

NOVEL REFERENCE FIELD FOR PULSED PHOTON RADIATION FOR RESEARCH AND TYPE TESTING



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Introduction

The application of pulsed radiation fields for medical investigations has increased remarkably in the last years. But until today, radiation protection dosimeters have only been tested in continuous fields, as shown by Ankerhold et al.. The characteristics of dosimeters determined in continuous fields cannot be transferred to those in pulsed radiation fields. Therefore, a reference field for pulsed radiation is needed. Such novel X-ray equipment has been installed at PTB for research and type testing of personal and area dosimeters (Klammer et al.).

References:

Ankerhold, U., Hupe, O. and Ambrosi, P. Deficiencies of active electronic radiation protection dosimeters in pulsed fields. *Radiat. Prot. Dosim.* 135, No. 3, 149-153 (2009).

Klammer, J., Roth, J. and Hupe, O., Novel reference radiation fields for pulsed photon radiation installed at PTB. *Radiat. Prot. Dosim.*, accepted.



Sources of pulsed photon radiation

Properties of the new X-ray equipment for pulsed photon radiation

All relevant field parameters, like pulse duration, tube voltage, and current can be varied independently with small uncertainty.

Tube voltage U_{tube}	40 kV to 125 kV
Tube current I_{tube}	0.5 mA to 800 mA
Radiation pulse duration t_{pulse}	0.2 ms to cw
Max. el. power	80 kW for 300 ms, 3 kW for cw
Pulse repetition frequency f_{pulse}	0.1 Hz to 100 Hz
Radiation qualities	N-series, RQR-series
Dose per radiation pulse	100 nSv to 300 mSv ($H_p(10)$)
Radiation pulse dose rate	4 mSv/h to 3700 Sv/h ($H_p(10)$)
Field size	5.5 cm to 52.5 cm

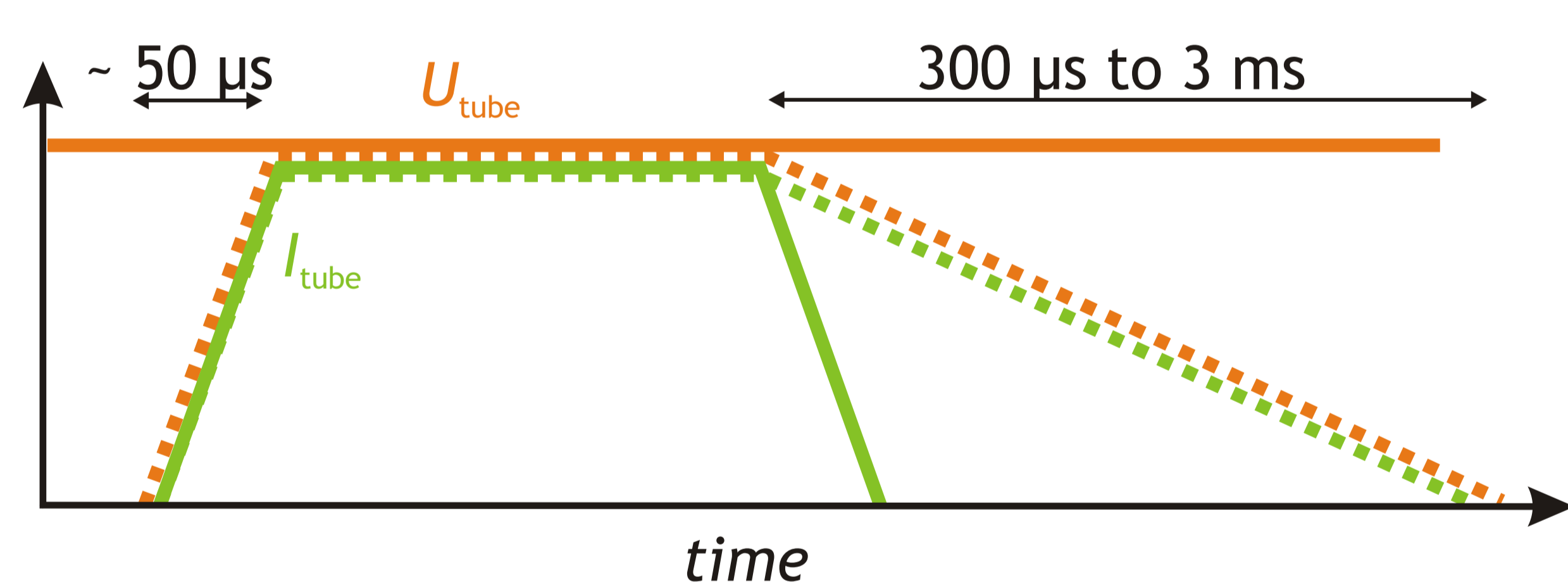
Measurement equipment for characterization

