Tuning Effect in Binding Energies of Nuclear Clusters

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Data on masses and binding energies of nucleons in very unstable nuclei were collected in PNPI as a part of file MDF (Mass Difference File) produced for performing of correlation analysis needed for the further development of microscopic nuclear models.

The presence of stable differences of nuclear binding energies ΔE_B in nuclei differing by ΔZ=2, ΔN=2 (α-cluster) or ΔZ=2, ΔN=4 (^{6}He-cluster) was considered in [1-3]. Now it is studied with data from MDF-file based on the recent AME-2003 compilation [4] and on results of model calculations (FRDM, RMF etc.). The grouping of ΔE_B in light nuclei differing by 4α-clusters (Fig.1 top left) and in all even-even nuclei differing by ^{6}He-cluster was found in the experimental data. The observed groupings of ΔE_B are not reproduced by existing models.

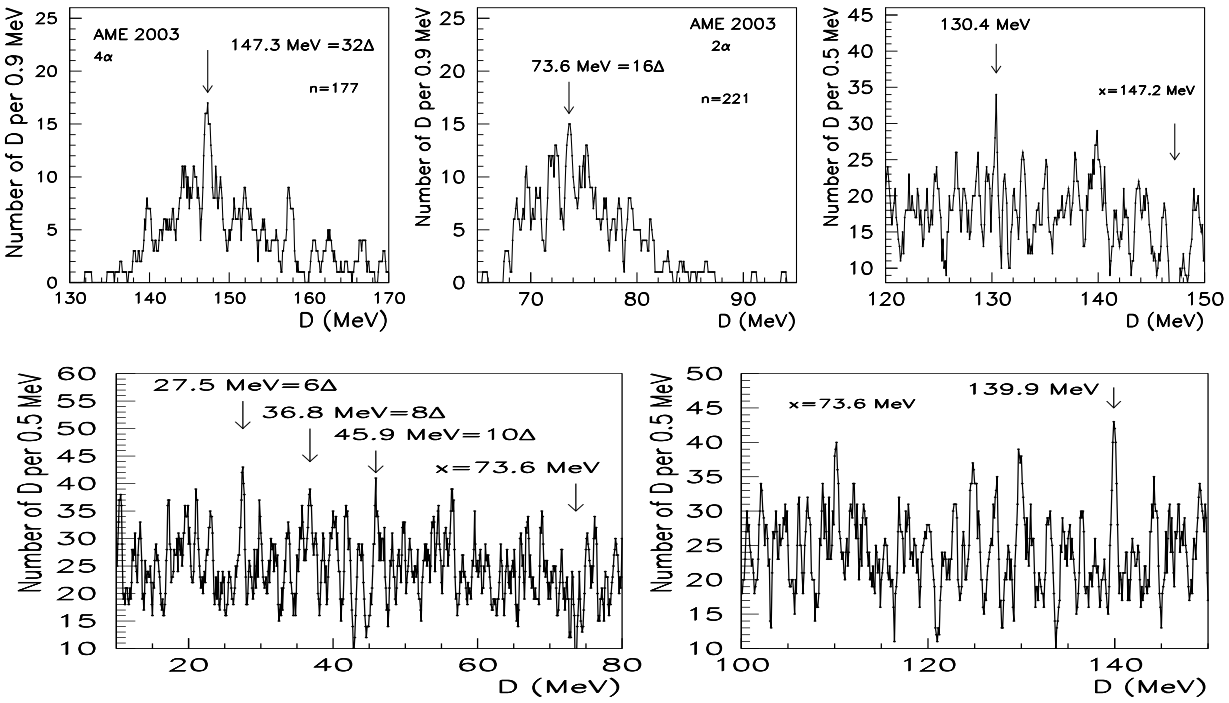

Fig.1 [5] *Top:* ΔE_B-distribution in nuclei Z$\leq$26) differing by four and two α clusters.
Top, right and bottom: Distribution of ΔE_B adjacent to x=147.2 MeV and to x=73.6 MeV.

We used the correlation program AIM (Adjacent Interval Method) for the check of the reality of the observed stable intervals. For example, intervals ΔE_B=147.2 MeV and 73.6 MeV were found to be interconnected (in all ΔE_B) with other ΔE_B (Fig.1 from [5]).

The observed stable interval ΔE_B=40.9 MeV in even-even nuclei is mainly from the nuclei with Z=80-84. It was found to be adjacent to large intervals ΔE_B=408.8 MeV (found earlier [2]) and ΔE_B=106.4 MeV. The relation 5:50:13 between these ΔE_B (parameters of the tuning effect) as well as 9:18 for ΔE_B=73.6 MeV and 147.2 MeV can be expressed by the period δ=8.18 MeV.

The observed discreteness in ΔE_B is similar to the tuning effect in particle masses [1-3] where masses of the muon, pion, nucleon as well as stable interval 409 MeV in masses of the pseudo-scalars and the nucleon Δ-excitation (294 MeV) were represented as n=13, 17, 50, 6$\times$17+13 (according to Y.Nambu relations) and 36 [2,5]. Discussion of results will be given in the report.

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