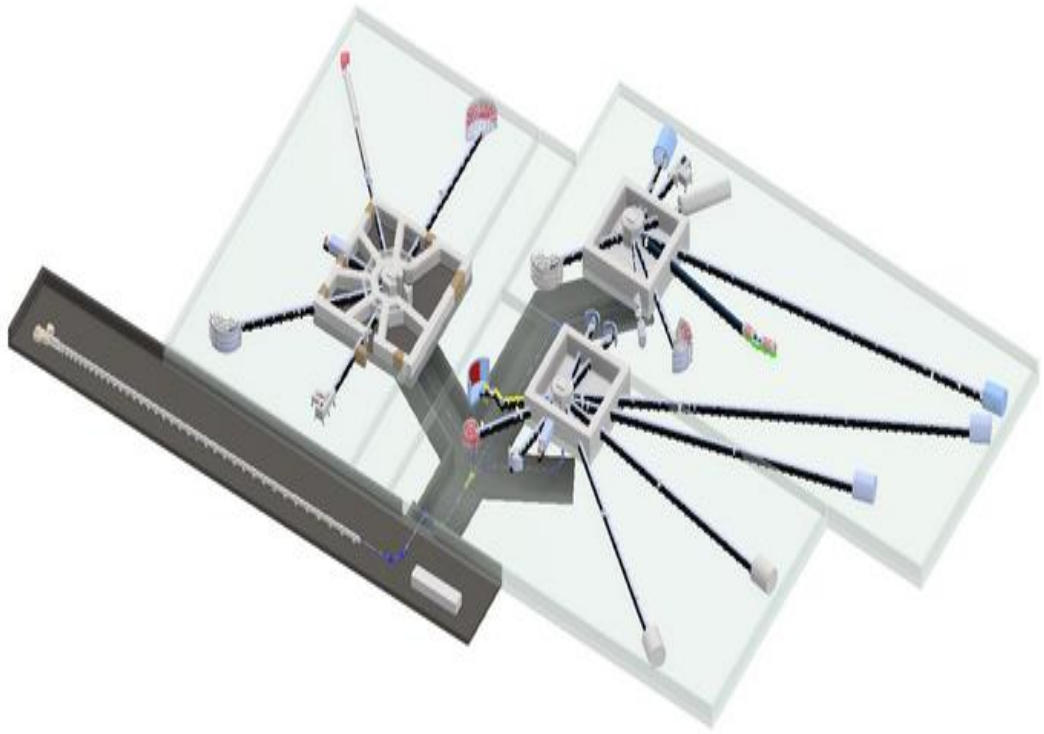
High Brilliance Neutron Source

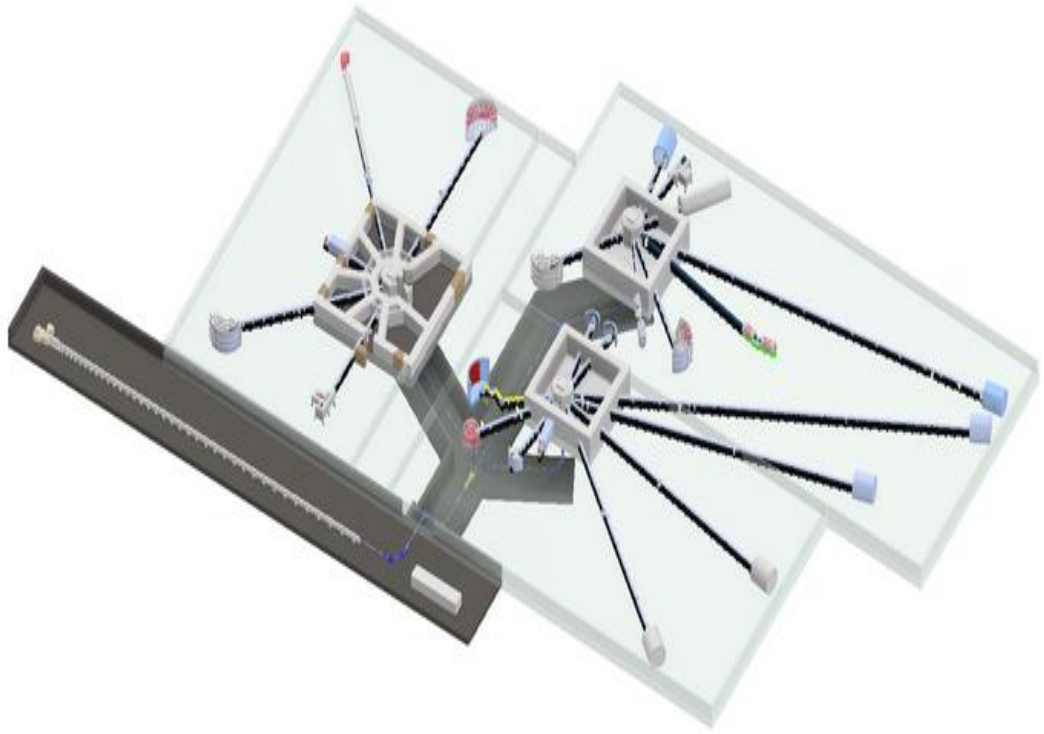
- Neutron beams optimized for brilliance

- Flexible neutron infrastructure



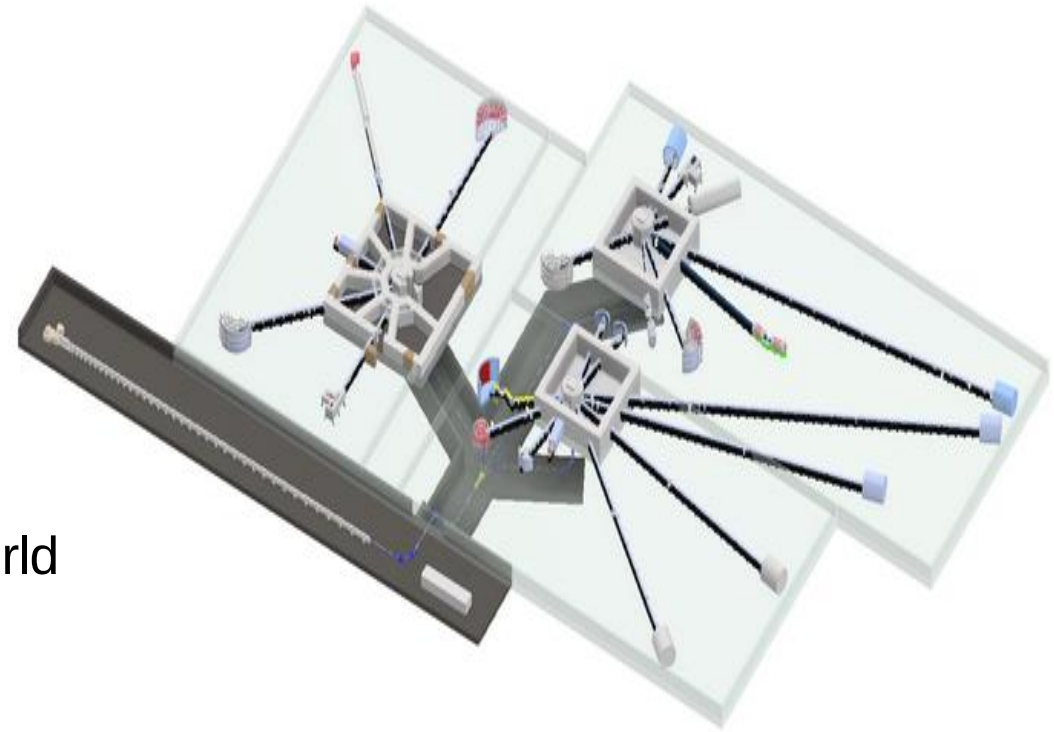
High Brilliance Neutron Source - Responsibilities

- Changing the paradigm of neutron facilities
- Offering a cost-efficient neutron production
- Scalable and flexible
- Based on green technology



