



ADVANCED MICROSCOPY

WHAT WE DO

Much of our work is done in the form of projects that are performed in close collaboration with research groups. These generally involve developing or modifying microscopy setups or acquisition protocols to answer specific biological/biomedical question. The following are examples thereof:

Investigation of DNA damage/repair dynamics using time resolved fluorescence microscopy

We use a modified time-resolved fluorescence confocal microscope to study DNA damage/repair dynamics that includes a custom software controllable 355nm laser to induce DNA damage at specific locations/times while studying recruitment dynamics and co-dynamics of different molecules using Fluorescence Correlation (Cross) Spectroscopy and Fluorescence Lifetime Imaging.

Mapping of mechanical properties of living cells

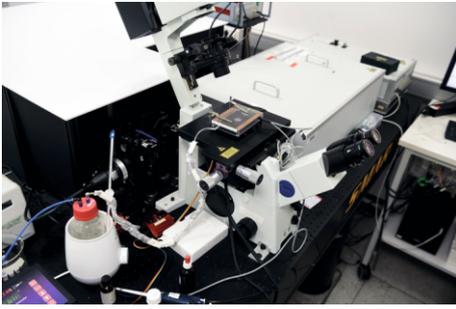
In collaboration with plant biologists at the Gregor Mendel Institute in the Vienna BioCenter, we visualized in 3D the mechanical properties of the extracellular matrix of live plant cells and their dependence on exposure to (perception of) light. Using a novel custom-built Brillouin + Fluorescence Microspectroscopy setup, we mapped changes in the mechanical properties with near diffraction limited resolution over time subject to various perturbations. Current work is based on correlating other molecular (chemical) signatures with underlying mechanical properties in a broad range of model systems.

“Next generation” imaging of cells

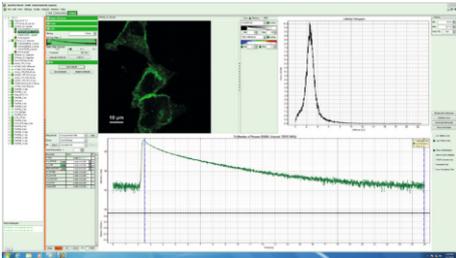
In collaboration with groups at the IMBA, IMP & MFPL, we have developed a so-called Lattice Light Sheet Microscope, capable of fast 3D time-lapse fluorescence imaging of cells with very high resolution and minimal phototoxicity. The instrument is currently generating the first significant results. The microscopes and microscope additions/modifications developed in the context of these specific projects usually also led to other diverse users performing experiments on the developed/modified setups, that are sometimes unrelated to the initial intended uses.

SERVICES AND METHODOLOGIES

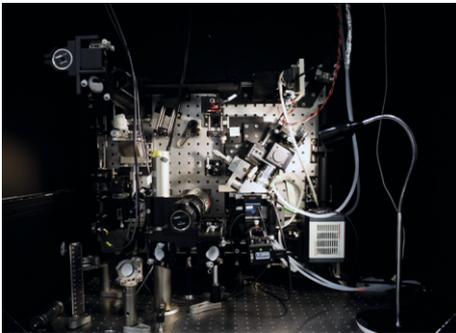
- Access to all our instruments and technologies (subject to availability, full list of techniques can be found on our website: <https://www.viennabiocenter.org/facilities/advanced-microscopy/>)
- Project specific know-how related to available technologies/techniques and assistance in performing experiments, as well as analyzing and interpreting data.



Fluorescence Lifetime Imaging Microscope



Fluorescence lifetime decay curves



Lattice Light Sheet Microscope



Analysis of fluorescent life-time data by expert VBCF staff scientists

EQUIPMENT

- **Time-Resolved Fluorescence Confocal Microscope** can be used for fluorescence lifetime imaging, fluorescence correlation/cross-correlation spectroscopy, fluorescence anisotropy imaging and many more.
- **Light Sheet Fluorescence Microscope (L-SPIM)** is a custom-built fast light sheet microscope, with a unique detection/excitation geometry (imaging is performed from below and light sheet is from the side). It has various features such as sample temperature control and simulation of day/night cycle optimized for studying plants.
- **Confocal Brillouin Light Scattering Microscopy (BLSM)** allows for the label free all-optical mapping in 3D of mechanical properties of samples with near diffraction limited resolution. Parallel fluorescence and Raman scattering measurements are possible.
- **Fluorescence Lifetime Imaging Microscope (FLIM)** measures the (nanosecond scale) fluorescence life-time of fluorophores (how long on average a fluorophore stays in its excited state following excitation from a short excitation light pulse). This gives you a wealth of information on the Fluorophores' local chemical and physical environment. One particular application is for estimating binding dynamics and structural properties using Fluorescence Resonance Energy Transfer (FRET). This can be used to estimate the distance between two labeled molecules when they are separated between 1-10nm. The setup has recently been upgraded with a fast scanning galvo mirror for high speed fluorescence lifetime imaging.

Additional equipment:

- **3D Structured Illumination Microscope** (superresolution fluorescence microscope) [GE/Applied Precision OMX Blaze]
- **LaVision BioTec Ultramicroscope II** (light sheet microscope for large cleared samples)
- **Lattice Light Sheet Microscope** (light sheet microscope for fast high-resolution studies of smaller samples)
- **Wetlab** facilities, including incubator and fume hood
- **AxiTIRF/Hi-Lo Microscope** (for high resolution and localization microscopy in the vicinity of the coverslip-sample interface)

CONTACT AND LOCATION

Advanced Microscopy

Vienna BioCenter Core Facilities (VBCF)

Dr. Bohr-Gasse 8 (ground floor), 1030 Vienna, Austria

<https://www.viennabiocenter.org/facilities/advanced-microscopy/>

kareem.elsayad@vbcf.ac.at