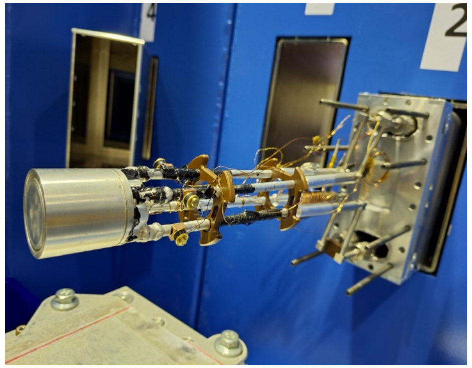 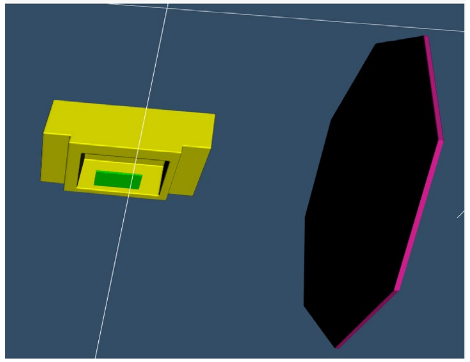 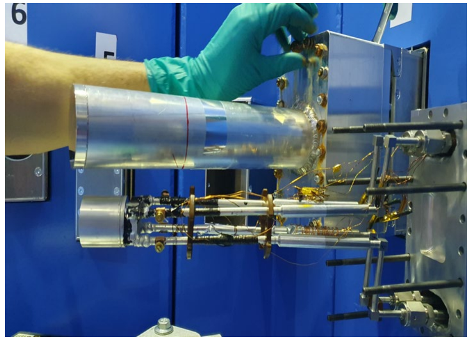 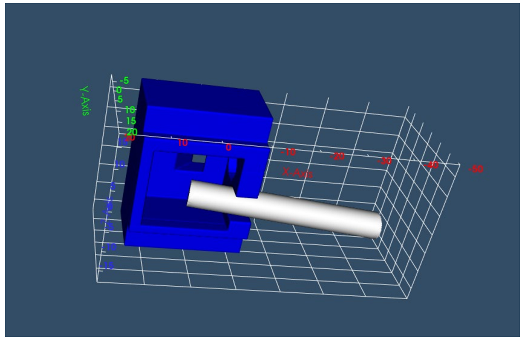

INVESTIGATING ETHANE'S EFFICACY AS A COLD NEUTRON MODERATOR IN LIQUID AND SOLID PHASES

M. EL BARBARI, JCNS-HBS

14 February 2024

Topics

- Introduction
- Experimental setup
- Results
- Correction processing
- Neutron temperature extraction
- Outlook

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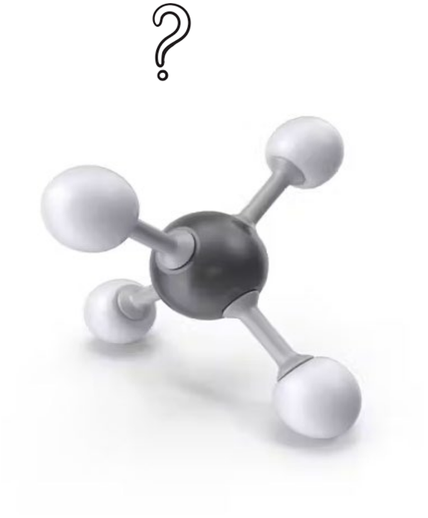
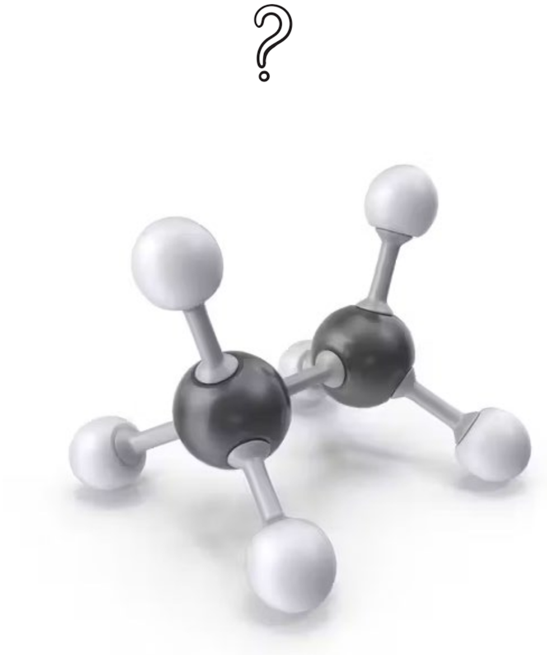
Introduction

