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Study of four-neutron correlations in cluster decay of ^{12}Be highly-exited states on RADEX channel

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Kinematic simulation of simultaneous four-neutron emission at α-cluster decay of ^{12}Be* highly-exited states has been considered in ^{13}C$(n,2p)^{12}$Be* reaction on RADEX cascade neutron. The cluster decay fragments should have specific energy and angular correlations reflecting strong spatial correlations of "valence" nucleons orbiting in the decay nucleus [1]. The study of characteristics of cluster decay channels is extremely important for studying the cluster properties of various nuclear states [2]. Calculations using the antisymmetric model of molecular dynamics revealed the α-cluster structure of the isotopes Be, B, and C [3]. In ^{12}Be highly-exited states the possibility the formation of ^{8}Be-cluster and a $4n$-correlated cluster with a radius of $\leq$ 3 fm in a nuclear field $\geq$ 3 MeV or as a resonance with an energy of 2 MeV in the continuous spectrum [4]. Excitation of the highly-exited α-cluster states in ^{12}Be is possible when a proton pair is quasi-elastically knocked out of ^{13}C at an angle of $\sim 15^\circ$ by a cascade neutron with an energy of $\geq$ 40 MeV or in an $n-p$ charge exchange reaction followed by rescattering by a proton at an energy $\leq$ 100 MeV. In the work a two-stage kinematic simulation of the process of formation and escape of $4n$-correlated cluster in ^{13}C$(n,2p2\alpha)4n$ reaction was carried out. At the first stage, the ^{13}C$(n,2p)^{12}$Be* reaction was considered with excitation of double analog state of ^{12}C (Fig. 1a). At the second stage, subsequent α-cluster decay of ^{12}Be* on $4n$-correlated cluster and ^{8}Be or α-particles was considered.
Estimated parameter of the pulsed source of cascade neutrons at an energy of 40-100 MeV is 10^{13} n/s. Calculations show that of two-proton registration from the formation of an excited state of ^{12}Be* is possible in a narrow cone. The decay of the α-cluster excited state of ^{8}Be $+ 4n$ should be recorded at the widest solid angle. The registration of 4-particle coincidence must suppress the background (Fig. 1b).

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