

3. For the total cross section of the process we obtain:

$$\sigma_{\nu} = 5.4 \cdot 10^{-44} \overline{R^2} \text{ cm}^2 (E = 30 \text{ MeV}),$$

$$\sigma_{\nu} = 1.7 \cdot 10^{-41} \overline{R^2} \text{ cm}^2 (E = 100 \text{ MeV})$$

($\overline{R^2}$ is the value of R^2 at the average point).

We note that the values of $R(q^2)$ calculated in [1 - 3] are different for ν_e and ν_{μ} in the q^2 interval considered by us, and can range from ~ 1 to $\sim 10^{-2}$. Similarly, from data on the photofission of nuclei [7] we estimated the cross section for the fission of nuclei by neutrinos. For Bi^{209} at a neutrino energy ~ 250 MeV we have $\sigma_{\nu} = 10^{-42} \overline{R^2} \text{ cm}^2$.

In conclusion, we note the following: 1) the cross section of the process (1) at high energies in the deeply inelastic region is proportional to the energy and can reach a considerable value (on the order of α^2 times the total cross section of the weak interaction of the neutrino), 2) the process (1) can be due to weak interaction with neutral currents.

In principle there is a possibility of distinguishing between the interaction with the neutral currents and the electromagnetic interaction of the neutrino. To this end it is necessary to compare the cross sections of the processes (1) with electronic and muonic neutrinos. If the process is due to neutral currents and universality takes place, then the cross sections are equal. If the processes are due to the electromagnetic interaction of the neutrino, the cross sections can differ noticeably.

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POSSIBILITY OF TWO-PROTON AND TWO-NEUTRINO RADIOACTIVE DECAY FROM MANY-PARTICLE ISOMERIC STATES OF NUCLEI

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In the first experiment of "true" proton radioactivity, i.e., decay whose observable delay is connected not with prior emission of the positron but with the penetration of the proton itself through the potential barrier, observed in 1970 by the CERNY group [1, 2], the emission of the proton occurs not from the ground state but from the three-particle state $\text{Co}^{53m} (19/2^-, T = 1/2) p(f_{7/2}) n(f_{7/2}) + e$.

It is precisely many-particle isomer states that are characterized by sufficiently high excitation energies (several MeV) capable of ensuring an increase of the mass number by several units, corresponding to the limit of proton radioactivity at a given z . This raises the question whether such a two-proton radioactive decay can take place from many-particle isomer states and is capable of shifting noticeably, towards the region of stable nuclei, the limit of the two-proton radioactivity, compared with that given in [3, 4].

We have considered the list of possible three- and four-particle isomer states with large angular momenta for spherical nuclei with even A and analyzed the question of the probability of observing two-proton decay of such many-particle isomers.

The excitation energies of the three-particle isomers (e.g., Fe^{47}) were assumed to be close to 3 MeV, and those for four-particle isomers ($I = 12^+$, 16^+) were assumed to lie in the range 4 - 5 MeV. The nucleon binding energies were taken from the tables of Seeger [5], Myers and Swiatecki [6], and Garvey et al. [7].

As a result of our analysis, it is possible to present the following examples of two-proton decay of many-particle isomer states:

$${}_{26}\text{Fe}^{47m}\left(\frac{17}{2}-\right) p(f_{7/2}^{-2})_{+6} n(f_{7/2}^1) \rightarrow {}_{24}\text{Cr}^{45*}\left(\frac{3}{2}+, d_{3/2}-\text{level}\right),$$

$${}_{42}\text{Mo}^{82m}(16+) p(g_{9/2}^2)_{+8} n(g_{9/2}^2)_{+8} \rightarrow {}_{40}\text{Zr}^{80}(0+),$$

$${}_{48}\text{Cd}^{96}(16+) p(g_{9/2}^{-2})_{+8} n(g_{9/2}^{-2})_{+8} \rightarrow {}_{46}\text{Pd}^{94}(0+),$$

$${}_{52}\text{Te}^{106}(12+) p(g_{7/2} d_{5/2})_{+6} n(g_{7/2} d_{5/2})_{+6} \rightarrow {}_{50}\text{Sn}^{104}(0+),$$

$${}_{52}\text{Te}^{108}(12+) p(g_{7/2} d_{5/2})_{+6} n(g_{7/2} d_{5/2})_{+6} \rightarrow {}_{50}\text{Sn}^{106}(0+).$$

