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THE FIRST EUROPEAN COLD NEUTRON SOURCE WITH A FOCUSSING MODORATOR CHAMBER - OPERATIONAL EXPERIENCE AND NEUTRONICS RESULTS -

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The GKSS research centre Geesthacht GmbH operates the MTR-type swimming pool reactor FRG-1 (5 MW) for more than 50 years. The FRG-1 has been upgraded and refurbished many times to follow the changing demands of safe operation and today's needs of high neutron flux for scientific research.

High neutron fluxes with highest availability is the permanent demand of the science on the operation of a neutron source.

WHY COLD NEUTRONS

- Long wavelength (cold) neutrons with high intensity are indispensable probe for the study of the microstructure and dynamics of condensed matter. These are necessary for its macroscopic characterization in applied as well in basic for example in material-, biological- and polymer research. With the existent CNS the number of long wavelength neutrons with wavelength > 0.4 nm were increased by a factor of more than 20 compare to the thermal flux.

Examples

Abbildung 1

Veranschaulichung des Größenbereiches, den die Strukturforschung zu meistern hat.

a) Entmischungsbereiche in einer Legierung.

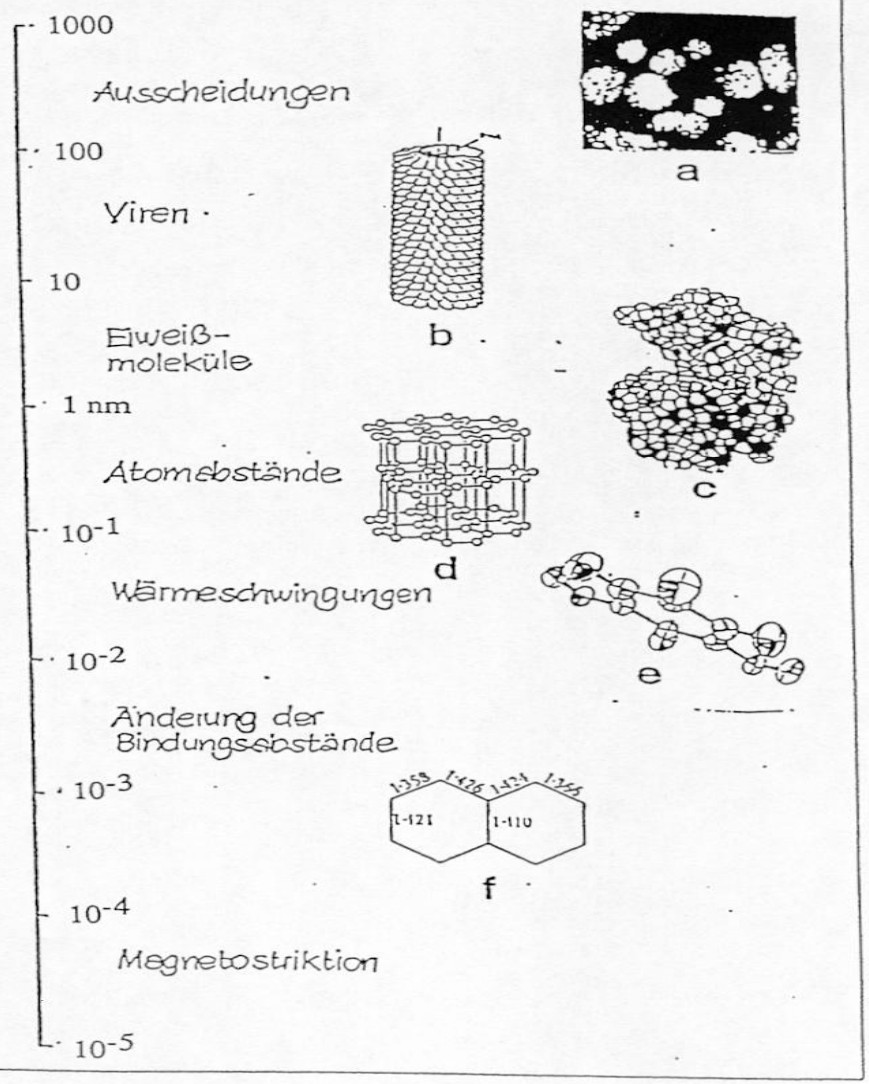
b) Schema des Tabak-Mosaik-Virus.

c) Struktur des Lyozyms.