Cold neutron moderator materials





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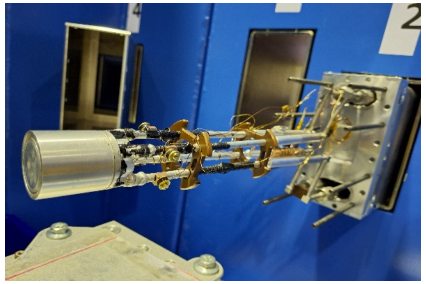
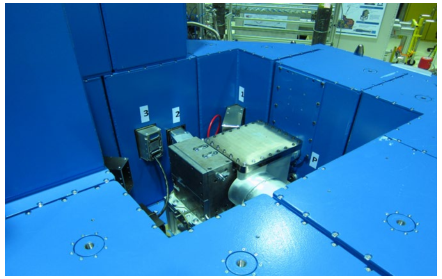
Experimental setup

Moderator assembly

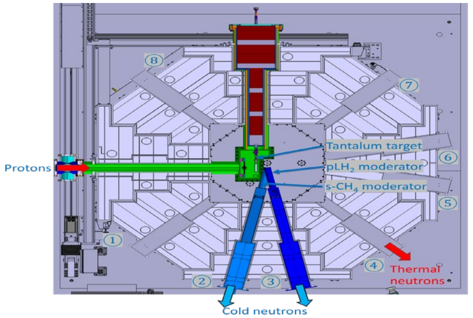
- The cryogenic moderator vessel is contained within a cylindrical vacuum vessel 6 cm in length and an outer diameter of 2.2 cm.



- The moderator vessel connected to a completely evacuated guideline of 6.5 meters, coated with nickel (^{58}Ni). At the end of the guide.

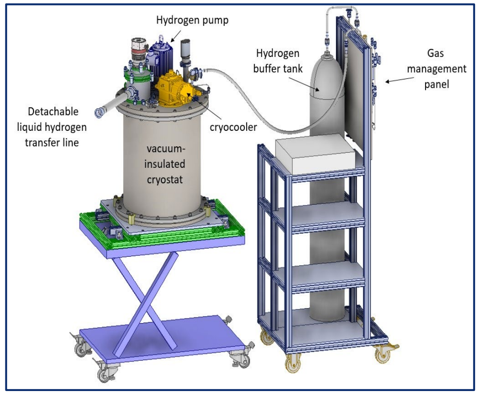


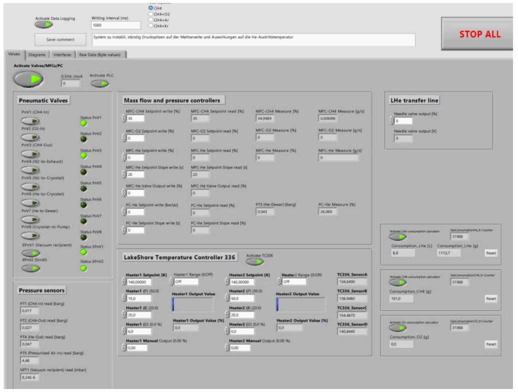
- The ethane moderator is placed at the beamline number 2 at BigKarl in the JULIC neutron platform.



