

## PhD position in research of Time Crystals

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### Scope of work:

PhD student will work on time lattices and time-space lattices and their applications to time-tronics. In practice PhD student is supposed to perform analytical calculations, prepare and run computer programs. They will also contribute in writing scientific publications and present results in scientific conferences and workshops.

### SHORT DESCRIPTION OF TIME-TRONICS:

Time crystals are quantum many-body systems that due to interactions between particles are able to spontaneously self-organize and start performing periodic motion. Spontaneous formation of periodic behavior in time is a temporal analogue of self-organization of atoms in space and formation of ordinary space crystals. Research on quantum time crystals was initiated by a Nobel Laureate Frank Wilczek in 2012. Since then, research on time crystals has developed a lot. Periodically driven systems have become perfect platforms for investigation of time crystals. Spontaneous formation of periodic motion in such systems was proposed and experimentally realized. Various condensed matter phenomena have been predicted in periodically driven systems. For example, Anderson localization, many-body localization, insulating phases and topological phases have been theoretically demonstrated in the time domain. Electronics, spintronics and atomtronics are fields where condensed matter phenomena are explored to research and realize useful devices. The described state-of-the-art indicates that we can already start developing condensed matter devices where time crystalline structures are the key element. This will pave the way for the new field of time-tronics which can be investigated in many different experimentally attainable systems. Our goal is to propose time-tronic devices and to find optimal experimental platforms for their realization and to convince scientists that time-tronics is attainable in present-day laboratories.

### LITERATURE:

<https://link.springer.com/book/10.1007/978-3-030-52523-1>

<https://physicsworld.com/a/time-crystals-enter-the-real-world-of-condensed-matter/>

### Requirements:

1. Holding a master degree in physics preferentially with specialization in theoretical physics;
2. Candidates have to be PhD students in Jagiellonian University at the moment when the fellowship starts.
3. An additional advantage will be:
  - a) experience in theoretical description of ultra-cold atoms or condensed matter systems,
  - b) good skills in numerical programming.

### Conditions of fellowship:

gross monthly fellowship 3.000,00 PLN

24 months

The start date is negotiable.

**Applications should be sent by email to:** [krzysztof.sacha@uj.edu.pl](mailto:krzysztof.sacha@uj.edu.pl)

**Deadline for the submission of applications:** 31.07.2023.

**The candidates can be called for online interview.**

The candidates, who would like to take part in the competitive selection process, should submit the following documents to Principal Investigator via e-mail: [krzysztof.sacha@uj.edu.pl](mailto:krzysztof.sacha@uj.edu.pl):

1. application form;
2. CV;
3. copy of the master diploma;
4. information on the candidate's scientific achievements;
5. recommendation letter/letters concerning the candidate's research prepared by scientific supervisors;
6. information regarding processing of personal data;

## INFORMATION ON DATA PROCESSING

### in the competitive procedure and the agreement for the implementation of research and funding of a scholarship awarded by the National Science Center

According to the Art. 13 of the 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 (...) (General Data Protection Regulation, hereinafter referred to as "GDPR") Jagiellonian University informs that:

1. **The controller** of your personal data is Jagiellonian University, Gołębia 24 Str., 31-007 Kraków, represented by the JU Rector.
2. The controller's representative designed for this purpose is the **Data Protection Inspector**, Gołębia 24 Str., 31-007 Kraków, office 31. You may contact him through his e-mail: [iod@uj.edu.pl](mailto:iod@uj.edu.pl), or by phone: 12 663 1225.
3. Your personal data will be processed according to the Art. 6.1. b) **in order to** carry out the necessary procedures for the scholarship competitions, the award of scholarships in research projects funded by the National Science Centre, and in the case of election of a Scholarship Holder in connection with the conclusion of an agreement for the scholarship payment and activities related to the collection of scientific scholarship according to the Regulations for granting scientific scholarships in the scientific projects funded by the National Science Centre, the project grant agreement "....." (Hereinafter referred to as the "Project"), under which is the competition for the position of Scholarship Holder.
4. Providing personal data is voluntary, but necessary to participate in the recruitment procedure, and in case of being accepted - is a condition for signing a project financing agreement and implementation of an agreement for the scholarship payment.
5. The recipients of your personal data **will be**: the National Science Centre based in Krakow, institutions evaluating or controlling the correct implementation of the project within which the agreement was concluded, auditors acting in accordance with the law or on behalf of Jagiellonian University, institutions such as the Supreme Chamber of Control, the competent tax office and the Social Insurance Institution, other entities authorized to obtain data on the basis of the law and the grant agreement concluded with the National Science Centre.
6. Your personal data will not be transferred to third countries (outside the European Economic Area) or to international organizations. If, however, your data in the recruitment process is transferred to the Jagiellonian University in an electronic version, they can be processed in the Office 365 OneDrive cloud based on the entrustment agreement between the Jagiellonian University and Microsoft and on the basis of a document called the "Privacy Shield" implemented by Microsoft.
7. Your personal data **will be processed for the period**: until the completion of the project and settlement of the project financing agreement concluded with the National Science Centre,

and then until the expiry of the period of prescription under the grant agreement; for archiving purposes - for a period of time prescribed by law.

8. You have the **right to**: obtain information about the processing of personal data and rights granted in accordance with the GDPR, access to your data and its rectification, as well as the right to delete personal data from the administrator's bases (unless further processing is necessary for the implementation of legal obligation or to establish, investigate or defend claims), and the right to limit the processing, data transfer, objecting to the processing - in the cases and on the conditions specified in the GDPR.

9. Your personal data will not be subject to automatic decision making or profiling.

10. You have the right **to complain to the President of the Office for Personal Data Protection** in the event of recognition that the processing of your personal data violates the provisions of the GDPR.

**I confirm that I have read and accept the information above.**

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*place, date, signature*