ALPHA-STABILITY OF SUPERHEAVY NUCLEI

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As it was shown in [1], in the region limited by magic numbers, the energy of beta-decay changes as a linear function of the charge Z, in particular for heavy nuclei [2] ($Z > 82$, $N > 126$)

$$Q_{\beta\pm} = \pm k\,(Z - Z^*) - D, \qquad (1)$$

where $Z^* = \alpha A + \beta$ is the beta-stability line; numerically $k = 1.13$ MeV, $\alpha = 0.35$, $\beta = 9.9$, D (parity correction) is 0.75 MeV for odd nuclei and 2.1 MeV for even nuclei. $Q_{\beta\pm}$ is connected with total energy of nucleus E: $Q_{\beta\pm}(A, Z) = E(A, Z) - E(A, Z{+}1) - E_e$ (E_e – energy of electron). From this and (1) it follows that $E(A, Z)$ is a quadratic function of Z:

$$E(A, Z) = E_0(A) - k/2\,(Z - Z^* - 1/2)^2 - DZ. \quad (2)$$

The energy of α-decay $Q_\alpha(A, Z) = E(A, Z) - E(A{-}4, Z{-}2) - E_\alpha$ (E_α is the energy of α-particle is reduced to expression

$$Q_\alpha(A, Z) = Q_0(A) + 2k\alpha\,(1 - 2a)\,Z \qquad (3)$$

and therefore $Q_\alpha(A, Z{+}1) - Q_\alpha(A, Z) = 2k\alpha\,(1 - 2a) = 0.65$ MeV, independently of parity of nucleus. This result agrees well with energy of α-decay of heavy and superheavy nuclei [3,4], and this allows to calculate the energy reduced on the line of beta-stability, Q^*_α. Dependence of Q^*_α on A, shown in the Fig. 1, determines the overall stability of superheavy nuclei.

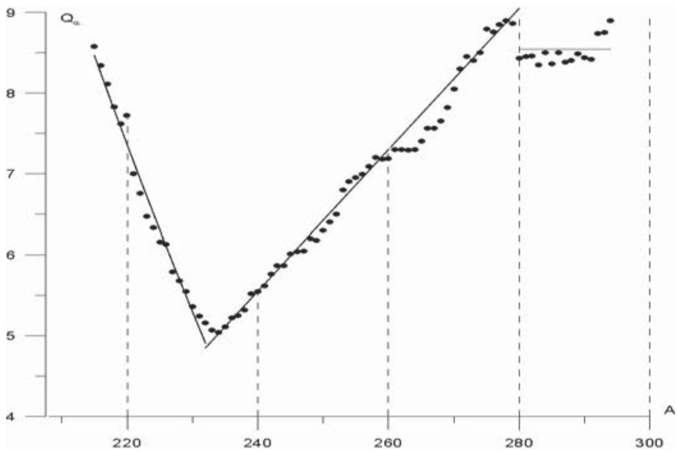

Fig.1 Stability of heavy nuclei to α-decay.

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4. Yu.Ts.Oganessian // J. Phys. G: Nucl. Phys. 2007. V.34. P.R165.