Experimental setup

Cryogenic system



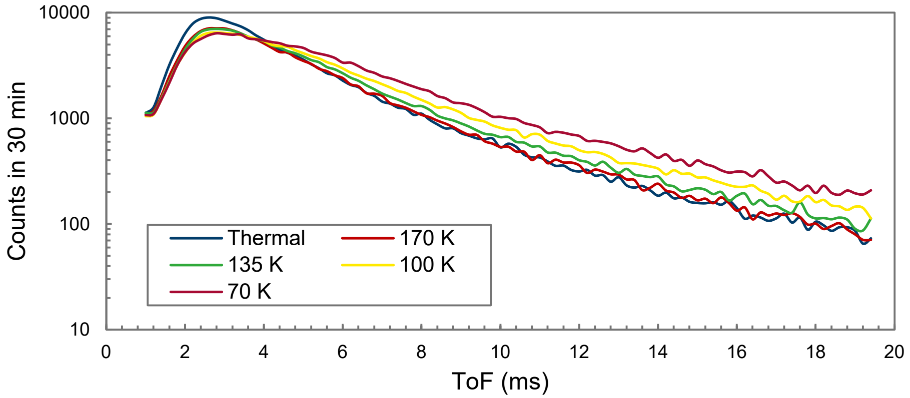


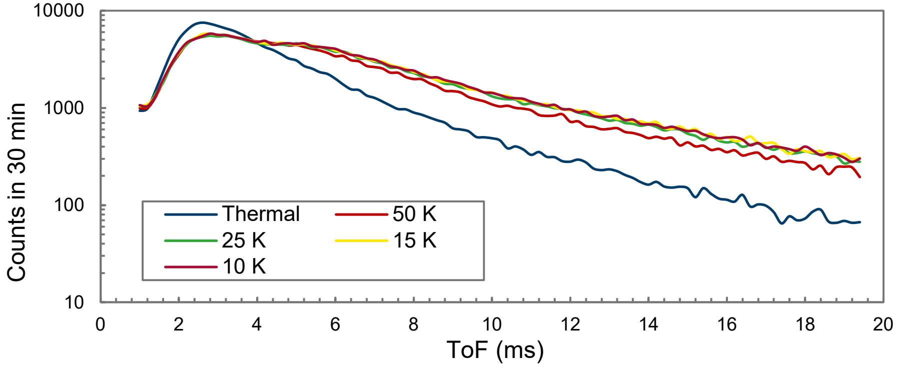
- The cryostat can be operated in large parts via the LabVIEW-VI interface for the processes of Cooling-down, Liquefaction, solidification and Warming-up.

Topics

Results

Cryogenic system





- Neutron spectrum emitted at 6.5m from the ethane cold neutron moderator in separate-on-time tests with different thermal contributions.

- temperatures of 170K, 135K, and 100K representing the liquid state, 70K for the solid state and crystalline phase, 50K for the second phase characterized by a metastable state, and subsequently 25K, 15K, and 10K for the amorphous phase of solid ethane.

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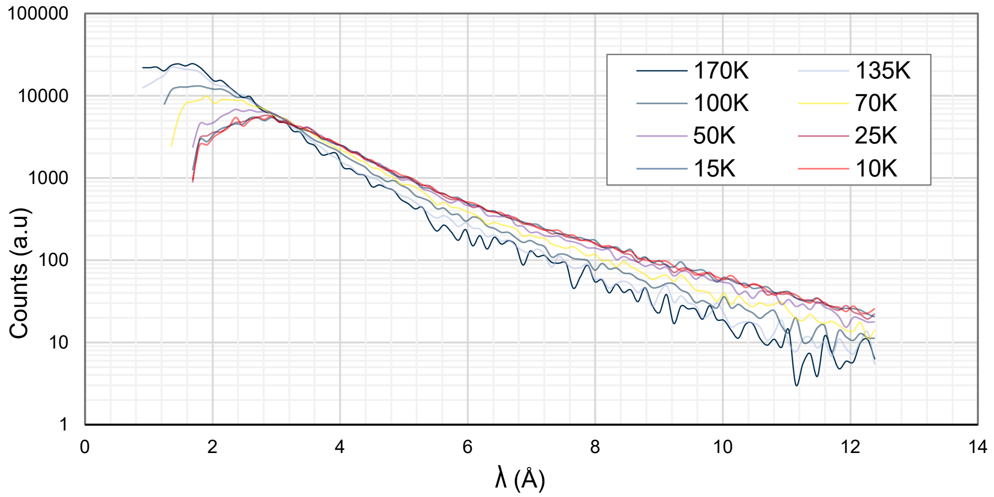
Correction processing