- Additional external high voltage divider and voltmeter for measurement
- Traceable to primary standards
- Monitoring ion chamber for measurement of dose per pulse
- Monitoring diode for measurement of pulse shape

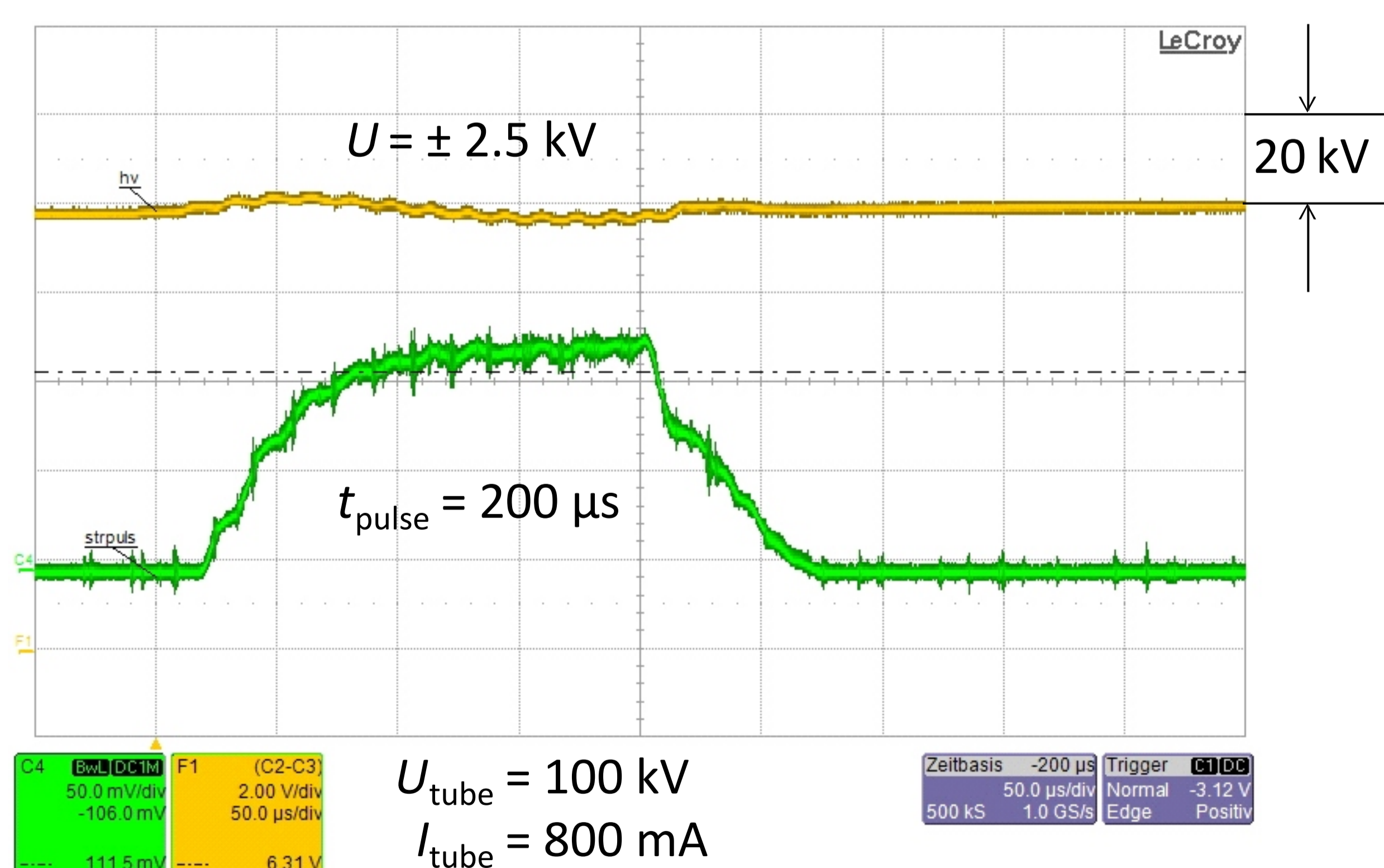


The new X-ray equipment for pulsed photon radiation has been developed in cooperation with Siemens AG Sector Healthcare and ESW GmbH.

