FAKULTÄT für PHYSIK
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PHYSIK-DEPARTMENT
TECHNISCHE UNIVERSITÄT MÜNCHEN
MÜNCHEN/GARCHING

MLL-KOLLOQUIUM

Donnerstag, 13.06.2013, 16^{15} Uhr

Hörsaal der LMU in Garching, Am Coulombwall 1
Treffen zum gemeinsamen Kaffee 16 Uhr

Dr. Bernhard Müller

(LMU / Helmholtz-Zentrum München)

Spectral X-ray Imaging Methods for the Detection of High-Z Tracer Distributions in Molecular Imaging

Todays clinically applied methods for highly sensitive molecular imaging can be found in the field of nuclear medicine. There the high sensitivity comes at the expense of many disadvantages resulting from the use of radiotracers. Also there the spatial resolution is inherently limited and the simultaneous acquisition of morphological information has to be provided by CT scans.
Therefore, alternative X-ray based imaging techniques for the highly sensitive detection of tracers are of interest. Recent studies on labeling gold-nanoparticles with biomolecules for x-ray imaging of certain tumor types in mice indicate that high-Z tracers can be used for specific tumor detection. Conventional X-ray absorption imaging, however, does not provide the sensitivity needed for the detection of very low concentrations of high-Z agents.
Therefore, we studied several imaging techniques based on energy resolved X-ray detection methods using specially prepared X-ray spectra. Most notably, using an analyzer-based X-ray fluorescence imaging method, it is shown that even with polychromatic X-ray sources highly sensitive tracer detection is possible using iodine and goldNP-based tracers. A feasability study using a highly-oriented pyrolytic graphite analyzer crystal shows that an iodine concetration down to 50 μg/ml is detectable. Also a complete imaging setup has been simulated using the Geant4 MC-toolkit, showing detectable concentrations below 1 μg/ml. Besides conventional X-ray sources, the compact quasi-monochromatic X-ray sources developed at the Center for Advanced Laser Applications (CALA) in Garching will be perfectly suited for these methods and should provide dose-efficient highly sensitive detection of high-Z tracers within reasonable scan times.

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