Thermal contribution/ normalization to monitor/ guide effect

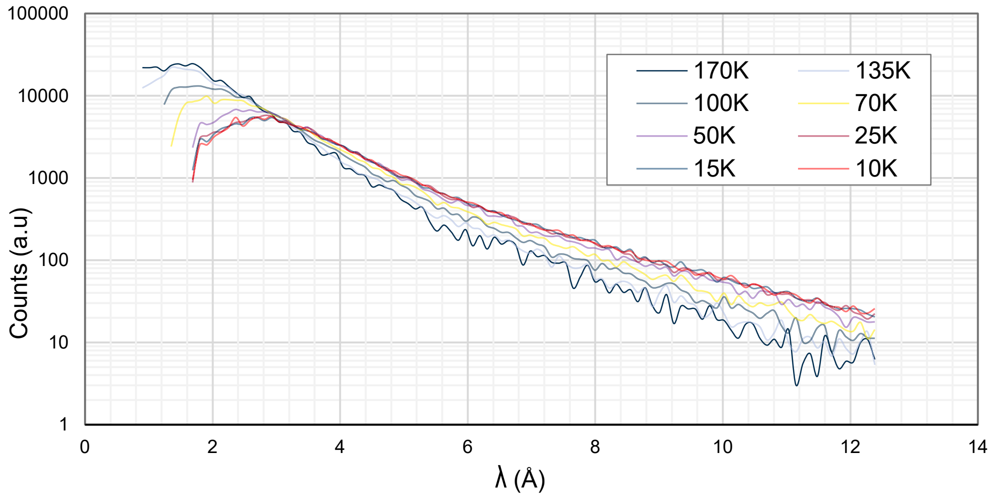


- The thermal flux contribution to the overall cold neutron spectra is influenced by the ratio of the cylindrical moderator's surface area (Ø 2.2 cm) to that of the rectangular guide (3.0 cm, 5.0 cm).