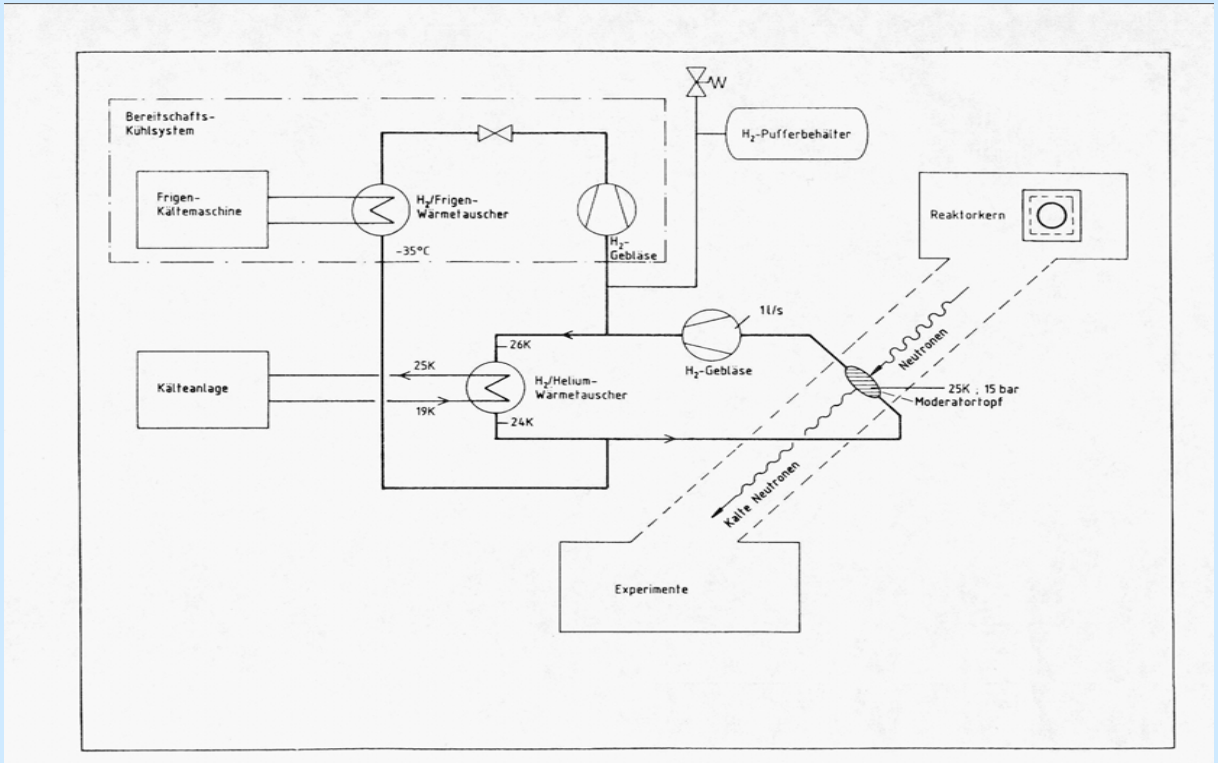
d) Struktur des Graphits.

e) Organisches Molekül: Die Stärke der Wärmebewegung jedes einzelnen Atoms ist durch ein Ellipsoid dargestellt.

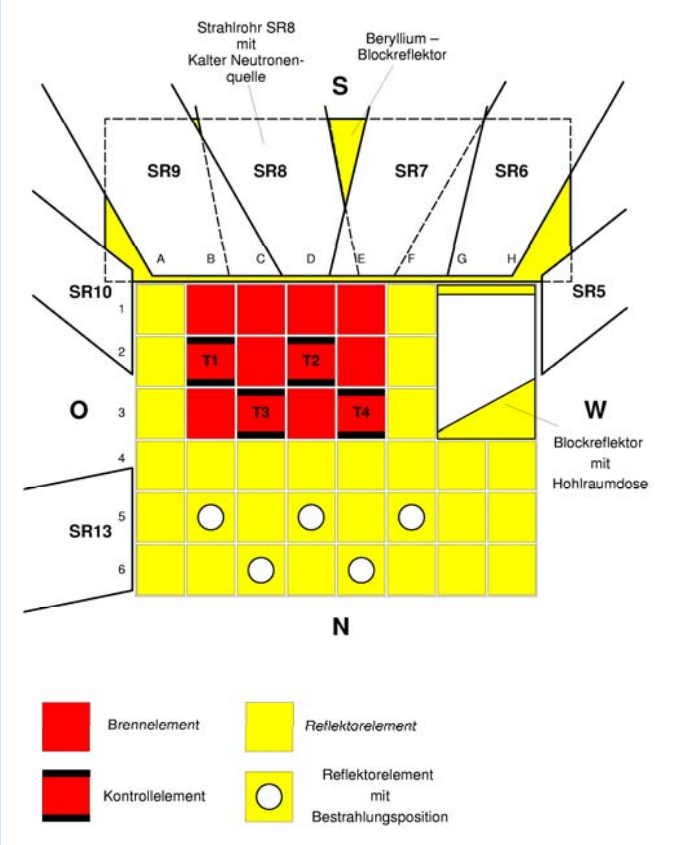
f) Kohlenstoff-Kohlenstoff-Abstände in Naphtalin.



Schematic View of the GKSS – CNS



FRG-1 3X4 COMPACT CORE



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Increasement of the cold neutrons flux

- For a further increase of the important cold neutron flux, which feed more than half of the neutron scattering instrumentations, the moderator chamber of an existing spare unit should be replaced by a new one. Model of the new layout were the focusing moderator chambers of the American research reactors MURR and ORNL. These new moderator chambers resulted in gain factors between 50 to 150%.

