

Report for GRC quantum sensing 2025 conference

-Diversity of Sensing Architectures for New Physics and Real-World

Applications



Les Diablerets Conference Center,

Eurotel Victoria, Les Diablerets,

Vaud (fr), Switzerland

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Thanks so much for awarding this funding to support this [GRC quantum sensing 2025](#) conference. This GRC quantum sensing conference focuses to advanced quantum sensing protocols, including a lot of physics platforms, such as well-known negatively charged nitrogen vacancy centres in diamond, quantum emitters in wide-bandgap semiconductors, protein spin, molecular spins, atom gas sensor, and superconducting Quantum Interference Device. These advanced quantum sensors can allow detecting very weak signals, such as magnetic field, electric field, temperature, and pressure. There are also many physics theorists discussing the fundamental sensing limit of sensitivity of these quantum sensors. Experimental physicists introduce the exciting quantum sensing applications, such as a nano thermometer in the living cell, quantum navigation, magnetic field imaging at the nanoscale, and ultra-light dark matter searching. Many fabrication experts also report the recent progress on the novel design of sensing devices and improved material processes. I have met a lot of outstanding researchers working on III-nitride-based quantum optics. I also presented a poster to introduce laser-written quantum emitters in Aluminum nitride and Gallium nitride, which attracted much attention not only to our work but also to the UK Nitrides Consortium. I will give a brief report to summarize some very interesting talks and posters in the III-nitride community.

Quantum Sensing with Spin Defects in Hexagonal Boron Nitride

9:00 am - 9:45 am, 2025/7/14

Professor Tongcang Li, Purdue University, USA.

The most interesting and exciting talk, Quantum Sensing with Spin Defects in Hexagonal Boron Nitride, is given by Professor Tongcang Li from Purdue University, USA. He presented the very comprehensive carbon-related defects in hexagonal boron nitrides (hBN), including fabrication, photodynamics study, optically detected magnetic resonance, quantum control of single electron spin, and nuclear spin. He starts the talk with the carbon ion implantation for QEs creation in hBN. By tuning the different dosages of carbon ion implantation, the ensemble of negatively charged boron vacancy centres and single-level carbon-related QEs are reliably fabricated. Additionally, by isotropic control, the important atomic structure of carbon-related QEs are finally demonstrated. This is a very important step for any further applications. Then, room temperature ODMR is observed in these QEs, which provides a very effective way to initialize, manipulate, and readout these QEs spin qubit, similar to the well-known negatively charged nitrogen vacancy centres. Moreover, he investigated the photodynamics of the transition of these QEs to achieve an enhanced quantum control protocol, eg near 10 times increase of ODMR contrast. The next brilliant work is conducting single nuclear spin detection and control, which offers a promising quantum register in a 2D material platform. This work has attracted a lot of attention and published in [Nature](#) two days earlier his talk. He also briefly heads up his unpublished results, which focus on quantum entanglement and nuclear spin-enhanced quantum sensing. Last but not least, he also inspiringly introduced his recent work on quantum sensing with boron nitride nanotube spin defects, offering a way to achieve quantum sensing with a 1D material.

Nonclassical Photon statistics as a resource in fluorescence-based optical microscopy

10:30 am - 11:15 am, 2025/7/16

Professor Dan Oron, Weizmann Institute of Science, Israel.

The second interesting talk, 'Nonclassical photon statistics as a resource in fluorescence-based optical microscopy', is presented by Professor Dan Oron from the Weizmann Institute of Science, Israel. He introduced the way to realize the super-resolution quantum imaging with quantum emitters in Nitride semiconductors.

It's based on the fluorescence depletion mechanism for stimulated depletion spectroscopy with super-resolution microscopy. He also introduce how to use Nonclassical photon statistics such as antibunching to perform the improved the quantum imaging. This indeed broadens my understanding of the QEs-based applications.

There are many posters introducing the recent progress on QEs in Nitride semiconductors, especially hBN. I will discuss two of them here.

Photodynamics of spin defects in hexagonal boron nitride

4 pm to 6 pm, 14/07/2025

Catherine L. Curtin, Cambridge University

The first poster is from Catherine L. Curtin (Cambridge University). She, specifically, presented the ODMR and photodynamics of a single spin defect in hBN. As the only two groups managing the single spin quantum control in hBN, the Cambridge group introduced their previous work on a quantum coherent spin in hexagonal boron nitride at ambient conditions published on [Nature materials](#). This work also predicts that the spin defect is the carbon-related defect, which is similar to the results from Professor Tongtang Li. The Cambridge group also demonstrated the first vector magnetometry with a single spin defect in hBN, which was published in [Nature communication](#). Additionally, by investigating the and combining the photodynamic simulation, they can determine the different $S=1/2$ and $S=1$ defects in hBN.

Quantum sensing at interfaces,

4 pm to 6 pm, 15/07/2025

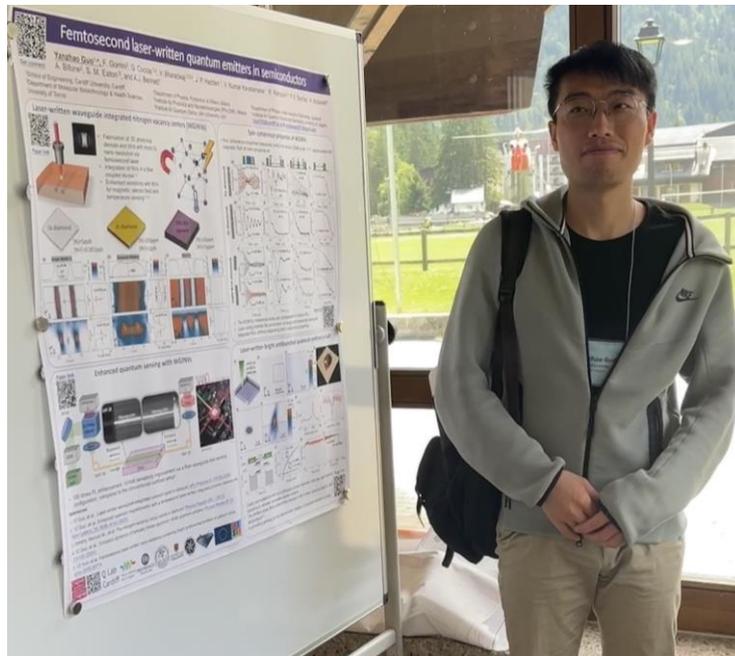
Dr. Alex J. Healey, RMIT

The second interesting poster, 'Quantum sensing at interfaces', is from Dr. Alex J. Healey (RMIT). He introduced wide-field sensing based on well-known negatively charged boron vacancy centres in hBN. They used a low NA but wide-view objective to excite and collect the ensemble boron vacancy centres. A CCD camera instead of APD is used to realize fast wide-view photoluminescence imaging. As hBN is a 2D material, a 2D ferromagnet CrTe₂ is easily imaged by covering an hBN flake with ensemble of boron vacancy centres. With this wide field sensor, they investigated the time-resolved simultaneous temperature and magnetic imaging of CrTe₂, revealing

important transition dynamics. This work is published in [Nature physics](#).

Wrap up

Thanks again for the generous support. This funding reserves my attendance at this wonderful conference. This is the best conference I have ever attended. It includes a lot of high-quality and front-end scientific works, many highly involved interaction sections. I learn a lot from the excellent research being conducted around the world on III-nitride materials, promote our GaN work, and identify numerous potential collaboration opportunities to enhance our group's research and improve the impact of UK nitride semiconductors.



Yanzhao Guo and his poster in GRC quantum sensing conference 2025