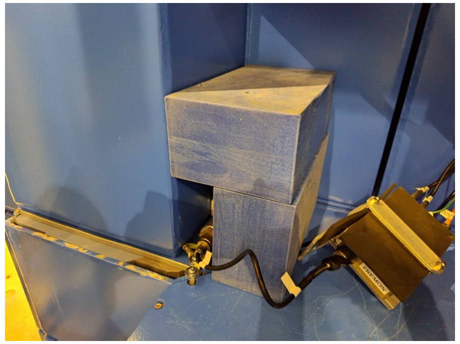
Sg-Sc/Sg = 0.747

Correction processing

Thermal contribution/ normalization to monitor/ guide effect

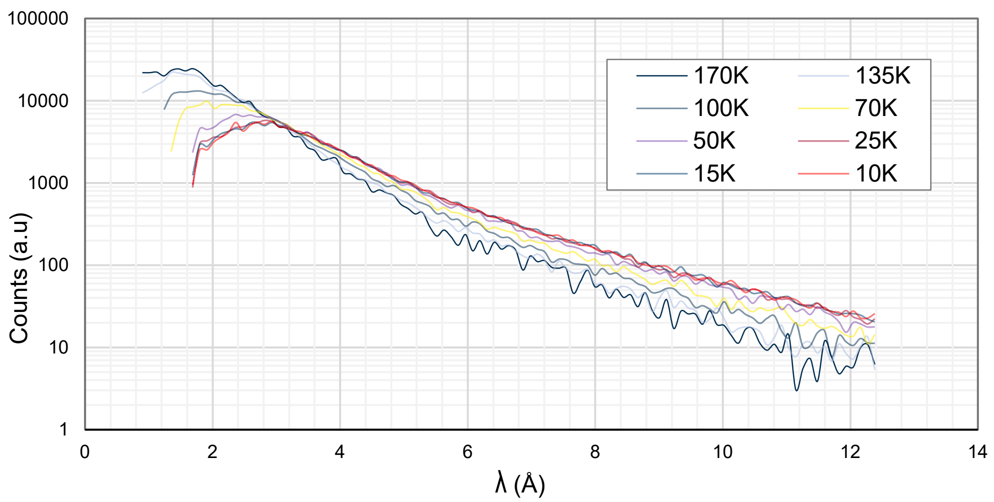


- Normalization to the monitor



Correction processing

Thermal contribution/ normalization to monitor/ guide effect



- Impact of the guides must be addressed as a factor dependent on the square of the wavelength.

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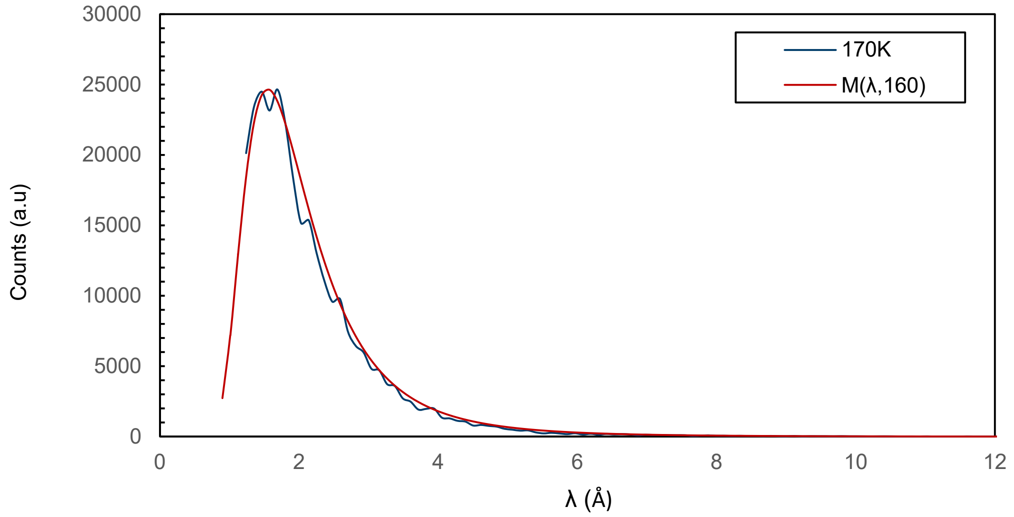
Neutron temperature extraction

Maxwellian distribution fitting



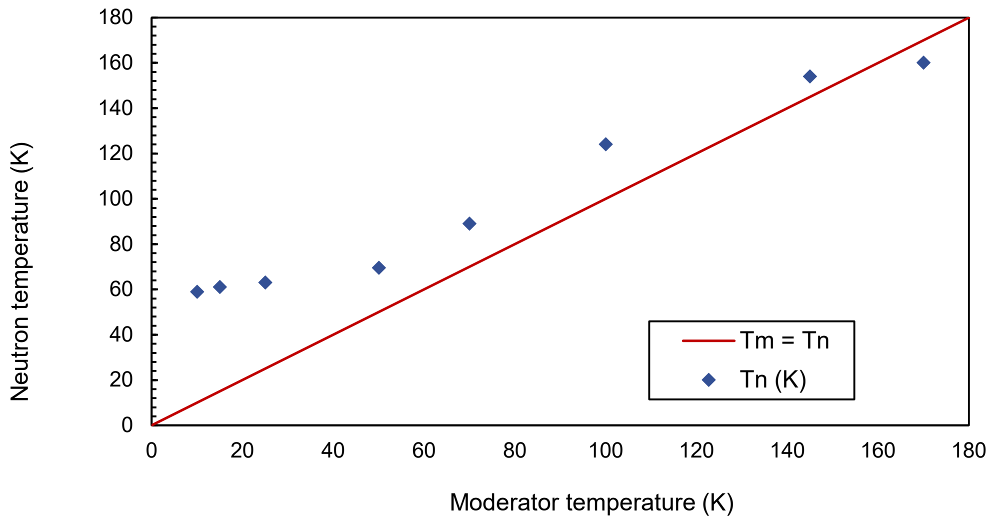
- The normalized Maxwell wavelength distribution is characterized by the following function

