ST 1: Radiation monitoring and dosimetry I

Time: Tuesday 11:00–12:00 Location: H-HS II

ST 1.1 Tue 11:00 H-HS II

Measurement of the radiation quality of a X-ray Source using ATLAS Pixel detectors — •Simon Jansen[1], Kevin Kröninger[1], Isabelle Schilling[1], Jörg Walbersloh[2], and Jens Weingarten[1] — [1]TU Dortmund, Dortmund, Deutschland — [2]Materialprüfungsamt NRW, Dortmund, Deutschland

ISO and DIN standards define various standard X-ray spectra (so-called "qualities") for the purpose of calibrating dosemeters at low photon energies.
To calibrate the X-ray facility at the Materialprüfungsamt NRW in Dortmund and verify the spectra with respect to the ISO and DIN standards, the spectrum of the X-ray facility is measured using an ATLAS Pixel detector while varying the voltage and current of the X-ray tube, as well as material and thickness of a set of absorbers.
With respect to a traditional spectroscopy setup using Germanium detectors the advantage of the proposed setup is that the detector is very mobile and does not need to be cooled, reducing the overhead for a measurement and thus allowing regular recalibrations of the X-ray facility. The talk will introduce the experimental setup and first spectroscopic result.

ST 1.2 Tue 11:15 H-HS II

Studies of emission spectra of various thermoluminescence materials — •Evelin Derugin[1], Florian Mentzel[1], Jens Weingarten[1], Jörg Walbersloh[2], and Kevin Kröninger[1] — [1]TU Dortmund, Lehrstuhl für Experimentelle Physik IV — [2]Materialprüfungsamt NRW

The individual monitoring service at the *Materialprüfungsamt NRW* develops the thermoluminescence(TL) dosemeter system TL-DOS for large scale individual dose monitoring in cooperation with the *Lehrstuhl für Experimentelle Physik IV* at the TU Dortmund University. When a TL material is exposed to ionizing radiation it stores the deposited energy by trapping excited electrons in metastable states. When heated, the material releases the trapped electrons depending on their energy difference to the next band. These electrons can recombine with holes and vice versa, leading to an emission of light. The intensity of the emitted light is proportional to the amount of initially deposited energy.
In the course of the improvement of the readout method in order to optimize TL light sensitive filters, it is important not only to make a statement about the glow curve, but also to consider the emission spectrum of the emitted TL light. In the context of a master thesis different TL materials, which are currently used as detector material are examined for their emission spectra after irradiation. The study provides information about the intensity distribution as a function of the wavelength of the light.
The talk will discuss the different emission spectra of the TL materials.

ST 1.3 Tue 11:30 H-HS II

The prospects of the evaluation of the high-LET peaks of thermoluminescence glowcurves in the context of neutron dosimetry — •Myriam Heiny[1], Ajvar Kern[3], Kevin Kröninger[1], Jörg Walbersloh[2], and Jens Weingarten[1] — [1]TU Dortmund University, Dortmund, Germany — [2]Materialprüfungsamt NRW, Dortmund, Germany — [3]West German Proton Therapy Centre Essen, Essen, Germany

The individual monitoring service at the Materialprüfungsamt Nordrhein-Westfalen and the TU Dortmund are developing the compact dosemeter system TL-DOS based on thin-layer thermoluminescence detectors as well as an associated glow curve analysis tool. This work focuses on the TL-DOS neutron dosemeter system.

The system consists of LiF:Mg,Ti detectors, an albedo badge and a readout device. In order to gain more information about the irradiation like the particle type, the detectors used are measured at 380°C to include the high-LET peaks. The resulting glow curve is deconvoluted into its individual peaks to analyze them. After a design specification was defined, the neutron dosemeter was characterized in different photon and neutron fields as well as in workplace fields. Additionally, the system was irradiated with mixed fields like alpha+photon and neutron+photon fields to analyzed the high LET peaks of a glow curve seperately. The analysis provides additional information about the radiation field, for example the particle type, the composition of mixed fields and the irradiation energy. I present the current development status and test results as well as future prospects.

ST 1.4 Tue 11:45 H-HS II

Co-registration of ionoacoustics and ultrasound signals in a 3D printed realistic mouse phantom. — •Pratik Dash[1], Julie Lascaud[1], Hans-Peter Wieser[1], Ronaldo Kalunga[1], Benjamin Wollant[1], Walter Assmann[1], Jonathan Bortfeldt[1], Alessandro Stuart Savoia[2], and Katia Parodi[1] — [1]Ludwig-Maximilians-Universität München, Garching b. Munich, Germany — [2]Department of Engineering, Roma Tre University, Rome, Italy

Proton therapy, owing to its pronounced maximum dose deposition (Bragg Peak-BP) at the end of its finite range in matter, allows for a highly conformal tumor irradiation. Ionoacoustic range verification uses thermoacoustic waves generated from irradiated regions to derive the BP positions, thereby enabling real-time treatment monitoring.

Superimposing ultrasound images with ionoacoustic signals requires both spatial and temporal co-registration between the two. The former is achieved by using the same transducer whereas the latter is achieved by using a synchronized trigger for data acquisition. Temporal co-registration was validated in simple water phantoms irradiated by a 20 MeV proton beam at the Maier-Leibnitz Laboratory in Munich. A dedicated procedure was then defined to correct for the time offset between the two signals (more specifically, their measurement triggers).

Finally, the effect of tissue heterogeneities in the medium was investigated by irradiating a 3D printed realistic mouse phantom. We demonstrated improved range verification accuracy and precise co-registration between the two modalities, facilitating a superposition of the pressure induced by 3D dose distribution and the mouse anatomy.