Referee Report

on the project FASA

"PROPERTIES OF HOT NUCLEI ON RELATIVISTIC BEAMS OF THE NUCLOTRON"

(in the framework of topic 02-1-1087-2009/2020)

The FASA setup is designed to work at the accelerator complex NUCLOTRON-NICA at LHEP JINR (Dubna). The main goal of the Project is to study the properties of nuclei with excitation energy of more than 3 MeV per nucleon in collisions of light relativistic ions (Z=2-15) with heavy target (Au). Excited nucleus, expanding due to thermal pressure, falls into the region of phase instability and due to the density fluctuations a homogeneous nuclear system disintegrates into an ensemble consisting of fragments and nucleons. The process is considered as a "liquid-gas" phase transition occurring at a temperature 5-7 MeV. The study of the disintegration process of excited nuclei allows us to obtain experimental information on the spinodal state of nuclear matter over a wide range of nucleus excitation up to binding energy.

Undoubtedly, this topic is seemed to be extremely relevant in connection with a programms of studies of the properties of nuclear matter produced in heavy-ion collisions, which are performed at the SPS, LHC (CERN) and RHIC (BNL) accelerator complexes and planned - at NICA (JINR) and FAIR (GSI).

The experimental setup FASA includes 30 telescopes for the detection of charged particles. The each telescope consists of a cylindrical ionization chamber and Si(Au) detectors to measure the total energy of the fragment. A system of thirty telescopes provides spectroscopic and correlation measurements for fragments at a relative angle (from 10 ° to 180 °) or relative velocities. The main part of the total solid angle of the device detector is the fragment multiplicity detector which consists of 58 CsI(Tl) scintillators (36 mg/cm2 thickness). Multiplicity selection allows you to "change" the average excitation energy of the fragmenting nucleus. Converting analog signals into digital sequence allows us to get the codes of all telescopes-spectrometers and photomultipliers of the detector of fragment multiplicity.

The methodological experience already acquired by the team in the implementation of the program for the physical research of nuclear multifragmentation using beams of relativistic light ions over the past decade allows us to hope that the FASA project will be successfully performed at the new accelerator complex NUCLOTRON-NICA.

The physical results obtained by the FASA collaboration are regularly presented at international conferences and published in refereed journals.

The most interesting results are related to the multibody decay of excited nuclei occurring after their expansion due to thermal pressure. Thermal multifragmentation includes two successive processes - expansion (formation of fragments) and explosive fission (thermal nuclear multifragmentation). The characteristic times of these processes, the size of the resulting systems are determined. The value of the critical temperature for the liquid-gas phase transition $T_c = (17 \pm 2)$ MeV has been estimated.

In the years 2019-2021 the FASA collaboration plans to measure the radial flow as a function of the fragment charge, measure the source velocity and determine the thermodynamic state of the target spectator before disintegration, measure the correlation function from the relative angles of the intermediate mass fragments in collisions of relativistic light ions with a gold target on the NUCLOTRON-NICA accelerator complex. It is also planned to upgrade the trigger system of the setup.

Resources requested by authors for the execution of the activity on the project FASA in 2019-2021 are justified. I recommend to support realization of the project with the first priority and present the Project at the JINR PAC.

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