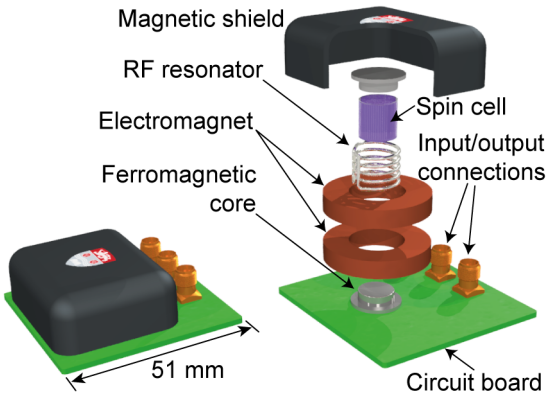
Research Assistant/Senior Research Assistant/Research Fellow in condensed-matter atomic clocks
JOB DESCRIPTION

Job Title: Research Fellow	**Present Grade:** 6-8
Department/College: Physics	
Directly responsible to: Prof. Edward Laird	
Supervisory responsibility for: Partial responsibility for graduate and MPhys students	
Other contacts **Internal:** members of the Physics Department and the Engineering and Management Schools **External:** Industrial collaborators at Teleplan Forsberg and LocatorX; other scientific collaborators	

This post is to carry out an intensive research programme in support of our development of a miniature condensed-matter atomic clock, supported by Innovate UK and LocatorX Inc., and in collaboration with Teleplan Forsberg Ltd. We have constructed a tabletop clock based on endohedral fullerene molecules. The goal of this project is to raise the technology readiness level (TRL) from its current status of TRL4 to TRL5, and to miniaturise the physics package (see concept figure).



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 identified and measured a transition in this molecule at which the frequency is insensitive to magnetic fields to first order, and have recently achieved clock operation based on this transition. This project will continue that development and be part of the new Innovate UK programme "ARC-MAC: A robust condensed-matter miniature atomic clock".

The tasks that need to be carried out are:

- To implement temperature and magnetic field stabilization in our existing clock, in order to improve its accuracy.
- To identify other ways to improve the clock accuracy, for example by narrowing the spin resonance transition or using other endohedral fullerene molecules.
- To miniaturise the physics package, aiming towards the concept illustrated.
- To test the miniaturized package under fluctuations of temperature, pressure, humidity and shock, in collaboration with our collaborators at Teleplan Forsberg.

Miniature atomic clocks have important applications in navigation, communication, and sensing. This project is an exciting opportunity to apply the fundamental physics of magnetic resonance for an important new technology.

For more information about this project, see:

- Spin resonance clock transition of the endohedral fullerene $^{15}N@C_{60}$
  Physical Review Letters **119** 140801 (2017)
- Keeping Perfect Time with Caged Atoms
  IEEE Spectrum **54** 34 (2017)

Major Duties

The appointment may be made at one of three grades, depending on the expertise of the researcher.

For a role as Research Fellow (Grade 8)

- Play a leading role in development of an endohedral-fullerene atomic clock by designing, constructing, testing, and improving prototypes.
- Identify and correct the sources of clock inaccuracy by developing improved designs or measurement schemes informed by the relevant physics and materials science.
- Perform environmental testing of the prototype in collaboration with Teleplan Forsberg.
- Analyse measurement results and present them within the project team at Lancaster, to collaborators at companies including LocatorX and Teleplan Forsberg, 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.
- Travel occasionally, if required to meet project partners in the UK or US.

For a role as Senior Research Assistant (Grade 7)

- Play a leading role in development of an endohedral-fullerene atomic clock by designing, constructing, testing, and improving prototypes.
- Identify and correct the sources of clock inaccuracy by developing improved designs or measurement schemes informed by the relevant physics and materials science.
- Perform environmental testing of the prototype in collaboration with Teleplan Forsberg.
- Analyse measurement results and present them within the project team at Lancaster, to collaborators at companies including LocatorX and Teleplan Forsberg, 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.
- In liaison with your line manager, support the protection of arising IP.
- In liaison with your line manager, support students working on the endohedral-fullerene clock.
- Travel occasionally, if required to meet project partners in the UK or US.

For a role as Research Assistant (Grade 6)

- Contribute to development of an endohedral-fullerene atomic clock by designing, constructing, testing, and improving prototypes.
- Identify and correct the sources of clock inaccuracy by developing improved designs or measurement schemes informed by the relevant physics and materials science.
- Perform environmental testing of the prototype in collaboration with Teleplan Forsberg.
- Analyse measurement results and present them within the project team at Lancaster, to collaborators at companies including LocatorX and Teleplan Forsberg, and at conferences.
- Ensure that the project objectives are achieved according to schedule.
- Contribute to technical documents to capture results and publish papers in peer-reviewed journals.
- In liaison with your line manager, support the protection of arising IP.
- In liaison with your line manager, support students working on the endohedral-fullerene clock.
- Travel occasionally, if required to meet project partners in the UK or US.