ZEA-1 | ENGINEERING AND TECHNOLOGY
Technology for Excellent Science

Time-of-flight measurements of neutron spectra using compact cold neutron moderators for a High-Current Accelerator-driven Neutron Source

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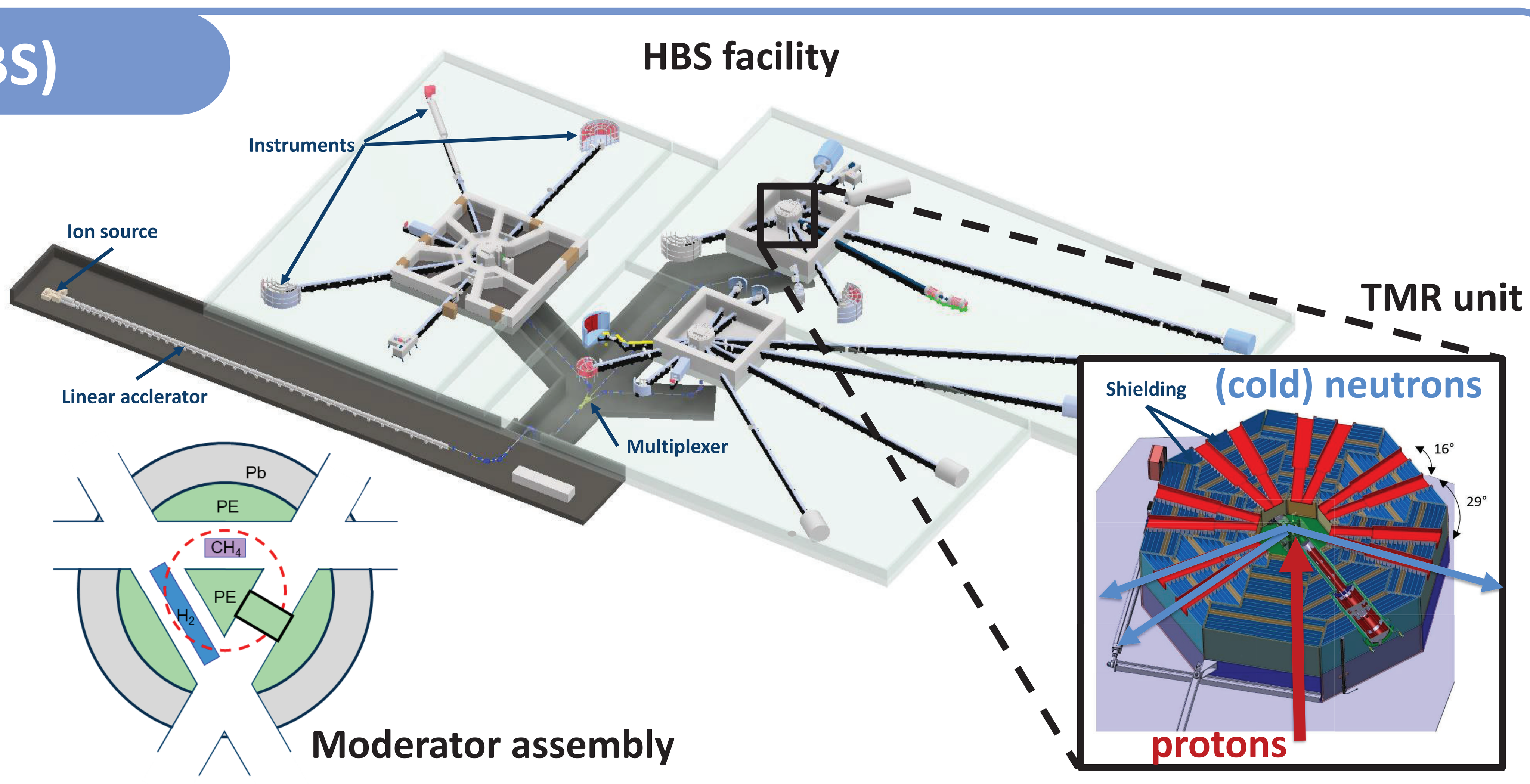
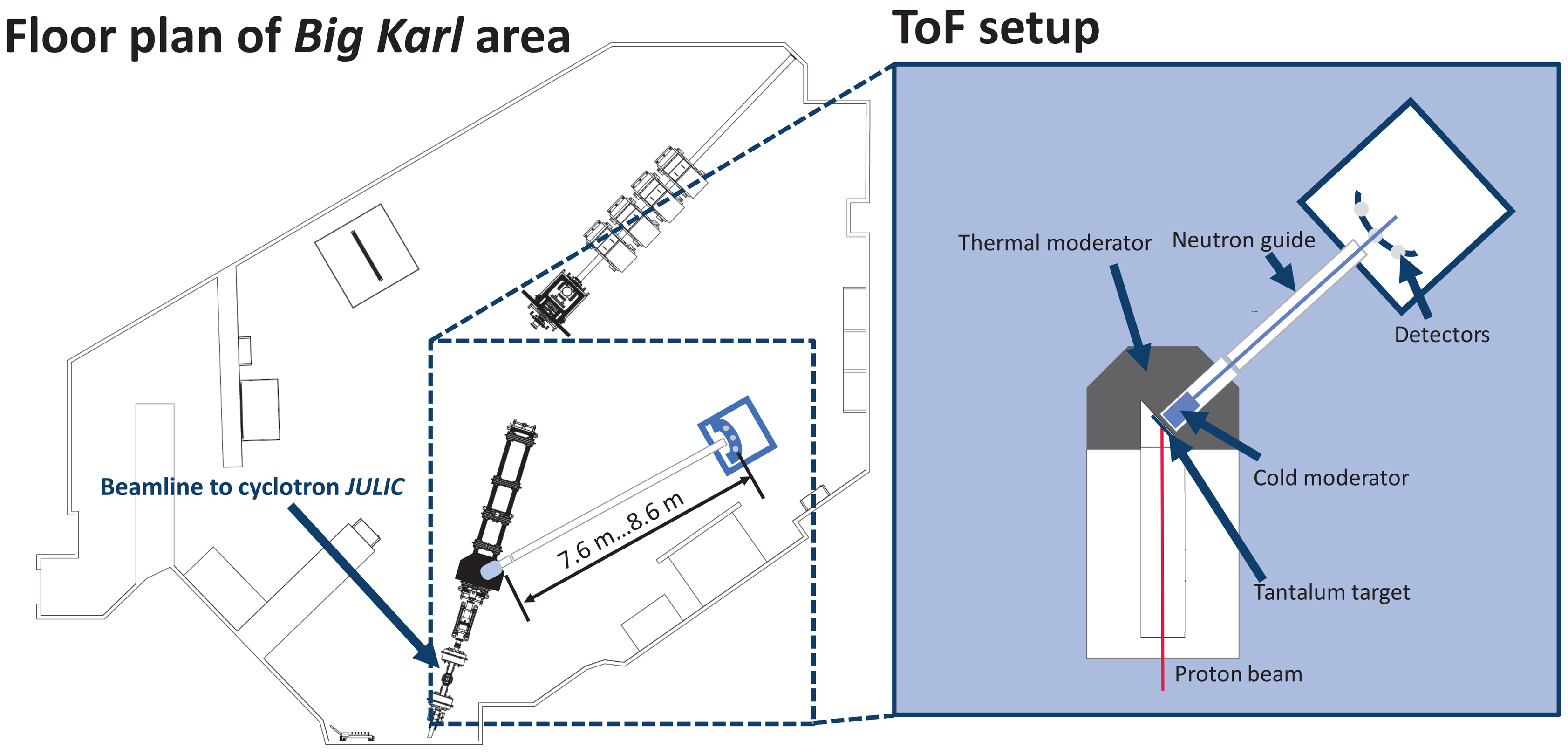
High Brilliance Neutron Source (HBS)

