



Press Release No. 111/2017

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28 November 2017

ERC Consolidator Grant for spectroscopy research at the University of Konstanz

Distinction for Professor Malte Drescher and his research team

“Spectroscopy of Complex Systems” research team honoured with EU research award – 2 million euros in funding for new approach to determining the structure of molecules in biological cells – development of molecular probes for use with different spectroscopy techniques – relevant for research into neuro-degenerative diseases

This is about nothing less than the complex mechanisms of life: In their project entitled “Spectroscopy in cells” - or SPICE for short - the physical chemist Professor Malte Drescher and his working group are developing innovative approaches to spectroscopy, which allows them to explore larger and more complex biological structures at the molecular level of the cell. They are particularly interested in intrinsically disordered proteins - macromolecules - which are also known as “chameleon proteins” because they react to their environment. Research into macromolecules is thought to be particularly promising because of the key role that they play in neuro-degenerative diseases like Parkinson’s and Alzheimer’s.

Experiments have shown that even small changes to environmental conditions lead to dramatic alterations in the proteins’ behaviour. This is why the following question is decisive: How do proteins behave in the cell? This approach is unusual, as structure determination in cells has been largely impossible due to the lack of suitable research tools. This is where SPICE comes in: To examine chameleon proteins in the cell, the working group “Spectroscopy of Complex Systems”, led by Heisenberg Professor Malte Drescher, is in the process of developing molecular probes that can be used with various spectroscopy techniques.

Funding in the amount of two million euros

The European Research Council (ERC) recognises the research team’s previous successes in the area with an ERC Consolidator Grant 2017. In the coming five years, it will provide funding worth approximately two million euros to support the group in its research efforts.

Until now, spectroscopic examinations for determining the structure of biological macromolecules were largely conducted in aqueous solution in test tubes. However, macromolecules can behave very differently in water than they do in their natural habitat, the cell. Intracellular spectroscopy, in

turn, faces the problem that biological cells contain a vast and incalculable number of bio-macromolecules. In aqueous solution, introducing molecular probes to identify proteins is routine. In the cell, however, attaching the probe to the correct part of the molecule that one wants to examine constitutes a major challenge.

A single molecular probe for various spectroscopy techniques

Malte Drescher is an expert in electron paramagnetic resonance spectroscopy (EPR spectroscopy), which is used to study the structure of proteins. A different type of spectroscopy - such as fluorescence microscopy - is used to localise the protein in the cell, while vibrational spectroscopy delivers the best results when examining the dynamics of the protein's interaction with its environment. Until now, all of these techniques required different molecular probes with very specific properties. In the future, a single kind of molecular probe - the "multiply-addressable nano-structural probe" - will be able to perform all of these functions. "The prerequisites are considerable, as is the scientific scope that this will afford us: synthetic chemistry, biochemistry, cellular biology, physical chemistry and spectroscopy will all benefit", explains Malte Drescher. Not merely because of this does the ERC Consolidator Grant represent additional support for the "ChemLife" cluster initiative, one of three University of Konstanz initiatives that have been invited to submit full proposals for the Excellence Strategy competition of the German federal and state governments.

Molecules in complex natural situations

This "one label fits all" approach allows the researchers to combine various types of spectroscopy, which can all be applied to the same molecular probe at the same time. It does not simply make things much easier, but ensures that it is the same situation that is being investigated every time. "We will show that these innovative intracellular spectroscopy techniques, which the SPICE team is in the process of developing with multiply-addressable nano-structural probes, generate a host of new opportunities for observing molecules in naturally occurring complex situations across all relevant length and time scales using the same probe. All of this is of crucial importance to our understanding of their physiological functions", Malte Drescher adds, with a nod towards the role that versatile chameleon proteins play in neuro-degenerative diseases.

He thinks of the ERC Consolidator Grant not simply as a quality label for European top-level research, but also as a chance for his team "to continue to attract the best students and researchers. We cannot do without them".

Facts:

- Project: "SPICE – Spectroscopy in cells with tailored in-vivo labelling strategies and multiply-addressable nano-structural probes" (SPICE)
- Funded with an ERC Consolidator Grant 2017
- Funding period from 2018 until 2022, funding amount: approximately two million euros
- Professor Malte Drescher is Heisenberg Professor for Spectroscopy of Complex Systems
- Interdisciplinary collaboration involving the Departments of Chemistry, Biology and Physics

Note to editors:

You can download a photos here:

https://cms.uni-konstanz.de/fileadmin/pi/filesserver/2017/Bilder/Drescher_zelle_vermessung.jpg

Caption: SPICE: Spectroscopy in cells. Distance measurements between multiply-addressable nano-structural probes provide insights in the structure of proteins in the cell.

https://cms.uni-konstanz.de/index.php?eID=tx_nawsecuredl&u=0&g=0&t=1512563709&hash=7b14b1fc966681af45ba7e746b1e548cae5801a9&file=fileadmin/pi/filesserver/2017/Bilder/Drescher_Gruppe2017.pdf

Caption: Professor Malte Drescher's working group

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