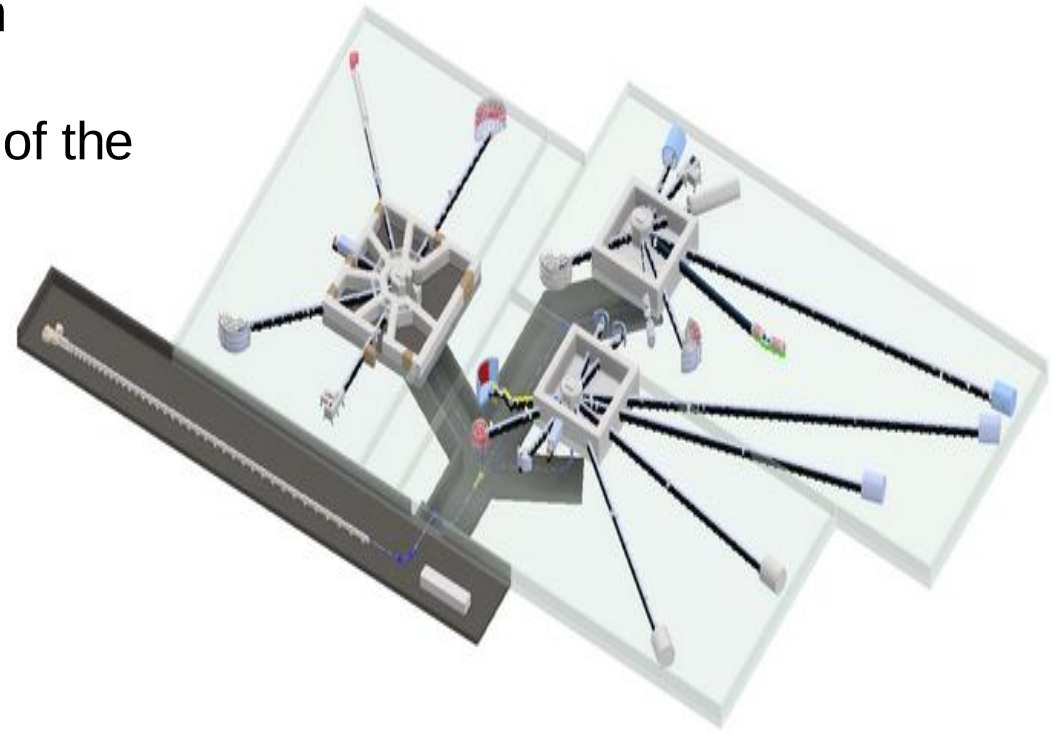
High Brilliance Neutron Source - Responsibilities

- Allow sustainable and energy-saving operation
- Adapted to regional or national requirements
- Can serve thousands of users from all over the world



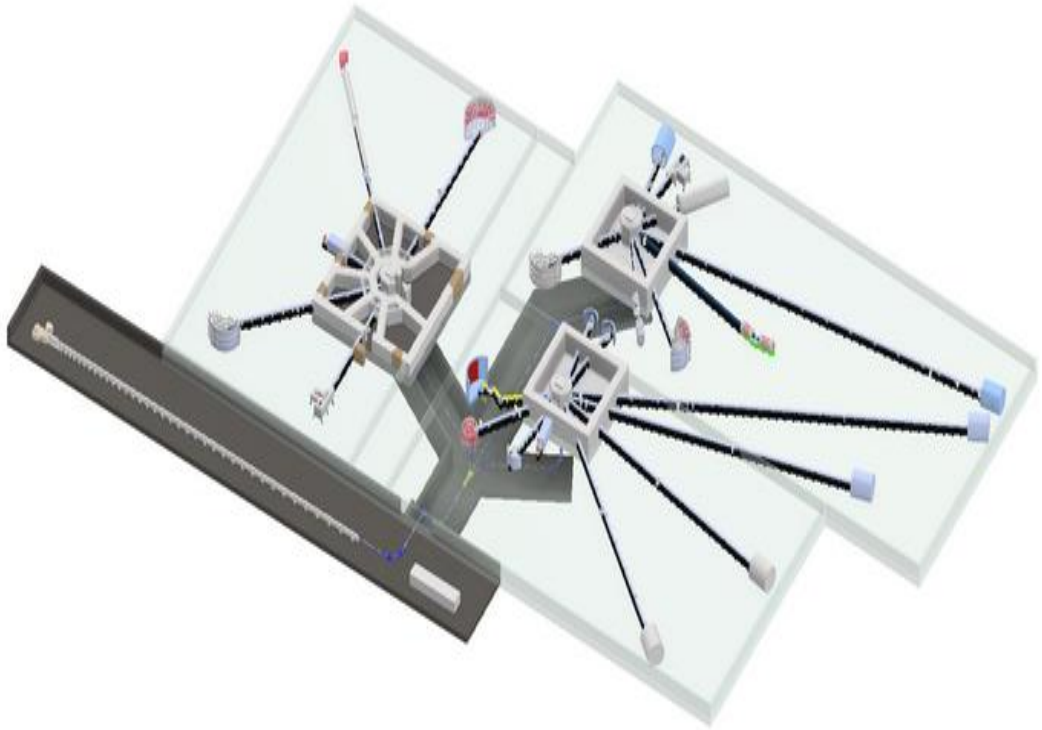
High Brilliance Neutron Source – Main advantages

- At the HBS each instrument can be provided with an individual cold source designed to the specific need of the corresponding instrument
- The shape of the cold source can be adapted to the beam size and divergence desired at the sample position
- The temperature and material can be chosen to fulfill the spectral demands of the experiment.



High Brilliance Neutron Source

https://www.fz-juelich.de/en/jcns/jcns-2/expertise/high-brilliance-neutron-source



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JULIC Neutron Platform as a technology test facility

