

Nuclear and Subnuclear Physics

Study of the $dp \rightarrow ppn$ reaction at intermediate energies

supervisor: doc. RNDr. Jozef Urbán, CSc.

consultant: RNDr. Marián Janek, PhD., University of Žilina

study form: full time

Annotation: The short range correlations (SRC) of nucleons in nuclei, in spite of the great amount of accumulated results in BNL, SLAC and JLAB, still leave many open questions and further investigations are required on both experimental and theoretical sides. At hadronic facilities deuteron structure investigations at large internal momenta allow to explore 2N SRC in $dp \rightarrow ppn$ breakup with the detection of two protons in the final state. Of great importance is the study of spin and relativistic effects in these reactions because the data on the SRC spin structure are scarce. Incorporation of three nucleon forces (3NF), when the interaction depends on the quantum numbers of the all three nucleons, allows to reproduce unpolarized deuteron-proton elastic scattering and breakup data.

Study of the analyzing powers in dp - elastic scattering at medium energies.

supervisor: doc. RNDr. Jozef Urbán, CSc.

consultant: RNDr. Marián Janek, PhD., University of Žilina

study form: full time

Annotation: The polarization observables are sensitive to the two-nucleon (2NF) and three-nucleon structures (3NF) of the nuclei. Their investigations is worth to carry out in different kinematic region and for different reactions. The aim of the deuteron short range spin structure (DSS) experiment is to obtain polarization observables in $d^A p$ elastic scattering at large CMS angles ($> 60^\circ$) and for a wide range of energy $T_d = 0.3 - 2$ GeV.

Quasi-periodic variations of cosmic rays according to neutron monitor measurements at Lomnický štít.

supervisor: prof. Ing. Karel Kudela, DrSc.

study form: full time and external

Annotation: After study of the basics in cosmic ray (CR) measurements at Lomnický štít, the first task of the applicant will be to identify the obvious errors in data by comparison with other neutron monitor stations in different locations and to create the data base of hourly measurements in wide time interval (including data from period before 1982). To study and to summarize the knowledge on quasi-periodic variations of CR (i) in the periodicity range around the quasi-biennial one, (ii) in the transitional range between that of 27 days (and its higher harmonics) and the quasibiennial periodicity, (iii) solar diurnal wave and its harmonics. To prepare the original study about the variations mentioned above utilizing specifically measurements at Lomnický štít, to put the results into the context of current knowledge of CR variability in their relations to solar, interplanetary and geomagnetic activity.

Study of night sky ultraviolet background for JEM-EUSO experiment

supervisor: RNDr. Pavol Bobik, PhD.

study form: full time

Annotation: The thesis is focused on the UV light study and UV model development on the night side of the Earth and its application in JEM-EUSO experiment. JEM-EUSO experiment is mission in preparation for the International Space Station with flight scheduled after the year 2020 with main aim to identify the sources of ultrahigh energy cosmic rays.

Study of distribution and cosmic ray particles motion in the Heliosphere and Earth's magnetosphere

supervisor: RNDr. Pavol Bobik, PhD.

study form: full time

Annotation: The thesis focuses on the study of the distribution and movement of charged particles in the Heliosphere and the Earth's magnetosphere. Voyager's and IBEX missions measurements done in recent years, bring many new facts, which alter our view of the Heliosphere and cosmic rays in it. Doctoral studies will focus on development of models of particle motion in the heliosphere and magnetosphere. The models will be used for interpretation of measurement from AMS-02, PAMELA experiments in the Earth magnetosphere and missions Voyager 1 and 2 in the outer Heliosphere.

Secondary charged particles and nuclear fragments in collisions of high energy atomic nuclei

supervisor: prof. RNDr. Stanislav Vokál, DrSc.

consultant: RNDr. Janka Vrláková, PhD.

study form: full time

Annotation: Study of the secondary charged particles production and nuclear fragments, their yields, multiplicities, correlations and angular spectra obtained by the same standard emulsion method using different primary nuclei ($A=1-208$), energies ($E=1-200$ GeV) and impact parameters of colliding nuclei – analysis of experimental data samples of EMU01 and Dubna emulsion collaborations. The comparison with proton-proton interactions. Search for fluctuations of particles production using the scaled factorial moments method, method of S1 and S2 parameters or wavelet analysis and other methods. Model calculations using modified FRITIOF and Dubna cascade models, or other theoretical approaches. Comparison of the experimental results with theoretical predictions.

Systematic study of proton/pion ratio in high-energy proton-proton collisions

supervisor: RNDr. Marek Bombara, PhD.

consultant: RNDr. Ivan Králik, CSc.

study form: external

Annotation: Measurements of p/π ratio in high-energy collisions are source of many surprises in hadron or ion collisions. The values, measured at RHIC and LHC, are unexpectedly high and their source is still unknown. A study of this phenomenon is still attractive because it offers both the experimental and theoretical challenges.

The goal of the thesis is a systematic study of p/π ratio in proton collisions at LHC energies from different points of view, like for example as a function of the jet fragmentation softness or the study via correlations with high momentum trigger particles. The thesis should also discuss possibilities of experimental separations of different physical sources. It should also bring a discussion about recent theoretical interpretation of experimental measurements.