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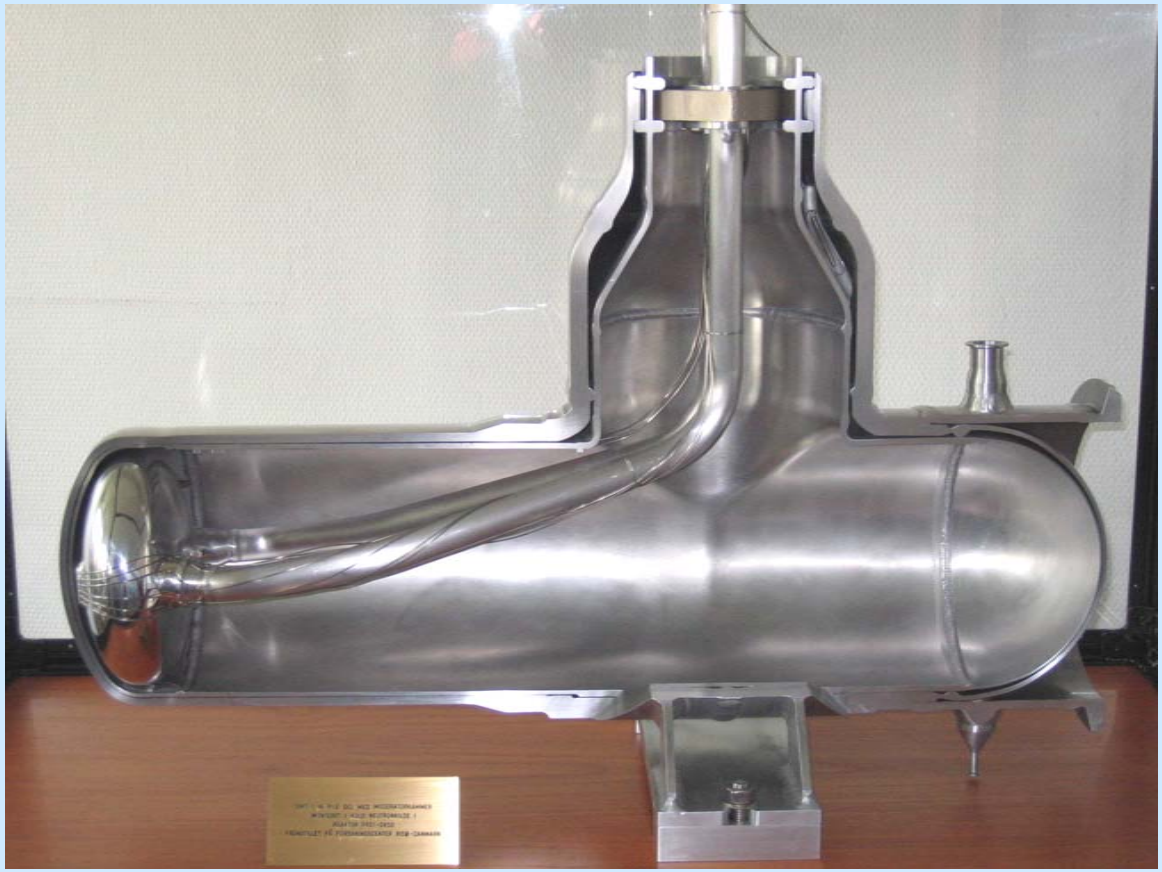
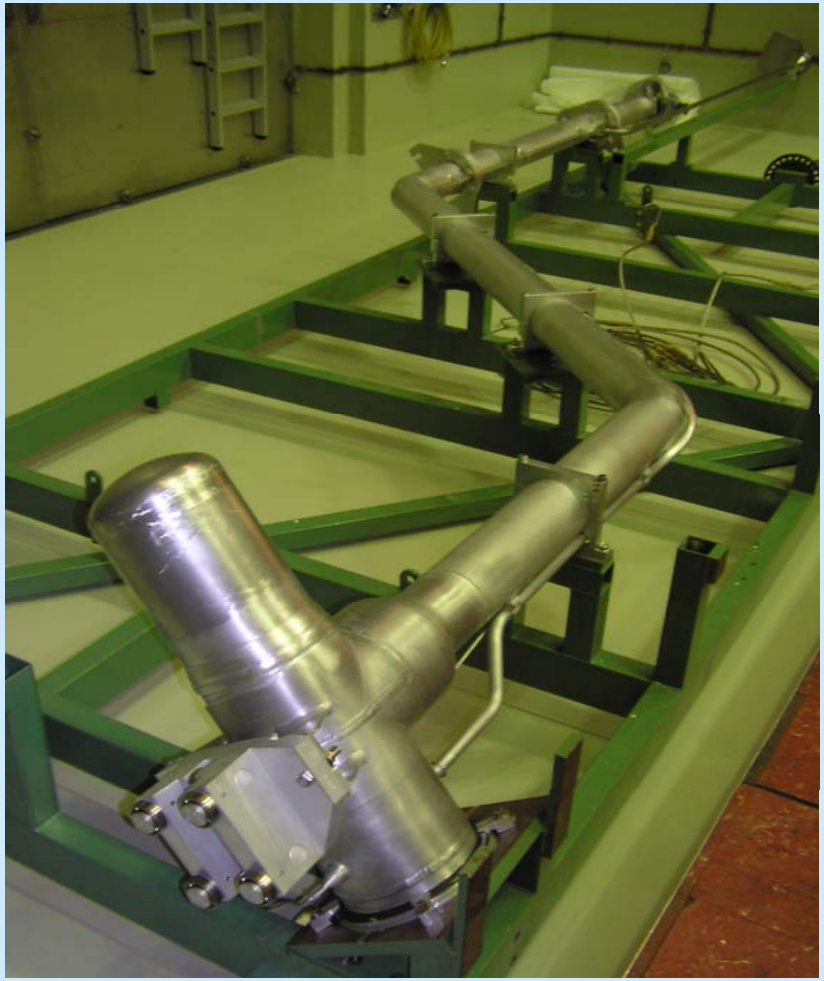
Existing Moderator Chamber



