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# MEPHISTO: Facility for particle physics with cold neutrons

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**Abstract:** The experimental area MEPHISTO, the measurement facility for particle physics with cold neutrons, operated by the Technische Universität München, is dedicated to those experiments in the field of nuclear and particle physics.

## 1 Introduction

Since the start of reactor the FRM II provides a cold white neutron beam for long term user dedicated experimental setups.

Such an experiment is normally planned and built up by external groups but additional help during the commissioning of the experiment at the reactor is necessary. Therefore, this work must be organised in close contact with the local instrument scientist. The desired precision is reached inter alia by good statistics which means long term experiments over several reactor cycles.

The experimental area MEPHISTO, the measurement facility for particle physics with cold neutrons, is dedicated to those experiments in the field of nuclear and particle physics. Currently, the experimental area moves from the Neutron Guide Hall West to the Neutron Guide Hall East. The solely used neutron guide SR-4b will deliver a white cold spectrum for experiments. A removeable 11 % velocity selector at the end of the guide will complete the beam line.

The MC-simulation for this beam with a dimension of 60 x 106 mm² proposes a mean wavelength of 4.5 Å and a gold capture flux of $2 \cdot 10^{10}$ n $cm^{-2}$ $s^{-1}$. The experimental area is 5 x 25 $m^2$, diagonally built-in in the Neutron Guide Hall East. The spectrum shows a shoulder to smaller wavelengths, the maximum of the spectrum is located at 3.3 Å.

It is planned to install the instrument PERC (Dubbers et al., 2008) at the MEPHISTO beam line during the first years of operation in the Neutron Guide Hall East. This instrument is a precise, bright and

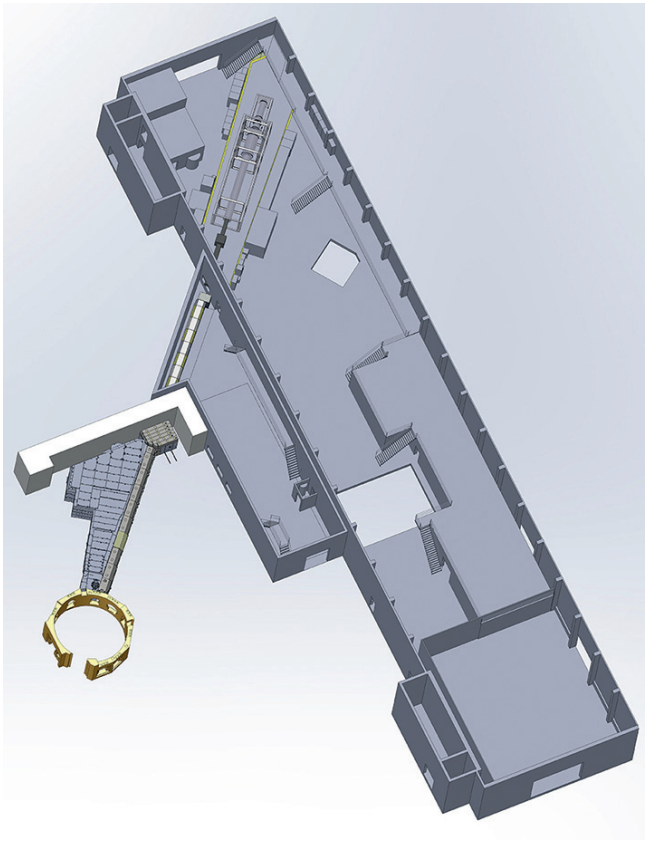

Figure 1: Instrument MEPHISTO.

intense source of protons and electrons from the neutron decay. The instrument PERC itself is open for external user groups with spectrometers to measure the protons and electrons.

## 2 Typical Applications

The experiments at MEPHISTO concentrate on induced nuclear reactions of the neutron with atoms or on the free neutron decay with its products.

Some of the experiment types performed at MEPHISTO:

- Free neutron decay and spectroscopy of the decay products
- Spectroscopy of neutron induced fission
- Production of ultra cold neutrons with liquid helium
- Production of ultra cold neutrons with solid gases

## 3 Infrastructure

A removeable neutron velocity selector is placed at the end of the neutron guide. The minimal wavelength is 4.5 Å. The resolution of the passing wavelength is 11 %. The selector can be rotated to tune the resolution.

A data system based on VME (ADC, peak ADC, QDC, TDC) is available. For signal forming purpose several NIM inserts exist, a list can be requested from the local instrument scientist. Also available are spectroscopic amplifiers and high voltage sources for detectors.

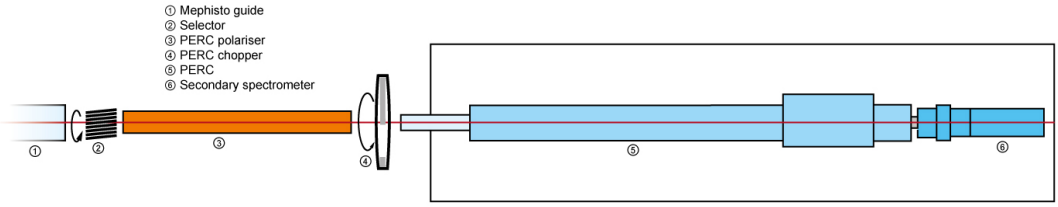


Figure 2: Schematic drawing of MEPHISTO.

## 4 Technical Data

### 4.1 Neutron beam

- End of the cold neutron guide SR-4b (m = 2.5)
- Cross section of the guide: 60 x 106 $mm^2$
- Thermal capture flux (simulated): $2 \cdot 10^{10}$ n $cm^{-2}$ $s^{-1}$
- Mean wavelength (simulated): 4.5 Å
- Beam height from floor: $\sim$ 1300 mm
- Experimental area: 5 x 25 $m^2$
- Maximum at 3.3 Å
- Standard neutron spectrum with shoulder to smaller wavelengths

### 4.2 Beam attenuators

- By geometrical attenuation, the beam intensity can by reduced to 20 %, 4 % and 2 %

### 4.3 Polarisation

- A bender (vertical direction) is available to polarise the complete cross section of the beam

## References

Dubbers, D., Abele, H., Baeßler, S., Märkisch, B., Schumann, M., Soldner, T., & Zimmer, O. (2008). A clean, bright, and versatile source of neutron decay products. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, *596*(2), 238 - 247. http://dx.doi.org/10.1016/j.nima.2008.07.157