

PostDoctoral Researcher at the University of Oxford

for Innovate-UK project 133092
Quantum Enhanced Sensing of Trace Compounds in Sealed Containers
in collaboration with VeriVin Ltd.

The Project

In collaboration with the University of Oxford, VeriVin Ltd is exploring the usefulness of Quantum Enhanced Sensing Techniques to investigate the chemical decomposition of complex liquids in sealed containers. The anticipated technique is a-priori non invasive and is expected to be sensitive at the single-molecule level. As a first commercial application, we intend to develop a device that is capable of generating a molecular finger print of beverages, such as wine and beer, without opening the bottle. This a-priori non-invasive technique will allow for the quality control and characterisation of liquid substances in a large variety of applications and circumstances. These range from testing and monitoring the production and long-term storage of liquid nutrients (e.g. beverages), fluids in technical or health-care applications, and the analysis of unknown liquids in defence applications.

The Quantum-Enhanced Sensing technique exploits the superposition of molecular quantum states and the quantum states of the radiation field inside an optical cavity in a Raman-type process to selectively detect compounds at the single-particle level. Not only is this level of sensitivity out-of reach for current spectroscopic sensing methods, but these are also mostly invasive, leading to either a spoilage of the substance or a contamination of the environment. At the end of this project, VeriVin will have acquired the skills to bring this quantum-sensing device to the market, while the University of Oxford demonstrates the inherent potential of their quantum sensing approach.

About VeriVin

Non-invasive molecular fingerprinting – know what's in the bottle without taking the cork out.

VeriVin is an innovative startup developing a unique non-invasive wine analyser and working on the quantum-enhanced spectroscopic sensing of trace compounds in inaccessible complex liquids. Non-invasive characterisation, fault testing, monitoring and authentication leading to a powerful database of molecular ID tags that could revolutionise the wine and spirits industry.

VeriVin is extending the capabilities of its already patented technology in order to non-invasively detect the presence and concentration of various molecular compounds in unopened bottles of wine – through the glass, without the need to take the cork out. The principal application of VeriVin's technology is in quality control, but it could also be used to characterise a bottle of wine in order to monitor its progress over time, compare it to other bottles, or even verify its authenticity, all without the need to open the bottle or extract a sample.

In more general terms, VeriVin is working on the quantum-enhanced spectroscopic sensing of trace compounds in inaccessible complex liquids and the database of molecular ID tags that could be built as a result. This capability could have a truly disruptive impact on the wine and spirits industry and eventually be applicable in other fields like defence or the chemical industry.

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About Oxford Physics

Oxford Physics is one of the largest and most eminent departments in Europe, pursuing forefront research and training the next generation of leaders in Physics. With an academic staff of almost one hundred, their activities range from fundamental particles to the furthest reaches of the universe to manipulating matter on an atomic scale. Oxford physicists are probing new ways to harness solar energy, modelling the Earth's atmosphere to predict the future climate, exploring computation on the quantum scale and executing calculations that reveal the fundamental structure of space and time.

The post-holder will be based in the Atomic and Laser Physics sub-department, which is one of the six sub-departments that together make up the Department of Physics; these are Astrophysics, Atomic and Laser Physics, Atmospheric, Oceanic and Planetary Physics, Condensed Matter Physics, Particle Physics and Theoretical Physics, with a seventh function (Central Physics) providing administrative and technical support to these sub-departments. Members of all sub-departments take part in research, teaching and matters such as examinations, discussion of syllabi, lectures and liaison with undergraduates and postgraduate students. For more information visit: <http://www2.physics.ox.ac.uk/research/the-atom-photon-connection>

About You

We are looking for a highly-qualified post-doctoral researcher with prior experience in quantum optics, laser spectroscopy or a similar field to join our team and be part of a UK government funded collaborative project with the University of Oxford physics department (<http://www2.physics.ox.ac.uk/research/the-atom-photon-connection>). The position is for a fixed-term contract with the University of Oxford and the possibility of continued employment with VeriVin after 12 months. We seek a self-motivated independent thinker who nevertheless also enjoys working in a team.