The change of the spin of the nuclei in such two-proton decays reaches $\Delta I = 16$, and the role of the centrifugal barrier in the observed decay rate turns out to be, in general, no less important than the role of the Coulomb barrier (e.g., a change of 12 units in the angular momentum in 2p-decay of the isotopes of Te lengthens the decay time, at a total energy of the two emitted protons 1 - 3 MeV, by approximately 10 orders of magnitude). An increase of the mass number of the 2p-active isomer compared with the 2p-decay from the ground state is at times quite large, for example for Te we have $\Delta A = 4$, which greatly facilitates the problem of searching for two-proton radioactivity.

Large centrifugal barriers can ensure also the possibility of observing a number of cases of relatively long-period two-neutron radioactive decay of many-particle isomeric states of neutron-excess nuclei, for example

$${}_{22}\text{Ti}_{48}^{70}(14+) p(f_{7/2}^2)_{+6} n(g_{9/2}^{-2})_{+8} \rightarrow {}_{22}\text{Ti}_{48}^{68}(0+),$$

$${}_{26}\text{Fe}_{52}^{78}(12+) p(f_{7/2}^1)_{+6} n(g_{7/2} d_{5/2})_{+6} \rightarrow {}_{26}\text{Fe}_{50}^{76}(0+),$$

if the energy of the emitted pairs of neutrons is sufficiently small (several hundred keV).

In this connection, definite interest attaches to a search for coincidences of pairs of delayed neutrons in spontaneous and induced fission, which might

be observed in two-neutron radioactive decay of fragments.

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POSSIBILITY OF EXPERIMENTALLY MEASURING THE ELECTROMAGNETIC FIELDS PRODUCED IN A METAL IN WHICH TRANSVERSE ULTRASONIC WAVES PROPAGATE

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We describe briefly the idea of an experiment in which it is possible to obtain quantities characterizing the change of the Fermi energy due to shifts in the lattice.

If a solid contains inhomogeneous elastic deformations produced by external forces or an acoustic wave, then this leads to the occurrence in the solid of extraneous electromotive forces analogous to those produced by the temperature gradient. The presence of a density gradient leads to the occurrence of potential extraneous emfs in the static state. In the absence of equilibrium, for example, when a transverse acoustic wave propagates, there can occur also non-potential emfs, leading to the appearance of current.

The microscopic theory of such phenomena is contained in a number of papers [1]. These lead to more definite expressions for these emfs.

In the presence of transverse acoustic oscillations (displacement along the z axis, wave vector along the x axis, frequency ω), which can be in the form of either a traveling wave or a standing wave, the emf K_z which enters in Ohm's law $j_z = \sigma(E_z + K_z)$ turns out to be

$$K_z = - \frac{m\omega^2 v_z}{e} \left[1 - i\omega\tau \left(\frac{v_F}{s_t} \right)^2 \alpha \right],$$

where m and e are the mass and charge of the electron, τ is the collision time, v_F the Fermi velocity, s_t the velocity of the transverse sound. In this formula we assume the absence of temporal and spatial dispersion, i.e., $\omega\tau(v_F/s_t)^2 \ll 1$. The dimensionless coefficient α is of the order of λ/ϵ_F , where ϵ_F is the Fermi energy and λ is of the order of the "deformation potential" λ_{ij} , which determines the dependence of the electron energy in the metal on its deformation

$$\epsilon(p) = \epsilon_0(p) + \lambda_{ij}(p)u_{ij}.$$