

Seminar Series: **Selected research topics in Biomedical Engineering: Medically Relevant Experiments with Synchrotron Radiation** (59017-01)

Fall Semester 2020 for PhD-students in Biomedical Engineering
Host: Bert Müller; Further lecturers: Georg Schulz and invited experts
Location: University Hospital Basel, ZLF, grosser Hörsaal

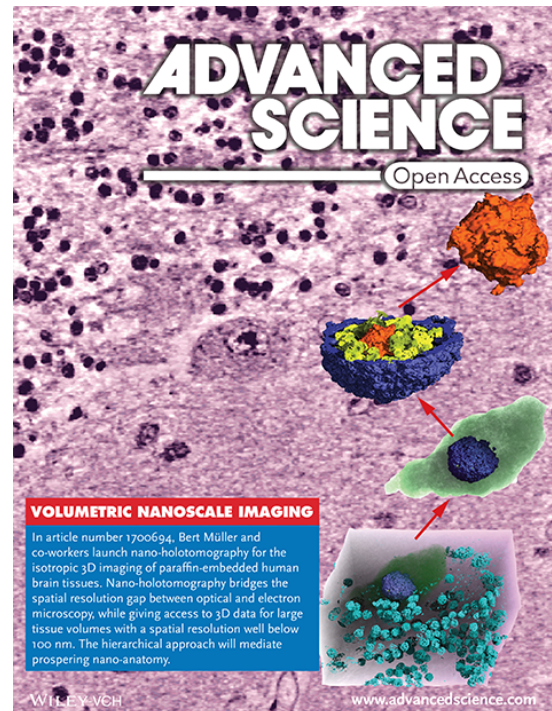
Background: X rays have been used for medical imaging since RÖNTGEN's fascinating discovery in 1895. The first radiographs appeared less than a month after his famous paper on X rays. Conventional X-ray sources integrated into the CT machines of today's hospitals still rely on the same principles. Synchrotron radiation was discovered more than 50 years after X rays, offering unique flux/brilliance, polarization and pulsed time structure. Therefore, unique experiments such as phase-contrast imaging, microbeam radiation therapy and spatially resolved small-angle X-ray scattering can be performed at synchrotron radiation facilities. Within this seminar series, beam-line scientists and experienced users will introduce the unique options for synchrotron radiation-based experiments and report on a variety of medically relevant approaches to diagnose and treat diseases. These approaches are focused on the three-dimensional imaging of soft and hard tissues in health and disease down to the molecular scale. The participants are invited to discuss future collaborations with the speaker's teams from Sweden, France, UK, and Germany with the aim to characterize their objects of interest with world-leading instrumentation. After the student presentations, the set-up and function of the Lyncean Compact Light Source as well as selected applications of medical relevance will be presented.

Learning goal: The PhD-students will gain detailed knowledge from world-class experts in synchrotron radiation-based characterization of tissues and MedTech products. Basic knowledge on the unique properties of synchrotron radiation will be provided. The lectures focus on medically relevant research activities and should encourage the audience to integrate such studies into their projects via cross-fertilizing collaborations.

Workload: 2 ECTS correspond to the work of $2 \times 30 \text{ h} = 60 \text{ h}$ for an average student, which includes the active participation at the lectures and a poster plus rapid-fire presentation of research papers of one of the lecturers.

Performance review: Poster and rapid-fire presentation of a selected research paper from one invited guest. B. Müller and G. Schulz will grade the performance.

Teaching material consists of the files from the presenters and literature cited.



Example of **nano-anatomy** research using a unique synchrotron radiation-based technique performed by the biomedical engineer Anna Khimchenko in the frame-work of the PhD-program at the University of Basel and awarded as one of the best doctoral theses at the Medical Faculty of the University of Basel in 2017/2018.

Semester schedule and content:

Dates	Lecturer	Preliminary Title
September 16 14:15 – 15:00	Bert Müller and Georg Schulz	Introduction of the speakers and related research at the Department of Biomedical Engineering
15:15 – 16:45	Hans M. Hertz	High-resolution biomedical imaging with laboratory and accelerator-based X-ray sources
September 23 13:30 – 15:00	Timm Weitkamp	Coherent imaging at the ANATOMIX beamline, an equipment of excellence
15:15 – 16:45	Marianne Liebi	Nanostructure surveys of macroscopic bone specimens by small-angle scattering tensor tomography
September 30 13:30 – 14:30	Alexandra-Teodora Joita-Pacureanu	Three-dimensional imaging of subcellular anatomical features (nano-tomography)
14:45 – 15:45	Christoph Rau	Cutting-edge tomographic imaging at the Diamond Light Source
16:00 – 17:00	Alexander Rack via zoom	Microimaging of tissues and dental implants at the European Synchrotron Radiation Facility
November 18 13:30 – 14:30	Felix Beckmann	Pushing towards the limits of density resolution in computed tomography
14:45 – 15:45	Ana Diaz	Ptychography and spatially resolved small-angle X-ray scattering at the Swiss Light Source
16:00 – 17:00	Alberto Bravin	Microbeam radiation therapy at the European Synchrotron Radiation Facility
December 02 12:30 – 13:30	Students (Bert Müller, Georg Schulz)	Rapid-fire presentations of student's posters
13:45 – 14:45	Benjamin Hornberger	Expanding the reach of synchrotron X-ray techniques with the Lyncean Compact Light Source
15:00 – 16:00	Julia Herzen	Advanced computed tomography for research in medicine and biology

After the lectures and formal discussions, the participants and the invited guests will have the chance to informally interact at <https://www.kitchenbrew.ch/de/> (craft beer and pretzels). These scientific discussions might be continued during common dinner.