



New ERC Advanced Grant

ICREA Prof Dr Morgan Mitchell awarded Advanced Grant for project Field-SEER

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The European Research Council (ERC) has announced the awarding of 218 Advanced Grants to outstanding research leaders across Europe, as part of the Horizon Europe programme. The grants - totaling ?544 million - support cutting-edge research in a wide range of fields, from medicine and physics to social sciences and humanities. ?

The ERC Advanced Grant funding is amongst the most prestigious and competitive E funding schemes, providing researchers with the opportunity to pursue ambitious curiosity-driven projects that could lead to major scientific breakthroughs. They are awarded to established, leading researchers with a proven track-record of significant research achievements over the past decade

ICREA Prof at ICFO Dr Morgan Mitchell, recipient of the ERC Starting Grant in 2012 for the project [AQUMET](#): Atomic Quantum Metrology, has recently been awarded an ERC Advanced Grant, for established research leaders, for the project **Field-SEER**: Field Sensors with

Exceptional Energy Resolution. In this new project, which will run from 2023-2028, Pro Mitchell will develop magnetic sensors with combined spatial, temporal, and field resolution beyond what is possible with existing sensing approaches

Many important applications, from gravitational wave detection to magnetic resonance imaging, are based on the precise detection of fields (for example gravitational, electrical magnetic, or other fields). As scientists explore deeper into nature, they want better sensitivity, which is the ability to see weaker fields, and they want to measure the field at smaller and smaller scales. Existing field sensors are running up against quantum mechanical limits, however, due to a kind of paradox. Consider detection of magnetic fields: one can use an electron, which is like a tiny magnetic compass, to detect fields. But a single electron cannot give much information about the field, because its orientation is always uncertain, due to the Heisenberg uncertainty principle. And if you try to pack a bunch of electrons into a small space, to get more sensitivity, you run into the paradox: the more electrons you pack in, the more their magnetic fields disturb each other, and the sensitivity doesn't actually improve. Field-SEER aims to escape this paradox using exotic quantum materials. Extremely cold atomic gases, known as Bose-Einstein condensates, are superfluids in which all the atoms together behave as a single atom. Optically-addressed nuclear spin ensembles don't use electrons at all, but rather nuclei, which are much less able to disturb each other, but are still affected by the magnetic field. If successful, the project will make possible new sensors for everything from brain imaging to detection of dark matter, the mysterious substance that accounts for 85% of the mass of the universe and which has never been seen.

This research will extend work carried out in the Atomic Quantum Optics group in the theses of Dr Silvana Palacios ([Single Domain Spinor Bose-Einstein Condensate](#); 2017) and Dr Pau Gomez ([Spinor Bose-Einstein Comagnetometer and Interhyperfine Interactions in Rb87](#); 2021), Dr. Charikleia Troullinou ([Squeezed-light-enhanced magnetometry in a high density atomic vapor](#); 2022) and other theses currently in progress.

With this project, we hope to open a new chapter in extreme sensing, using exotic materials like Bose-Einstein condensates and optically-addressed nuclear spin ensembles to detect signals that are too faint to measure with any existing equipment, explains Prof Mitchell. It is really a 'moon shot' kind of project, aiming at breakthroughs and with no guarantee of success.

ERC grants are a top recognition and a significant commitment from our best researchers, commented Mariya Gabriel, European Commissioner for Innovation, Research, Culture, Education and Youth in the ERC's announcement of the grants. The 2544 million funding puts our 218 research leaders, together with their teams of postdoctoral fellows, PhD students and research staff, in pole position to push back the boundaries of our knowledge, break new ground and build foundations for future growth and prosperity in Europe.

Congratulations Morgan. We are looking forward to seeing where this ambitious project will take you!

About the ERC:

The ERC, set up by the European Union in 2007, is the premier European funding organisation for excellent frontier research. It funds creative researchers of any nationality and age, to run projects based across Europe. The ERC offers four core grant schemes: Starting Grants, Consolidator Grants, Advanced Grants and Synergy Grants. With its additional Proof of Concept Grant scheme, the ERC helps grantees to bridge the gap between their pioneering research and early phases of its commercialisation. The ERC is led by an independent governing body, the Scientific Council. Since November 2021, Maria Leptin is the President of the ERC. The overall ERC budget from 2021 to 2027 is more than ?16 billion, as part of the Horizon Europe programme, under the responsibility of the European Commissioner for Innovation, Research, Culture, Education and Youth, Mariya Gabriel.