

P-S2-109: New reference field for testing radiation protection dosimeters in pulsed high-energy photon radiation and the link to the new European Metrology Network for Radiation Protection

The Gap: Missing reference fields for development and testing

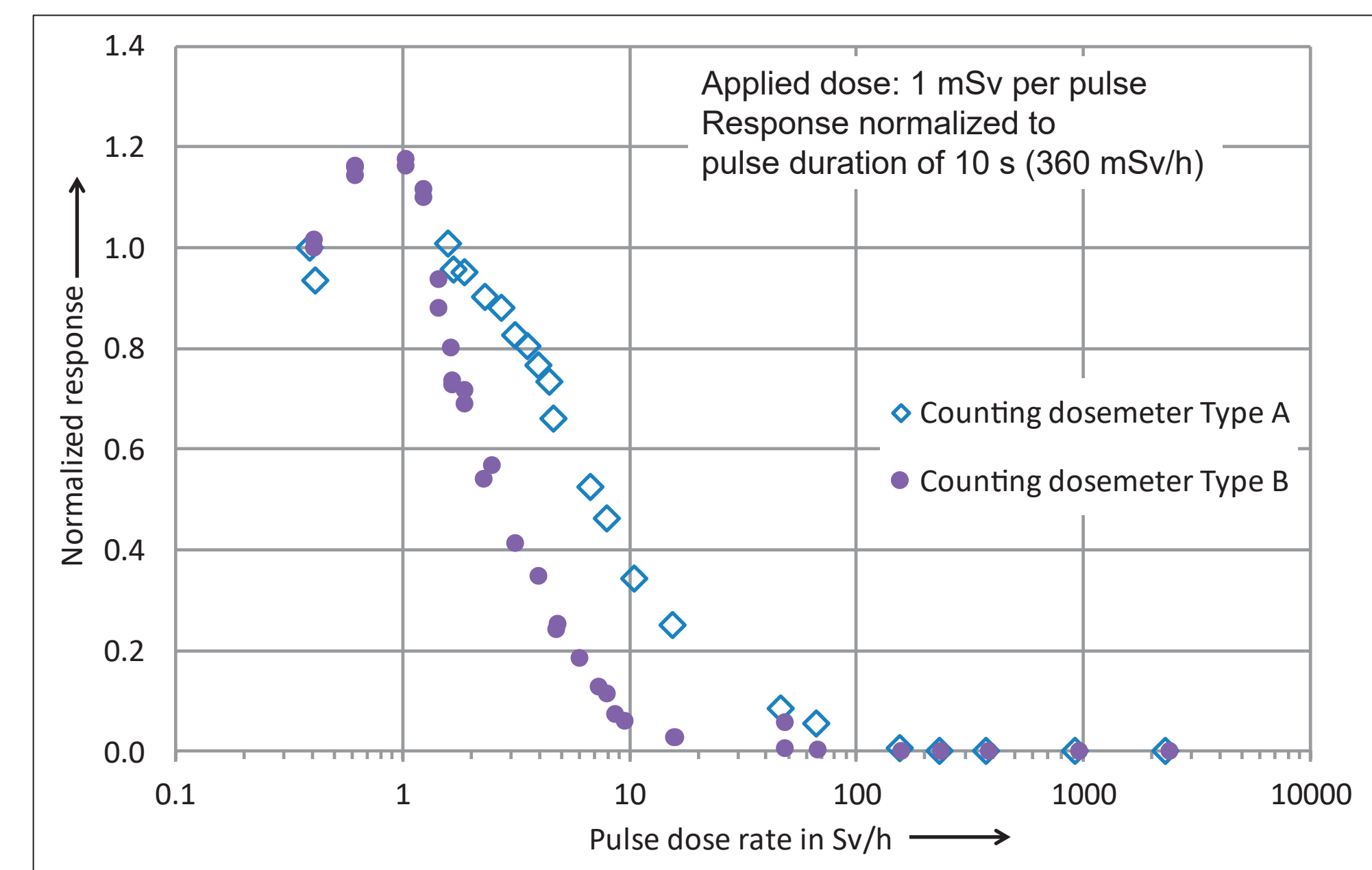
Electronic dosimeters often show severe under-responses in pulsed fields of ionizing radiation.