- JULIC

  - JUeLich Isochronous Cyclotron

  - 1967 –> today

  - p : 45 MeV, ca. 10 µA

  - d : 70 MeV

  - Pulses 50 µs – 1.9 s, flexible rep.rate

JULIC Neutron Platform as a technology test facility

- COSY

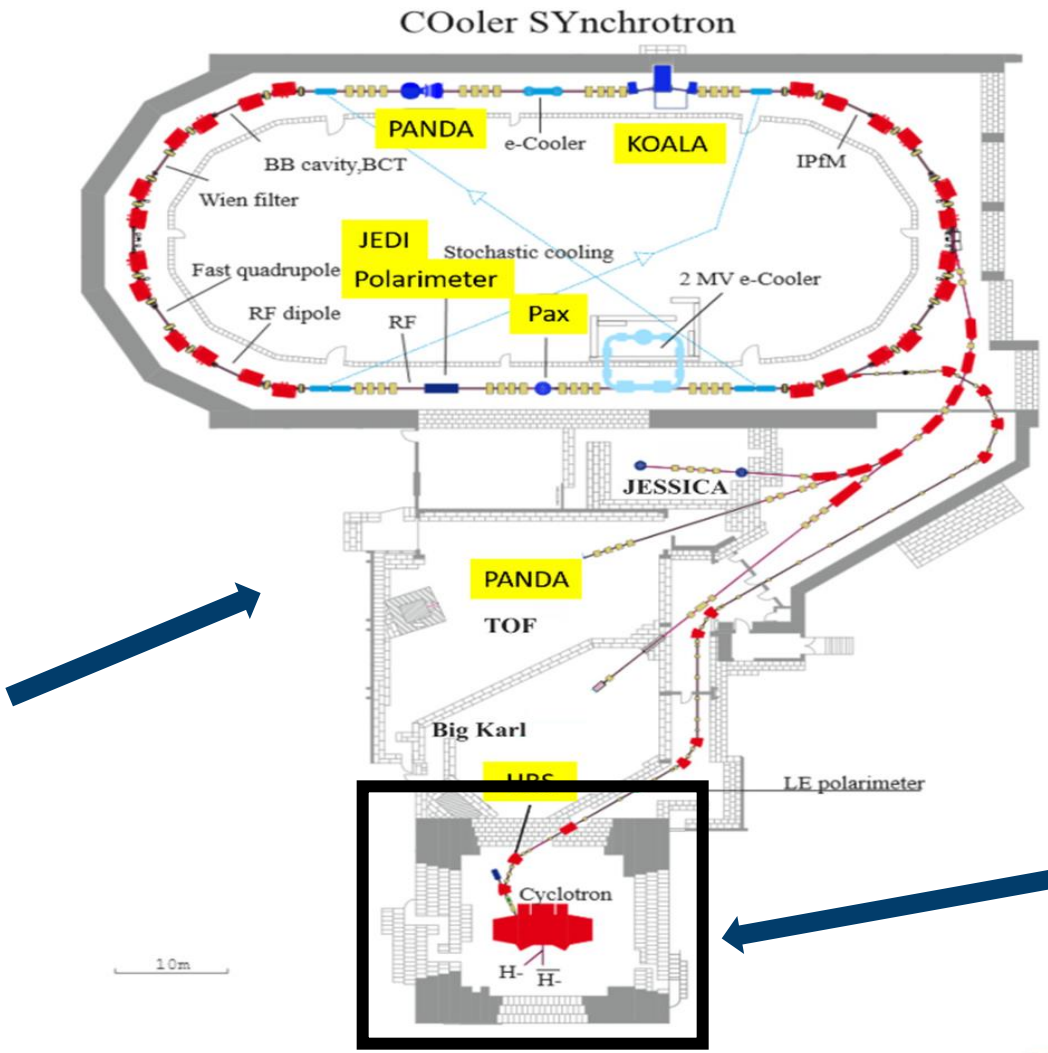
  - COoler SYnchrotron

  - 1993 –> today

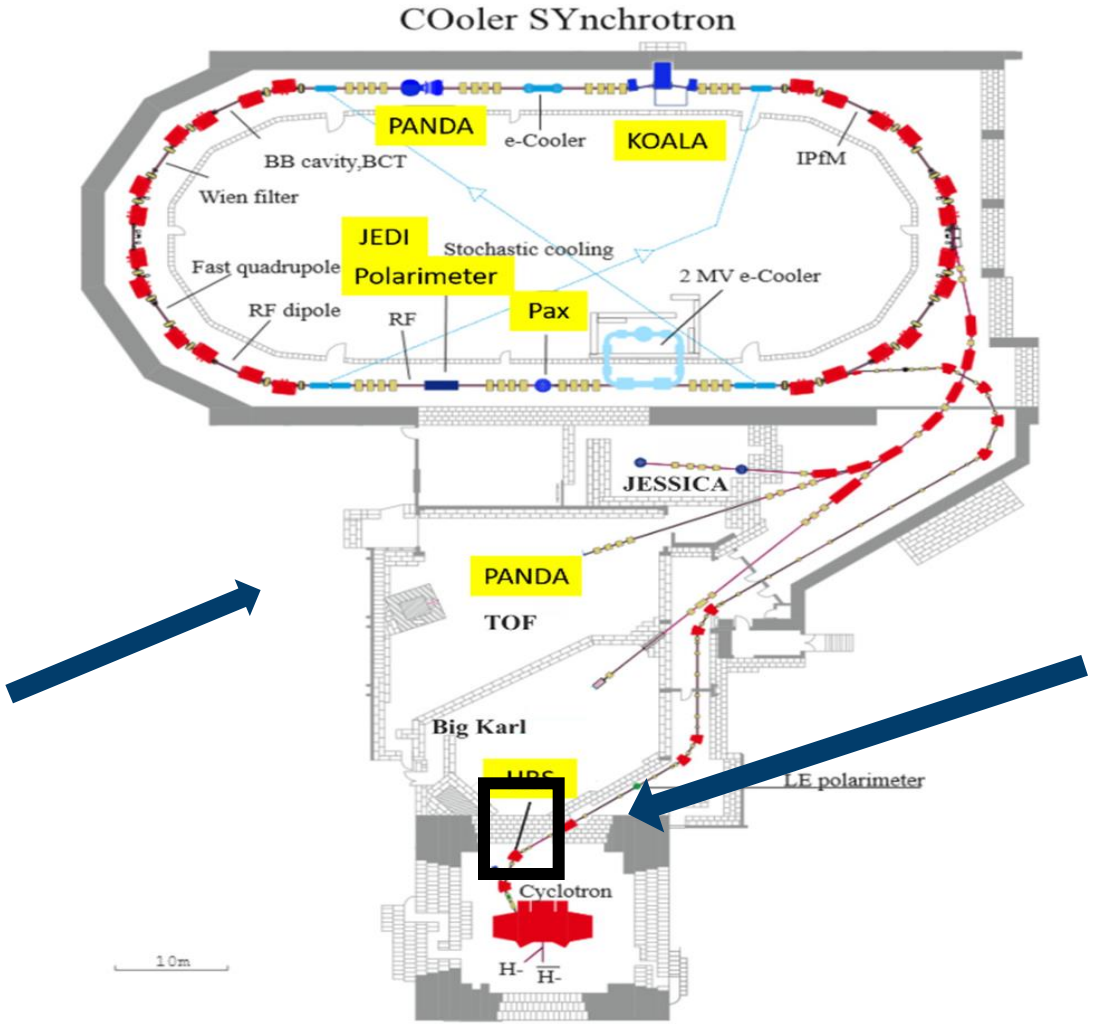
  - 200 – 2880 MeV

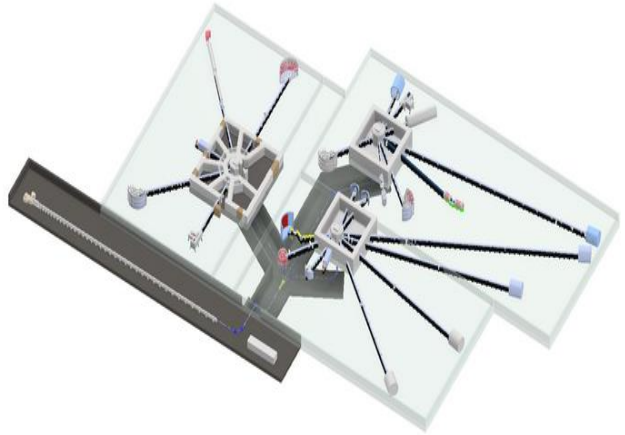
  - rep. rate 0.5 Hz

JULIC Neutron Platform as a technology test facility

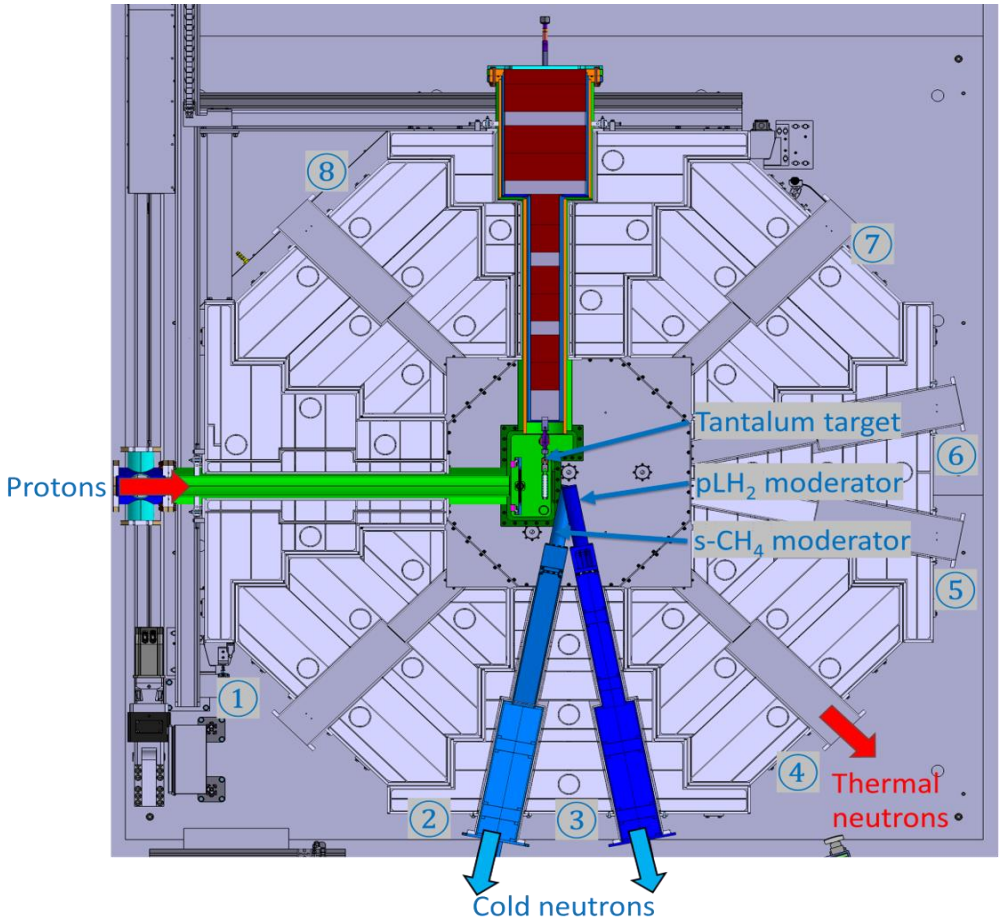


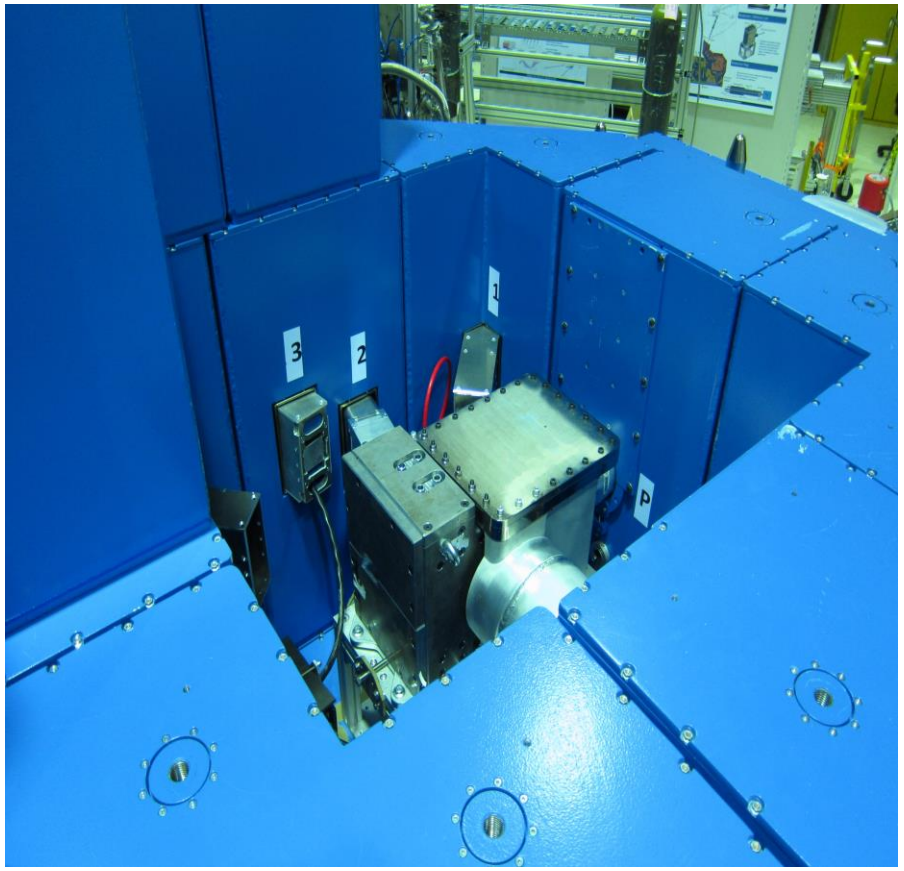
JULIC Neutron Platform as a technology test facility





JULIC Neutron Platform as a technology test facility





