



Institute of Molecular Physics
Polish Academy of Sciences
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FORM FOR EMPLOYERS

Institution: Institute of Molecular Physics Polish Academy of Sciences (IMP PAS)
[PL: Instytut Fizyki Molekularnej Polskiej Akademii Nauk (IFM PAN)]

City: Poznań, Poland

Position: Student scholarship holder

Scientific discipline: physical sciences (or related)

Opening date: 8 July 2026

Application deadline: 31 July 2026; 15:00 CEST

Website: <https://www.ifmpan.poznan.pl/en/>

Key words:

statistical physics, computational physics, nonequilibrium thermodynamics, synchronization, complex systems

I. Offer description:

Title of the scientific project:

Nonequilibrium phase transitions, synchronization and chaos in thermodynamically consistent models

Principal investigator: Dr. Eng. Krzysztof Ptaszyński

Description of the project:

This project focuses on the study of synchronization phenomena in the driven clock Potts model, consisting of two or three interacting oscillators with a finite number of discrete phase states. The interaction between oscillators favors phase alignment, leading to the emergence of synchronized states.

The clock Potts model provides a minimal model of synchronization whose stochastic dynamics are fully consistent with the laws of thermodynamics. This makes it possible to investigate the dynamical, statistical, and energetic properties of the system within a unified framework. In particular, the model allows one to analyze the conditions under which synchronization emerges and to quantify its consequences for energy dissipation, energy transfer between oscillators, and phase fluctuations. It also enables the study of information-theoretic quantities, such as mutual information and information flow. In the case of three coupled oscillators, the model exhibits more complex collective behaviors, including partial synchronization and persistent oscillations of phase differences between oscillators.

Research objectives:

The main objective of the project is to provide a quantitative characterization of synchronization mechanisms and to determine their thermodynamic and stochastic consequences. The study will employ two complementary approaches: numerical solutions of mean-field equations and solutions of the master equation describing the full stochastic dynamics of the system.

The mean-field approach will be used to construct bifurcation diagrams characterizing the dynamical and thermodynamic states of the system, as well as the transitions between them. It will also allow us to determine how these transitions – particularly the onset of synchronization – affect energy dissipation and energy flows between oscillators.

The predictions of the mean-field theory will subsequently be validated using solutions of the master equation. This approach will further enable a detailed analysis of phase fluctuations and energy-flow fluctuations, as well as their behavior in the vicinity of transitions between different dynamical states. An additional objective is to investigate the relationship between synchronization, mutual information, and information flow within the system.

The project combines concepts and methods from statistical physics, nonequilibrium thermodynamics, information theory, and computational modeling. The results are expected to contribute to a deeper understanding of universal synchronization mechanisms that may also govern more complex systems, such as chemical oscillators, biological oscillators, and other active matter systems.

II. Requirements for candidates:

1. Research career stage:

R1: First Stage Researcher (up to the point of PhD).

More information on career stages: <https://www.more-4.eu/indicator-tool/career-stages-r1-to-r4>

2. Required education: Minimum secondary education required; a Bachelor's degree (B.Sc. or B.Eng.) in Physical Sciences (or a related discipline) is preferred.

3. Required qualifications and skills:

- Knowledge of physics and mathematics at the undergraduate level;
- Basic programming skills.

4. Specific requirements:

The candidate must be a student of full-time first or second-cycle degree programmes or uniform Master's studies at any university in Poland

5. Knowledge of English: Basic proficiency in English sufficient to read and understand scientific publications written in English.

6. Scientific experience required:

- in the discipline of physical sciences (or similar);
- Research area: not applicable;
- Experience in computer simulations or programming is desirable.

III. Duration of the employment: 9 months (with a possibility of extension)

IV. Type of contract: National Science Centre (NCN) scholarship

V. Expected date of employment start: 1 October 2026

VI. Employment type: contract covered by the NCN SONATA-19 project
No. 2023/51/D/ST3/01203

VII. Salary: 3,000 PLN per month [three thousand] (total cost of the employer)

VIII. Number of positions available: 1

IX. Job benefits: Improving research skills and competencies, access to modern scientific software, opportunities to participate in international scientific conferences/schools in physics, and the possibility of engaging in international collaboration (University of Luxembourg).

