

# Study of $4n$ continuum in the ${}^8\text{He} + {}^2\text{H}$ collisions at ACCULINNA-2 fragment separator

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Recently in the experiment [M. Duer *et al.*, Nature **606**, 678 (2022)] a peak, reported as “resonance-like structure” in  $4n$  system, was observed in the  ${}^1\text{H}({}^8\text{He}, p\alpha)4n$  reaction at  $E(4n) = 2.37$  MeV with  $\Gamma = 1.75$  MeV. Here we present the results of the experiment performed at ACCULINNA-2 fragment separator with a 26 AMeV secondary  ${}^8\text{He}$  beam to study low-energy continuum of  $4n$  system in the reactions on deuterium target. These data were previously analyzed for the studies of  ${}^7\text{H}$  and  ${}^6\text{H}$  systems in the  ${}^2\text{H}({}^8\text{He}, {}^3\text{He}){}^7\text{H}$  and  ${}^2\text{H}({}^8\text{He}, {}^4\text{He}){}^6\text{H}$  reactions [I.A. Muzalevskii *et al.*, Phys. Rev. C **103**, 044313 (2021), E.Yu. Nikolskii *et al.*, Phys. Rev. C **105**, 064605 (2022)]. Evidence for a hump in the  $4n$  continuum at  $3.5 \pm 0.7$  and  $3.2 \pm 0.8$  MeV was observed in the  ${}^2\text{H}({}^8\text{He}, {}^6\text{Li})4n$  and  ${}^2\text{H}({}^8\text{He}, {}^3\text{He}){}^7\text{H} \rightarrow {}^3\text{H} + 4n$  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  ${}^2\text{H}({}^8\text{He}, {}^6\text{Li})4n$  reaction are shown to be good, favoring the physical nature of the observed events. The  ${}^2\text{H}({}^8\text{He}, {}^3\text{He}){}^7\text{H} \rightarrow {}^3\text{H} + 4n$  process transforms to the  ${}^2\text{H}({}^8\text{He}, {}^6\text{Li}^*)4n$  reaction in the limit of the highest  ${}^7\text{H}$  decay energies. The population of the low-energy region in the  $4n$  spectrum is found to be correlated with the population of the lowest  ${}^6\text{Li}$  states in the  ${}^3\text{He} + {}^3\text{H}$  continuum.

Theoretical calculations of  ${}^8\text{He}$  in a five-body  $\alpha + 4n$  and of  $4n$  in a four-body hyperspherical models are presented. The  ${}^8\text{He}$  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.