ACQAO

AUSTRALIAN RESEARCH COUNCIL
CENTRE OF EXCELLENCE FOR
QUANTUM-ATOM OPTICS

PhD Projects at ACQAO

THEORY

About ACQAO

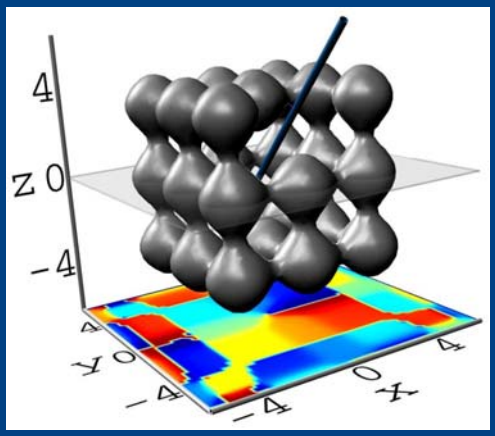
The Australian Centre for Quantum-Atom Optics (ACQAO) was formed in 2003 as one of the recently established Australian Research Council Centres of Excellence. It involves collaboration between the Australian National University in Canberra, the University of Queensland in Brisbane, and the Swinburne University of Technology in Melbourne.

The aim of ACQAO is to carry out strategic fundamental research, which combines the ideas of quantum optics, such as squeezing and entanglement, and the techniques of atom optics, such as Bose-Einstein condensation and atom lasers. The theory core of ACQAO has the challenging task of developing the fundamental theory of these novel quantum many-body systems, and proposing new experimental tests for the laboratories.

MATTER WAVES IN LATTICES AND WAVEGUIDES

A dilute atomic gas at temperatures close to absolute zero can form a new state of matter - the Bose-Einstein condensate (BEC); its experimental creation in 1995 was recognised by the Nobel Prize award in 2001. In a condensate, a macroscopic number of particles share the same quantum state and hence the collection of atoms can behave coherently, as a single giant "matter wave".

A BEC loaded into periodic potentials created by interference of laser beams, optical lattices, forms a perfectly ordered periodic "crystal". The dynamics of the coherent matter waves can then mimic the behavior of a single electron in a crystalline solid or a coherent wave of laser light in a periodic photonic structure ("photonic crystal"). The critical factors that make BECs in optical lattices remarkably different from both solid state and optical periodic structures are the inherent nonlinearity of the condensate due to atomic interactions and amazing tunability of the optical lattice potential.



This project will examine the effects that arise due to the interplay of the BEC nonlinearity and periodicity of the optical lattice. This study aims for a deeper understanding of links between the physics of superfluidity, condensation, and nonlinear atom optics.

The research program will include the study of:

- **Nonlinear localization of multi-species BECs in lattices**
- **Formation and dynamics of topological defects (vortices)**
- **Condensate dynamics in lattices of nontrivial geometries**
- **Nonlinear effects in quasiperiodic and random lattices**
- **Atomic-molecular Bose gases in Optical Lattices**

Supervisors

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Scholarships and further information

For further details about the research project and information about PhD scholarships please contact one of the prospective supervisors or visit the webpages of the ANU, UQ or SUT Nodes of ACQAO:
rsphy2.anu.edu.au/nonlinear
www.physics.uq.edu.au/BEC/Prospective_Students.html
www.swin.edu.au/biosciencecng/soll/caous

www.acqao.org