This was already investigated in pulsed X-ray fields. A typical example of the response of two personal dosimeters is shown on the right. The reasons for this behavior are well understood but suitable dosimeters for such fields are still missing.

Testing is possible in reference fields according to ISO/TS 18090-1 with procedures given in IEC TS 63050.

In area dosimetry, e.g. for checking the shielding of a medical linear accelerator, a suitable **high-energy, pulsed reference field** for testing and development of dosimeters was missing up to now.

Such gaps and needs have to be identified at an early stage and the solutions have to be communicated to stakeholders. This is done with help of the novel **European Metrology Network (EMN) for Radiation Protection**.



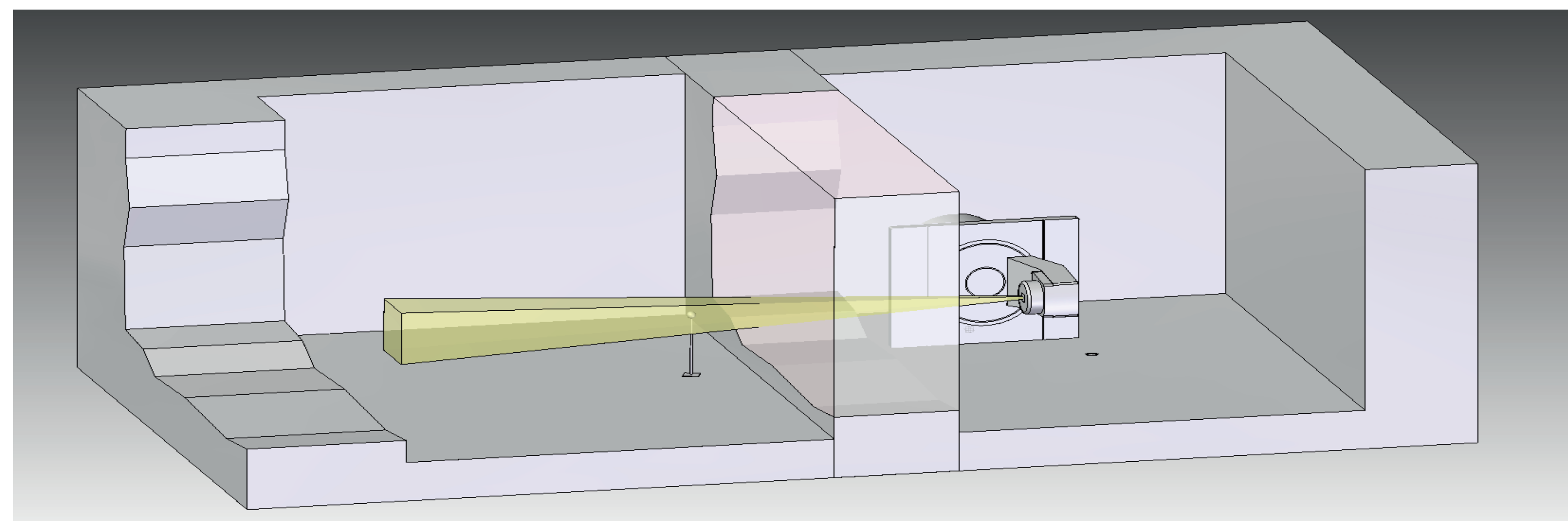
The Project: "High-energy, pulsed reference field"

National 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

The aim of the project is to develop a validated, traceable, accelerator-based, high-energy, pulsed reference radiation field using a cost-effective method. The reference field should mimic the radiation protection conditions behind the protective shielding where the workplaces for occupationally exposed worker are located.