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December 2022’s beam-on-target

- On 12 December 2022
- Protons delivered by IKP's JULIC cyclotron produce the first neutrons at the tantalum target developed for the HBS project at TMR
- Experimental test station for a High Current Accelerator-driven Neutron Source (HiCANS)
- In the "Big Karl" area of the Institute of Nuclear Physics (IKP)

December 2022’s beam-on-target

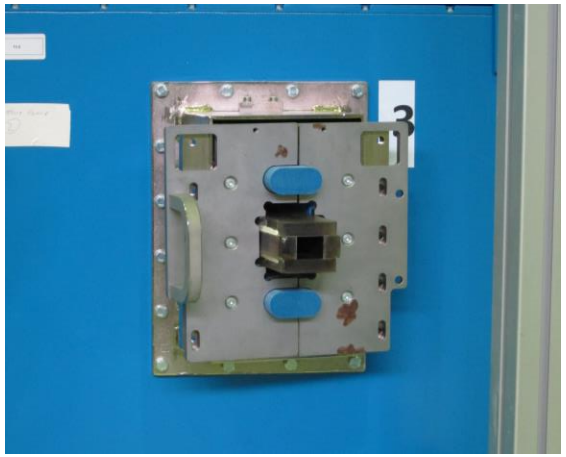
- HERMES

The former HERMES time-of-flight reflectometer was transferred from Saclay to Jülich and installed in the Big Karl to demonstrate the performance of a reflectometer at a pulsed neutron source based on an accelerator.