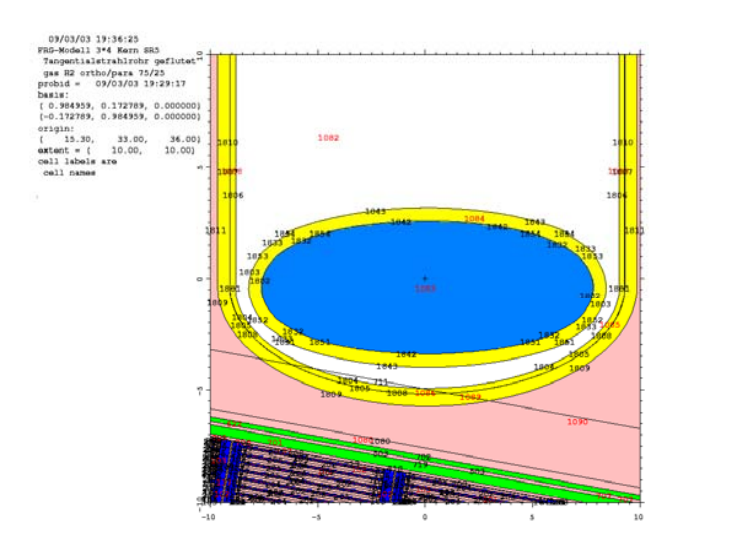
INPILE LINER

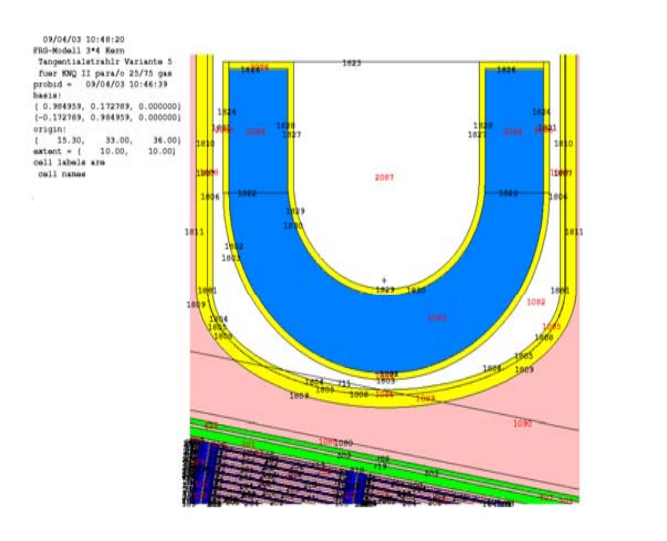


New moderator chamber

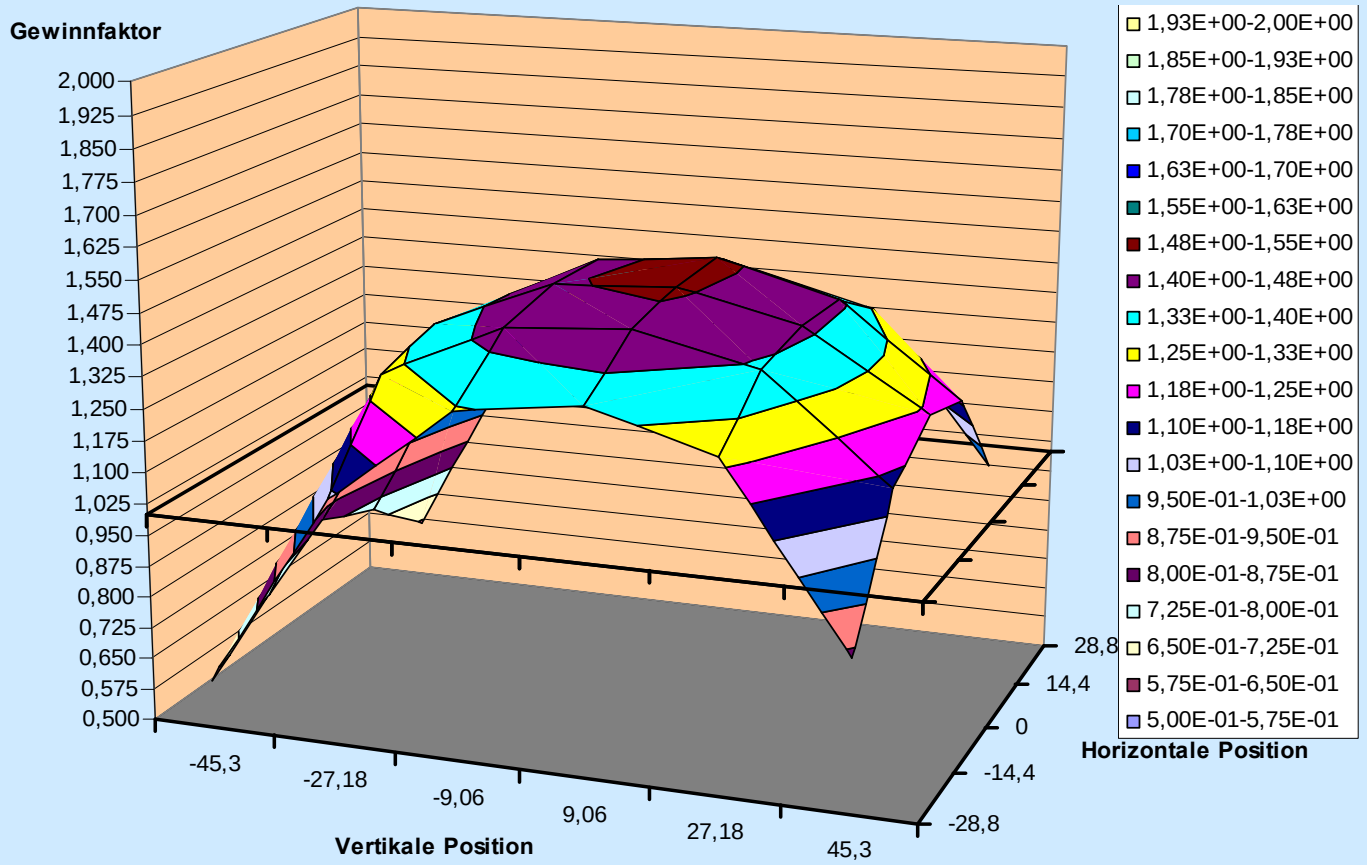
- ➔ Simple design (hemispherical shape) and fabrication
- ➔ The same material specification for the new moderator chamber as for the existing one
- ➔ The same technical inspection as for the existing one
- ➔ The same incident conditions (pressure, melting etc.) as for the existing one
- ➔ Comparable nuclear heating for the new and exiting chamber