- 1) The field will be realized based on the results from rough Monte Carlo simulations.
 - Using PTB's medical linear accelerator with one rather weaker shielding i.e. the room's wall to a neighboring irradiation room.
- 2) The reference field is then validated by measurements and comparison with the simulation results of the detailed geometry. The validations include:
 - Measurement of photon spectra, e.g. by means of a few channel spectrometer
 - Dosimetry of photons, electron and neutron dose by e.g. secondary standard ionization chambers (photons) and Bonner spheres (neutrons)

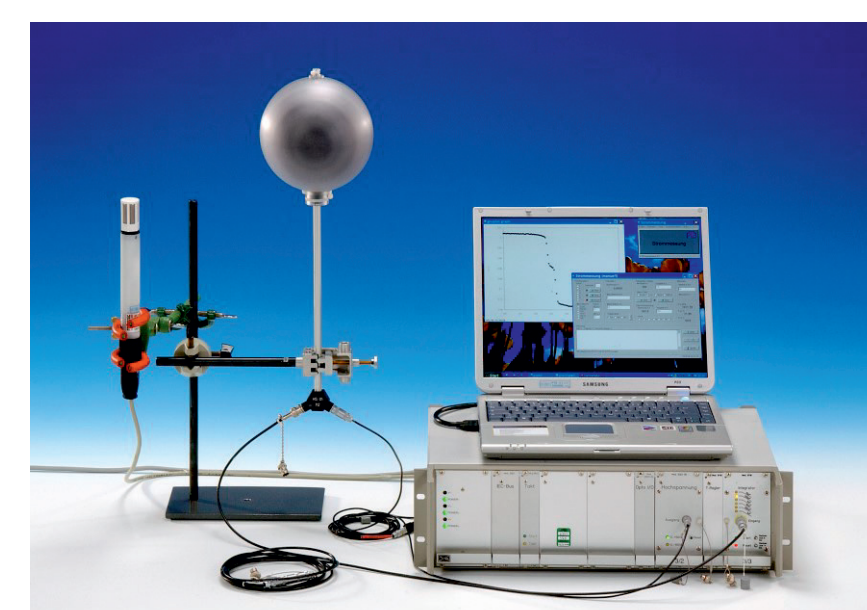
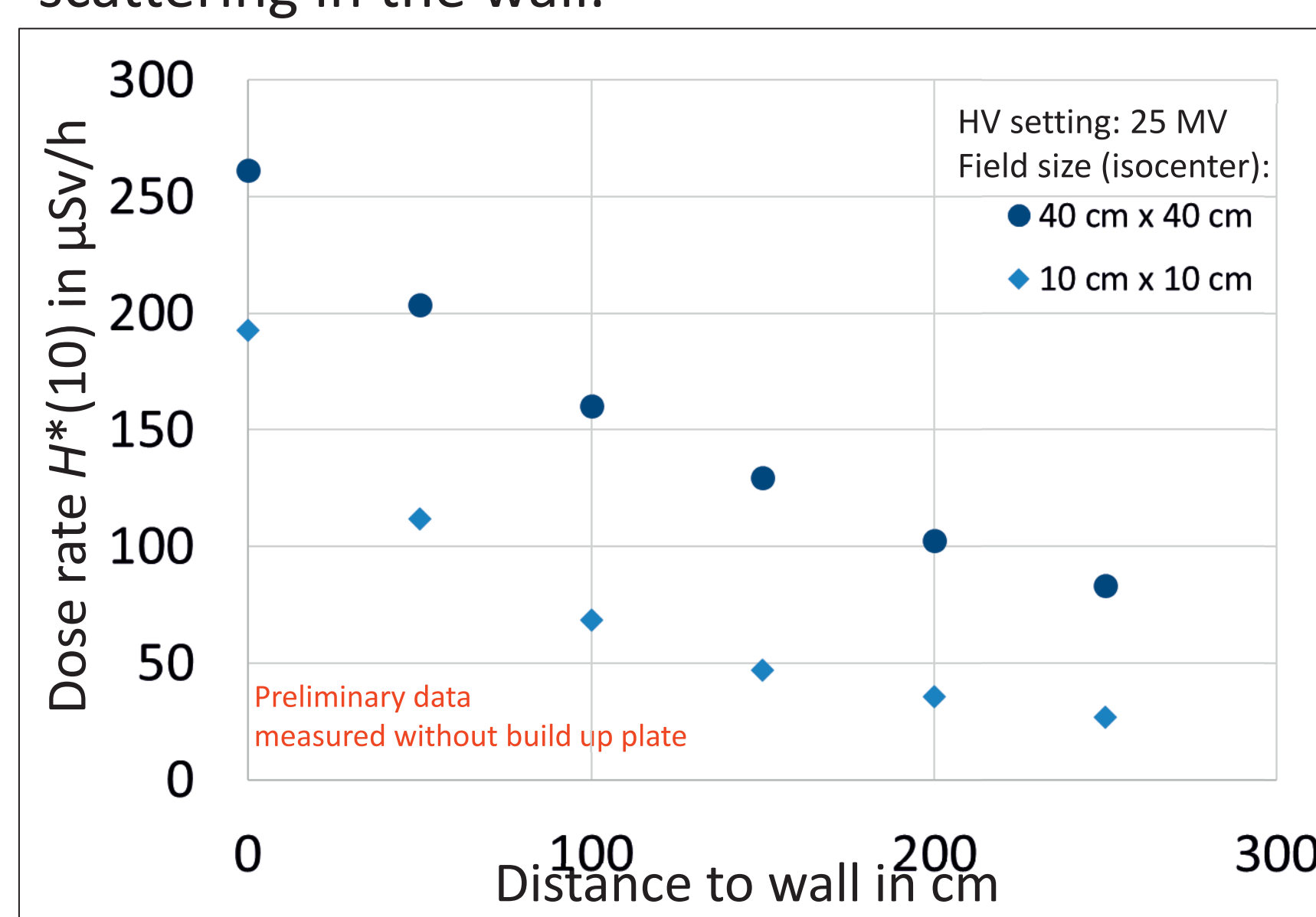
The reference field project is funded by the Bundesamt für Strahlenschutz <https://www.bfs.de; project no. 3619S2236>.



