NUCLEAR AND SUBNUCLEAR PHYSICS

Production of multi-strange particles in ALICE experiment at CERN LHC
supervisor: doc. RNDr. Marek Bombara, PhD. (marek.bombara@upjs.sk)
study form: full time
Annotation: Results with multi-strange baryons produced at LHC collider have shown an enhancement of strange quark production as a function of multiplicity even in small collisional systems such as proton-proton or proton-lead collisions [1]. Upgrade of the collider and the LHC experiments (for Run3) comes with higher luminosity and bigger collisional energy. For the ALICE experiment it means 10-100 times increased statistics. This opens new possibilities for studying of multi-strange particles, for example correlations with jets or exotic resonances. The thesis will deal with multi-strange particle production with focus on statistically inaccessible physical processes connected with this production.

Secondary charged particles and nuclear fragments in collisions of high energy atomic nuclei
supervisor: doc. RNDr. Janka Vrláková, PhD. (janka.vrlakova@upjs.sk)
consultants: prof. RNDr. Stanislav Vokál, DrSc., RNDr. Martin Vaľa, 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 BECQUEREL, EMU01 and Dubna emulsion collaborations. The comparison with proton-nucleus interactions. Search for fluctuations of particles production using the scaled factorial moments method, and other methods. Model calculations using modified FRITIOF and Dubna cascade models, or other theoretical approaches. Comparison of the experimental results with theoretical predictions.

Study of angular substructures of particles produced in heavy ion collisions
supervisor: doc. RNDr. Adela Kravčáková, PhD. (adela.kravcakova@upjs.sk)
consultants: prof. RNDr. Stanislav Vokál, DrSc., RNDr. Martin Vaľa, PhD.
study form: full time
Annotation: An important aim of nucleus collisions investigation at high energies is to search for a phenomena connecting with large densities obtained in such collisions. As an example, the transition from the QGP (quark - gluon plasma) back to the normal hadronic phase is predicted to contribute to fluctuations in the number of produced particles in local regions of phase space. Using unique emulsion method collisions of ^{16}O, ^{22}Ne, ^{28}Si, ^{32}S, ^{84}Kr, ^{197}Au a ^{208}Pb nuclei with ^{108}Ag(^{80}Br) at momenta between 1 AGeV/c and 160 AGeV/c will be analyzed. The methods of transverse momenta, principal vectors, azimuthal correlation functions and the Fourier expansion of the azimuthal angle distributions and other methods will be applied. Comparison of experimental results with model calculations.

Radiation effects of cosmic rays on manned missions and acceleration of cosmic ray particles
supervisor: RNDr. Pavol Bobik, PhD. (bobik@saske.sk)

study form: full time

Annotation: Application of 2D models of cosmic rays modulation to estimate radiation doses during manned missions to the Moon and Mars, or possible future flights to other planets in the solar system. The aim is to estimate radiation doses for different mission scenarios and to find the optimal strategy and time for the realization of such missions.

The second goal is the development of models of acceleration of cosmic rays on shock waves. Specifically, on the supernova shock waves and the terminating shock wave of the heliosphere. Simulation of self-similarity solution of supernova explosion and solution of Fokker-Planck equation for this case. Acceleration is solved by approximation of the shock wave with a function similar to a jump function with a smooth and continuous function and the search for alternative solutions.

Study of a strangeness production in collisions of high-energy ions in ALICE experiment at LHC.

supervisor: RNDr. Peter Kaliňák, PhD. (kalinak@saske.sk)

study form: full time

Annotation: The study is focusing on measurement of transverse momenta spectra and yields of the strange particles in particular classes of the multiplicity (centrality) of the collision. The method includes the identification of strange particles based on the topology of the decay. Using the reconstructed trajectories of the charged particles traveling trough the ALICE detector, the candidates – the couples of trajectories which passes the selection criteria are used to compute the distributions of invariant masses. The signal is extracted from under the peak area of this distribution. In order to acquire final yields and spectra of the strange particles it is necessary to know the acceptance of the detector, efficiency of the reconstruction and to understand how the detector affects the measurement. Then it is necessary to perform the corrections for each effect and to perform the extrapolation to the areas where the measurement isn’t possible. Some of the corrections are possible to acquire by using Monte Carlo simulations. The final results carry systematical errors, which needs to be studied and understood.