

Press Release

FBI: Vienna Biocenter's new microscopy technology investigates non-invasively what happens inside a cell

(Vienna 5th July 2016) - A new microscopy technique, named FBI (Fluorescence emission Brillouin scattering imaging) by its inventors, has been developed at the Vienna Biocenter in Austria and used to for the first time to non-invasively investigate and map in 3 dimensions the mechanical properties of growing cells with a resolution better than a thousandth of a millimeter.

The study was the result of a close collaboration between plant biologists and physicists, co-led by Dr. Youssef Belkhadir, Group leader from the Gregor Mendel Institute of Molecular Plant Biology (GMI) of the Austrian Academy of Sciences (ÖAW) and Dr. Kareem Elsayad, Head of the Advanced Microscopy Facility at the Vienna Biocenter Core Facilities (VBCF), and was published in the journal *Science Signalling*.

Dr Elsayad says: *"The key feature of FBI is that it allows one to non-invasively and all-optically compare the mechanical properties at a point with the abundance of fluorescently labelled molecules, - thereby allowing one to potentially discern how an arbitrary molecule is responsible for changes in the mechanical properties of different parts of a live cell or tissue. This is useful in biomedical and life science research focused on understanding the molecular origins or basis of various physical or morphological processes, but conceivably also in areas of material science where one is interested in how the presence of one particular constituent or structure affects the mechanical properties"*

According to Youssef Belkhadir, *"The FBI method developed by Dr Elsayad and colleagues is a technological Tour-de-Force. With the VBCF's Advanced Microscopy group who develops and builds optical microscopes in collaboration with local research communities, we were able to help develop and also exploit a new microscopy system to its full extent to begin to answer questions that were thought impossible to address. For instance, using FBI we discovered how specific mechanical signatures act to produce the typical plant cell's rectangular shape. We further performed an FBI 'interrogation' of plant mutants that cannot sense light properly and found that these mutants are no longer able to maintain their original cell shape because the extracellular matrix (the glue that make cells stick to each other) in the mutant plants does not do the job properly"*.

"Our teamwork highlights the synergies that can be developed when working with a facility like the VBCF. While similar facilities are available at many locations in the world, I have never seen it work as well as it does here at the Vienna Biocenter Campus". Youssef Belkhadir adds.

Though some applications in plant science have been demonstrated in this study, there are numerous other far reaching potential applications. Over the last decades the onset of many diseases including heart diseases, Alzheimer's, and numerous cancers have been found to be accompanied by or precluded by changes in cellular mechanical properties. FBI is likely to prove instrumental in tracing the origin of these diseases, which would lead to novel diagnostic approaches. While mechanical measurements of cells and tissue have been possible for a long time, these are typically confined to accessible surfaces, and give no information on what is going on inside a cell. FBI on the other hand can probe "below the surface" - inside cells and tissue. It is entirely an optical approach and there is no need for a physical force or perturbation to be exerted on the sample and is thus potentially suitable for diagnostic purposes.

Dr Elsayad adds: Our work with Dr. Belkhadir was perfect in the sense that we were together able to show through our combined knowledge that we can address important biological questions related to the extracellular matrix previously considered completely inaccessible, but we think that this is just the tip of the iceberg”.

Also contributing to the work were postdoctoral fellows Jixiang Kong and Marcal Gallemi of the Belkhadir laboratory, Lijuan Zhang and Edmundo R. Sánchez Guajardo from the VBCF Advanced Microscopy Facility, Stephanie Werner and Thomas Greb formerly at the GMI, and Yvon Jaillais of the University of Lyon, CNRS, INRA in France.

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About the Gregor Mendel Institute

The Gregor Mendel Institute of Molecular Plant Biology (GMI) was founded in 2000 by the Austrian Academy of Sciences (ÖAW) to promote research excellence in the area of plant molecular biology. It is the only international center for basic plant research in Austria and one of the most important plant research centers worldwide.

The GMI provides a lively, international working environment with some 100 staff from 30 countries. Research at the GMI covers many aspects of molecular genetics, from basic mechanisms of epigenetics to population genetics, chromosome biology, stress resistance and evolutionary biology.

The GMI is located in the Vienna Biocenter within the purpose-built Austrian Academy of Sciences Life Sciences Center Vienna. The Vienna Biocenter encompasses both independent and academic research institutes as well as biotechnology companies,

About the VBCF:

The Vienna BioCenter Core Facilities GmbH (VBCF) is a publicly funded non-profit research institute, situated at the Vienna Biocenter. The VBCF offers access to state-of-the-art research infrastructure and scientific services. The VBCD Advanced Microscopy Facility develops and maintains cutting edge optical microscopy solutions for life science research applications at the Vienna Biocenter in Austria.

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