



# PhD Projects at ACQAO EXPERIMENTAL

## 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.

## COHERENCE OF A BEC ON AN ATOM CHIP

The combination of laser cooling and evaporative cooling techniques can freeze a cloud of atoms to such an extent that they undergo a phase transition to a new state of matter – a Bose-Einstein condensate (BEC). A remarkable property of a BEC is that all atoms in the ensemble are in a single quantum state and thus behave as a single “giant matter wave”. Atom chips, or microfabricated atom optical elements on a substrate, provide an excellent platform for the coherent manipulation of matter waves and in particular for the production and quantum control of BECs.

The Swinburne Atom Chip project aims at the development of on-chip atom interferometers and investigation of decoherence effects associated with the macroscopic phase of a condensate. The scope of the project includes experimental and theoretical studies involving interactions of BECs with the environment, atom interferometry, applications of BECs for surface magnetometry and the development of on-chip single-atom detection and non-destructive measurements of BECs. Our current atom chip uses a combination of miniature wires and a permanent magnetic film to integrate a number of elements into a single device. We routinely produce from one up to sixteen condensates on the chip, which offers numerous opportunities for studies of “giant matter waves”.

The project is a part of the ARC Centre of Excellence for Quantum-Atom Optics (ACQAO) and is very well equipped with top-performance lasers, a versatile computer control and a sophisticated imaging CCD system. It is also a part of the Centre for Atom Optics and Ultrafast Spectroscopy (CAOUS) and is located in the Swinburne Optics and Laser Laboratories (SOLL) complex. Our team has established international links with leading laboratories in Great Britain, Austria, Germany and Italy. ACQAO runs annual workshops, which encourage collaboration and interactions between PhD students and chief investigators across different universities.



## 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 webpage of the SUT Node of ACQAO:

[www.swin.edu.au/bioscieleceng/soll/caous](http://www.swin.edu.au/bioscieleceng/soll/caous)