ST 5: Poster Session

Time: Wednesday 11:00–12:30 Location: Poster A

ST 5.1 Wed 11:00 Poster A

Angle-dependent light scattering in the case of thin bone layers for the application of optical cochlear implants — •Tom Witke[1], Fabian Teichert[2,3,4], and Angela Thränhardt[1] — [1]Institute of Physics, Chemnitz University of Technology, Chemnitz, Germany — [2]Fraunhofer Institute for Electronic Nano Systems (ENAS), Chemnitz, Germany — [3]Center for Microtechnologies, Chemnitz University of Technology, Chemnitz, Germany — [4]Center for Materials, Architectures and Integration of Nanomembranes (MAIN), Chemnitz University of Technology, Chemnitz, Germany

Understanding light scattering in human tissue is essential for the further development of optical cochlear implants. We investigate this using Monte-Carlo simulations and an analytical approach. The focus in simulation and analytics is on the investigation of phase functions that can model the properties of tissue best. Here we will present a phase function that has the same precision as a calculated distribution and yet has all the advantages of an analytical function, and show how multiple scattering and corresponding transmissions can be calculated analytically and compared with Monte-Carlo simulations.

ST 5.2 Wed 11:00 Poster A

Advanced nano-CT with laboratory X-ray radiation: optimization of geometry and anode material — •Claas Warnecke, Paul Meyer, Jordi Carstens, and Tim Salditt — Institute for X-ray physics, University of Göttingen, Germany

Phase-contrast tomography of biological tissue with laboratory X-ray sources is a quickly advancing imaging modality which opens up new possibilities for three-dimensional virtual histology and clinical pathohistology, to be performed in hospitals rather than at synchrotron sources.

In this work, a 3D virtual histology setup is realized using a nanofocus X-ray tube with a cone-beam geometry, as well as scintillation and direct photon-counting detectors. The focus of this work is the optimization of the experimental parameters of the setup including focal spot size and photon flux, magnification and phase contrast. The X-ray tube also allows for an easy exchange of anodes that makes a quantitative comparison between different anode materials possible, including tungsten, copper and molybdenum. The results are compared to data from a synchrotron source.

ST 5.3 Wed 11:00 Poster A

Unravel patterns of chronic diseases in India using Graph Networks — •Carola Behr, Anna Nitschke, Jannis Demel, Jonathan Berthold, Carlos Brandl, and Matthias Weidemüller — Physikalisches Institut, Universität Heidelberg, Deutschland

To uncover insights from complex and diverse medical datasets, Network Science and Graph based approaches can play an important role. Based on the DHS 2019-2021 dataset from India, we apply different methods to gain a deeper understanding of the prevalence of chronic diseases. In this poster we present the application of techniques such as Community Detection, which aims to identify inherent structures within the dataset, and Graph Convolutional Networks, designed to exploit the rich relational information embedded in the data. Our goal is first to uncover the nuanced connections of socio-economical parameters and biological parameters within that dataset using advanced network-centric methodologies and second improve the disease management for individuals and the health care system.

ST 5.4 Wed 11:00 Poster A

Development of a Monte Carlo computational software and its application in Medical physics — •Milena Živković and Dragana Krstić — University of Kragujevac, Kragujevac, Serbia

The FOTELP-VOX code (author R. Ilić), with its advanced Monte Carlo techniques and precise dose distribution analysis, serves as a versatile tool applicable not only to particle transport simulations but also to the field of radiotherapy, including the specific application of the gamma knife. The software*s adaptability allows for its integration into radiotherapeutic practices, contributing to optimizing radiation treatments with a high degree of precision. The capability to model radiation interactions within the human body, coupled with the flexibility to customize parameters such as beam type, shape, and energy levels, positions FOTELP-VOX as a valuable asset in the planning and refining of radiotherapeutic interventions. For post-simulation analysis, the deposited energies, measured in either MeV/kg or Gy, are recorded in the REDOSE.TXT and SLIKA.DAT output files. These files, in conjunction with CT anatomy data, serve as the foundation for visualizing slices of the anatomy and the corresponding deposited doses in the individual voxels. In summary, FOTELP-VOX*s versatility makes it a powerful tool not only for general radiotherapeutic applications but also for addressing the unique challenges and requirements of gamma knife procedures, ultimately aiding in improving patient outcomes.

