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THE UNIVERSITY OF MANCHESTER
SCHOOL OF PHYSICS AND ASTRONOMY
PHOTON SCIENCE INSTITUTE

Postdoctoral Research Associate
Super-elastic electron scattering from laser excited atoms in a resonant optical cavity

Closing date: 21/08/2009
Reference: EPS/90783

Applications are invited for the post of Research Associate in the Photon Physics Group (area: Atomic & Molecular physics) to work on an EPSRC funded project involving the super-elastic scattering of electrons from atomic targets prepared by coherent single mode laser radiation in a resonant optical cavity. In this project atoms will be prepared in an excited state using laser radiation from a frequency doubled (or quadrupled) CW laser. The radiation will enter a resonant optical cavity surrounding the interaction region (where electron collisions take place), so as to significantly increase the laser intensity in this region. This new optical technique will allow the collision process to be studied for excitation by UV laser radiation, and will open up the super-elastic scattering process to many new targets, including those of technological and theoretical interest. This research will be carried out in the atomic physics research laboratories in the Photon Science Institute, located in state of the art research facilities recently built at a cost of more than $23M. The post is available for up to three years from 1st October 2009. Applicants should have, or be about to obtain, a PhD in Experimental Atomic or Laser Physics and should have experience in either CW laser interactions with atoms, electron excitation of atoms or preferably a combination of both.

Salary: £28,839 – 30,595 pa
Informal enquiries: Professor Andrew Murray
Email: andrew.murray@manchester.ac.uk

Quote ref: EPS/90783

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Postdoctoral Research Associate
Super-elastic electron scattering from laser excited atoms in a resonant optical cavity

1. The University invites applications for the above post of Research Associate in the School of Physics and Astronomy, to work in the Atomic Physics laboratories located in the Photon Science Institute.

2. The post will be available from 1 October 2009 (or as soon as possible after) for a period of up to three years.

3. Salary will be within the range £28,839 – 30,595 per annum according to relevant experience and qualifications.

4. Informal enquiries may be made to Professor Andrew Murray by e-mail at andrew.murray@manchester.ac.uk

5. A completed University application form, together with a letter of application and a full *curriculum vitae,* the names of three referees and the Equal Opportunities Monitoring form, should be marked "*Confidential – Staff Application*" and addressed to:

   Professor Andrew Murray,
   Photon Science Institute,
   Alan Turing Building,
   The University of Manchester,
   Manchester, M13 9PL

   or by fax to +44 (0)161 2751001

   E-mail submissions are welcome, as *.rtf* or *.pdf* format, and should quote reference number EPS/90783 in the subject line and be submitted to: andrew.murray@manchester.ac.uk

6. **Applications must be received no later than 21st August 2009**

7. All correspondence should quote reference number **EPS/90783**

8. If you have not been contacted by the end of September 2009 you should assume that, on this occasion, your application has not been successful. We would, however, like to take this opportunity to thank you for your interest in The University of Manchester, and we hope that this will not deter you from applying for other positions in the future.

9. For further information on the School of Physics and Astronomy see http://www.manchester.ac.uk/physics

WITH THE COMPLIMENTS OF THE DIRECTORATE OF HUMAN RESOURCES

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Project Title:

Super-elastic electron scattering from laser excited atoms in a resonant optical cavity

Project Description:

This new research programme will expand on and advance the highly successful work into electron impact excitation of atoms carried out in Manchester over the last few years. Results from this work have been published in Physical Review Letters, J Phys B, Physical Review A and Measurement Science & Technology (14 publications resulted directly from this 3 year programme). This research was further distinguished by being chosen and published in Euro-physics News as a *European Research Highlight of 2008*, and was selected as one of only 20 'hot topics' (out of over 800 submissions) at the 2007 International Conference on Photonic, Electron and Atomic Collisions (ICPEAC) in Germany. The work was further selected as one of 12 *research highlights of 2008* from over 440 submissions to J Phys B.

In this previous work the atomic collision parameters (effectively determining the 'shape' of the excited atom following electron collision) were measured for the first time over the full scattering geometry, using the laser-based super-elastic scattering technique in combination with a Magnetic Angle Changing device (invented in Manchester), which steers electrons to and from the interaction region in a controlled way. A new quantum electro-dynamic (QED) model of the laser-atom interaction in a magnetic field was also developed, which has wide applicability in many areas of atomic physics. The super-elastic technique produces high precision results thousands of times faster than conventional methods. The results were compared to theoretical models of the collision process, and were found to be in close agreement at higher incident energies. The super-elastic spectrometer in Manchester is now the most sophisticated in the world, and is the only spectrometer that can provide a complete description of the excitation process for comparison to fundamental quantum collision theories.

In this new work we intend to develop and apply a novel technique allowing measurements to be conducted with a much wider range of targets than previously possible. This new technique will use an optical enhancement cavity to increase the laser intensity in the interaction region to a level where many new targets can be studied for the first time. In particular, experiments will investigate targets excited by UV laser radiation. These include zinc, which is important for technological applications in future light sources, and silver and gold, which are of significant interest to theoreticians developing new models for excitation of these complex atoms. The goal is to provide precise data which will allow different theories to be unified into a single model applicable to all targets at all energies, which will then be used in a wide range of scientific, technological and industrial applications.

Job Description:

Job Title: Research Associate
Job Reference: EPS/90783
Organizational Unit: PHYSICS and ASTRONOMY
Post Grade: 6
Reports to: Prof Andrew Murray

Main purpose of the Job:
The key objectives and aims of the post are:

- To develop a new method to study the interaction of atoms with laser radiation and electrons inside a resonant optical cavity. This will allow atomic physics studies to be made from a much wider range of targets than has been possible before, and will be applied to collision studies as well as the study of cold atoms.
- To determine new super-elastic collision data over the complete angular range for targets with d-shell electronic structure (Zn, Ag, Au) for the first time.
- To theoretically and experimentally study the effects of the cavity on the collision and laser interaction processes.
- To carry out new experiments over a wide range of energies from atoms excited by the cavity field.
- To provide experts in collision theory with new and accurate data to help unify different models into a single quantum theory which will have wide applicability.
- To provide data for the development of future lamps, which may use zinc as the principal UV source excited by electron impact.

Person Specification:
The person appointed will work on the project given above under the general direction of Professor Murray. He/she will be expected to work independently on the various tasks required and will also need to work collaboratively with other members of the group to achieve the overall project aims. He/she will be expected to author and/or contribute to publications and papers on the work of the project and may be expected to attend and present papers to conferences, seminars, etc. The postholder may be expected to contribute to teaching activities within the School.

Essential Criteria:

- Hold, or be about to obtain, a PhD in Experimental Atomic or Laser Physics
- Experience in either CW laser interactions with atoms, electron excitation of atoms or preferably a combination of both
- The ability to work in a team
- Good verbal and written communication skills in English
- Experience in experimental physics at a research level
- Expertise in experimental design and analysis

Desirable Criteria:

- Experience in CW laser-atom interactions as used in electron scattering experiments
- Experience in electron spectroscopy as in super-elastic experiments
- Experience in optics, saturated absorption spectroscopy, optical cavity design
- Experience in modelling laser-atom interactions using semi-classical or QED models
- Experience in digital & analogue electronics
- Experience in programming and computer control of experiments

Further Information:
For further information on the School of Physics and Astronomy see:
http://www.manchester.ac.uk/physics