

# STUDIES OF HADRON PRODUCTION MECHANISMS IN PROTON-PROTON COLLISIONS AT THE LHC ENERGY VIA INCLUSIVE SPECTRA MEASUREMENTS OF LIGHT NEUTRAL MESONS

Moscow Institute of Physics and Technology (National Research University)

Degree or qualification is awarded: **PhD (Candidate of Science)**

Language of study: **English**

Mode of study: **full-time**

Duration: **4 years**

Availability of free education: **yes**

Price: **375 000 RUB**

Programme webpage at the university website:

<https://eng.mipt.ru/programs/studies-of-hadron-production-mechanisms-in-proton-proton-collisions-at-the-lhc-energy-via-inclusive/>

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## Entry requirements:

- Master's degree / equivalent in a related field
- B2 level of English
- Good track record of publications related to the topic of the intended research
- Strong research proposal 1,500 - 3,500 words

## Research supervisor:

[Yuri Kharlov](#)

PhD, DSc, Head of the Laboratory of Fundamental Interactions

## Supervisor's research interests:

Experimental studies of photon and hadron production in high-energy collision of protons and heavy ions at the Large Hadron Collider at CERN; strong interactions; deconfined state of matter of quarks and gluons; detectors for high-energy physics experiments; electromagnetic calorimetry; methods of big data analysis; detector calibration; Monte Carlo simulations.

## Research highlights:

The research will be performed within the international collaboration ALICE at the Large Hadron Collider Experiment in the European Organization for Nuclear Research CERN. The ALICE experiment has started operating in 2009 and will continue collecting data for analysis at least till 2030. The physics program of ALICE is focused on fundamental properties of hot and dense quark-gluon matter at extremely high temperature created in ultra-relativistic collisions of proton and ion beams at the energies 5-14 TeV in the center-mass system. The measurements of direct photon and hadron spectra is a sensitive probe for the initial state of collisions, for transport properties of a parton passing through the quark-gluon matter, and for fragmentation of partons to observable hadrons. A PhD student will be involved in processing of data from the ALICE precise electromagnetic calorimeter which requires data quality validation, calorimeter calibration, development of analysis software, analyzing of petabytes of recorded data using the world-wide distributed computing system GRID. Among duties of a student, detector maintenance and operation, participating in the experiments shifts during data taking will be considered as a part of service work.

## Supervisor's specific requirements:

- A good candidate should demonstrate a knowledge of general and theoretical physics in the field of elementary particle physics, should know relativistic classical kinematics.
- A candidate should be familiar with phenomenology of particle physics, experimental methods in highenergy physics, particle interactions with matter.
- Knowledge of mathematics such as mathematical analysis, linear algebra, statistics is mandatory.
- Programming skills in C++, Python, bash are needed. A student should be able to understand the source code in these languages and write the own software packages.
- Good communication skills and ability to present the proper results for a large English-speaking audience is one of the essential requirement for working in a large international collaboration.
- Experience in Linux at the user level and basic knowledge in Linux system administration is needed. Experience in LaTeX for text processing is welcome.

## Main publications

- S. Acharya et al. [ALICE Collaboration], Calibration of the photon spectrometer PHOS of the ALICE experiment, JINST 14 (2019) 05, P05025, DOI: 10.1088/1748-0221/14/05/P05025.
- J. Adam et al. [ALICE Collaboration], Jet-like correlations with neutral pion triggers in pp and central Pb-Pb collisions at 2.76 TeV, Phys.Lett. B763 (2016) 238-250, DOI: 10.1016/j.physletb.2016.10.048.
- J. Adam et al. [ALICE Collaboration], Direct photon production in Pb-Pb collisions at  $\sqrt{s_{NN}} = 2.76$  TeV, Phys.Lett. B754 (2016) 235-248, DOI: 10.1016/j.physletb.2016.01.020.
- S. Acharya et al. [ALICE Collaboration], Calibration of the photon spectrometer PHOS of the ALICE experiment, JINST 14 (2019) no.05, P05025, DOI: 10.1088/1748-0221/14/05/P05025.
- Y. Kharlov, Performance of Calorimetry in ALICE, PoS LHCP2018 (2018) 231, DOI: 10.22323/1.321.0231.
- S. Acharya et al. [ALICE Collaboration], Neutral pion and eta meson production at mid-rapidity in Pb-Pb collisions at  $\sqrt{s_{NN}} = 2.76$  TeV, Phys.Rev. C98 (2018) no.4, 044901, DOI: 10.1103/PhysRevC.98.044901.
- S. Acharya et al. [ALICE Collaboration], Neutral pion and eta meson production in p-Pb collisions at  $\sqrt{s_{NN}}=5.02$  TeV, Eur.Phys.J. C78 (2018) no.8, 624, DOI: 10.1140/epjc/s10052-018-6013-8.
- S.Acharya et al. [ALICE Collaboration],  $\pi^0$  and eta meson production in proton-proton collisions at  $\sqrt{s}=8$  TeV, Eur.Phys.J. C78 (2018) no.3, 263, DOI: 10.1140/epjc/s10052-018-5612-8.
- S.Acharya et al. [ALICE Collaboration], Production of  $\pi^0$  and eta mesons up to high transverse momentum in pp collisions at 2.76 TeV, Eur.Phys.J. C77 (2017) no.5, 339, DOI: 10.1140/epjc/s10052-017-4890-x.
- S.Acharya et al. [ALICE Collaboration], Measurement of the inclusive isolated photon production cross section in pp collisions at  $\sqrt{s}= 7$  TeV, Eur.Phys.J. C79 (2019) no.11, 896, DOI: 10.1140/epjc/s10052-019-7389-9
- S.Evdokimov et al., The ALICE CPV Detector, KnE Energ.Phys. 3 (2018) 260-267, DOI: 10.18502/ken.v3i1.1752.

## Specializations within this programme