Pulse shape of the grid-controlled X-ray tube

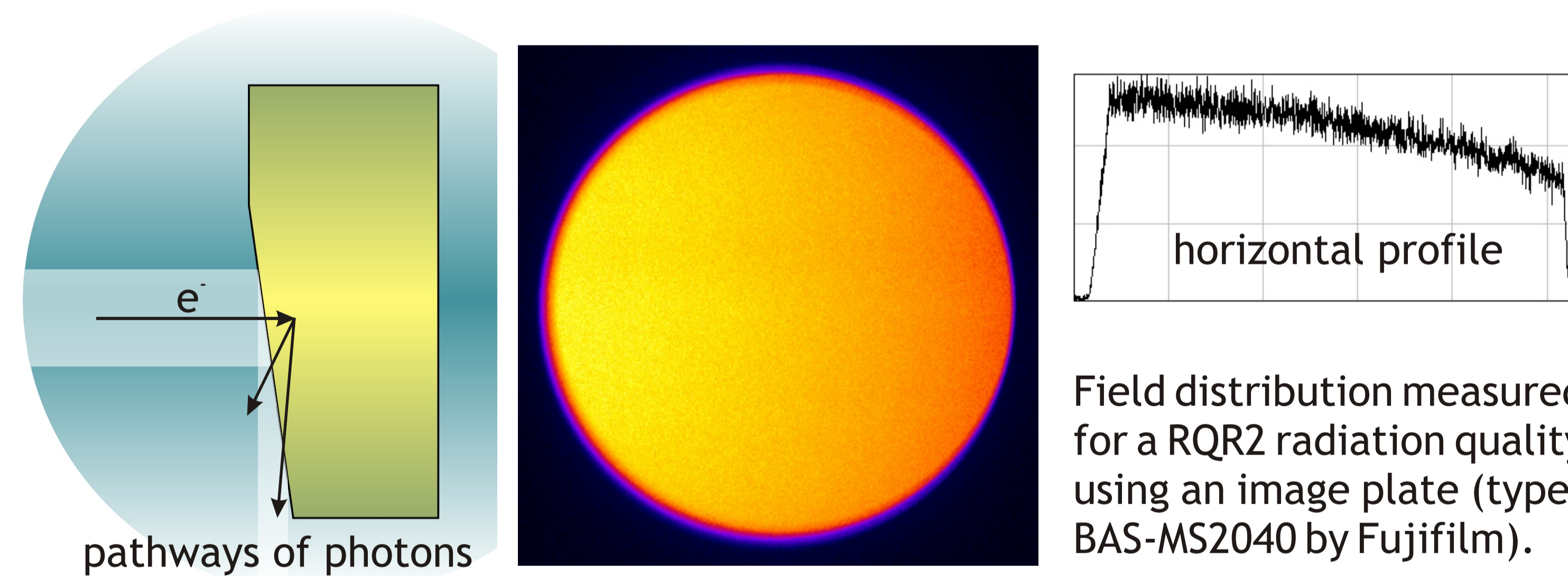


The X-ray tube in the novel X-ray equipment for pulsed photon radiation is used in a grid-controlled mode (—). Commonly in standard medical X-ray equipment the high voltage generator is switched on and off (---).



Pulse shape measured with a semiconducting diode (type: Hamatsu S3590-19) and tube voltage.

