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.

COMPUTATIONAL PHYSICS AND QUANTUM SIMULATIONS

Recent pioneering experiments with ultracold atoms have opened up experimental regimes in which many-body quantum physics can be investigated with unprecedented simplicity and precision. Theoretical predictions can thus be tested to high accuracy. Although described by relatively simple models, except in special cases such systems cannot be solved analytically without serious approximations.

The accurate simulation of quantum many body systems is one of the great challenges of many body physics. Fermionic simulations, plagued by infamous Fermi sign problem, are particularly difficult. Quantum phase-space methods are a proven way of simulating interacting quantum systems. Originally developed to simulate optical systems, they are under development in the Centre, by means of "stochastic gauges", alternative basis sets, and hybrid approaches, to tackle systems with stronger interactions (such as atoms) and to simulate fermions as well as bosons.

ACQAO has a strong program in computational physics. The in-house simulation package for stochastic PDEs, known as XMDS, is useful for many projects in the Centre, and its extension to new types of problems is an active area of development. A new 64bit Linux cluster at the UQ node is available for researchers in the Centre.

ACQAO PhD projects in this area cover:

- Novel simulation methods for fermions
- Dynamics of ultracold atoms in a lattices
- Stochastic gauges for stable quantum simulations
- Dynamics of BEC formation and vortices

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 UQ, ANU or SUT Nodes of ACQAO:

www.physics.uq.edu.au/BEC/Prospective_Students.html
www.anu.edu.au/Physics/ANUBEC/projects.html
www.swin.edu.au/bioscieleceng/soll/caous