Seminar über Biomedizinische Photonik

Referent/in: Mayeul Chipaux, EPFL

Titel: Spectroscopy of microwave signals and monitoring individual cells’ metabolism with NV centers in diamonds

In biology, Free Radicals (FRs) play crucial roles in cells’ metabolism, in healthy and in various pathogenic conditions. Despite their importance, detecting them with both sufficient specificity and sensitivity for cell-biology studies still represents a tremendous challenge. In chemistry, FRs are very reactive compound holding unpaired electrons. They can therefore react with dye molecules and so be detected very sensitively. Unfortunately, such processes are irreversible, non-specific. They also interfere with the cells' biology. In physics, FRs are paramagnetic and can interact with electromagnetic fields in the microwave domain. Such interactions however are very week, and while Electron-Paramagnetic Resonance (EPR) methods allow their full spectroscopy to be performed, they take time and lack sensitivity by orders of magnitude to allow individual cells to be studied. Here I present how we use Nitrogen-Vacancy centers in diamond to combine the advantages of those methods.

At first, I will present how the monitoring of NV centers photoluminescence with standard optical microscopes allows both microwave signals (with application to radars) and EPR compounds to be detected efficiently, and their broadband spectroscopy to be acquired rapidly.

I will then show how tracking internalized nanodiamonds in living cells can reveal their metabolism with an unprecedented spatiotemporal precision. In particular, the effects of stress, aging and treatment with antioxidant, on the generation of FRs, can be distinguished between different type of genetically modified yeast cells. The immune reaction of human dendritic cells can be differentiated between different donors. Down to the organelle’s level, the metabolic activities of individual mitochondria can be sense specifically. Finally, specific generation of nitric-oxide radicals, that is of major biological interest, can be monitored both in real-time and with a subcellular-resolution.

Zeit: Wednesday, 21.02.2024, 10:15
Ort: Hörsaal A97, Gebäude Exakte Wissenschaften, Sidlerstrasse 5, Bern, Schweiz