Neutron Metrology and Dosimetry at PTB
- Changes and Progress since May 2003 -

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1. Changes since May 2003

In the framework of a general re-organisation of the PTB, the division 6 "ionising radiation" with 150 staff members was subdivided into 6 departments with a staff between 20 and 30 members each. Two departments 6.4 "ion accelerators and reference radiation fields" and 6.5 "neutron radiation" were formed out of the former department 6.4 "neutron radiation" and share the tasks of neutron metrology.

Dep. 6.4 is, among others, responsible for the production, characterisation and application of (quasi-) mono-energetic neutron reference fields which comprise:

- a thermal neutron beam, well characterised in the spectral fluence rate and almost free of contamination with epithermal neutrons and photons. This thermal neutron beam is at our disposal two times for two weeks per year for any kind of irradiations.
- mono-energetic neutrons in the energy range from 24.5 keV to 19 MeV according to ISO 8529 part 1 as produced for about 30 years at the PTB accelerator facility by means of selected nuclear reaction. These calibration measurement capabilities are submitted through EUROMET to JCRB for international approval and publication on part C of BIPM-KCDB. The quality management shall be supported by CCRI key and EUROMET supplementary comparisons partially completed or in progress.
- Quasi mono-energetic neutrons in the energy range from 30 MeV to 200 MeV as produced at cyclotrons at Louvain-la-Neuve in Belgium and at Faure in South Africa and characterised in terms of the spectral fluence rate by PTB. These calibration capabilities are unique but the neutron beams can be applied only on request in the framework of approved scientific projects.

Dep. 6.5 uses sets of radio-nuclide neutron sources to perform calibrations of neutron sensitive devices in the PTB 'bunker' room in terms of fluence-, ambient dose equivalent- and personal dose equivalent-rate. In addition, dep. 6.5 is running different neutron spectrometers for determination of the spectral fluence rate of these sources, at workplaces and plasma experiments.

2. Progress achieved in recent two years

The excellent properties of the thermal neutron beam were determined by time-of-flight spectrometry with a chopper and 6m flight-path. The measured spectral fluence is well described by a Maxwellian distribution and is independent on the flux rate ranging from 10^4 to 10^6 neutrons per second behind a 2.5cmx2.5cm aperture. Traceability of the neutron flux measurement to the primary radioactivity standard of PTB was established by Au-foil activation (report PTB-N-47).

The Monte Carlo code TARGET is used at PTB for almost 20 years to calculate the spectral distribution of mono-energetic neutrons. The code has been redesigned and considerably extended by D. schlegel. Besides energy straggling, the angle straggling of the projectiles in the solid targets influence the spectral distribution, in particular for non-zero-degrees neutron emission. In addition, double valued kinematics and cross sections are taken into account for endothermic reactions close to the threshold. A modern Windows-platform is used to control the revised PC-version of the code, which will soon be released.

In the framework of a EUROMET supplementary comparison, IRMM, NPL and PTB carried out the measurements in December 2004 at the PTB accelerator facility. According to a protocol very similar to the protocol for the CCRI(III)-K.10 key comparison, the fluence rate of neutrons with energies of 15.5, 17 and 19 MeV were determined in the low scatter experimental hall of PTB by means of recoil proton telescopes (IRMM, PTB) or a long counter (NPL). Analysis of the rough data and corrections for background neutrons are in progress. The results will be evaluated at PTB.

In spring 2004, the dep. 6.5 received a new ^{252}Cf-source. The isotope abundance was carefully specified by the producer of the basic material (Oak Ridge) and the emission rate was calibrated by the NPL in a Mn-bath. The emission rates of old and new Cf-sources in use at PTB were compared by means of a long counter. Excellent agreement has been achieved.