Center for Theoretical Physics
Polish Academy of Sciences
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HR EXCELLENCE IN RESEARCH

Warsaw, 2025-07-11

# PhD student fellowship position at Center for Theoretical Physics PAS

The Director of the Center for Theoretical Physics PAS (CTP PAS) invites applications **for a PhD student position** at the CTP PAS, financed from the project **"Towards a useful Quantum Advantage" TouQan** (https://touqan.eu/) , financed by the National Science Center (NCN), registration No. 2023/05/Y/ST2/00140 (ERA-NET Cofund QuantERA II). PI of the project is dr hab. Michał Oszmaniec.

The proposed project concerns the use of indistinguishable particles (bosons, fermions, and more exotic variants obeying so-called *parastatistics*) for quantum computation. On one hand, indistinguishable particles provide an intriguing platform for implementing computations (e.g., multiparticle photon interference or neutral atoms in optical traps). On the other hand, physical processes involving such particles can give rise to computational problems that are well-suited for quantum computers.

The project is funded by the international Quantera grant TouQan (https://touqan.eu/), which aims to rigorously investigate the computational power of quantum simulators, particularly in the context of quantum advantage — that is, situations where quantum devices outperform their classical counterparts.

**The project will focus on a theoretical analysis of proposed realizations of quantum advantage, with special emphasis on Fermion Sampling, Boson Sampling, and their generalizations. Particular attention will be given to realistic scenarios in which noise is present and the implementation of protocols is imperfect (e.g., due to particle losses, partial distinguishability, or errors in quantum gates). From a technical perspective, the project will combine advanced mathematical tools (differential geometry, representation theory, high-dimensional probability) with numerical simulations that exploit the structure of the studied problems.**

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Topics that can be pursued within the project include:
• Investigation of the robustness of the Fermion Sampling scheme against local noise in state preparation, gate implementation, or measurements;
• Analysis of the experimental realization of the Fermion Sampling scheme in optical latices;
• The computational hardness of the Boson Sampling scheme in the presence of partial photon distinguishability;
• Development of tools for characterizing partial distinguishability of photons;
• Analysis of the computational hardness of quantum advantage schemes based on parastatistics, and exploration of their connection to partial distinguishability of photons;

**Requirements:**
• Master degree in physics, mathematics, computer science, or related field;
• Very good command of English;
• Familiarity with the foundations and basic concepts of quantum information and quantum computing;
• Interest in the current state of research in the field of quantum computation;
• (Recommended) knowledge of the fundamentals of quantum many-body physics, in particular the quantum description of indistinguishable particles using the method of second quantization;
• (Optional) knowledge of the basics of complexity theory (complexity classes such as P, NP, BPP, BQP, PSPACE, etc.);
• (Optional) familiarity with advanced mathematical physics techniques, such as representation theory (finite groups, Lie groups and algebras), high-dimensional probability theory (measure concentration), differential geometry;
• (Optional, not all skills are required):
  o Experience in programming (C++, Python, Matlab or Mathematica)
  o Experience with quantum computing platforms (e.g., Qiskit)

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**The application must include:**

1. The scientific CV, including the progress in the university studies, scientific achievements (publications, participation in research projects and conferences), with the clause "I agree to the processing of my personal data contained in the application documents for the purposes necessary for the implementation of the process recruitment by the doctoral school WARSAW-4-PhD".
2. Cover letter.
3. A copy of the master's degree diploma, or a statement from the Candidate's MSc Advisor about the planned date of diploma obtaining
4. Copies of documents confirming scientific or professional achievements.
5. At least one letter of recommendation from a researcher with at least a PhD degree,
concerning the candidate and his/her current scientific activity.
6. Application for admission to the WARSAW-4-PhD doctoral school (Attachment No. 1).

Documents should be submitted electronically via the recruitment system on the website www.warsaw4phd.eu from **25.07.2025** to **08.08.2025**.

All questions can be sent directly to: oszmaniec@cft.edu.pl

The scholarship will be awarded in accordance with the applicable laws in Poland and in accordance with the Resolution of the NCN Council no. 124/2022 of December 1, 2022, regarding the Regulations for the Awarding of NCN Scientific Scholarships in Research Projects Funded by the National Science Center, in the amount of 4 700 PLN net for a period of four years, with the first twenty one months being funded as part of the research project QuantERA II „Towards a useful Quantum Advantage", financed by the National Science Center based on grant agreement no. UMO-2023/05/Y/ST2/00140, and the subsequent twenty seven months - being funded from other sources.

**The competition will be settled by 15.09.2025**. Candidates will be informed electronically on the results of the competition.

Admission to the Warsaw4Phd doctoral school and the beginning of the scholarship are scheduled for **01.10.2025**.

Magdalena Kacprzak
Deputy Director for General Affairs
Center for Theoretical Physics PAS

Magdalena Marta Kacprzak
Elektronicznie podpisany przez Magdalena Marta Kacprzak
Data: 2025.07.11 14:44:11 +02'00'

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## Information Clause – Job Recruitment

**Information Obligation under the Article 13 of the RODO *:**

1. **Data Administrator**

The administrator who is a deciding entity on how your personal data will be used is the Center for Theoretical Physics PAN represented by the Director with the seat in Warsaw Al. Lotników 32/46. You can contact the Administrator by using one of the contact forms available on the website: : http://www.cft.edu.pl/

2. **Data Protection Inspector**

The Director of the Center for Theoretical Physics of the Polish Academy of Sciences has appointed the Data Protection Inspector (Inspektor Ochrony Danych - IOD) with whom you can contact in all matters relating to your personal data. You can contact the Inspector by sending an email to: iod@cft.edu.pl

3. **The Purposes of Processing and the Legal Basis for Processing**

Your personal data will be processed for the purpose of running the current recruitment.

The basis for the processing of personal data are the provisions of the Labor Code Act of June 26, 1974 (uniform text: Dz. U. of 2018, item 917) and based on your consent for data processing.

4. **The Period of Storage of Personal Data**

Your personal data will be kept for the duration of the present recruitment.

5. **Data Recipients****

The recipients of your personal data will be only entities authorized to obtain personal data on the basis of the law. Access to your data is provided only to employees authorized by the administrator and associates who must have access to the data to perform their duties.

6. **Your Processing Rights**

You have the right to access your data and the right to correct it or limit processing, as well as the right to appeal against the processing.

6. **The Obligation to Provide Data and the Consequences of not Providing Data**

Providing your personal data specified in the Labor Code is obligatory, and for the remaining extent voluntary.

7. **The right to make a complaint to the President of the Office for the Protection of Personal Data**

When you feel that the processing of personal data violates the provisions of the general regulation on the protection of personal data, you have the right to make a complaint to the President of the Office for the Protection of Personal Data.

**Consent to Data Processing**

**I consent to the processing of my personal data by the Center for Theoretical Physics PAN for the needs of:**

☐ Present recruitment.

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I provide the data voluntarily and I declare that they are truthful. I got acquainted with the contents of the above information, including information about the purpose and methods of processing personal data and the right to access my data and the right to correct them.

.....

date, signature of the candidate

* Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of individuals with regard to the processing of personal data and on the free movement of such data and repealing Directive 95/46 / EC (general regulation on data pr