ANALYSIS OF NUCLEAR EXCITATIONS IN DIFFERENT ELEMENTS

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In this work, we continue the analysis of the unexpectedly accurate relations between the nucleon masses and the electron rest mass m_e, contained in the CODATA evaluation. According to F. Wilczek, such a new aspect of the nuclear spectroscopy ("nuclear chemistry" with very accurate results for energies of nuclear states) can be used in several important applications, for example, in laser technology. This new approach to the development of nuclear physics is based on the observation made in the 1960s that the doubled value of the pion's β-decay energy is close to the period δ=16m_e.

For confirmation of CODATA relations we use the results of the global analysis of nuclear data collected in PNPI and published in Springer Landolt-Boernstein Library New Series. The Editor-in-chief of L.-B. Library W. Martienssen compared data-compilations with the bridges between different branches of Science. Nuclear data files were used for a check of empirical relations in particle masses due to the fact that theoretical models, for example, NRCQM, provide a description of the origin of nucleon masses, and the QCD is a general theory of nuclear excitations and nuclear binding energies. In the analysis of data on energies of all known nuclei, both parameters of the CODATA fine structure ($m_e/3$=170 keV=$\varepsilon_o/6$ and $m_N/8$=161 keV) were found earlier, in a separate analysis. We use a new method of data analysis based on the selection of data for all isotopes of each element. We study the location of the grouping effect in the values of the excitation energies collected among all the isotopes of given element. In the combined E^* distribution for Z=40–72, maximum at 3.072 MeV close to 3ε_o=3.066 MeV was found. The random probability of such a grouping is less than 10^{-5}.

Another method of data analysis was to obtain and analyse combined data for isotopes of neighbouring near-magic elements (nuclei with Z=8-9-10, Z=20, 22 etc.). The grouping effect in the values of the excitation energies of different isotopes of a certain element, which was considered earlier, was the first step. The second step was based on the observation of the similarity in the excitations in several near-magic nuclei. For example, it was noticed long ago, that the first excitations of ^{18}O and ^{24}Ne $E_1^*(2^+)$=1982.1(1) keV and $E_1^*(2^+)$=1981.6(4) keV are unexpectedly close to each other. Now we have found that the grouping effect in the sum of ordinary D-distributions in neighboring elements Z=8, 9, 10 at the first excitations of ^{18}O and ^{24}Ne at D=1982 keV (161 intervals with a deviation of 2.4σ over the mean value) can be compared with a maximum at the same value in a similar analysis of the combined spectrum of the same three elements (n=546+804+701=2051, for Z=8, 9, 10). The mean value n=≈1200 in the combined spectrum of all 55 isotopes of these three elements is much larger than the mean value n=126 (the sum of the results of a separate analysis), but the effect of about 160 values (over the mean level, in the combined analysis) is much greater than the effect of 35 values, obtained during the routine analysis of individual data. To explain this effect, we use the AIM-method of data analysis.

This result independently confirms the common parameters of the CODATA relations and has been checked with data for nuclei from other Z–regions.