ST 5.5 Wed 11:00 Poster A

Cell Irradiation Experiments and Film Dosimetry with Low Energy Electrons from a Compact Ultrafast Electron Source — •Julian Freier[1], Bastian Löhrl[1], Leon Brückner[1], Christoph Bert[2], Luitpold Distel[3], and Peter Hommelhoff[1] — [1]Department Physik, FAU Erlangen-Nürnberg — [2]Department Medizinische Strahlenphysik, Universitätsklinikum Erlangen, FAU — [3]Department Strahlenbiologie, Universitätsklinikum Erlangen, FAU

Millimeter-sized accelerators could provide new opportunities for radiotherapy [1]. Such a chip-based (electron) accelerator using nanophotonic structures driven by femtosecond laser pulses could be built into an endoscopic system and be used for highly localized cancer treatment, for example. Motivated by this goal, we present the successful implementation of a cell irradiation experiment using pulsed 40 keV electrons, which coincides with the latest electron energy achieved in an accelerator on a chip [2]. The femtosecond laser-triggered compact electron source can provide currents of few fA on the sample position. Irradiation-induced DNA double strand break damages are detected and visualized in different types of cells through gH2AX immunofluorescence staining. Furthermore, the first signs of high radiation severity have been shown with colony formation assay and damage after long repair times. For dosimetry, unlaminated EBT3 GafChromic films are investigated on their response and efficiency to low energy electron radiation and are compared with X-Ray radiation. [1]*England, et al. "Dielectric laser accelerators." RMP 86, 1337 [2]*Chlouba, et al. Nature 622, 476 (2023).

ST 5.6 Wed 11:00 Poster A

Comparison of the proton therapy doses obtained with the Geant4 and matRAD — •Mariam Abuladze[2], Achim Stahl[1], Ronja Hetzel[1], and Revaz Shanidze[2,3] — [1]RWTH Aachen University, Aachen, Germany — [2]Kutaisi International University, Kutaisi, Georgia — [3]Ivane Javakhishvili Tbilisi State University, Tbilisi, Georgia

Proton therapy is a high-quality radiation therapy that uses a proton beam to irradiate cancer tissue. The advantage of this type of treatment is a highly conformal dose deposition due to the presence of the Bragg peak. The treatment planning systems (TPS) which are used for calculation of delivered doses in radiation therapy are usually based on semi-analytical methods and hence are less precise than Monte-Carlo technique. GEANT4 is the most well-developed software platform for the simulation of the passage of particles through matter using Monte Carlo methods. It can calculate delivered doses with high accuracy, by considering all the possible particle matter interactions which can occur during proton passage into tissue. MatRad is well-known open-source TPS software for intensity-modulated photon, proton, and carbon ion therapy, which is actively used for educational and research purposes. In this work we compared dose distributions in matRad and Geant4 by executing matRad with the help of Octave platform which makes it possible to extract beam parameters generated by matRad optimization algorithms and then simulating it in Geant4 monte-carlo simulation for the same patient phantom and see how DVH obtained from both simulations differ.

ST 5.7 Wed 11:00 Poster A

From a single to a multi-channel array Prompt Gamma detection system based on PETsys Electronics — •Olga Novgorodova and Arno Straessner — IKTP TU Dresden, Dresden, Germany

Prompt Gammas (PG) in proton therapy are one of the developing techniques for non-invasive measurement of the in-vivo proton range.

For the prompt gamma timing (PGT) application, we have successfully characterized a single channel system of a $CeBr_3$ crystal read out by a SiPM based on PETsys Electronics. Both time and spectral characteristics achieved the required resolution. Measurements at the OncoRay TU Dresden facility with energies between 100 and 162 MeV protons suffered from very low statistics for a single channel. We investigated several multi-channel arrays that were read out by Hamamatsu SiPMs with 3x3 mm^2 dimensions and 50 μm microcells, as well as by Sensl SiPMs with 6x6 mm^2 dimensions and 35 μm microcells, and Hamamatsu SiPMs with 6x6 mm2 dimensions and 25 and 50 μm microcells. We present our investigation of system characteristics, including crosstalk and homogeneity, as well as energy and time spectra using multi-channel $CeBr_3$ crystal array.