Old an new moderator chamber





Gain factors at the entrance to the neutron guide



Parameters of the discus chamber moderator and the hemisphere chamber

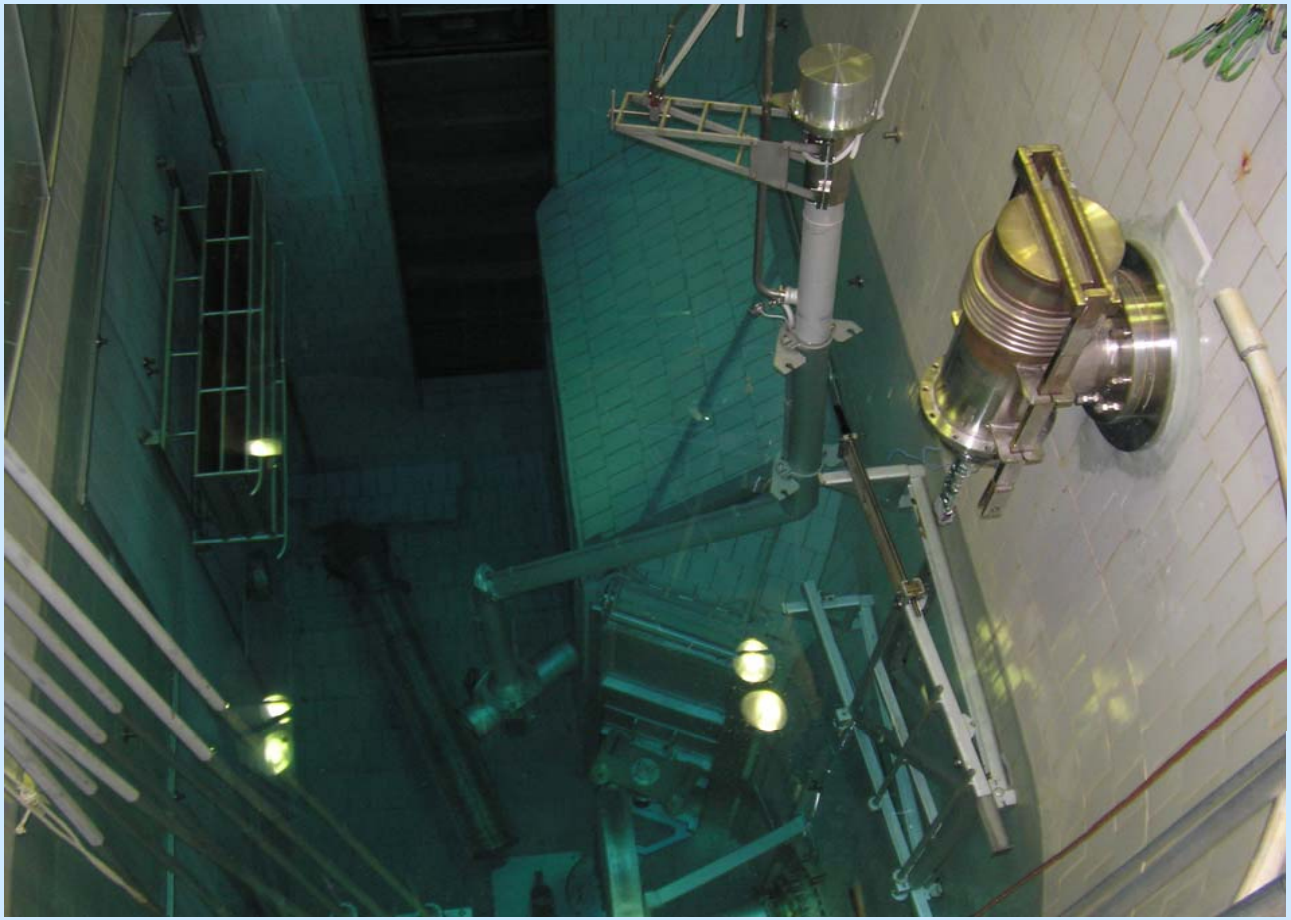
	Discus Shape Chamber			Hemisphere Chamber		
	Volume [cm^3]	Mass [g]	Power [W]	Volume [cm^3]	Mass [g]	Power [W]
Moderator H_2	796.0	55.0	353.8	1329.5	100	457.1
AlMg3	298.6	788.4	998.4	416.5	1090	1054.5
∑			1352.2			1511.6

Milestones of the new moderator chamber

- License procedure from May to September 2006
- fabrication and installation of new moderator chamber (January to Mai 2007),
- Mounting of the new Inpile Liner with new moderator chamber and set in operation programm May / June (3 weeks)