Courtesy of Dr. U. Rücker

December 2022's beam-on-target

HERMES assembly and optical alignment



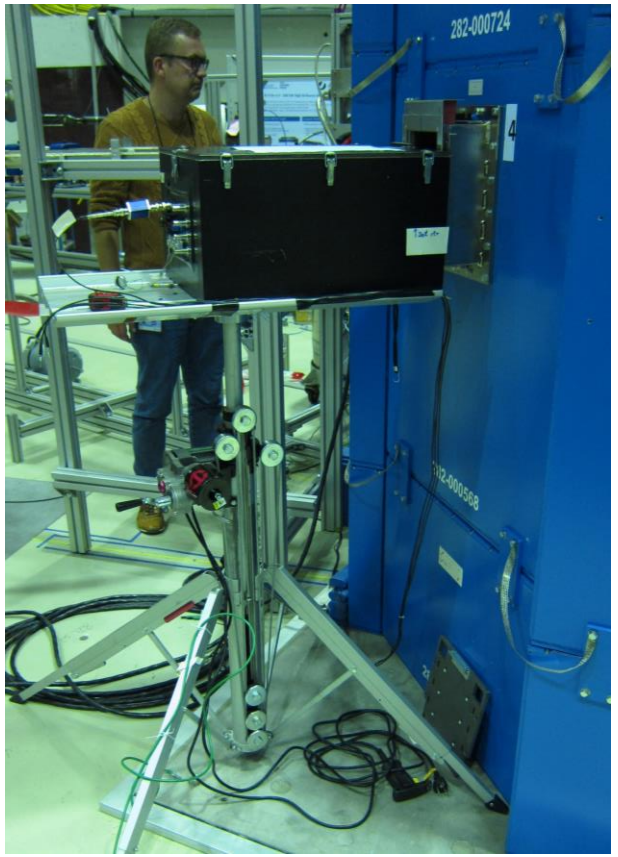
Beamline 3

December 2022's beam-on-target

- PSD Test beam

A test on the SONDE detector meant to be installed at the ESS

- Pixel size: 6 x 6 mm²
- Time resolution of 50 µs

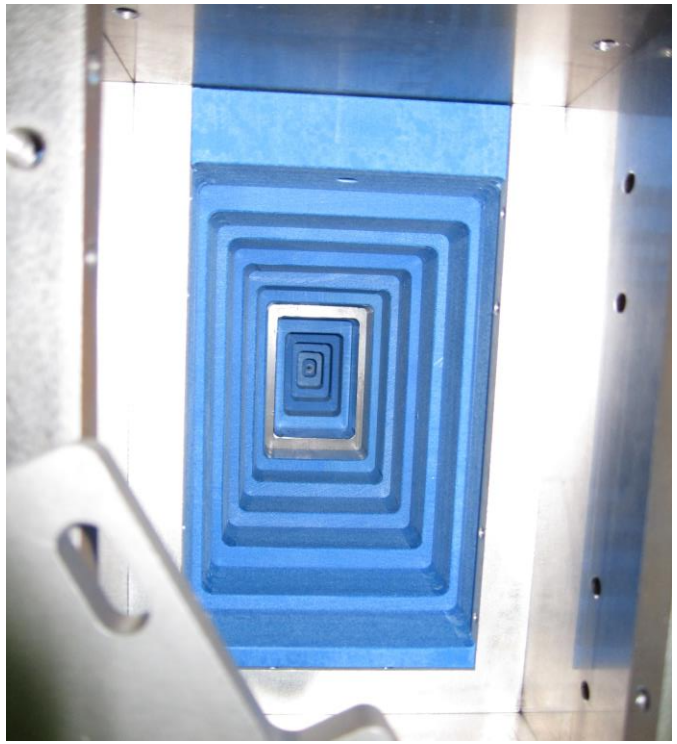


Courtesy of Dr. U. Rücker

December 2022's beam-on-target

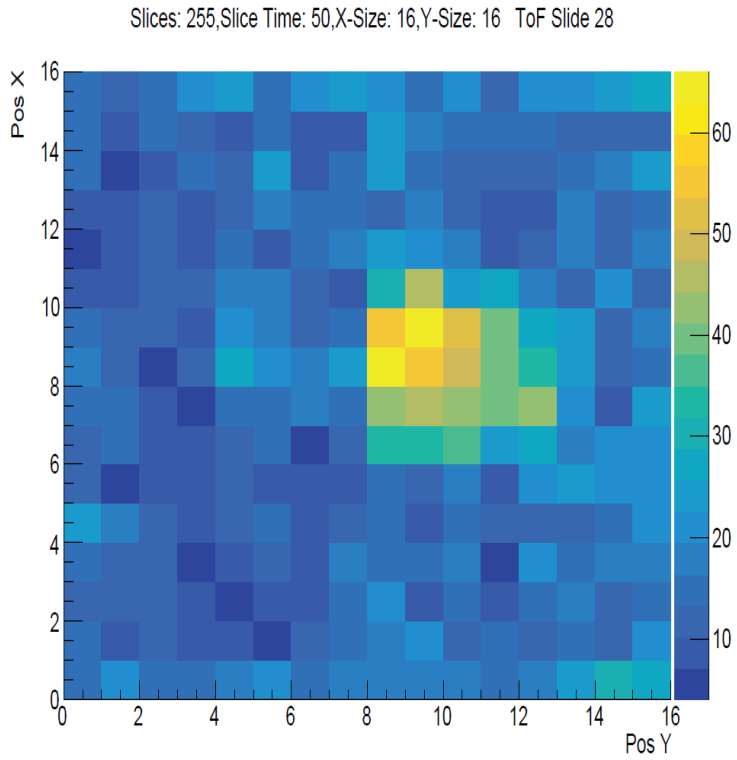
- PSD Test beam

Camera pinhole 5 mm Ø installed in face of the thermal extraction channel

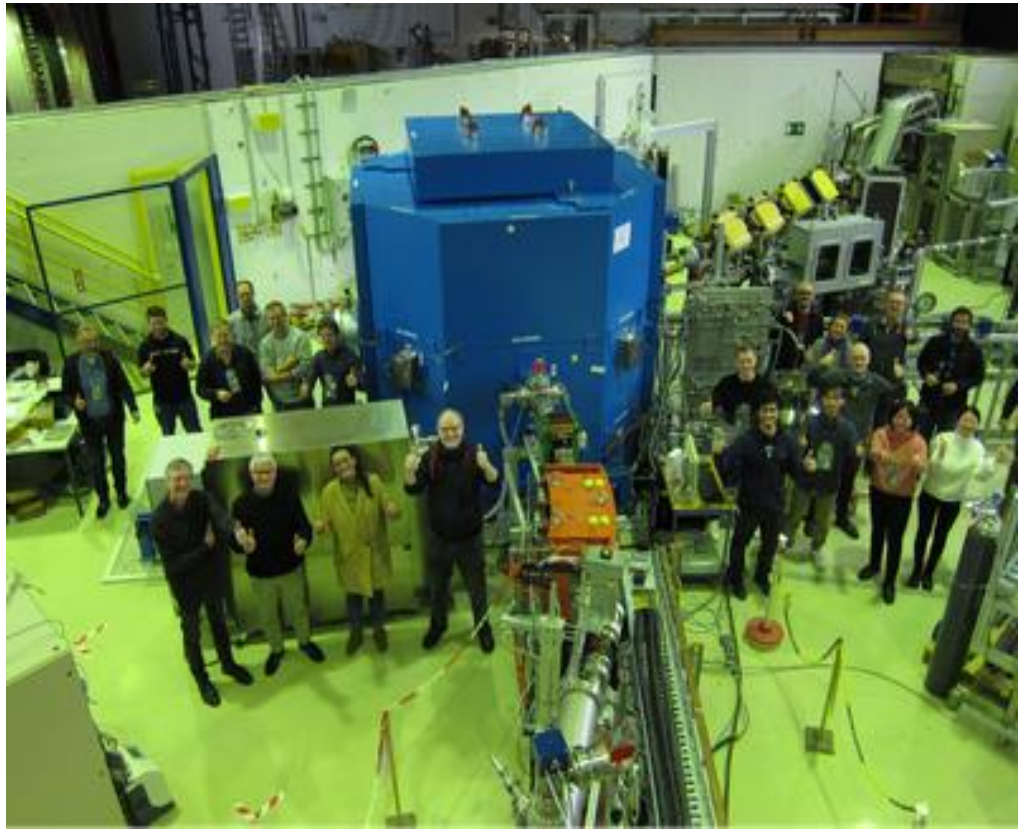


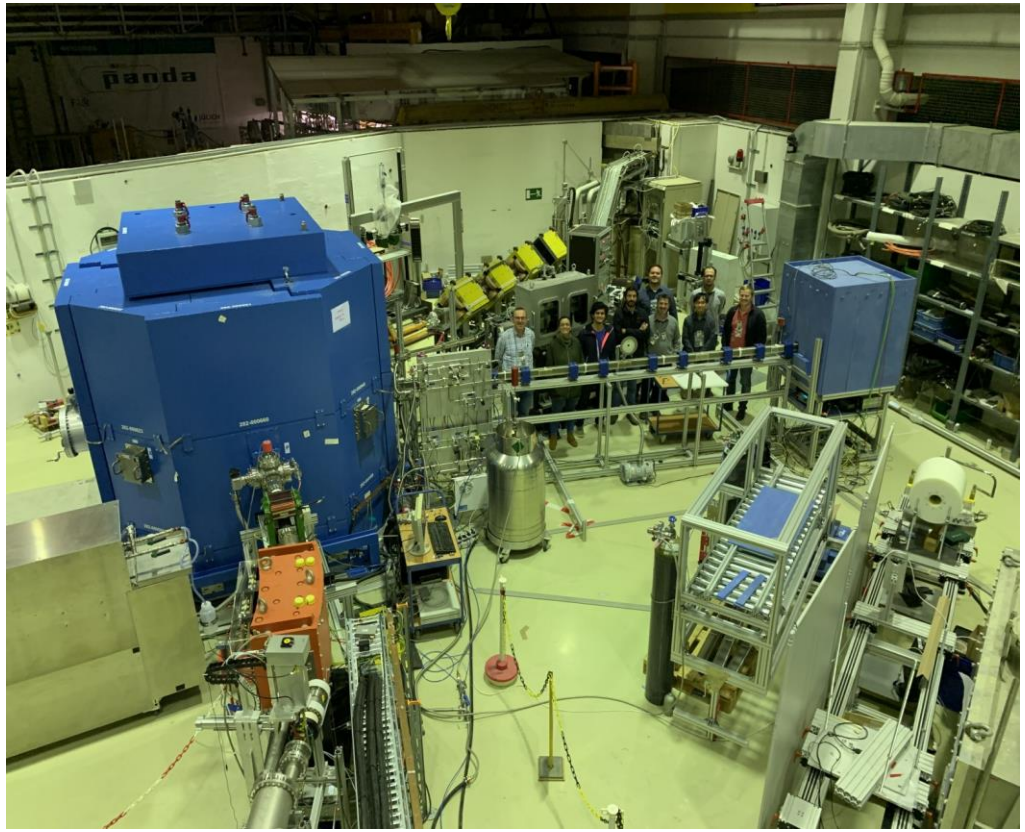
Time-of- flight

image at 1.4 ms



December 2022’s beam-on-target





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Low Dimensional Cold Moderator

