Review

on the proposal of the experiment:
Creation of a precision magnetic spectrometer SCAN-3 and research of non nucleon degrees of freedom in nuclei, nucleon correlations and nuclear fragmentation at the internal target of the Nuclotron.
(S. Gmutsa et. al., 2022).

The review is renewal version of the same one created by myself.

The physics program of the experiment consists of several topics:
1. search and study of η – nuclei;
2. investigation of changes in the properties of the Δ-isobar in the nucleus of the target.
3. the study np and pp correlations;
4. a study of cumulative processes;
5. a study of the disintegration of heavy nuclei into fragments of low energy.

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Currently measured static characteristics of a huge number of elementary particles. At the same time on the cross-sections of the interaction between the particles is known and much less mainly because the beams of unstable particles is difficult to do, and make the target of such particles is even harder. Recently for the evaluation of these cross sections is often used method of femtoscopy. In particular, new data on hyperon interactions have been obtained recently by ALICE collaboration. Femtoscopic effects depend both on the parameters of interaction, and the spatial and temporal characteristics of the reaction. Therefore, extracting information about cross-sections of interaction of unstable particles with each other is a difficult task and the availability of alternative approaches can improve the accuracy and reliability of this information. The first paragraph of the proposed program is aimed at it and this can be only approved.

The creation of the Δ-isobar Δ(1232) in nuclei is interesting from different points of view, and many of them are submitted in the proposal of the experiment. In the opinion of the reviewer, based on the technical capability of the spectrometer to record particles at angles close to 90^0 to the beam, you should pay attention to studying the cumulative isobars, which of course would complement the topics of the program related to the study of cumulative processes. In particular, it would be interesting to compare the displacement of the mass in the lower side and decrease the width of the isobars with the dependence of the cross sections of cumulative processes from kinematic variables and compare with the prediction in quasi-free approximation.

Cumulative processes are one of the most important and exciting areas of research in relativistic nuclear physics. The optimal energy of the nuclei for studies of such processes has scales of 2-6 GeV/nucleon. This opens up a large field for advanced studies in the proposed experiment therefore, the efforts of the authors seem to be totally reasonable. Proposed measurements will provide essential supplement to high energy data from current IHEP experiments in this field and SRC-BM@N experiment at JINR.

In particular, it is proposed to investigate the contribution of the mechanism of fusion in the formation of nuclear fragments. Model of fusion is based on the dependence between the cross sections of the deuteron formation and the cross section for the formation of free nucleons with parallel spins (Мигдал А.Б. ЖЭТФ 28(1955)10; Анисович В.В., Дахно Л.Г., Макаров М.М., ЯФ32(1980)1521; В.Л.Любошиц, препринт ОИЯИ Р2-88-8,1988). These articles are follows that for the correct application of the model it is necessary to compare the cross section of the deuteron formation and the cross section for np-pair production while taking into account spatial and time parameters of the interaction. Often to simplify – cross section of deuterons production is compared to the square cross section of protons at half momentum. After this simplification to compare the consistency of the model

with the data is uninviting. The proposed experiment have all necessary capabilities for correct comparison with the model fusion and these are the measurements of the spectra of deuterons and spectra of proton-neutron pairs in the field of femtoscopic correlations, and outside of it. Therefore, the data obtained will be interesting. If well be observe deviations from the model of fusion in its correct form. This will be a fundamentally new result. If the deviation will not find the model of fusion can be a tool for determining the most difficult measured components of theory on the basis of more simple measurements.

In earlier measurements of azimuthal correlations of cumulative particles (Ю.Д.Баюков и др., ЯФ 44(1986) 412; ЯФ 50(1989) 712; ЯФ 52(1990) 480) discovered a number of interesting regularities (А.В.Власов и др., ЯФ 58(1995) 669). The proposed experiment can make to this story is a valuable contribution. The planned configuration of the spectrometer allows to fill the gaps in measurements in the areas of azimuthal angles that are sensitive to interpret the data.

The proposed spectrometer is adequate to the planned research. Overall, the project is worthy of approval.

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