Recent Studies of Light Exotic Nuclei at the Fragment Separator ACCULINNA-2 (FLNR, JINR)

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Recently the extremely neutron-rich systems 7H and 6H were studied in the direct 2H(8He,3He)7H [1,2] and 2H(8He,4He)6H [3] transfer reactions with a 26 AMeV secondary 8He beam produced at the fragment separator ACCULINNA-2 (FLNR, JINR)[4]. The missing mass spectra and center-of-mass angular distributions of 7,6H, as well as the momentum distributions of the 3H fragment in the 7,6H frames, were reconstructed.

An experimental evidence is provided that two resonant states of 7H are located in its spectrum at 2.2(5) and 5.5(3) MeV relative to the 3H+4n decay threshold. Based on the energy and angular distributions, obtained for the studied 2H(8He,3He)7H reaction, the weakly populated 2.2 MeV peak is ascribed to the 7H ground state (g.s.). It is quite possible that the 5.5 MeV state is the 5/2+ member of the 7H excitation 5/2+−3/2+ doublet, built on the 2+ configuration of valence neutrons.

The supposed 7.5 MeV state can be another member of this doublet, which could not be resolved in [1].

The measured missing mass spectrum of 6H shows a broad bump at ≈ 4–8 MeV above the 3H+3n decay. This bump can be interpreted as a broad resonant state in 6H at 6.8(5) MeV. The obtained spectrum is practically free of 6H events below 3.5 MeV. The steep rise of the 6H spectrum at ≈ 3 MeV allows us to derive the lower limit for the possible resonant-state energy in 6H to be 4.5(3) MeV. According to the paring energy estimates, such 4.5 MeV resonance is a realistic candidate for the 6H ground state. The obtained results confirm that the decay mechanism of the 7Hg.s. (2.2 MeV) is the "true" (or simultaneous) 4n emission. The resonance energy profiles and the momentum distributions of fragments of the sequential 6H ⟶ 5Hg.s. + n ⟶ 3H+3n decay were analyzed by the theoretically updated direct four-body-decay and sequential-emission mechanisms. The measured momentum distributions of the 3H fragments in the 6H rest frame indicate very strong "dineutron-type" correlations in the 5Hg.s. decay.

Very recently in the experiment [5] a peak, reported as "resonance-like structure" in 4n system, was observed in the 1H(8He,pα)4n reaction at E(4n) = 2.37 MeV with Γ = 1.75 MeV. We will present the results of studying low-energy continuum of 4n system using the data previously analyzed for the studies of 7H and 6H systems [6]. Evidence for a hump in the 4n continuum at 3.5 ± 0.7 and 3.2 ± 0.8 MeV was observed in the 2H(8He,6Li)4n and 2H(8He,3He)7H⟶3H+4n reactions, respectively. The obtained statistics is very low (6 and up to 40 events) corresponding to very low cross sections of few microbarns or tens of microbarns. The background conditions for the 2H(8He,6Li)4n reaction are shown to be good, favoring the physical nature of the observed events. The 2H(8He,3He)7H⟶3H+4n process transforms to the 2H(8He,6Li*)4n reaction in the limit of the highest 7H decay energies. The population of the low-energy region in the 4n spectrum is found to be correlated with the population of the lowest 6Li states in the 3He + 3H continuum. The results of theoretical calculations of 8He in a five-body α+4n and of 4n in a four-body hyperspherical models will be presented. The 8He wave function is shown to contain strong specific correlations, which may give rise to very low-energy structures in 4n continuum in extreme-peripheral reaction scenarios.

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Characterisation of the first 1/2+ excited state in ^{9}B through R-matrix analysis

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Although the ^{9}Be | ^{9}B isospin doublet has been studied along many years, the observation and prediction of the first 1/2+ state in ^{9}B remains inconclusive. Different reactions have been used, where the experimental values oscillate between 0.80 to 1.90 MeV.

An experiment was proposed to measure the charge exchange reaction of ^{9}Be(^{3}He,t)^{9}B at the K600 spectrometer, iThemba LABS. This experiment combines the high-resolution spectrometer (K600) at 0° and a high efficiency detector array CAKE. Data analysis is performed by reconstruction of the