The solution: First Scientific Results

The dose rate behind the 2 m thick shielding was evaluated using a $H^*(10)$ -secondary standard ionization chamber.

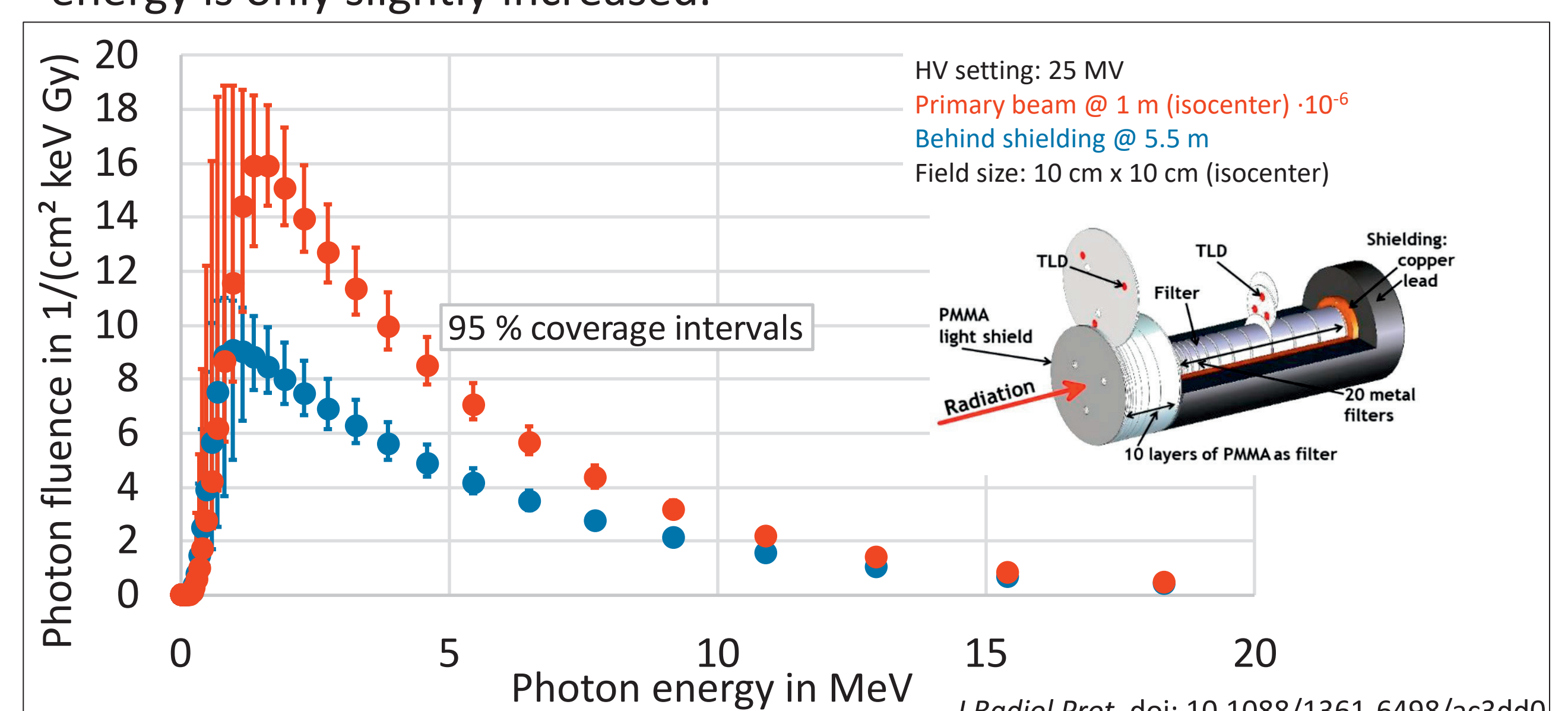
- The dose rate follows roughly a quadratic decrease with the distance.
- Increasing the size of the primary beam increase the dose rate due to increased scattering in the wall.



Additional build-up material of approx. 2 cm to 3 cm PMMA needed to ensure charged particle equilibrium.

Spectrometry has been performed using a TLD-based few channel spectrometer.

- The primary beam spectrum has been scaled by a factor of 10^{-6} to compensate for attenuation and distance.
- The shape of the spectrum does not change significantly, accordingly its mean energy is only slightly increased.



Dissemination of the Results to the stakeholders

The metrological Gap has been recognized during a stakeholder workshop of the 19NET03 supportBSS project.

The project supportBSS resulted in the foundation of a **European Metrology Network (EMN) for Radiation Protection**.

The network aims to act as a single point of contact to cover the metrological needs related to radiation protection.

One of the most important tasks of this EMN will be to give a strong voice to the field of radiation protection metrology in Europe, so that it can provide responsible guidance and support to future technological development.

16 Members:



2 Partners:



www.euramet.org/european-metrology-networks/radiation-protection/

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.



- ✓ Approval of the EMN in June 2021 in the 15th EURAMET GA
- ✓ EMN established 16th September 2021
- ✓ Annual General Meeting 13th October 2022

EMN CHAIR: Annette Röttger, PTB, Germany

EMN VICE-CHAIR: Teemu Siiskonen, STUK, Finland

EMN SECRETARY: Behnam Khanbabaee, PTB, Germany