

# **Selected topics of theoretical physics: Introduction to Electrodynamics and Theory of Relativity**

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*Wednesdays 16:00-18:00, room D, al. Lotników 32/46, starting from 22 February 2023. 30 hours (15 x 2 hrs). Ending with exam. 3 ECTS.*

Prerequisites: Mathematical education required in the field of mathematical analysis, linear algebra and analytical geometry corresponding to bachelor's studies at the faculties of exact sciences (mathematics, physics, chemistry) or engineering.

## **Content:**

1. Time and space according to Aristotle.
2. What is Euclidean space: its metric and affine properties in modern terms.
3. Examples of non-Euclidean geometries.
4. Space-time according to Galileo and Newton.
5. String equation and its symmetries. Lorentz transformation. Initial problem and boundary-initial problem.
6. Fourier transform: the basic tool of the physicist and engineer to study the properties of differential equations.
7. Sound propagation equation. Green's function and strong Huygens' principle.
8. Fundamentals of electrodynamics in Maxwell's formulation. The discovery of electromagnetic waves.
9. Contradictions between electrodynamics and Galileo's principle of relativity. The Michelson-Morley experiment.
10. What does it mean that two distant events occur simultaneously. Analysis of the concept of "simultaneity".
11. Discovery of pseudo-Euclidean geometry by Einstein and Minkowski.
12. The so-called "paradoxes" of relativity: the Lorentz contraction, the twin paradox, etc.
13. Relativistic equation of motion of a particle carrying an electric charge. The dependence of inertia on speed.
14. Equivalence of mass and energy.
15. Do we "know everything"? What difficulties remain. Particles and fields and their interaction. Local and global inertial frames. A glimpse into the theory of gravity.