$$M(\lambda,T) = 2\, a^2\, \lambda^{-5} \exp(-a/\,\lambda^2)$$

'a' is a parameter calculated as 950.52/T, determined by the wavelength and temperature of a 25 meV neutron.

Neutron temperature extraction

Maxwellian distribution fitting



- the trend of the neutron temperature shows a decreasing value of temperature proportional to the decreasing of the moderator.

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Outlook

- PHITS simulations to compare with the experimental results and also, confirm the validity of cold source kernels

- Measure other moderator materials

    - Gases (condensed)
    - Liquids (frozen)
    - Binay mixtures

Thank you!

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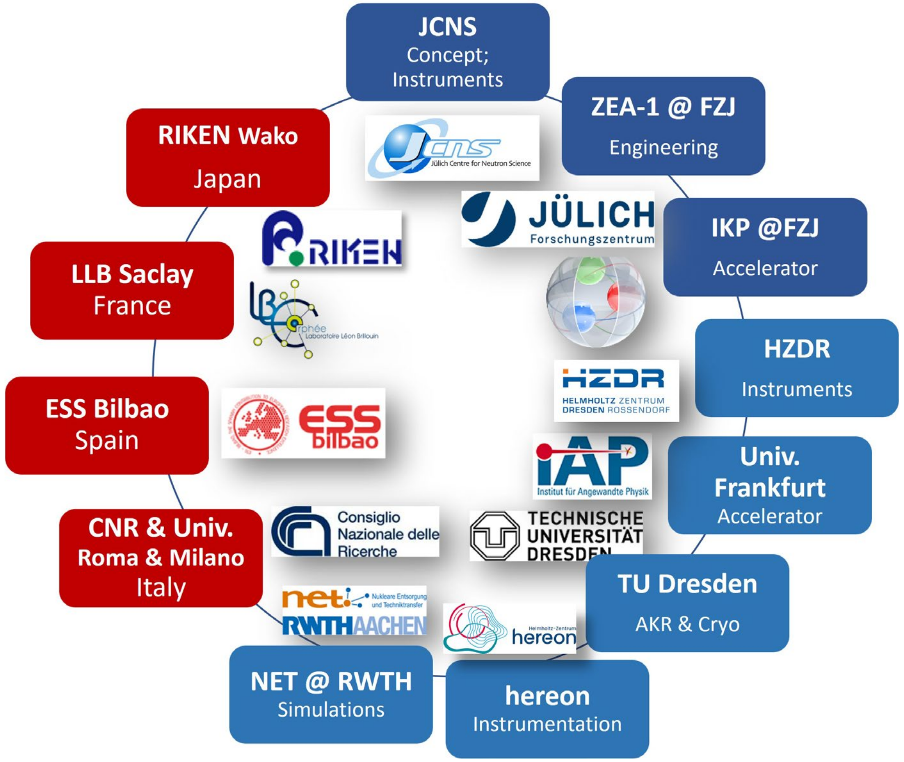
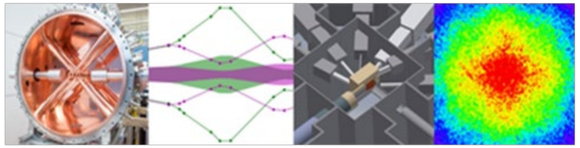


HBS Innovationpool Project



Federal Ministry of Education and Research

ELENA
European Low Energy accelerator-based Neutron facilities Association

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