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NEPOMUC: Neutron induced positron source Munich

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Abstract: NEPOMUC, operated by the Technische Universität München and the Universität der Bundeswehr München, provides a high-intensity low-energy positron beam for applications in solid state and surface physics as well as for fundamental research in nuclear and atomic physics. The intensity amounts to $> 10^9$ moderated positrons per second at a beam energy of E = 1 keV.

1 Introduction

At NEPOMUC, the positrons are generated by pair production from absorption of high-energy prompt gamma-rays after thermal neutron capture in cadmium (Cd) (Hugenschmidt et al., 2008). A cadmium cap is mounted inside the tip of the inclined beamtube SR11. The released high-energy gamma-radiation is converted into positron - electron pairs in a structure of platinum foils which is mounted inside the cadmium cap. Positive high voltage is applied in order to extract the moderated positrons. The positron beam is magnetically guided in a solenoid field of typically 7 mT.

After upgrading NEPOMUC, 80 % ^{113}Cd enriched cadmium is used as neutron-γ-converter which has a projected lifetime of 25 years of reactor operation (Hugenschmidt et al., 2012) and an intensity of $> 10^9$ moderated positrons per second has been achieved (Hugenschmidt et al., 2014).

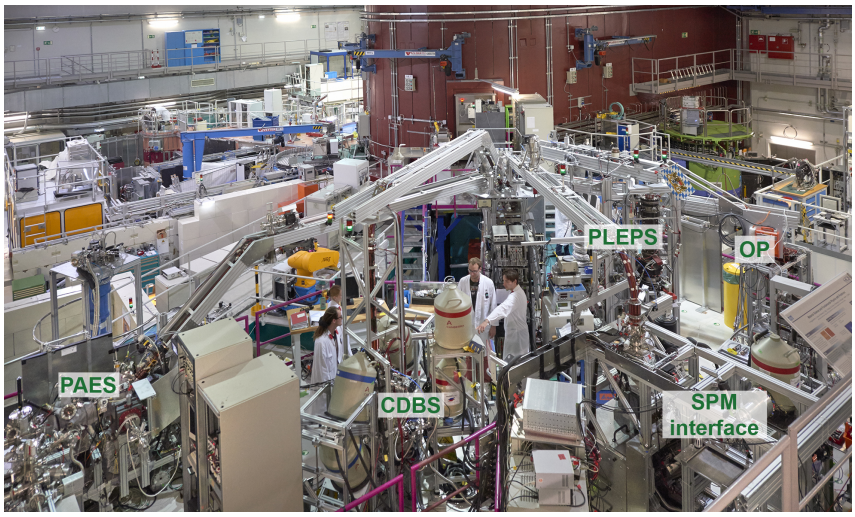

Figure 1: Positron beam facility and instrumentation at NEPOMUC (Copyright by W. Schürmann, TUM).

2 Technical Data

2.1 Key values of the primary positron beam

- E = 1 keV
- Intensity: $> 10^9$ moderated positrons per second
- Diameter of beam spot: $\approx$ 9 mm (FWHM) in 7 mT beam guiding field.

2.2 Key values of the remoderated positron beam

- E = 10 ... 200 eV
- Intensity: $5 \cdot 10^7$ remoderated positrons per second
- Diameter of beam spot: 1.85 mm (FWHM) in $\approx$ 4 mT beam guiding field

3 The positron beam facility

The remoderation device of NEPOMUC (Piochacz et al., 2008) enhances the brightness of the positron beam and hence enables positron experiments which are highly resolved in space or/and in the time domain. The remoderator is based on the stochastic positron cooling in a W(110) single crystal and reemission of thermalised positrons into the vacuum with discrete energy. For most of the measurements the brightness enhanced positron beam is used. However, there are also experiments which do not depend on a high phase space density but need the full intensity of the primary beam. Therefore, the primary beam can also be used unaltered via two beam switches e.g. for experiments at the open beam port.

By the central, fivefold beam switch the positron beam is delivered to one of the five experiment beam lines. Currently, at these beam lines four instruments are permanently installed:

- Pulsed low-energy positron system (PLEPS) (Heinz Maier-Leibnitz Zentrum, 2015c)
- Coincident Doppler-broadening spectrometer (CDBS) (Heinz Maier-Leibnitz Zentrum, 2015a)
- Positron annihilation induced Auger-electron spectrometer (PAES) (Heinz Maier-Leibnitz Zentrum, 2015b)
- Scanning Positron Microscope Interface (SPM Interface) (Heinz Maier-Leibnitz Zentrum, 2015d)

The fifth beam line is for the multi-purpose open beam port (OP) which is used for transportable short-term experimental set-ups.

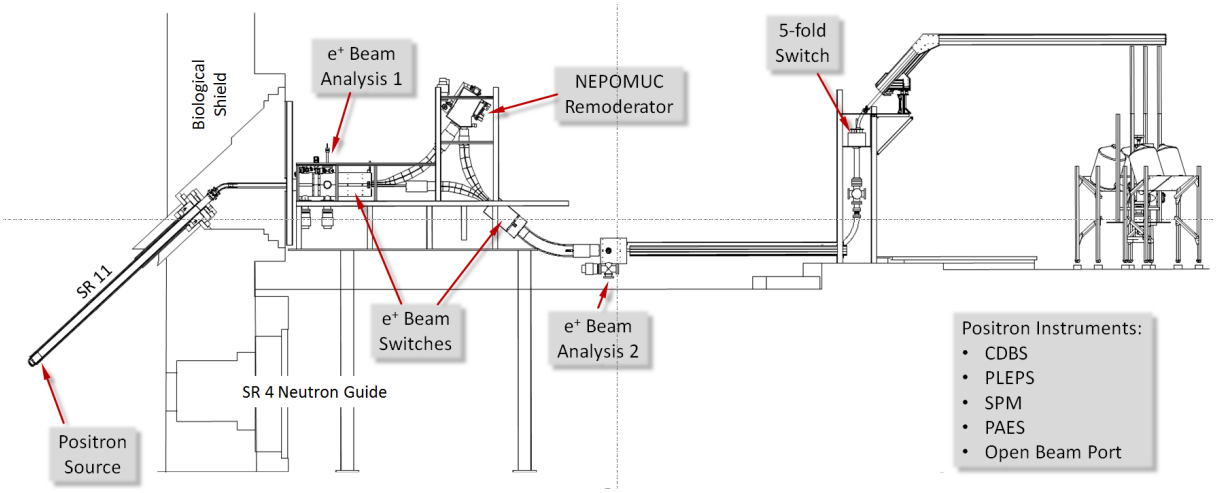

Figure 2: Schematic drawing of NEPOMUC and the positron beam facility.

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