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Few-body dynamics and few-body correlations in the dripline nuclei

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Studies of nuclear systems close to and beyond the driplines is an important field of the modern radioactive ion beam studies. Because of paring and clusterization effects the lowest threshold in the dripline systems are often few-body thresholds (2p, 2n, 4p, 4n, etc.). This lead to emergence near such thresholds of states having expressed few-cluster structure or/and corresponding few-body cluster decay channels. Such states may demonstrate complicated forms of few-body dynamics. These forms of nuclear dynamics are often poorly understood and their studies could be challenge for theory. I review several examples of theoretical studies focusing on various qualitative few-body phenomena near the driplines.

(1) **Two-proton radioactivity and "true" three-body decay**. In the last decade high-quality data was obtained for two-proton decays of light 2p emitters ^{6}Be and ^{16}Ne. This allowed to validate accurate description of these decays in a broad range of excitation energies [Egorova et al., Phys. Rev. Lett. 109, 202502 (2012); Brown et al., Phys. Rev. Lett. 113, 232501 (2014)]. Recently a detailed data on the excitation spectrum of 12O became available [Webb et al., Phys. Rev. C 100, 024306 (2019)]. It was a challenge to provide precise description BOTH of three-body core+p+p correlations for decays of 12O states and their Thomas-Ehrman shifts with respect to corresponding states in the isobaric mirror partner system 12Be.

(2) **"Transitional dynamics" in the three-body decays**. This is specific case of topic (1) concerning the decay dynamics available on the borderline between "true" 2p decay and sequential 2p decay. This decay regime has features typical for phase transition enabling in-depth studies for parametric dependencies of three-body and two-body decays [T.A. Golubkova et al, Phys. Lett. B 762 (2016) 263]. There is experimental evidence that the decays of the recently discovered 2p emitters ^{30}Ar and ^{67}Kr belong to transitional dynamics [I. Mukha et al., Phys. Rev. Lett. 115, 202501 (2015); L.V. Grigorenko et al, Phys. Rev. C 95, 021601(R) (2017)]. The prospects to observe the transitional dynamics in various systems beyond the proton dripline is discussed.

(3) **Soft dipole (E1) excitations in three-body systems**. In the halo nuclei the extreme radial extent of the wavefunction may lead to extreme low-energy concentration of E1 strength above the first breakup threshold. This concentration (the so-called soft dipole mode) can be crucial for understanding of the reciprocal processes of radiative capture in astrophysical environments [Parfenova et al., Phys. Rev. C 98, 034608 (2018)]. Studies of soft dipole excitation in three-body systems (^{17}Ne, ^{6}He, ^{11}Li) are specifically complicated and there are important controversies both in theory and experiment. The new high-precision theoretical studies of soft dipole excitation in 6He resolve several puzzling issues of the previous studies. The obtained three-body core+n+n correlation patterns provide insight in the mechanism of the soft dipole excitation [Grigorenko et al. submitted].

(4) **Five-body decays**. Studies of such extreme neutron-rich systems as ^{7}H or ^{28}O are very complicated from experimental side. This complexity is to large extent connected with their unique 5-body (4n emission) decay channel. Such decay processes are poorly studied theoretically so far. The recent experimental results on ^{7}H [Bezbakh et al., Phys. Rev. Lett. 124, 022502 (2020)] underline importance of understanding of correlations in such decays. It was demonstrated theoretically that potentially a detailed information of the structure of the decaying system can be extracted from the 5-body correlation data [Sharov et al., JETP Letters, 110, 5(2019)].

Primary author: Prof. GRIGORENKO, Leonid (Flerov Laboratory of Nuclear Reactions, JINR)

Presenter: Prof. GRIGORENKO, Leonid (Flerov Laboratory of Nuclear Reactions, JINR)

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