Results of the first experiments at the ACCULINNA-2 separator and the scientific programme for 2024

First experiments with high intensity ^{8}He (I ~ 10^{5} pps), ^{9}Li and ^{6}He (both with I ~ 10^{6} pps) radioactive beams obtained at the new fragment separator ACCULINNA-2 [1] at the U-400M cyclotron were carried out in 2018-2020. As a result, new information regarding the spectra of energy excitation and decay schemes of the neutron rich isotopes $^{5\text{-}7}$H [2-5], ^{7,9}He [6], $^{8\text{-}10}$Li [7] were obtained. One of the interesting and still open question is the population of 4n system as a resonant state in the ^{2}H(^{8}He,^{6}Li)4n reaction which indication was found in the experimental data of the ^{8}He (26 AMeV) beam interacting with the ^{2}H target initially intended for population of ^{7}H [8]. In this work, we report observation of events at ~3.5 MeV in the energy spectrum of 4n, consistent with the near-threshold bump observed in [9]. Results obtained from the analysis of these experimental data will be reported.

The upcoming work plan at the ACCULINNA-2 fragment separator following the cyclotron upgrade in 2024 will be presented. Utilizing a ^{6}He beam directed at the ^{2}H target, the study aims to explore the transfer of neutron, protons, and alpha particle in reactions using combination of the ^{8}He beam with deuterium gaseous targets. First of all, the ^{2}H(^{6}He, 2n)^{6}Li reaction, along with the potential ^{2}H(^{6}He,^{6}Li)2n charge-exchange, is considered as a test for the reaction mechanism and the experimental setup. Furthermore, this reaction will provide a foundation for a precise study of the 4n system in reaction ^{2}H(^{8}He,^{6}Li)4n. Besides, the combination ^{6}He+^{2}H makes it possible to study a number of other reactions, particularly ^{2}H(^{6}He,^{7}He)^{1}H, ^{2}H(^{6}He,^{5}He)^{3}H, ^{2}H(^{6}He,^{5}H)^{3}He. Moreover, objects of the first experiments are 2n/4n transfer in the reactions ^{4}He(^{8}He,^{6}He)^{6}He, ^{4}He(^{6}He,^{6}He)^{4}He, ^{4}He(^{8}He,^{4}He)^{8}He. An important role in new experiments is a new neutron detection system improving neutron detection efficiency by the factor of 10.

[1] A.S. Fomichev et al., Eur. Phys. J. A 54, 97, 2018.
[2] Bezbakh et al., PRL
[3] I.A. Muzalevskii et al., Phys. Rev. C 103, 044313, 2021
[4] E. Yu. Nikolskii, et al., Phys. Rev. C, 105:064605, 2022.
[5] I. A. Muzalevskii, et al., EPJ Web of Conferences, 290, 09001, 2023.
[6] A.A. Bezbakh et al., Int. J. Mod. Phys. E, 33:01n02, 2024.
[7] Bezbakh et al., BulRAS
[8] I.A. Muzalevskii, et al., submitted to Phys. Lett. B, 2024.
[9] M. Duer et al., Nature 606, 678–682, 2022.