SHAKE AS THE MAIN MECHANISM OF THE NEUTRINOLESS DOUBLE ELECTRONIC CAPTURE

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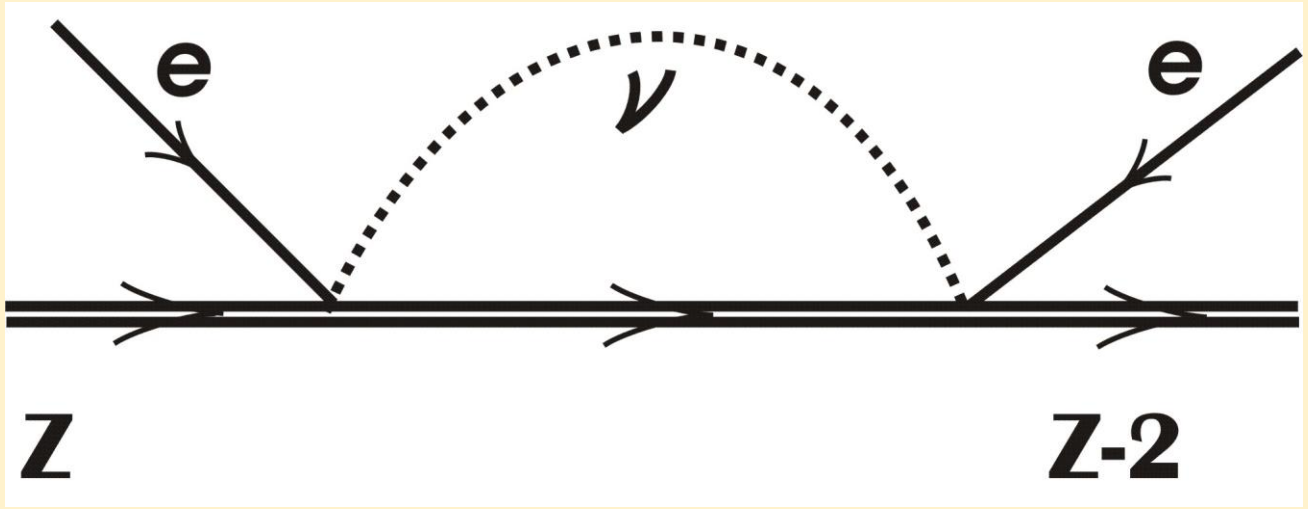
It is generally accepted that double neutrinoless electron capture is a resonance process. The calculations of the probability of shaking with the ionization of the electron shell occurring during the transformation of 164Er nucleus – one of main candidates for discovering the neutrinoless mode – are performed below. The result shows predominant contribution of the new mechanism. Its probability is three times as high as that of the traditional mechanism. Thus, in principle, double neutrinoless electron capture appears not to be a resonance process at all.

2e0ν capture – test of the Majorana neutrino



$$Q = M(A.Z) - M(A-2, Z-2)$$

Defect of resonance: $\Delta = Q - E_{A-2}$

Resonance mechanism: $$P_{2e0\nu} = W_{2e}\frac{\Gamma/2\pi}{\Delta^2 + (\Gamma/2)^2}$$

SHAKE-OFF: $$W_{sh} = |\langle\phi_E \mid \phi_i\rangle|^2 \approx \left|\frac{\langle\phi_E \mid \Delta V(r) \mid \phi_i\rangle}{Q - E_{A-2}^{(3h)}}\right|^2$$

with the energy of the emitted electron $E = Q - E_{A-2}^{(3h)} - I$

As a result of shake-off, the process *ceases to be resonant:*

$$P_{2e0\nu}^{(sh)} = W_{2e}W_{sh}$$

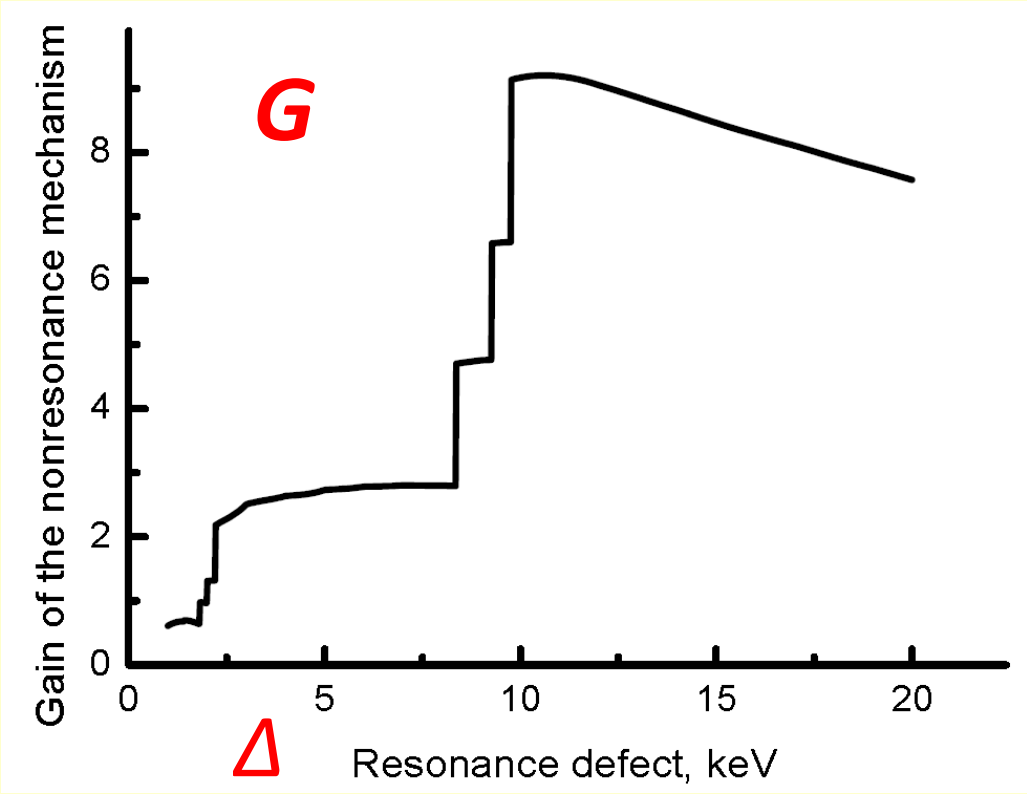
The gain $$G = \frac{P_{2e0\nu}^{(sh)}}{P_{2e0\nu}} = \frac{W_{sh}}{\frac{\Gamma/2\pi}{\Delta^2 + (\Gamma/2)^2}}$$

^{164}Er → ^{164}Dy L_1L_1 2e0v capture

Q = 25.07(12) keV

Δ = 6.82(12) keV

Half-life: 2 x 10^{30} years *(old)*



G = 3

Half-life *new*: 6 x 10^{29} years

Order of magnitude faster!

CONCLUSION

- We have proposed a new mechanism of neutrinoless nuclear double electron capture. This is a *nonresonance mechanism* of *shake-off* in the electron shell of the final atom. Therefore, it is expect that, it will turn out to be more probable. In the case 164Er, the nonresonance mechanism shortens its lifetime by *three times*, thus making it an attractive candidate in searches for neutrinoless double electron capture as an indication of the Majorana nature of the neutrino.

Thank you!

Спасибо!