

DOCTORAL STUDIES COURSE UNIT DESCRIPTION

Name of subject	Scientific Field	Faculty	Center/Institute/ Department
Selected Topics of Experimental Particle Physics (10 ECTS credits)	Physics N 002	Faculty of Physics	Institute of Photonics and Nanotechnology
Student's workload	Hours	Student's workload	Hours
Lectures		Consultations	30
Individual study	200	Seminars	20

Course annotation

During this doctoral course, the candidate will delve into topics of experimental particle physics related to major CERN experiments, such as LHCb. The course will cover the historical and current context of experimental particle physics and introduce the latest results relevant to the doctoral research topic. The focus will be put on types of results in experimental particle physics and how they are achieved.

Outline of the course content:

1. History of large scale particle physics experiments and their main results.
2. Detector components.
3. Data flow in large experiments at CERN.
4. Detector effects in particle physics.
5. Interpreting particle physics results.
6. Particles and interactions.
7. Relativistic kinematics.
8. Measurement of particle properties.
9. Total cross section measurement.
10. New particle searches.

List of literature

1. „Introduction to Experimental Particle Physics.“
Fernow, R. C. (2023)., United States: Cambridge University Press.
2. „50 Years of Quantum Chromodynamics“, arXiv:2212.11107.
3. „The history of LHCb“, arXiv:2101.05331.
4. „Observation of J/ψ resonances consistent with pentaquark states in $\Lambda^0_b \rightarrow J/\psi K^- p$ decays“, arXiv:1507.03414.
5. „Observation of a Narrow Pentaquark State, $P_c(4312)^+$, and of the Two-Peak Structure of the $P_c(4450)^+$ “, arXiv:1904.03947.

List of additional literature

1. „The LHCb Detector at the LHC“, DOI 10.1088/1748-0221/3/08/S08005.
2. „LHCb Detector Performance“, DOI 10.1142/S0217751X15300227.
3. „The LHCb Upgrade I“, DOI:10.1088/1748-0221/19/05/P05065.

Subject presentation and method of payoff

Graded Seminar

Consulting teachers	Scientific degree	Pedagogical name	Main scientific works published in a scientific field in last 5-year period
Mindaugas Šarpis	Dr.		Dr. Mindaugas Šarpis: publication list

			CERN-THESIS-2023-345
Oleg Kravcov	Dr.		1. O. Kravcov, J. Mickevičius, and G. Tamulaitis, Kinetic monte carlo simulations of the dynamics of a coupled system of free and localized carriers in algan, Journal of Physics: Condensed Matter 32 (2020) 145901. 2. O. Kravcov, J. Mickevičius, and G. Tamulaitis, Origin of thermal quenching of exciton photoluminescence in AlGa_N epilayers, Lith. J. Phys. 61 (2021). 3. R. b. u. Aleksiejūnas et al., Impact of alloy-disorder-induced localization on hole diffusion in highly excited c-plane and m-plane (In,Ga)_N quantum wells, Phys. Rev. Appl. 14 (2020) 054043. 4. T. Saxena et al., Spectral dependence of carrier lifetime in high aluminum content algan epitaxial layers, Journal of Applied Physics 118 (2015) 085705.
Augustas Vaitkevičius	Dr.		1. A. Vaitkevičius et al., Segregation-driven formation of bismuth quantum dots in parabolic GaAsBi/AlGaAs quantum structures, Surf. Interfaces 68 (2025) 106586. 2. E. Dudutienė et al., Impact of elevated GaAs barrier growth temperature on the homogeneity and photoluminescence of GaAsBi multiple quantum wells, Mater. Sci. Semicond. Process. 199 (2025) 109828. 3. G. Tamulaitis et al., Transient optical absorption technique to test timing properties of lyso:ce scintillators for the cms barrel timing layer, SSRN Electron. J. (2022). 4. G. Tamulaitis et al., Transient optical absorption technique to test timing properties of LYSO:Ce scintillators for the CMS barrel timing layer, Radiat. Phys. Chem. Oxf. Engl. 1993 206 (2023) 110792. 5. M. Korzhik et al., Engineering of a new single-crystal multi-ionic fast and highlight-yield scintillation material (Gd_{0.5}–0.5)Al₂Ga₃O₁₂:Ce,Mg, CrystEngComm 22 (2020) 2502.
Certified during Doctoral Committee session 17/09/2025, protocol No. (7.17 E) 15600-KT-445			
Committee Chairman prof. S. Juršėnas			