Principles and Applications of X-ray Fluorescence Imaging (XFI)

X-ray fluorescence imaging (XFI) is based on the excitation and subsequent detection of X-ray fluorescence photons excited by a scanning incident X-ray beam. In order to make entities of interest visible, they need to be labelled with markers such as molecular iodine or palladium nanoparticles. The spatial resolution of the modality is solely determined by the applied X-ray beam diameter, which is typically in the range between 0.2 and 1 mm for *in vivo* measurements and between 80 and 200 nm for single cell measurements.

As the modality is non-invasive and the used markers do not decay over time, longitudinal studies are possible in one and the same animal, hence offering the potential for a significant reduction of test animals. Moreover, not only a single marker element, but multiple ones can be tracked simultaneously, providing the possibility to monitor multiple entities such as different subtypes of immune cells or medical drugs. Applications comprise, among others, uptake measurements of functionalized nanoparticles in tumor cells or mRNA-carrying nanoparticles, monitoring of T-cells in cell therapy or in immune-mediated inflammatory diseases, as well as biodistribution measurements of certain entities in single cells.

This talk will cover the physical principles of the modality, presenting results of recent pilot studies and discussing different application fields of XFI, especially the recently published single cell measurements in collaboration with Gerald Falkenberg at the P06 beamline at PETRA III.