Inpile part with the new moderator chamber

Dismounting of the old Inpile Liner



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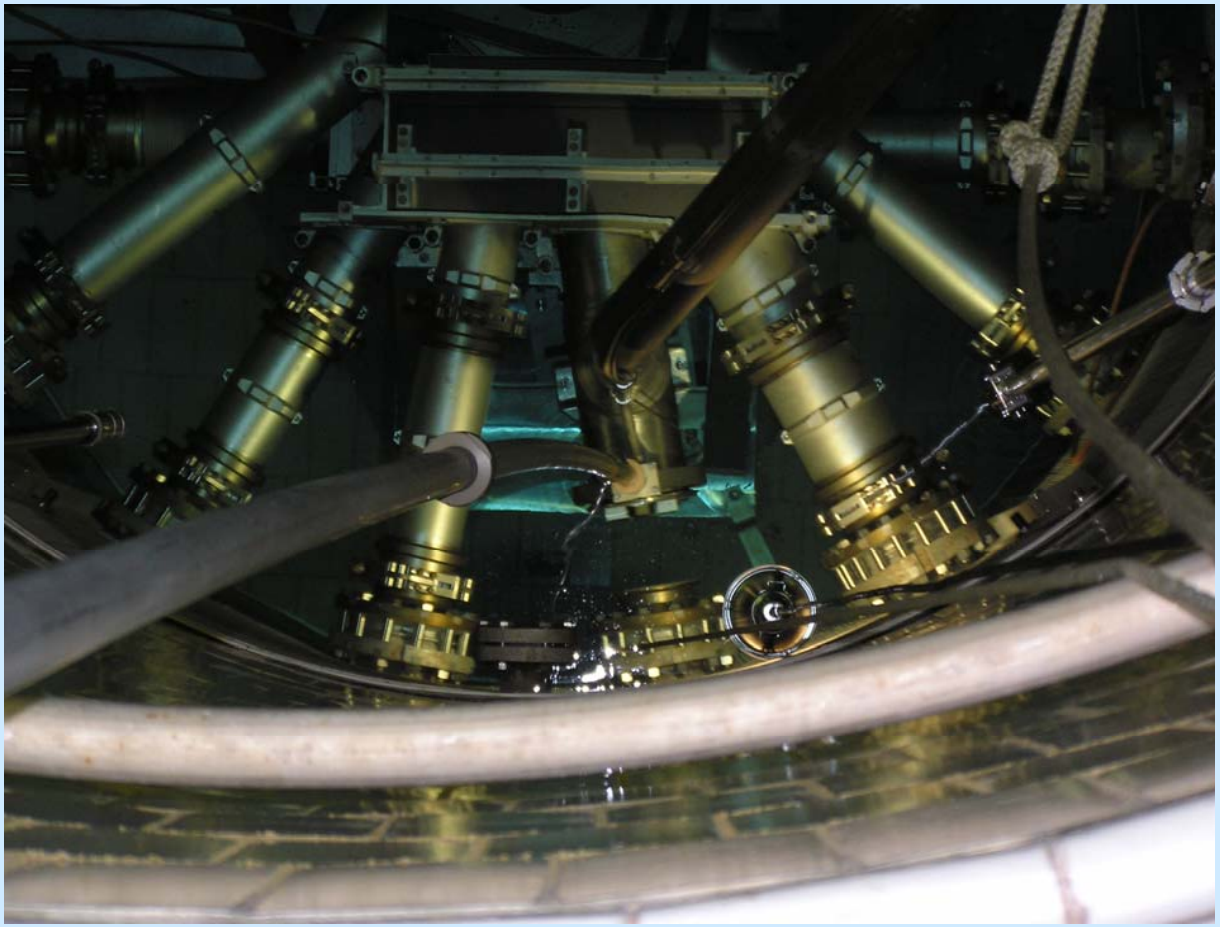
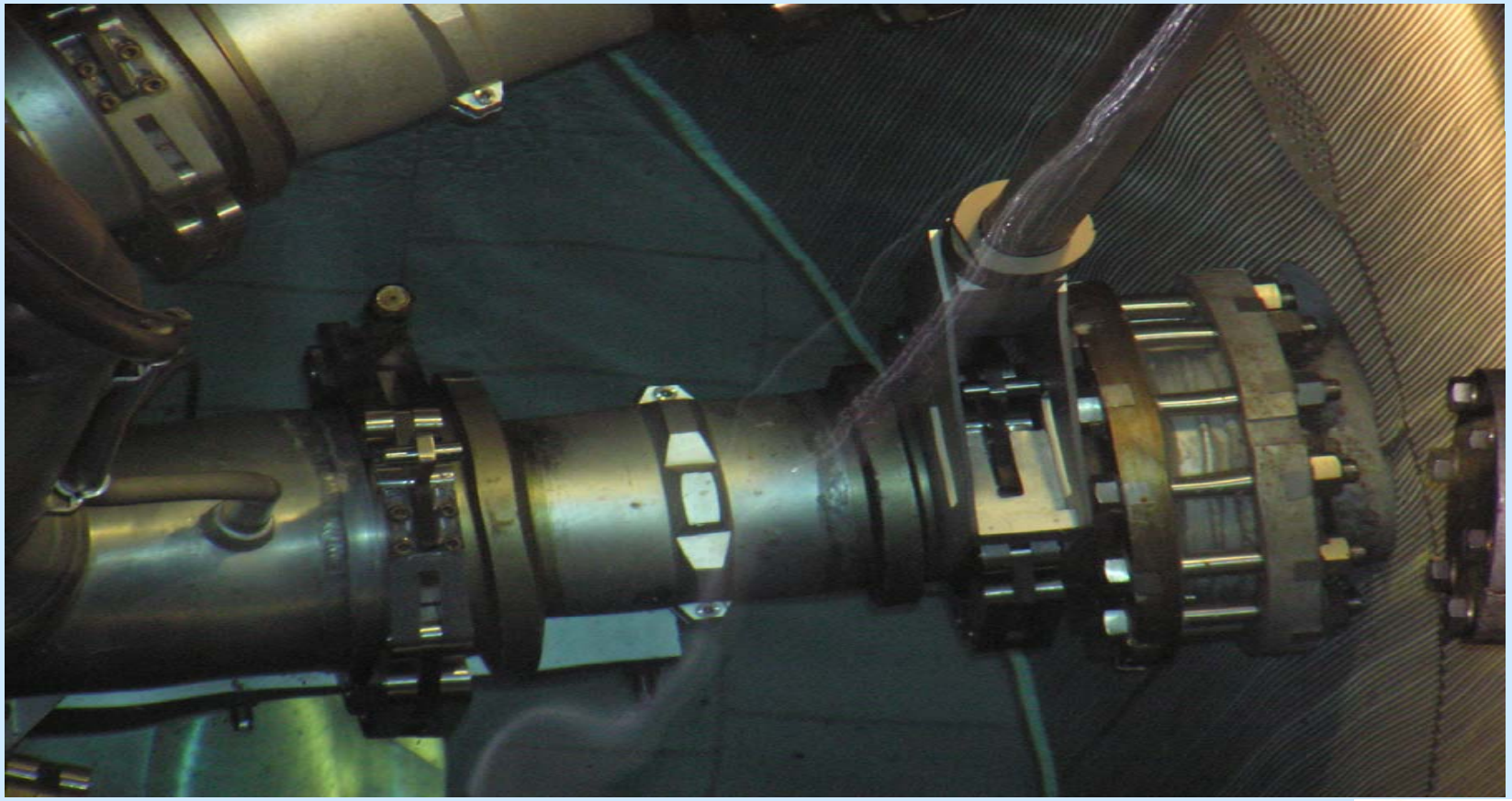
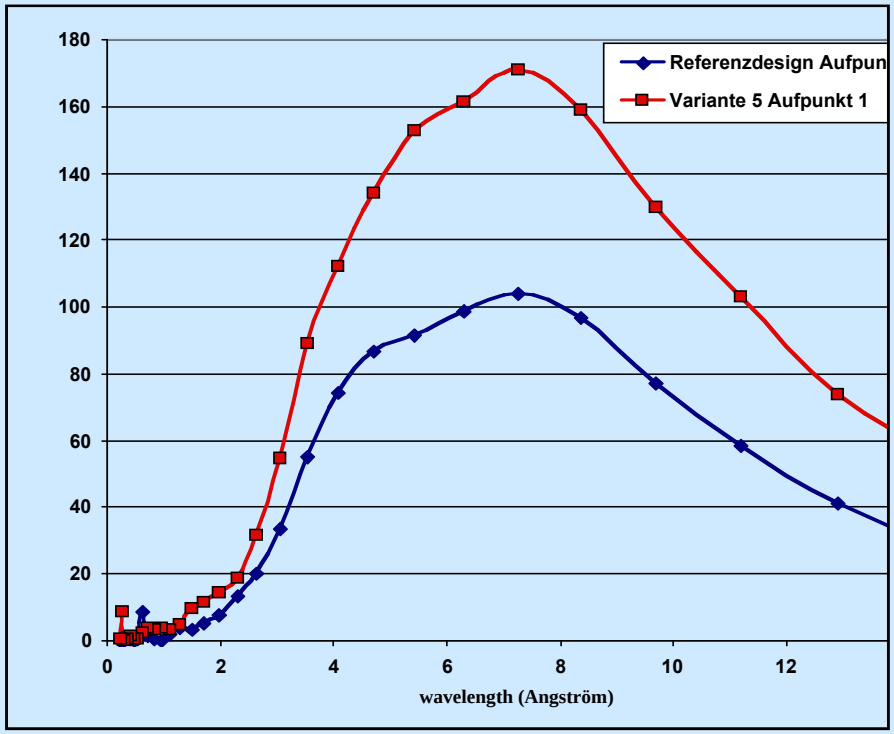
Mounting of the new Liner

