NONSTATISTICAL EFFECTS IN RESONANCES OF HEAVY NUCLEI

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In a report at the First Geneva Conference (1955) of the Atomic Energy Institute (Kurchatov Institute, Moscow), attention was turned to the proximity of the positions of neutron resonances of different isotopes (E_n grouping at the value of ≈0.3 eV).

In the case of similar stable intervals D=99 eV=18×5.5 eV in the resonance spacing distributions of three neighbouring isotopes ^{241,243,245}Pu (shown in Figure, top), we can notice that the doubled value of stable 2^+ excitations in these isotopes (42.8-42.0-44.5-44.2 keV in ^{240,241,242,244}Pu) is in the ratio 99(1) eV/86(2) keV=115·10^{-5}, which is close to the QED radiative correction $\alpha/2\pi = 116 \cdot 10^{-5}$. Such superfine structure intervals have been observed in many heavy nuclei.

The possibility to check the common dynamics of the influence of physical condensate within a nuclear medium should be studied in different regions of the nuclear chart. In regions with stable collective excitations, such an analysis could be based on the expected relation between the well-established fine structure ($D = k$×5.5 eV) and the hyperfine structure corresponding to third-order effects with QED radiative correction parameter $\alpha/2\pi$. Stable superfine structure intervals (1.32-1.48 eV in ^{238}Np, close to 5.5 eV/4=1.38 eV=ε'') are connected with stable intervals of hyperfine structure $\varepsilon_\circ \cdot (\alpha/2\pi)^3$ corresponding to stable $E(8^+) = \varepsilon_\circ/2$ ≈511 keV (497-522=518-518-516-514-497-518 keV in ^{234,236,237,238}U, ^{236,238,240,242}Pu). From the relation 6:20:42:72 for excitations with $J = 2, 4, 6, 8$ one could expect the possible appearance of an additional hyperfine structure with the value (1.38 eV/72)×(6, 20, 42, or 100 meV, 400 meV and 800 meV). Intervals of the hyperfine structure of the order of 300-400 meV, observed as resonance positions in isotopes with Z=92-95, can be associated with the stability of 4^+ and 6^+ excitations in heavy nuclei.

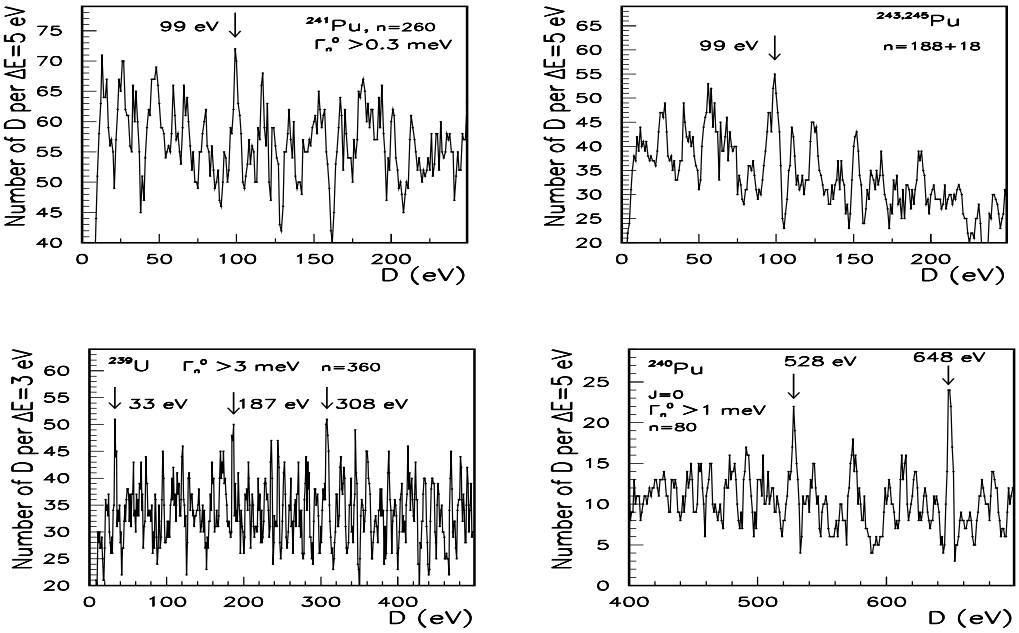

Figure. D-distributions in neutron resonances of heavy compound nuclei.