University of Birmingham

Dr Vincent Boyer PhD

Lecturer

School of Physics and Astronomy (/schools/physics/index.aspx)

Contact details

Telephone +44 (0) 121 414 4573 (tel:+44 121 414 4573)

Email v.boyer@bham.ac.uk (mailto:v.boyer@bham.ac.uk)

School of Physics and Astronomy
University of Birmingham
Edgbaston
Birmingham
B15 2TT
UK

About

Vincent is a lecturer in the group of Cold Atoms and is part of the **Midlands Ultracold Atom Research Centre (http://mpa.ac.uk/muarc/)** . His research bridges between the fields of Ultracold Atom physics and Quantum Optics in order to develop new quantum technologies impacting the way we process spatial (visual) information. He also participates in collaborative projects aiming to produce the next generation of quantum sensors based on atom interferometry, for instance to detect the gravitational field created by objects under the ground.

Qualifications

- PhD in Quantum Physics, University of Paris 6, 2000
- MSc in Physics, University of Paris 6

Biography

- Guest researcher, NIST, Gaithersburg, USA. Quantum optics with atomic vapours, quantum images, quantum buffers, 2005-2009
- Marie Curie fellow, University of Oxford. Bose-Einstein condensation, dynamic optical potentials, 2002-2005
- Guest researcher, NIST, Gaithersburg, USA. Subrecoil laser cooling for the space clock programme, 2000-2002

Teaching

- Y3 Atomic Physics
- Quantum Optics for postgraduates
- Y4 Project supervision

Research

Vincent's main research interests lie at the boundary between quantum optics and cold atom physics, where experiments combine the quantum nature of light and the exquisite control of cold atoms.

Quantum images
Recent advances in quantum optics have allowed the generation of nonclassical states of light such as pairs of spatially entangled beams [1, 2]. These light fields, dubbed "quantum images", have subtle quantum correlations in their phases and their amplitudes that depends on the position in their transverse profiles. They could be used for the imaging of hard to see (transparent) objects, accurate beam positioning, or quantum cryptography [2]. They are created by 4-wave mixing in an atomic vapour, which gives them another crucial property: they are narrowband and resonant with an atomic transition. We recently used this feature to build a quantum buffer for quantum images, that is to say an atomic device that can slow down the propagation of light without destroying the quantum entanglement [3].

Atomic quantum memories
The possibility of generating quantum light which is resonant with atoms allows us to envision the creation of quantum information processing (QIP) systems (for quantum communications, quantum computations, etc.) where light plays the role of information carrier and atoms the role of a memory. The challenge is to transfer quantum information from a beam of light to a collection of atoms, and to transfer it back to the light at a later time. The development of long-lived quantum memories is of paramount importance to the nascent field of QIP, and cold atoms in optical lattices are good candidates to provide a flexible and controllable testing ground for the implementation of new ideas toward this goal.

Publications

[1] "Entangled images from four-wave mixing",
Vincent Boyer, Alberto M. Marino, Raphael C. Pooser and Paul D. Lett,
Science 321, 544 (2008).

[2] "Entangled light beams from four-wave mixing carry spatial information",
Johanna Miller,
Physics Today 61, 16 (2008).

[3] "Tunable delay of Einstein-Podolsky-Rosen entanglement",
Alberto M. Marino, Raphael C. Pooser, Vincent Boyer and Paul D. Lett,

Nature 457, 859 (2009).