



Institute of Physics of the Polish Academy of Sciences

Scholarship for a PhD Student



Job ID: #JOB 30/2020

Job Description

Job Title: PhD student – scholarship holder

Job Summary:

Magnetic atoms quantum simulators

Job Description:

The student will join the Quantum Gases group under the supervision of prof. Mariusz Gajda.

Aim:

The PhD project aims at understanding of quantum correlations in many-body systems. They are still very cryptic, difficult to detect and control. The main idea of the present project is to study quantum correlations not in a condensed matter setting but in significantly larger systems of ultracold atoms placed periodically in space in optical lattices created by laser beams, mimicking this way a real crystal.

The project is devoted to the theoretical studies of spin dynamics of ultracold atomic samples. In particular we will focus on investigation of the equilibration of a lattice spin system initially set out-of-equilibrium, characterized by spin fluctuation. We also plan to investigate quantum droplets – self-bound objects stabilized by quantum fluctuations as well as mixtures of two different dipolar gases in optical traps. We shall develop state-of-the-art numerical simulations for the dynamics of quantum spin systems, combined with the diagnostic tools of quantum correlations.

The project will be realized in a close collaboration with leading theoretical and experimental groups in Europe within the QuantERA consortium – Magnetic Atoms Quantum Simulators - MAQS. On the theory side we will collaborate with groups of M. Lewenstein from Barcelona and T. Roscilde from Lyon. Our studies will be closely related to the experimental works of teams lead by B. Laburthe-Tolra in Paris, T. Pfau in Stuttgart, F. Ferlaino in Innsbruck and G. Modugno in Florence.

Background:

Very dilute atomic samples cooled down to a nano-Kelvin range are very unique quantum systems. They behave according to laws of quantum mechanics, nonetheless are big enough to be available for an easy manipulation and direct observation by optical means. These features make the ultracold atomic systems the perfect candidates for quantum simulators mimicking in a controlled way a large variety of other quantum systems known in condensed matter. They enable for a deeper understanding of mysterious world of quantum mechanics, for creation of new states of matter such as supersolids, exotic superfluids, new magnetic systems, and for not yet discovered future applications.

Experimental realization of dilute ultracold atomic samples of atoms characterized by a large magnetic dipole moment, like Dysprosium, Erbium and Chromium, opened a possibility of experimental and theoretical study of quantum many-body systems with long-range correlations. The systems form a perfect platform to study quantum

correlations for quantum technologies applications such as communication, simulation, precision measurements and sensing or metrology.

Requirements:

The candidate should have MSc in Physics. A very good theoretical background is required, in particular knowledge of quantum mechanics and statistical physics. Some experience in atomic and/or many-body physics is desirable. The candidate should have also very good numerical skills and experience in C++ or Fortran programming.

To be employed, the candidate must be accepted into the PhD school in which the Institute of Physics participates. Applications for the position are through recruitment to the School, online at <http://warsaw4phd.eu>.

Main research field: Physics

Sub Research Field: Ultracold quantum gases

Career Stage: Early stage researcher or 0-4 yrs (Post-graduate)

Research Profile ([details](#)): First Stage Researcher (R1)

Type of Contract: Fixed term (36 months)

Status: Full-time

Salary: grant funding of **4500** PLN per month, before subtracting obligatory employer and employee social security contributions.

Contact

More information can be obtained from

Mariusz Gajda (e-mail: gajda@ifpan.edu.pl)

http://info.ifpan.edu.pl/ON-5/quantum_gases/

Please make contact.

Application details

Application deadline: 18.8.2020 Later applications will not be considered.

Required materials:

- Scientific CV
- Cover letter
- Scan of MsC diploma or equivalent (or an explanation of when one is expected)
- Academic record (for finalized semesters)
- Recommended: A recommendation letter by an academic, or their contact email.

All materials should be submitted in electronic form by application to the PhD school <http://warsaw4phd.eu>, choosing the project: "*Magnetic atoms quantum simulators*". (The application system will be active from 5 August 2020).

Results regarding the position will be made available by 20 September 2020.