Senior Research Associate (x2) in condensed-matter atomic clocks

**JOB DESCRIPTION**

Job vacancy: A3650

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<tr>
<th><strong>Job Title:</strong> Post-doctoral Research Associate</th>
<th><strong>Present Grade:</strong> 7</th>
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<td><strong>Department/College:</strong> Physics</td>
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<td><strong>Directly responsible to:</strong> Dr Edward Laird</td>
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<td><strong>Supervisory responsibility for:</strong> Partial responsibility for graduate and MPhys students</td>
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<td><strong>Other contacts</strong></td>
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<td><strong>Internal:</strong> members of the Physics Department</td>
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<td><strong>External:</strong> Industrial collaborators at LocatorX; other scientific collaborators</td>
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These posts are to carry out an intensive research programme in support of our development of a condensed-matter atomic clock based on nitrogen endohedral fullerenes. The goal is to raise the technology readiness level (TRL) from its current status of TRL3 to TRL5. The research is supported by LocatorX, Inc. and by EPSRC, and builds on prior research in collaboration with Professor Andrew Briggs and others at the University of Oxford.

The proposed clock uses the extremely sharp spin resonance transitions of the endohedral fullerene molecule $^{15}$N@C$_{60}$ as its frequency reference. Most spin transitions are unsuitable as clock references because their frequencies are affected by magnetic field noise. However, we have recently identified and measured a transition in this molecule at which the frequency is insensitive to magnetic fields to first order. This project will exploit this discovery by developing a prototype suitable for industrial development.

The main tasks will run approximately in parallel, and will be divided approximately as follows. However, a high degree of collaboration is expected in order to make rapid progress.

The main task of Researcher 1 is to develop a working benchtop clock in our laboratory with the aim of reaching TRL4, i.e. component validation in a laboratory environment. The objectives are:

- Duplication of our existing spin resonance spectrometer
- Integration of frequency feedback into our existing spin resonance detection scheme
- Integration of magnetic field feedback in order to mitigate magnetic noise
- Validation of the benchtop clock by measuring the Allan deviation.

The main task of Researcher 2 is to improve the fidelity of the clock in order to reach TRL5, i.e. component validation in a relevant environment. The objectives are:

- Improvement of the spin coherence time, using pulsed spin resonance to identify decoherence mechanisms in order to mitigate them.
- Implementation of a temperature-compensation scheme to prevent thermal drift.
- Characterisation of a benchtop prototype stabilised against field and temperature fluctuations.
- Validation of the prototype under simulated real-world fluctuations of temperature and magnetic field.

For more information about this technology, see:

- Spin resonance clock transition of the endohedral fullerene $^{15}$N@C$_{60}$
- Keeping Perfect Time With Caged Atoms

**Major Duties:**

- Play a leading role in development of an endohedral-fullerene atomic clock by designing, constructing, and testing tabletop prototypes.
- Identify and correct the sources of clock inaccuracy by developing improved measurement schemes informed by the relevant physics and materials science.
- Analyse measurement results and present them within the project team at Lancaster, to collaborators in other universities and at companies including LocatorX, and at conferences.
- Ensure that the project objectives are achieved according to schedule.
- Write technical documents to capture results and publish papers in peer-reviewed journals.
- Support the protection of arising IP
- Support students working on the endohedral-fullerene clock.