Two-proton radioactivity as a genuine three-particle decay: the ^{19}Mg probe.

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Two-proton emission, the specific case of three-particle decays, may be described by two complementary mechanisms: the sequential emission of protons via an intermediate state, and the simultaneous, or direct, emission of protons. The first mechanism includes also the model of emission of "diproton", or a ^{2}He cluster with very strong *pp*-correlations. This model is traditionally associated with the two-proton radioactivity, [1], which is unobserved yet.

In the Ref. [2], a two-proton emission has been considered for the first time in a realistic three-body model. This approach is suitable for treatment of a genuine three-particle decay, where resonances in the binary subsystems are located at higher energies than in the three-body system, and the emission process is non-sequential. This situation is similar to the "borromean" property of bound halo nuclei (e.g. ^{6}He, ^{11}Li, ^{17}Ne). Genuine three-body decay modes are known for several states in light nuclei, e.g. ^{6}Be [3], ^{9}Be* [4], ^{12}C* at 15.11 MeV [5]. The model is applied to candidates for the two-proton radioactivity, the ^{19}Mg and recently discovered ^{48}Ni [6], which are likely to be bound to single proton decay but unbound to two-proton decay.

The results of the calculations predict 1000 times larger life-times of ^{19}Mg and ^{48}Ni than the traditional diproton model, e.g. up to 100 ps for ^{19}Mg. Specific observable, p-p correlations following the ^{19}Mg decay, differ drastically in predictions of these models as well. The strong *pp*-correlations which exist in the interior of the nuclei are significantly smoothed in asymptotic by the proton pairing and Coulomb interactions.

We discuss the comprehensive experiment, in which a possible radioactivity of ^{19}Mg might be studied as its decay in flight by invariant mass method detecting all three fragments in the ^{17}Ne+p+p coincidences. The specific *pp*-correlations as well as mass excess and life-time of the ground state of ^{19}Mg can then be obtained. The ^{19}Mg life-time may be derived from the measured decay vertex distribution. Then a precise determination of all fragment trajectories is needed that can be achieved by microstrip detectors. We show that such an experiment could be performed using the radioactive beam of ^{20}Mg, [7].

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