GSI – **BIOPHYSICS SEMINAR**

Thursday, June 26, 2025 at 2:00 p.m.

Lecture hall, Theory SB3 3.170a
Planckstraße 1, 64291 Darmstadt

Prof. Dr. Anna Bakenecker

Medical Engineering
Department of Electrical Engineering and Information Technology (etit)
TU Darmstadt, Germany

„Micro- and Nanorobotics & Magnetic Particle Imaging"

Micro- and nanorobots can be magnetically guided to a target in the body and enable the local administration of therapeutics or thermal treatment. These microrobots can reach re-gions of the body that are not accessible by catheter-based or open surgical procedures. The necessary magnetic properties are achieved through magnetic coating or the integra-tion of magnetic nanoparticles (MNPs). Various materials and shapes are being developed for this purpose that are specially tailored to their respective medical application, are bio-compatible or biodegradable and react to stimuli. This enables a triggered release of medi-cation at the site of the disease. Magnetic fluid hyperthermia is the induction of heat with the help of MNPs that have been enriched at the site of the disease and are stimulated by fast alternating magnetic fields. It can be used as a gentle therapy against cancer and inflammation or as a trigger for re-sponsive materials to release medication.

Tomographic real-time visualization is essential for precise and safe control of micro- and nanorobots. For this purpose, a worldwide novel imaging technology will be used and tested for the tracking of micro- and nanorobots: magnetic particle imaging (MPI). This imaging technology allows real-time tomographic visualization of the concentration distribution of MNPs that serve as contrast agents. MNPs, which typically consist of iron oxide with a sugar shell, are well tolerated and degradable by the body. MPI is currently only used pre-clinically, but the first prototype devices have recently been developed in human size. Apart from the advantages of three-dimensionality, speed and non-ionizing radiation, one of the most fascinating potentials of MPI is the combination with magnetic micro- and nanorobot-ics.
MPI is of interest to medical professionals because it represents an excellent alternative to imaging techniques based on radioactive tracers, such as positron emission tomography. I would like to discuss whether and in what form MPI is a suitable imaging technique for planning and monitoring radiotherapy at the colloquium and look forward to exchanging ide-as and fruitful discussions with scientists from GSI.

Organized by Prof. Dr. C. Graeff & Prof. Dr. M. Durante
GSI Helmholtzzentrum für Schwerionenforschung GmbH