- High-Current Accelerator-driven Neutron Source (Hi-CANS) with an average power of 100 kW per target
- Free neutrons are created in multiple Target-Moderator-Reflector (TMR) units by Ta(p,n)-reactions ($E \backsim$ MeV)
- Measurements with nano-scale spatial resolution require long-wavelength neutrons (λ > 10 Å)
- Optimization of cold moderator brilliance by material, geometry and/or operation parameters



Big Karl experimental hall

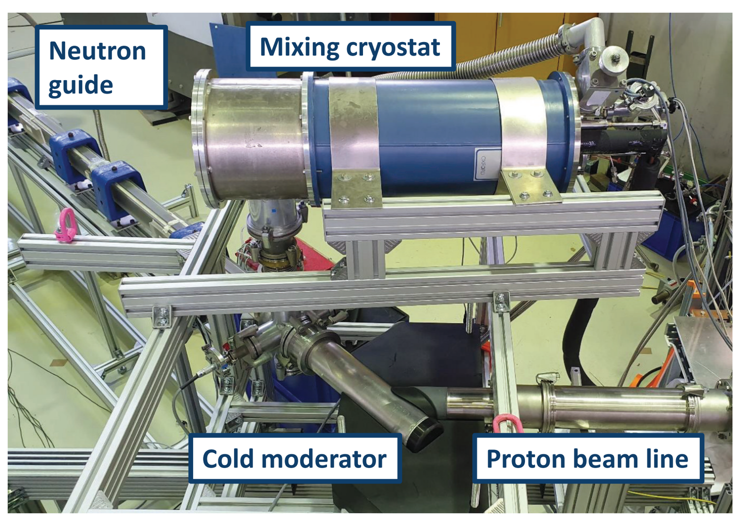
- Juelich Light Ion Cyclotron (JULIC) for **proton** or **deuteron** beams with energies up to **45 MeV** and **76 MeV**, respectively
- Proton beam currents of up to **10 nA** during measurements (max. 10 µA possible)
- 7 m (H_2) and 8 m (s-CH_4) neutron guides, multiple ^{3}He detectors
- Liquid hydrogen (LH_2) and solid methane (s-CH_4) used as cold moderators in individual cryostats

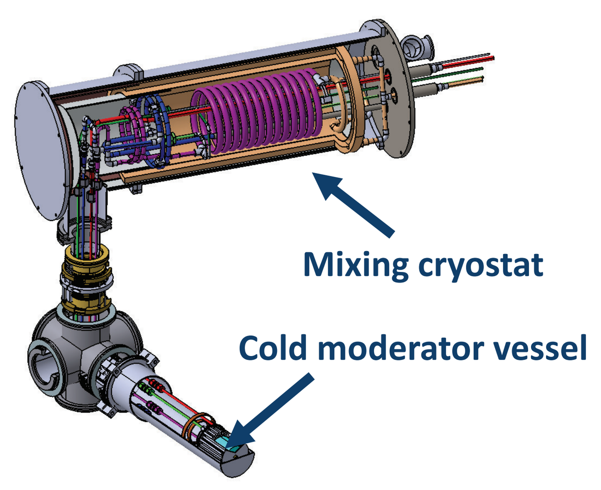


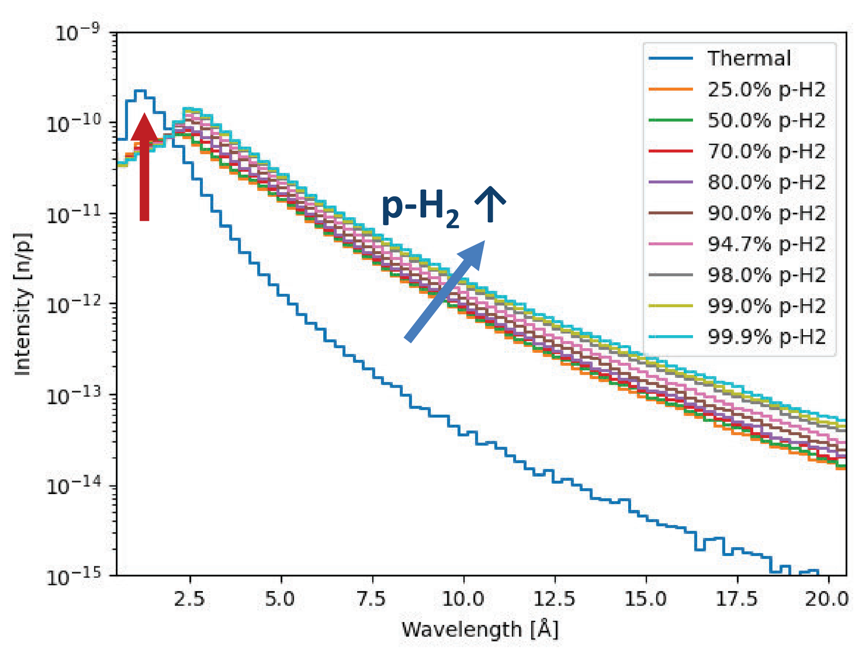
Time-of-Flight measurements

Liquid hydrogen (LH_2) at 18 K

- Moderator dimensions (Ø50 mm, length 100 mm)
- Variable ortho-para-H_2 ratio (by mixing p-H_2 with n-H_2)
- o-H_2 ratio ranging from 0.1% to 75%
- Measurement of o-p-H_2 ratio by speed-of-sound method