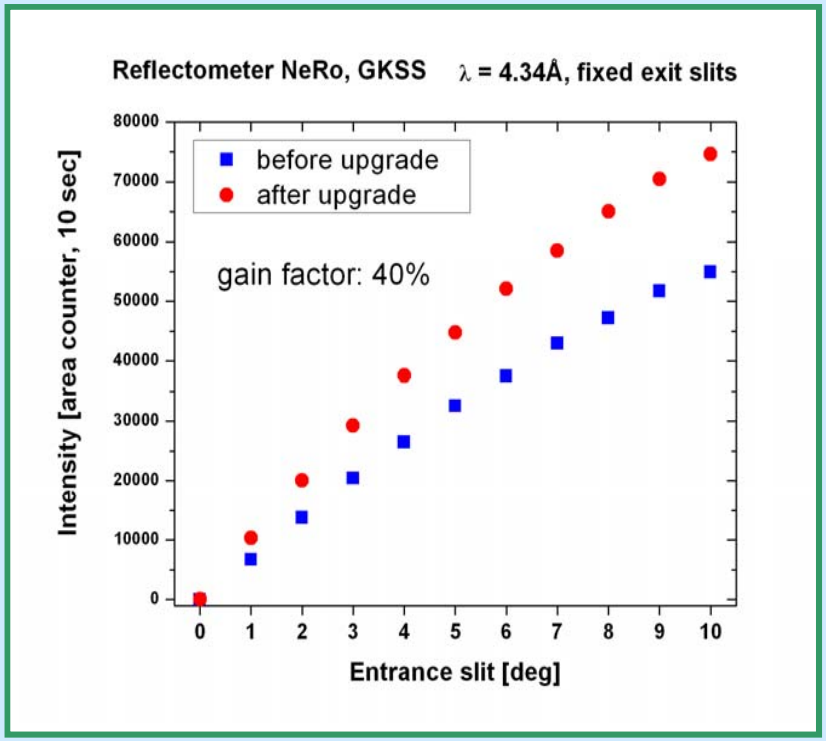


Connection of the new Liner with the beam tube

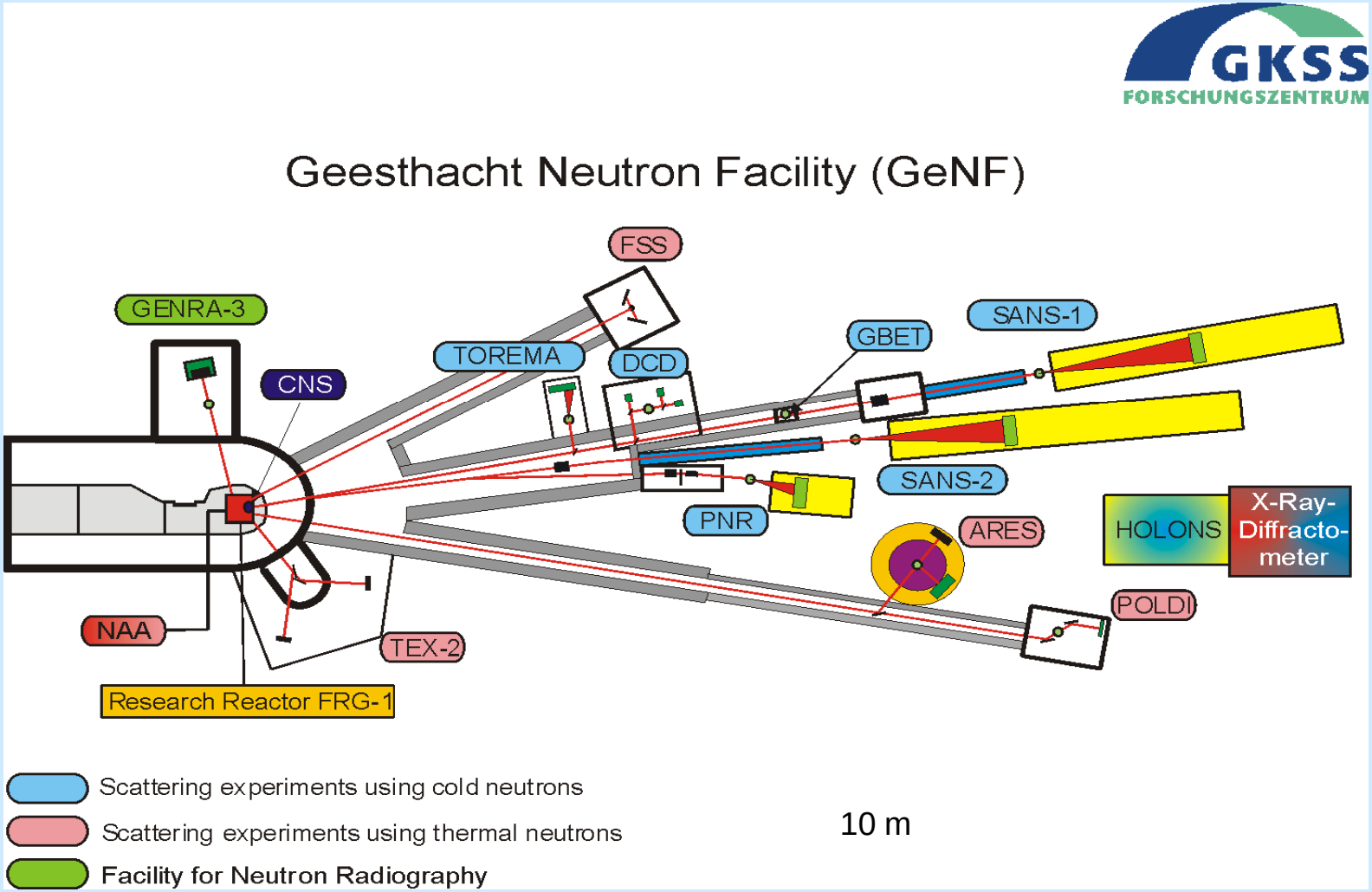


Gain measurements at the experiment Nero





GeNF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Geesthacht Neutron Facility (GeNF)
FSS
GENRA-3
TOREMA
DCD
GBET
SANS-1
CNS
SANS-2
PNR
ARES
HOLONS
X-Ray-Diffracto-meter
POLDI
NAA
TEX-2
Research Reactor FRG-1
Scattering experiments using cold neutrons
Scattering experiments using thermal neutrons
Facility for Neutron Radiography
10 m

Summary

- GKSS has already realized a continuous increase of the neutron flux by 2 core compactions and by the installation of the first elliptical CNS. The installation of the focussing moderator chamber is a new step for a further increase of the important cold neutron flux. With the additional gain of cold neutrons by approx. 60%, the FRG-1 results in an interesting middle flux neutron source available to the national and international user community.