The Role

In this role, you will be working with high-calibre physicists on the design and development of a novel type of spectrometre exploiting quantum effects. You will be working in a team of researchers at the post-graduate level to transfer cutting-edge technology working in the lab at the single atom level to a commercial setting, and developing a commercially ready device. The successful candidate will have a key role in transferring specific scientific knowledge into the project, and will need to address and solve any specific scientific questions which might arise during the project, both from the theoretical and practical point of view. Responsibilities will include involvement in apparatus design and specification, purchasing, and key decisions on research directions and methodologies. More detailed responsibilities can be obtained from the academic partner (see How to Apply).

Location

The work will take place in the University of Oxford physics department with frequent visits to VeriVin's premises and our industry partner in the south of England. The dreaming spires of Oxford, near a train station with direct access to London.

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Qualifications

Candidates should possess or be very close to obtaining a PhD in physics, engineering or a similar field.

Experience

Experience working in an optics lab or similar environment is a must. A sound background and experience in experimental design is highly desirable. The post-holder should have a record of research experience (e.g. publications and conference contributions) and have the ability to take forward a research project and deliver output.

Skills

Essential: Candidates should have technical expertise in appropriate areas, in particular spectroscopy (e.g. SRS or CARS), laser physics, quantum optics, laser frequency locking, cavity-qed, process control and data acquisition using LabView, Matlab, Python, C++, and data analysis and evaluation.

Desirable: Profound knowledge of quantum optics and quantum-enhanced sensing methods; Proven track record in quantum atom-optics, cavity-qed and spectroscopy; Practical experience with lasers, cavities, detection systems and spectrometers; A solid grasp of classical optics and the fundamental principles of light-matter interaction; Numerical modelling skills

Bonus: Knowledge of wine chemistry or even just an appreciation of wine.

Responsibilities

- Define, develop and undertake experiments directed towards the research programme.
- Involvement in key decisions on research directions, methodologies and responsibilities.
- Involvement in apparatus design, specification and purchasing.
- Contribute to the positive atmosphere, maintenance and smooth running of the collaboration, as required.
- Instruction and day-to-day mentoring of interns and other scientists contributing to the project, and oversight of laboratory operations and procedures.
- Accepting delegated responsibility for safe laboratory practice, especially for the operation of laser systems for which training is required.
- Writing of research papers for internationally refereed journals and presenting results at national and international conferences.
- Contribute to the writing of reports required for external grants and contracts, including milestone reports, and final reports before the end of the contract.
- Assisting with other reasonable practical and administrative duties as required.

The post-holder will have the opportunity to teach. This may include lecturing, small group teaching, and tutoring of undergraduates and graduate students.

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Company Culture

This is a unique opportunity to do hands-on science in a start-up environment and not only work alongside high-calibre physicists from the University of Oxford but also get a sneak peek into the wine and spirits industry and the Oxford start-up ecosystem. You will be working closely with the start-up founder, and will have the opportunity to get acquainted with some of the other aspects of the start-up process. We are essentially entrepreneurial physics nerds with a serious work ethic who like to drink wine.

Compensation

Between £41k and £48k pa depending on experience and qualification.

How to Apply

Interested applicants should send an email to axel.kuhn@physics.ox.ac.uk for more details on the formal application process with the University of Oxford. You will need to supply a CV and a supporting statement explaining how you meet each of the selection criteria for the post using examples of your skills and experience. You will need to follow a formal online application process with the University of Oxford and provide details of two referees.

Equality of Opportunity

Entry into employment will be determined only by personal merit and in all cases, ability to perform the job will be the primary consideration. No applicant shall be discriminated against because of age, disability, gender reassignment, marriage or civil partnership, pregnancy or maternity, race, religion or belief, sex, or sexual orientation.

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