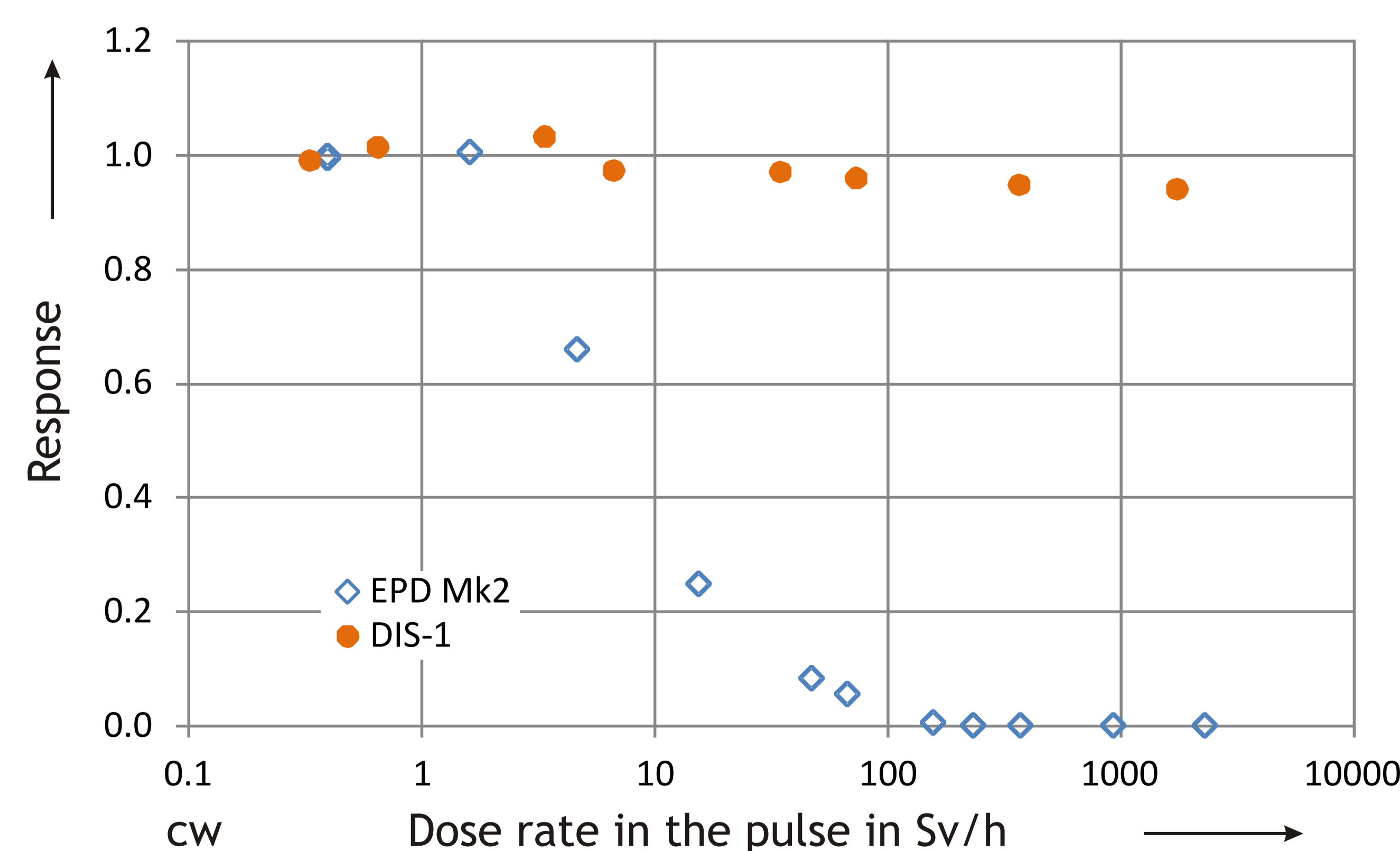
Dose rate distribution due to the Heel effect



Field distribution measured for a RQR2 radiation quality using an image plate (type: BAS-MS2040 by Fujifilm).

Personal dosimeters in pulsed radiation fields

The response of two different personal dosimeters has been tested at the novel equipment for pulsed photon radiation for single pulses with constant dose per pulse but increasing dose rate.



Status

- The novel equipment for pulsed photon radiation has been installed at the PTB, characterized and is now ready to use.
- The capability to measure under pulsed conditions has been tested with active dosimeters of different measuring principles.
- ISO-Proposal 18090: "Radiological protection - Characteristics of reference pulsed radiation"
- IEC Technical specification IEC 62743 TS Ed.1 - see poster by Hayo Zutz

Contact

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