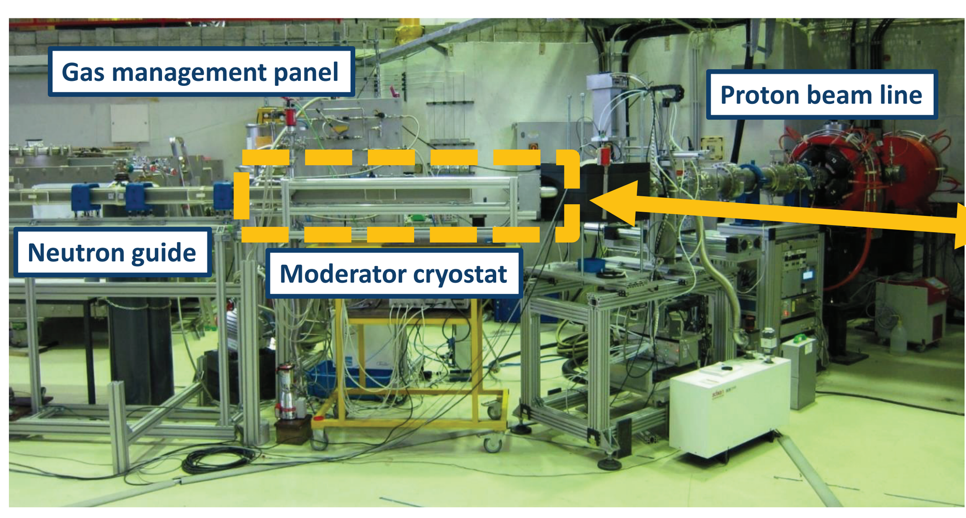


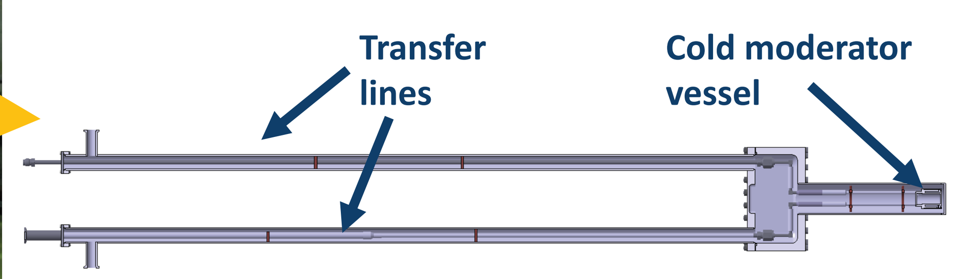


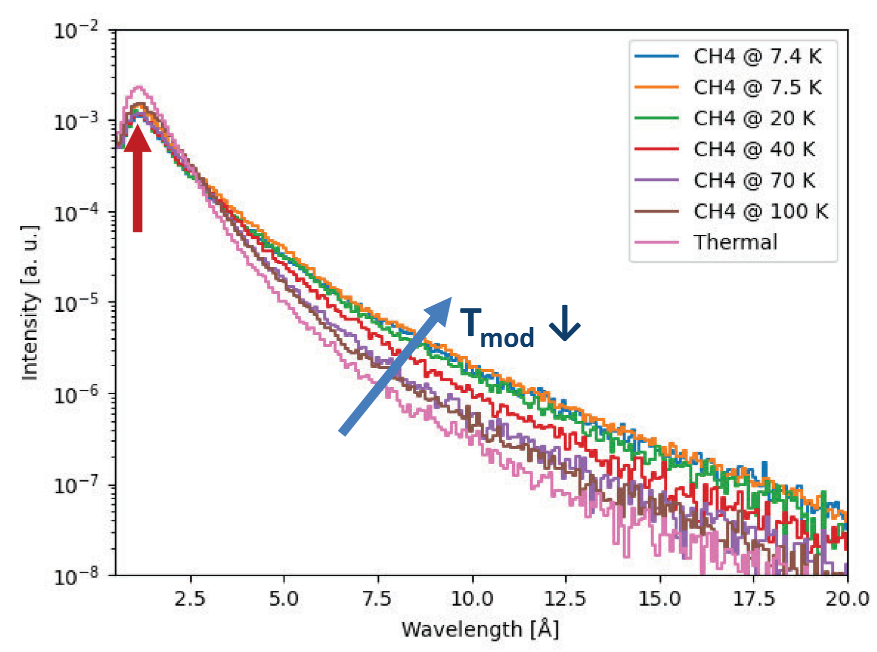
→ Decreasing intensity with increasing amount of orthohydrogen due to higher scattering cross section
→ absorption
→ volume too large for o-H_2

Solid methane (s-CH_4)

- Moderator dimensions (Ø20 mm, length 50 mm)
- Variable operating temperatures (7.4 K to 100 K)







→ Thermal peak still distinctly visible for lowest temperatures (bispectral)
→ Moderator volume too small

More detailed analysis of measurement data in progress!

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