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.

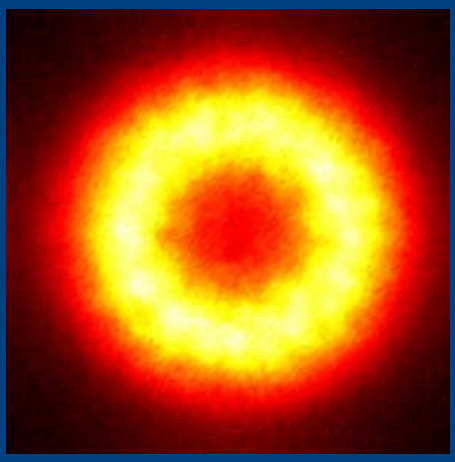
The aim of ACQAO is to carry out strategic fundamental research, which combines the ideas of quantum optics, such as squeezing and entanglement, and the techniques of atom optics, such as Bose-Einstein condensation and atom lasers. The theory core of ACQAO has the challenging task of developing the fundamental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

ULTRA-COLD FERMIONS AND MOLECULES

The discovery of Bose-Einstein condensation in 1995 by C. Wieman and E. Cornell, and the subsequent Nobel Prize awards in 2001, have introduced a new era in fundamental physics research. One of the outstanding opportunities in this new field is the theory and measurement of quantum correlations in ultra-cold atomic gases. These have applications to many areas, from novel tests of macroscopic quantum mechanics and quantum field theory, to determining fundamental quantum noise limits in atom lasers and precise engineering of novel condensed matter systems.

This project is concerned with exploring the physics of the superfluid phase transition in strongly interacting Fermi gases and the study of dissociation of molecular Bose-Einstein condensates (BEC) as means of producing strongly correlated and entangled atomic ensembles.

This is closely linked to an experimental program at the Swinburne University of Technology node of ACQAO on ultra-cold molecule formation using fermionic Lithium atoms near a magnetic Feshbach resonance. There are additional international links with experimental programs at École Normale Superiere (France), Innsbruck University (Austria), and Max Planck Institute for Quantum Optics (Germany).



The research program will include the study of:

- **Fermionic and bosonic atom correlations in molecule dissociation**
- **Einstein-Podolsky-Rosen paradox and Bell's inequalities with fermions**
- **BCS-BEC crossover regime in degenerate Fermi gases**
- **Quantum many-body simulation methods**
- **Thermodynamics of trapped Fermi gases**
- **Collective modes, vortex structures, and finite temperature effects**

Supervisors

UQ Dr Karen Kheruntsyan <kherunts@physics.uq.edu.au>
Dr Joel Corney <corney@physics.uq.edu.au>
Prof Peter Drummond <drummond@physics.uq.edu.au>

SUT A/Prof Bryan Dalton <bdalton@swin.edu.au>

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 UQ or SUT Nodes of ACQAO:
www.physics.uq.edu.au/BEC/Prospective_Students.html
www.swin.edu.au/bioscieleceng/soll/caous

www.acqao.org