- Methane moderator

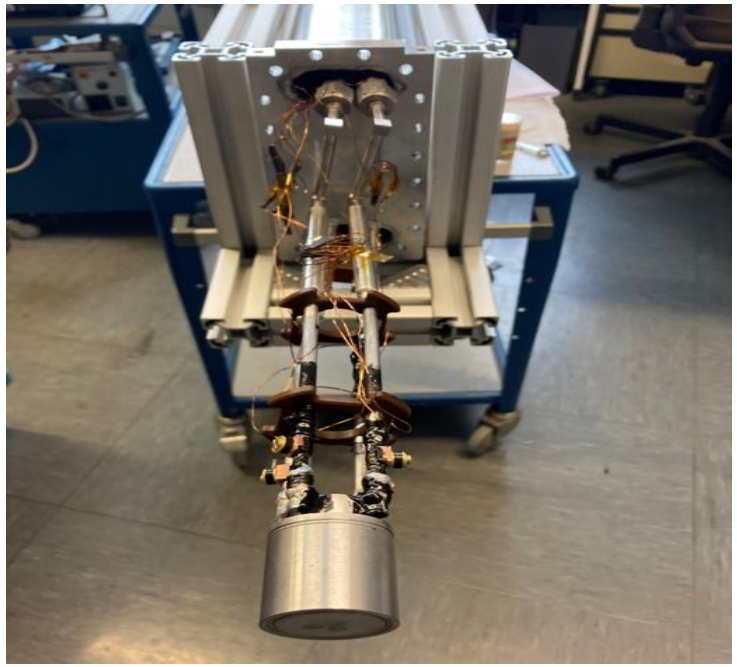
  - Solid methane generally shows the highest neutron flux

  - Poor thermal conductivity

Cantargi and Granada (2010)

Low Dimensional Cold Moderator

Methane moderator



Courtesy of Dr. U. Rücker

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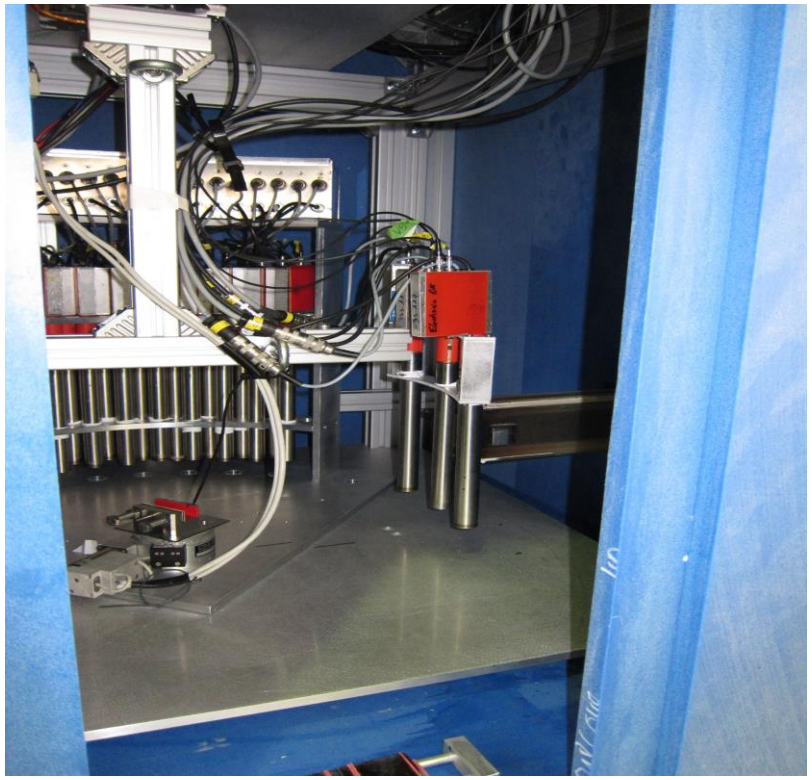
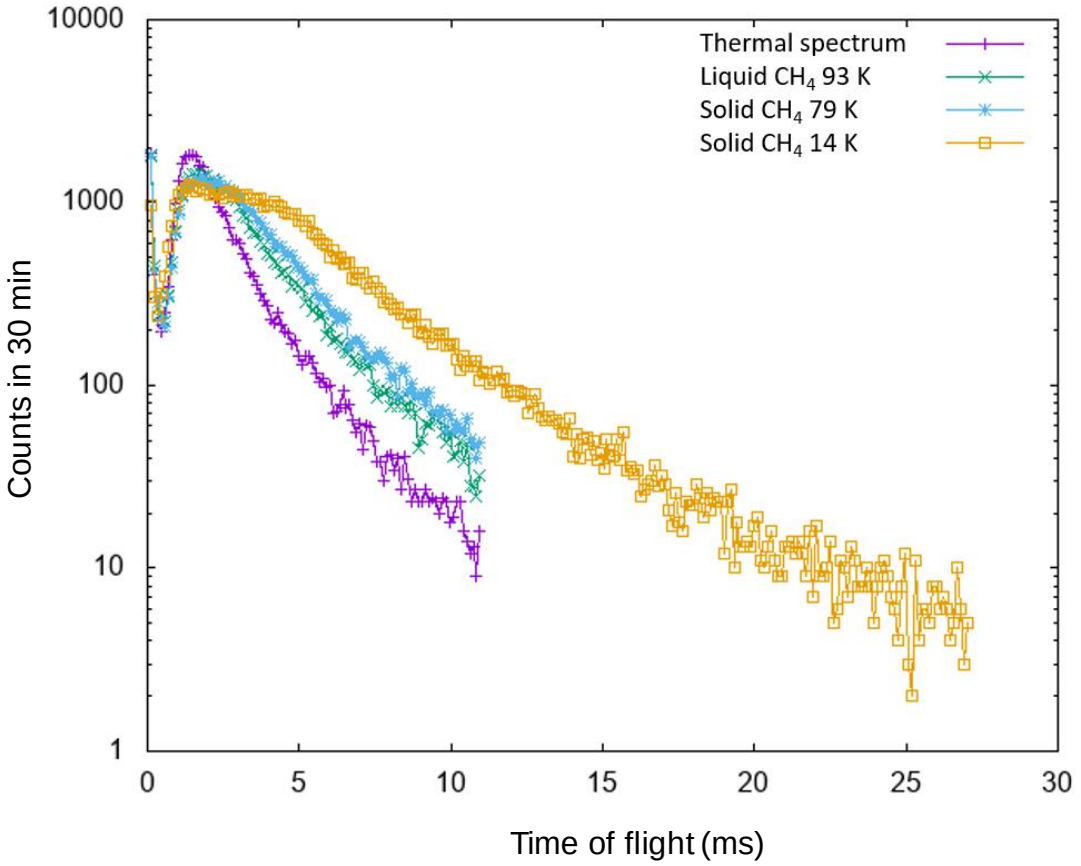
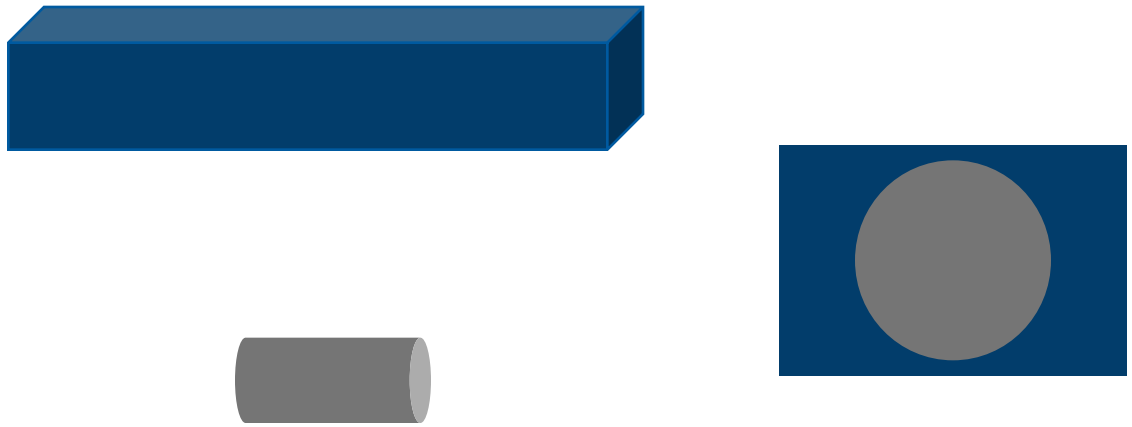
Results

