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New reference field for testing radiation protection dosemeters in pulsed high-energy photon radiation and the link to the new European Metrology Network for Radiation Protection

Radiation facilities need to meet the legal and normative requirements for radiation protection. This applies also to modern accelerator facilities used in science, technology, and medicine.

The radiation protection safety of such accelerators is currently ensured by dosimetric measurements with area dosemeters. However, the dosemeter's suitability for these high-energy and pulsed radiation fields is usually not tested according to the state-of-the-art in science and technology due to the lack of suitable reference fields. In order to address this, PTB aims to establish a new reference radiation field allowing for measurements traceable to national standards within a project funded by the German Federal Office for Radiation Protection (BfS)[(1)]. This field can be used for tests, development and verification of existing or novel dosimetry systems.

Type-testing is usually performed with energies up to 7 MeV in continuous radiation fields. As the response of radiation protection dosemeters can be affected by pulsed radiation, e.g. due to dead time effects, the international standards for testing dosemeters in pulsed fields of ionizing radiation (ISO/TS 18090-1 and IEC TS 63050) were established. However, a reference field similar to the fields typically expected behind (weak) shieldings of medical accelerators is non-existent. Within the German project "Establishment and characterisation of a reference field for ensuring radiation protection at accelerator facilities in medicine and research and for testing and calibrating of corresponding measuring instruments"[(1)] such a reference field has been established. Within this characterized pulsed photon reference field, dose rates occurring behind (insufficient) shielding of medical and research accelerator facilities can be realized. The field is based on a commercial medical linear accelerator at PTB. It is generated behind a 2 m-thick concrete wall with a composition typical used for radiation shielding.

The absence of a suitable reference field as described above has been a noticeable gap in the metrology infrastructure, both nationally and internationally. During a workshop within the EMPIR project 19NET03 supportBSS[(2)] this absence was also identified as a gap in the European metrology infrastructure. International awareness to the existing deficiency of radiation protection dosemeters in pulsed fields of ionizing radiation has also been raised. These gaps will be introduced into the new strategic research agenda (SRA) of the European Metrology Network for Radiation Protection approved by the General Assembly of EURAMET in June 2021[(3)].

In this presentation, results from the characterization of a new suitable reference field will be shown. This includes ambient dose rate measurements using a traceably-calibrated secondary standard ionization chamber as well as photon spectra determined using a passive few-channel spectrometer and Monte Carlo simulations. Information about the European Metrology Network for Radiation Protection will also be included.

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(2) The project 19NET03 supportBSS has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme. 19NET03 supportBSS denotes the EMPIR project reference.

(3) https://www.euramet.org/european-metrology-networks/radiation-protection/

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