FUNDAMENTAL ASPECTS OF NEUTRON SPECTROSCOPY

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Neutron resonance spectroscopy provides data on a large number of highly excited states. This information can be used to check nuclear microscopic models, including the Nonrelativistic Constituent Quark Model (NRCQM), which R. Feynman considered very successful. A global extension of NRCQM, called the Electron-based Constituent Quark Model (ECQM), combines the properties of hadrons and leptons with the universal character of the influence of physical condensate (vacuum) and provides a possibility to estimate the discreteness in nuclear excitations and binding energies, as well as nonstatistical effects in the neutron resonance positions and spacing distributions.

The properties of the ECQM model (the electron mass as a unique parameter, its symmetry and QED radiative correction to the particle masses) have been considered in many nuclei. Here we discuss recent results obtained for nuclei with Z=58-64. In these nuclei with closed shells N=82 and N=90, stable intervals were found that are multiples of the value of the first fine structure parameter $m_e/3$=170 keV, namely, in ^{141}Ce resonances D=21.7-43.1-86.2 keV=170 keV/2, stable 0^+ excitations in ^{150}Nd, ^{152}Sm, ^{154}Gd (675, 684, 681 keV=4 × 170 keV) and in ^{145}Sm a single-particle ($J = 7/2 - 11/2$) excitation E^*=1538 keV≈ $3m_e$. Simultaneously, in the positions of the strong neutron resonances of the magic ^{141}Ce, the exact ratio 9:4=21. kev+9.57 keV was found by M. Ohkubo (common period 21.6+9.6 keV/9+4=2.4 keV=$2\varepsilon'$). In D-distributions of neutron resonances in ^{145}Sm (for orbital momenta L=0 and 1, see Figure), the maxima are located exactly at $3\varepsilon'$ and $2\varepsilon'$.

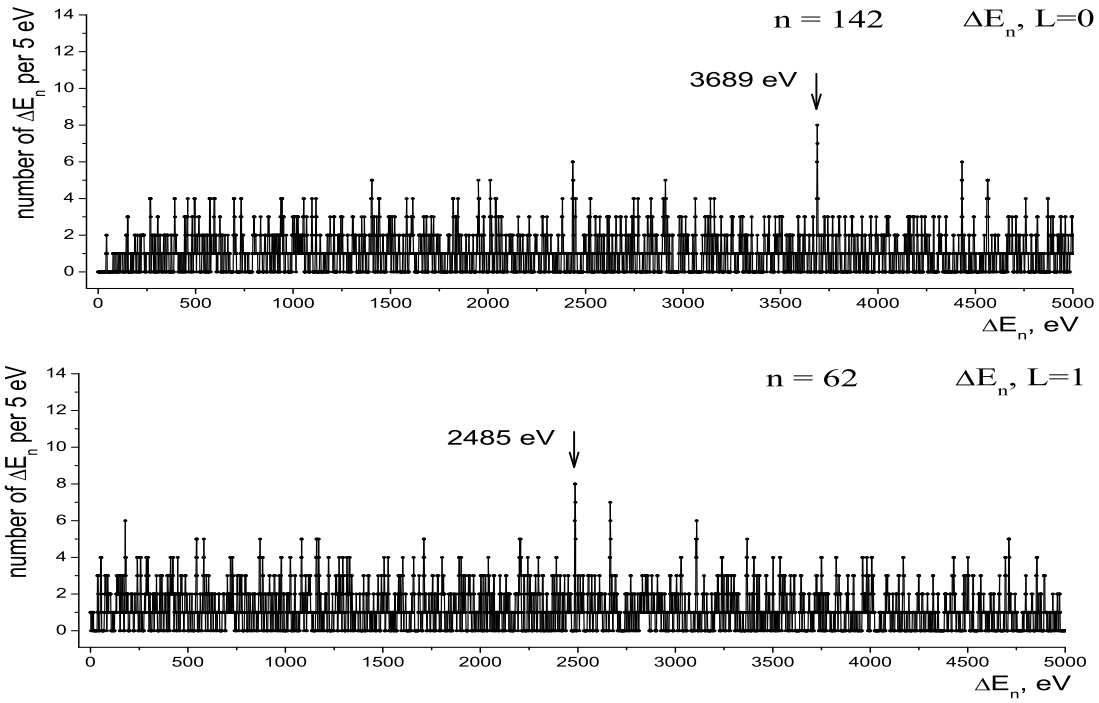

Figure. Spacing distributions of neutron resonances in ^{145}Sm (for orbital momenta L=0 and L=1 with maxima at $3\varepsilon'$ and $2\varepsilon'$, the ratio 3689 eV/2485 eV=1.48≈3/2, period ε'=1.229 keV).