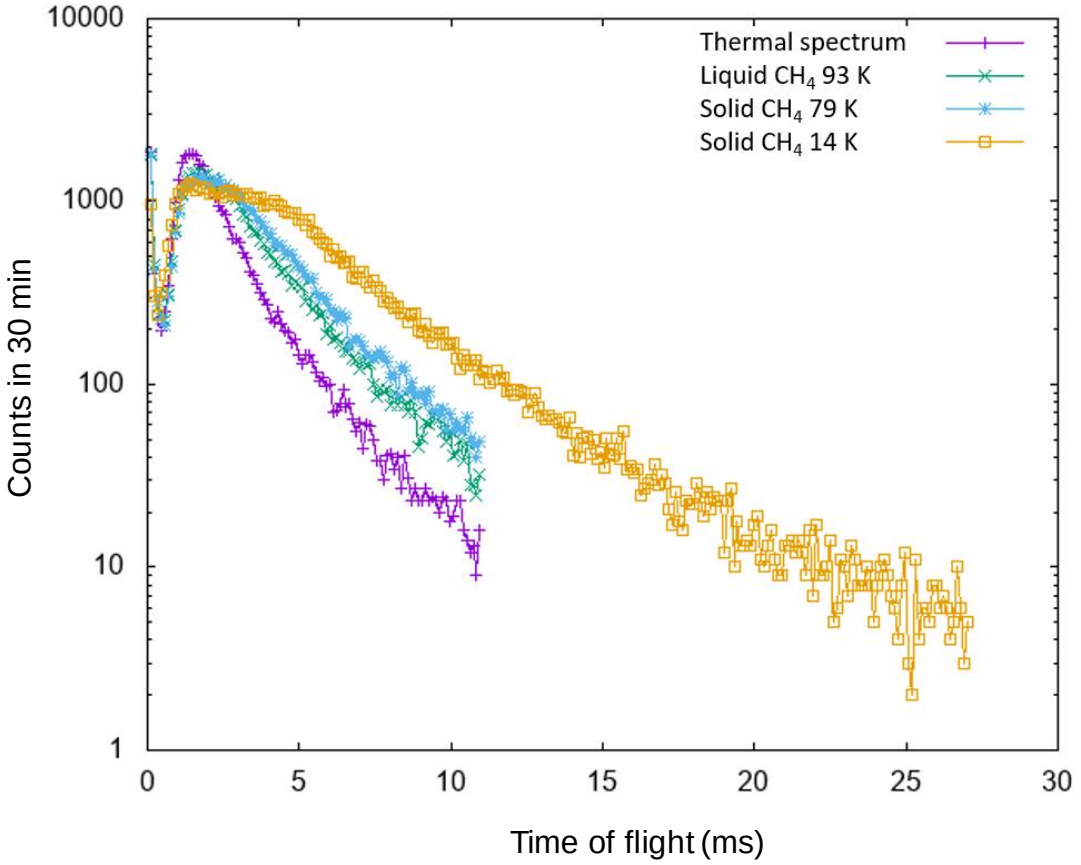



Thermal spectrum
Liquid CH_4 93 K
Solid CH_4 79 K
Solid CH_4 14 K
Counts in 30 min
10000
1000
100
10
1
0
5
10
15
20
25
30
Time of flight (ms)

