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Prestigious ERC Consolidator Grant awarded to Dr. Matthias Althammer

A new push for antiferromagnetic magnonics at the Walther-Meißner-Institute

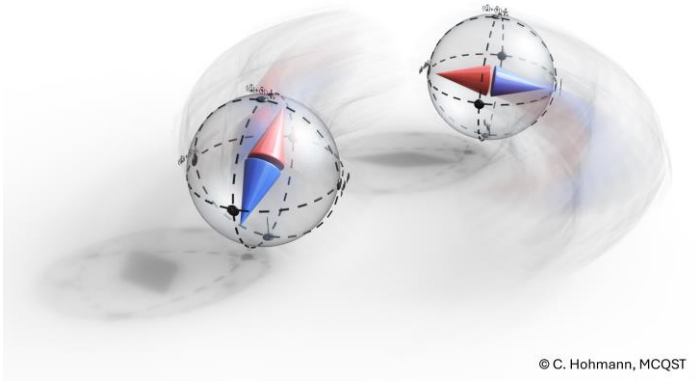
The European Research Counsil (ERC) has awarded its Consolidator Grants (CoG) to 328 outstanding scientists in 25 EU Member States with a total budget of 678 million euros. Dr. Matthias Althammer, a research group leader at the Walther-Meißner-Institute (WMI) of the Bavarian Academy of Sciences and Humanities (BAdW) and lecturer at the Technical University of Munich (TUM) was awarded one of these prestigious grants. The project funded by the research grant aims to establish antiferromagnetic magnonics as a platform for energy-efficient information processing.

About the ERC Consolidator Grants

The ERC awards Consolidator Grants (ERC-CoG) to established scientists with 7-12 years of experience since completion of PhD, having an outstanding scientific track record and presenting an excellent research proposal. The funding is provided through the EU's Horizon Europe program. The grants, awarded up to € 2 million for a period of 5 years, are very prestigious, and unfortunately, the success rate is quite low. In the last round, only 14.2% of the total of 2313 submitted proposals have been selected for funding. "*As the head of the research group, I am very happy that Matthias Althammer was successful in this highly competitive funding scheme. The ERC-CoG will allow him to explore the full potential of antiferromagnetic magnonics in the coming years*", Prof. Dr. Rudolf Gross, scientific director at WMI, says. "*The grant also can be viewed as a distinction of the excellent research conducted at the WMI and our continuous efforts to promote talented young researchers,"* he adds.

A Fascinating Research Proposal

In the project "**Pseudospin-based Antiferromagnetic Magnonics (POSA)**", Matthias Althammer will address the important problem that in our information-driven society, the demand for more powerful and faster information processing systems is continuously increasing – and the same is true for the associated energy consumption. Therefore, there is an urgent need for novel approaches that allow for faster and, most importantly, more energy-efficient information processing. Today, information technology is dominated by electronics, where the charge of the electrons is used in information-processing devices. Besides its charge, electrons also possess a spin, representing an angular momentum and being associated with a magnetic moment. This spin is an intrinsic property, which can assume two discrete states along a quantization axis, making it ideal for binary information encoding. Therefore, the spin is already routinely exploited in the research field called spintronics and successfully used for information storage in non-



volatile magnetic random-access memories or magnetic hard disks. A key question is how to efficiently transport information encoded in the spin degree of freedom. Here, a promising approach is to use the quantized excitations of the magnetic lattice in electrically insulating ferromagnets or antiferromagnets, called magnons. The realization of this interesting approach is at the heart of the project POSA, which will explore the full potential of antiferromagnetic magnonics. An important goal of the project is to realize so-called antiferromagnetic spin-torque oscillators, which enable the conversion of DC charge currents into THz magnons. The unique properties of these oscillators enable their use as artificial neurons. The ultimate goal is to link these artificial neurons via magnons to realize a spiking artificial neuronal network. Implementing this concept provides the perspective to achieve a novel type of artificial neuronal network with low power consumption and fast operation speed.

Building on Excellent Research and Infrastructure

Over the last few years, researchers at WMI already successfully studied antiferromagnetic insulators for their unique properties concerning spin information transport. For a ferromagnetic material, the localized magnetic moments are oriented in parallel. For an antiferromagnet, the neighboring localized magnetic moments order in an antiparallel fashion and thus exhibit no net magnetization. Although this property makes it challenging to manipulate antiferromagnets by external magnetic fields, it leads to much higher magnon frequencies to the terahertz regime in antiferromagnets. Therefore, antiferromagnetic magnonics has been studied intensively in the past decade. A unique aspect is that the magnons in antiferromagnets come in pairs with opposite chirality, that is, pairs of “spin-up” and “spin-down” magnons. In recent experiments, the research group at WMI with theory support by Prof. Akashdeep Kamra from the RPTU Kaiserslautern-Landau, showed that these two spin states can be experimentally accessed and manipulated. Dr. Matthias Althammer says: “*This is the first step towards a spin-based magnonic concept, which provides an exciting perspective for future information processing concepts. With the received funding by the ERC, we can now develop energy-efficient methods for the generation, manipulation, and detection of magnonic spin transport in antiferromagnetic insulators.*” A key advantage of antiferromagnetic insulators is that electron-magnon scattering is suppressed, reducing the power consumption of such devices.

About the Awardee

Dr. Matthias Althammer received his PhD from TU Munich in 2012, which led to the discovery of a new magnetoresistance effect, now called the spin Hall magnetoresistance.After finishing his PhD, Dr. Althammer spent a year researching spin transport effects in oxide materials at the University of Alabama, USA, in the materials for information technology center within the group of Prof. Arunava Gupta as a Post-Doc. After a short stint in industry, working as an engineering consultant at BMW AG, he started his junior research group at WMI in 2015. With his research group, he spearheaded the

research activities at WMI, focusing on spin transport phenomena and spin excitations in magnetic insulators and metals. In 2021, Dr. Matthias Althammer finished his Habilitation at TU Munich and became a “Privatdozent” at TU Munich in the physics department in 2023. In addition to excellent research, Matthias Althammer has tremendously contributed to the education and development of young talents and received the 2022 PhD supervisory award from the physics department of TU Munich.

Contact information:

PD Dr. Matthias Althammer, Prof. Dr. Rudolf Gross
Walther-Meißner-Institut
Bayerische Akademie der Wissenschaften & Technische Universität München
Walther-Meißner-Straße 8, D-85748 Garching
www.wmi.badw.de