X. Required documents:

1. Application;
2. CV (containing information on the candidate's education and competencies relevant to performing research tasks within the project, as well as a description of the candidate's scientific achievements, including scientific publications, distinctions, scholarships, awards, completed scientific training courses, workshops, participation in research projects, and scientific experience gained outside the home research institution in the country or abroad);
3. scan or photocopy of the Bachelor's/Engineer's degree diploma (if applicable);
4. consent to the processing of personal data for recruitment purposes (Appendix No. 1);
5. optionally, a supervisor's opinion on the Bachelor's/Engineer's thesis (if applicable) or other letters of recommendation.

Documents in other languages than Polish or English should be translated into Polish or English.

XI. Method of submitting offers: Applications with the annotation „**Competition for the student scholarship holder position – ZN 2 – No. 03/2026**” should be delivered to the Institute's address or sent to the e-mail address: director@ifmpan.poznan.pl.

Contact person:

Principal investigator: Dr. Eng. Krzysztof Ptaszyński

E-mail: krzysztof.ptaszynski@ifmpan.poznan.pl

Department of Theory of Nanostructures and Quantum Materials

XII. Qualification criteria:

- 1) The candidate's competencies for performing research tasks within the project;
- 2) The candidate's scientific achievements, including scientific publications;
- 3) Distinctions, scholarships, awards, completed scientific training courses and workshops, participation in research projects, as well as scientific experience gained outside the home research institution in the country or abroad.

XIII. Qualification process:

- 1) Application competition.
- 2) The best-ranked candidates may be invited to an interview (either on-site interview or videoconference)

The evaluation and selection will be conducted by a three-person recruitment committee appointed by the Director of the Institute of Molecular Physics of the Polish Academy of Sciences following "Regulations for awarding NCN scholarships for NCN-funded research projects" constituting an annex to the resolution of the NCN Council No. 124/2022 of December 1, 2022.

A candidate who receives a negative opinion from the recruitment committee has the right to appeal against the evaluation results to the Director of the Institute within 7 days from the date of receiving the opinion.

XIV. Expected date of the results announcement: August 2026

XV. Additional information: IMP PAS does not provide accommodation.

/signed: prof. Ph.D. Zbigniew Trybuła
Director/

DISCLAIMER:

According to art. 13 1 and 2 of 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 (Journal of Laws UE L 119/1 of 4.5.2016), hereinafter referred to as GDPR, we inform that:

1. The administrator of your personal data is the Institute of Molecular Physics Polish Academy of Sciences in Poznań, ul. Mariana Smoluchowskiego 17.
2. Your personal data will be processed for the duration of the recruitment process.
3. You have the right to request from the administrator access to personal data, the right to correct them, delete or limit processing, the right to object to the processing of personal data, as well as the right to transfer data.
4. You have the right to withdraw your consent at any time. The above does not affect the compliance with the law, which was made on the basis of your consent before it was withdrawn.
5. It is possible to lodge a complaint with the supervisory body – the President of the Office for Personal Data Protection.
6. Providing personal data is voluntary.
7. Your data will not be shared with entities other than entities authorized on the basis of applicable law.
8. The administrator will not transfer your personal data to recipients in third countries and international organizations.

Consent for the processing of personal data for recruitment purposes

I agree to the processing of personal data provided in this document for realising the recruitment process pursuant to the Personal Data Protection Act of 10 May 2018 (Journal of Laws 2018, item 1000) and in agreement with Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

.....
Name

.....
Date and signature

DECLARATION

I declare that if I win the Contest the Institute of Molecular Physics of the Polish Academy of Sciences will become my primary place of work within the meaning of the Act of 20 July 2018, Law on Higher Education and Science (Journal of Laws of 2018, item 1668, as amended).

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Name

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Date and signature