Oleksandr Fialko

Researcher at Massey University

oleksandrfialko@gmail.com

Summary

I am enthusiastic about data science and science in general.

My enthusiasm originates from my research background in theoretical statistical physics. I have developed strong problem-solving skills and gained solid experience in applied mathematics and computational physics.

Favorite tools of mine are Python (inc. Numpy, Matplotlib, Pandas, Scikit-learn), Matlab, R, Fortran. I am also proficient in database technologies such as querying with Transact-SQL and building SQL Data Warehouse.

Experience

Research physicist at Massey University

April 2013 - Present (3 years 4 months)

I won a Marsden Fast-Start fund in 2013 to work on the project "Understanding quantum thermodynamics with the smallest heat engine". This project set the stage for my career as an independent researcher in New Zealand. I have been working on quantum thermodynamics and statistical physics. I became enthusiastic about data science.

Postdoctoral Researcher at Massey University

October 2010 - March 2013 (2 years 6 months)

During my work as a postdoctoral researcher I initiated and progressed several ideas which went far beyond the scope of the original project. These includes: macroscopic quantum tunneling of superfluid vortices, soliton magnetization dynamics in spin-orbit coupled bosonic systems, quantum thermodynamics of an isolated quantum heat engine, simulation of the Early Universe with cold atoms. I supervised several master students on different projects.

Research Assistant, Ph.D at University of Augsburg

October 2005 - June 2010 (4 years 9 months)

During my PhD in theoretical condensed matter physics at University of Augsburg, I developed key skills of a researcher: defining and initiating research projects, problem solving, presentation of progress in international physics journals and at conferences. I worked on different aspects of ultra-cold atomic systems such as Anderson localisation and Mott insulator to Superfluid transition in optical lattices.

Skills & Expertise

Matlab
Science
Mathematica
Python
Research
Theoretical Physics
R
C
SciPy
T-SQL
Microsoft SQL Server
Lecturing
LaTeX
Linux
Programing
SQL Server Management Studio
Physics
Mathematical Modeling
Data Analysis
Programming

Education

Kyiv National Taras Shevchenko University
Master's degree, Physics, 2004 - 2005
Grade: with honour

Kyiv National Taras Shevchenko University
Bachelor's degree, Physics, 2000 - 2004
Grade: with honour

AMES IT Academy
Certificate, SQL SERVER IMPLEMENTATION AND SUPPORT, 2016 - 2016

Certifications

Machine Learning
Coursera Course Certificates License 37NUWDHL9498 June 2016

edX Verified Certificate for Programming in R for Data Science
edX License 0d47a0e6d4cf47eb99379d565e2d357e June 2016

edX Honor Code Certificate for Fundamentals of Nanoelectronics: Basic Concepts
edX

Introduction to R
DataCamp License 4b5f4098e5b0eecf466422f8bfcd175d13e89684

Volunteer Experience

Communicating science to the public at Museum of Transport and Technology (MOTAT)

2015 - Present

Communicating scientific principles to the public during the 2015 Science Street Fair at MOTAT.

Publications

Interacting bosons in an optical lattice

Ann. Phys. (Berlin) 17, 48 2008

Authors: Oleksandr Fialko, Ch. Moseley, K. Zielger

Several models of a strongly interacting Bose gas in an optical lattice are studied within the functional-integral approach. The one-dimensional Bose gas is briefly discussed. Then the Bose-Einstein condensate and the Mott insulator of a three-dimensional Bose gas are described in mean-field approximation, and the corresponding phase diagrams are evaluated. Other characteristic quantities, like the spectrum of quasiparticle excitations and the static structure factor, are obtained from Gaussian fluctuations around the mean-field solutions. We discuss the role of quantum and thermal fluctuations, and determine the behavior of physical quantities in terms of density and temperature of the Bose gas. In particular, we study the dilute limit, where the mean-field equation becomes the Gross-Pitaevskii equation. This allows us to extend the Gross-Pitaevskii equation to the dense regime by introducing renormalized parameters in the latter.

“Isolated quantum heat engine

Phys. Rev. Lett. 108, 085303 2012

Authors: Oleksandr Fialko, D. Hallwood

We present a theoretical and numerical analysis of a quantum system that is capable of functioning as a heat engine. This system could be realized experimentally using cold bosonic atoms confined to a double well potential that is created by splitting a harmonic trap with a focused laser. The system shows thermalization, and can model a reversible heat engine cycle. This is the first demonstration of the operation of a heat engine with a finite quantum heat bath.

Fate of the false vacuum: towards realization with ultra-cold atoms

Europhys. Lett. 110, 56001 2015

Authors: Oleksandr Fialko, B. Opanchuk, A. I. Sidorov, P. D. Drummond, J. Brand

Quantum decay of a relativistic scalar field from a false vacuum is a fundamental idea in quantum field theory. It is relevant to models of the early Universe, where the nucleation of bubbles gives rise to an inflationary universe and the creation of matter. Here we propose a laboratory test using an experimental model of an ultra-cold spinor Bose gas. A false vacuum for the relative phase of two spin components, serving as the unstable scalar field, is generated by means of a modulated radio-frequency coupling of the spin components. Numerical simulations demonstrate the spontaneous formation of true vacuum bubbles with realistic parameters and time-scales.

Anderson localization in a correlated fermionic mixture

Europhys. Lett. 85, 60003 2009

Authors: Oleksandr Fialko, K. Ziegler

A mixture of two fermionic species with different masses is studied in an optical lattice. The heavy fermions are subject only to thermal fluctuations, the light fermions also to quantum fluctuations. We derive the Ising-like distribution for the heavy atoms and study the localization properties of the light fermions numerically by a transfer-matrix method. In a two-dimensional system one-parameter scaling of the localization length is found with a transition from delocalized states at low temperatures to localized states at high temperature. The critical exponent of the localization length is ##0.88.

Quantum tunneling of a vortex between two pinning potentials

Phys. Rev. Lett. 108, 015301   2012

Authors: Oleksandr Fialko, A. S. Bradley, J. Brand

A vortex can tunnel between two pinning potentials in an atomic Bose-Einstein condensate on a time scale of the order of 1s under typical experimental conditions. This makes it possible to detect the tunneling experimentally. We calculate the tunneling rate by phenomenologically treating vortices as point-like charged particles moving in an inhomogeneous magnetic field. The obtained results are in close agreement with numerical simulations based on the stochastic c-field theory.

Languages

English (Full professional proficiency)

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Contact Oleksandr on LinkedIn