Results

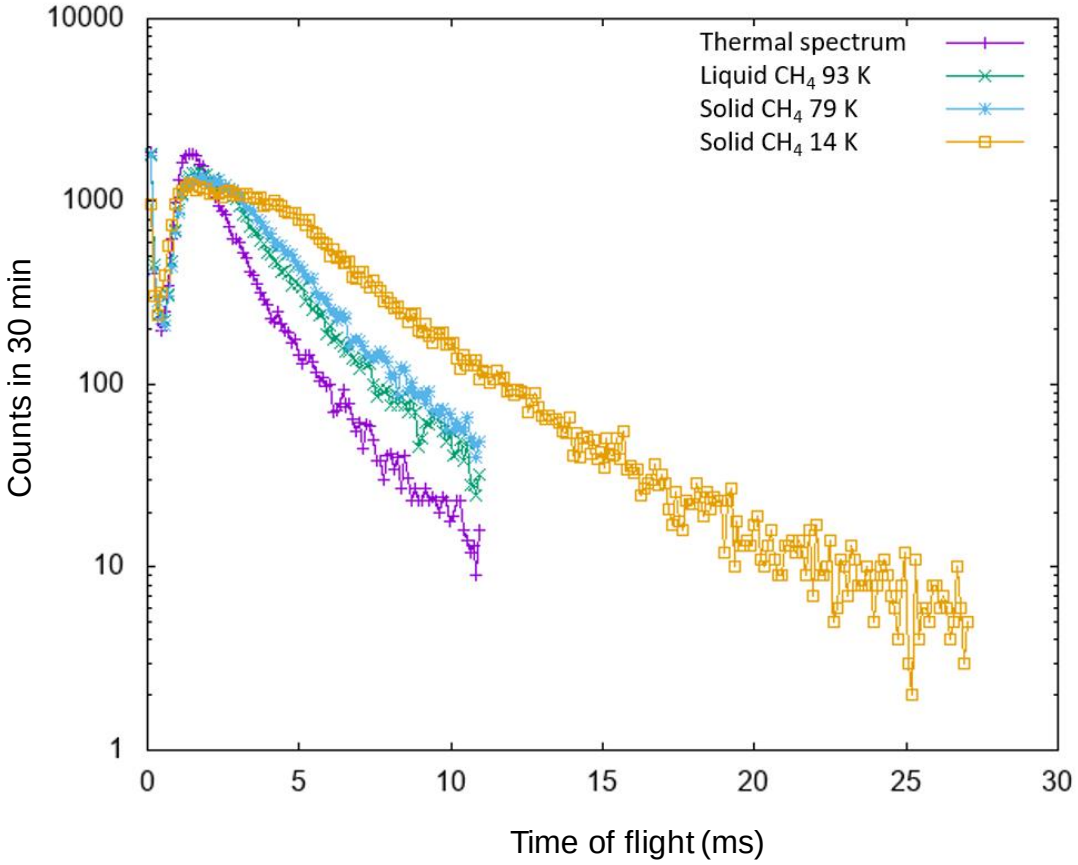
- Geometry corrections



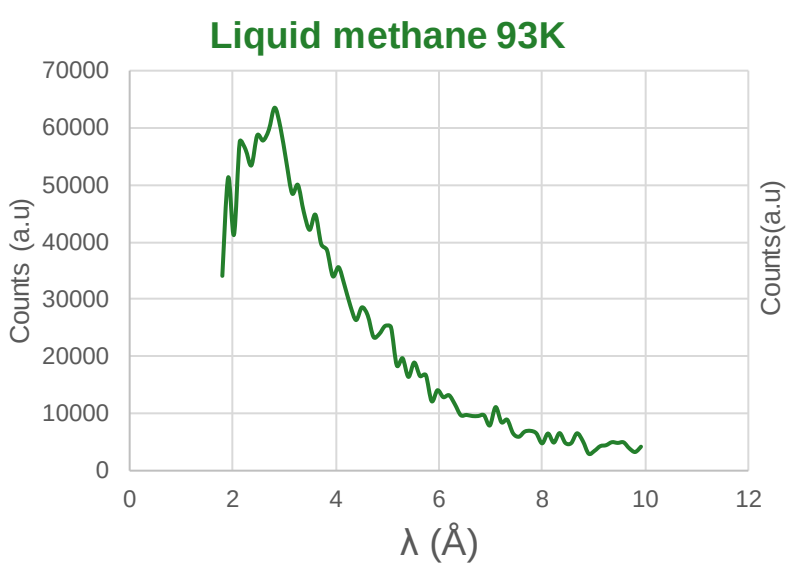


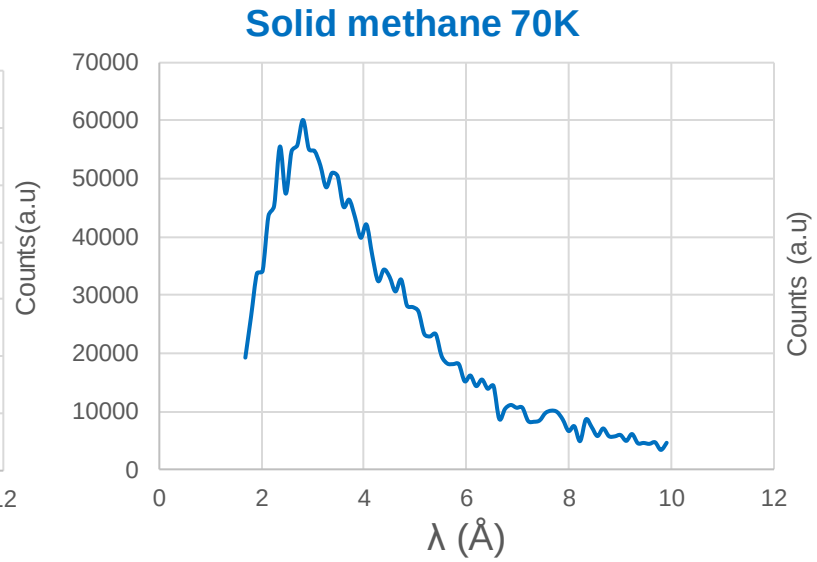
Results

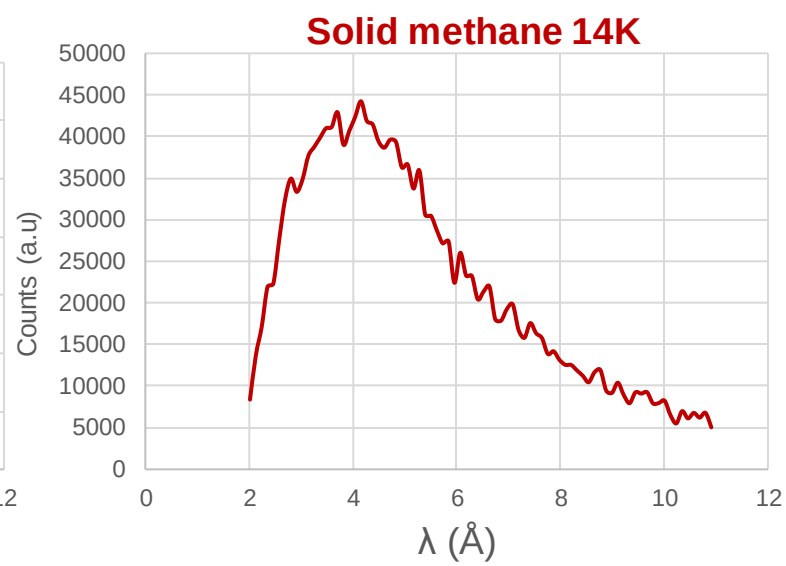
- Geometry corrections
- Normalisation to the number of neutrons
- And normalisation to the unit



Results







	Wavelenght	Energy rane
Fast neutrons		E > 10 keV
Resonance neutrons		2 eV < E < 10 keV
Epithermal neutrons		500 meV < E < 2 eV
Thermal neutrons	0.4 – 3 Å	10 meV < E < 500 meV
Cold neutrons	3 Å – 9 Å	1 meV < E < 10 meV
Very cold neutrons	> 9 Å	E < 1 meV

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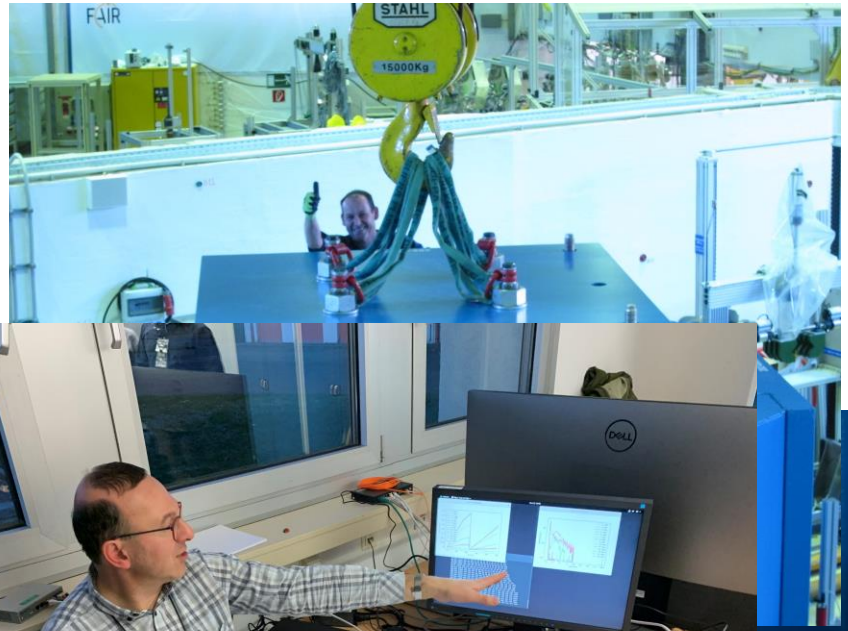
Outlook

- Applied for 6 weeks of beamtime in 2023
- Intensity * 100
- Cold source + Frame overlap chopper for HERMES
- PGNAA option at TOAD
- Imaging instrument in cooperation with LLB Saclay
- Additional Instrumentation by hereon
- New technology in thermal and cold moderators
- Extraction of fast neutrons MCNP simulations to confirm the validity of cold source kernels
- Measure other moderator materials
  - Gases (condensed)
  - Liquids (frozen)
  - Binay mixtures


FAIR
STAHL
15000Kg

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INM-5:
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- Radio isotopes

S. Böhm
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O. Meusel
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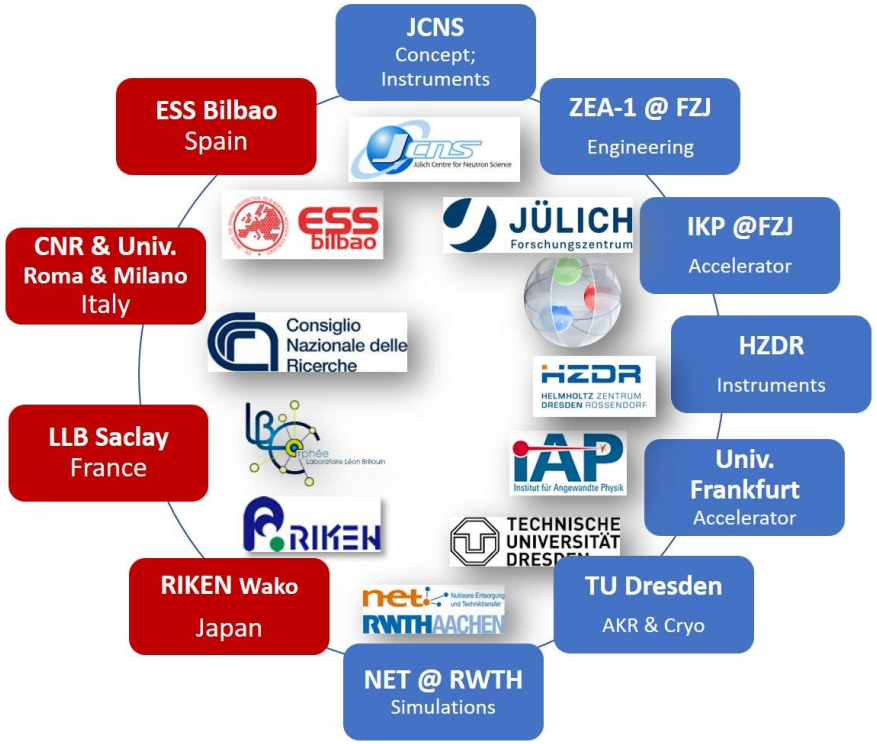
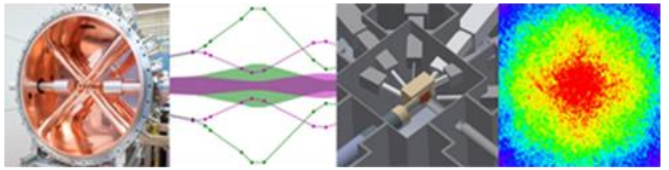
- Accelerator

W. Barth

- Accelerator



HBS Innovationpool Project



FB Matter: MML, MT

Federal Ministry of Education and Research