Next-generation quantum sensors for medical applications

UCL Lead department: Physics and Astronomy

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Project Summary:

Atrial fibrillation (AF) is believed to be caused by permanent modification of the heart's local conductivity, which produces deterministic sources known as rotors, and by the stochastic interaction with the local anatomy, which creates randomly distributed re-entry paths (wavelets). However, the topic is still widely debated. The diagnosis of fibrillation and its monitoring during surgery currently requires an ongoing arrhythmia; hence, for example, AF is induced during the RFCA procedure, and even professional athletes – notwithstanding regular tests of their cardiac activity – can be left undiagnosed for a long time.

The proposed study is a collaborative work with clinicians at UCL, and specifically Prof. Pier Lambiase and his team. The project aims to develop novel approach to the non-invasive diagnosis of fibrillations. The proposed technique, based on electromagnetic induction imaging with atomic magnetometers, has the potential to generate a non-invasive, space-resolved map of the heart's conductivity, thus addressing directly the presence of permanent conduction anomalies and their relationship with the on-set and the dynamics of fibrillation. The proposed instrument has the potential for bedside non-invasive tomography capability, with expected impact also in the screening and monitoring of patients, and in the AF surgery planning and navigation.

The PhD student will be responsible for the design and realization of the quantum sensor for mapping of the human heart, in close collaboration with clinicians at UCL. The technology will be progressed to the pre-clinical level, with tests performed on phantoms of the human heart.

We are looking for an enthusiastic student, interested in developing quantum sensors to solve a real-world problem, and happy to work on a multidisciplinary project involving clinicians.