

Tuning Effect in Nuclear Excitations

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In recently produced compilation of all excited states of all nuclei a special volume is devoted to very unstable nuclei [1]. Data on excitations (E^*) in nuclei situated far from the line of stability are useful for a check of the tuning effects observed in many near-magic nuclei [2-4]. For example, stable excitations shown in Fig.1 (left) in nuclei with $Z \leq 29$ with values $D_o=1293$ keV and $2D_o=2586$ keV (where D_o is the nucleon mass difference) were considered [2] as a part of a system of energy intervals with the period 161 keV ($n=8$ and 16). Stable $E^*=1942$ and 646 keV ($n=12$ and 8) were found in [2] (Fig.1), stable $D=D_o=1293$ keV $\approx 161 \times 8$ were found in $^{32,33}\text{S}$.

We used in this work data on E^* and spectroscopic factors S_N from the above mentioned PNPI-file CRF (Combined nuclear Reaction File) [1]. In data for $N=21$ nuclei (Table 1) a linear trend with the slope of 647 keV is derived from the ratio $1942.8/646.2=3.006$ in E^* of $7/2^-$ states with large S_N . Excitations $E^*=159-484$ keV in ^{33}Mg triplet correspond to $n=1$ and 3 in units $D_o/8$. Excitations in ^{32}Si and ^{38}S are given for comparison.

Table 1. Comparison of energies with integers (n) of 161 keV= $D_o/8$ (E^* in keV, large S_N)

A/Z	^{41}Ca		^{39}Ar		^{37}S		^{33}Mg			^{32}Si		^{38}S	
E^*	0.0	1943	0.0	1267	0	646	0.0	159	484	0	1942	0	1292
$2J^\pi$	7^-	3^-	7^-	3^-	7^-	3^-	(3^+)	(7^-)	(3^-)	0^+	2^+	0^+	2^+
S_N	0.85	0.67	0.64	0.57	5.54	1.75				1.6	5.3		
$n \frac{D_o}{8}$	0	1941	0	1293	0	646		161	483		1941		1293
n		12		8		4		1	3		12		8

An example of stable intervals from the same system is shown in Fig.2 (see [4]). It was suggested [2] that nuclear tuning effects with parameters close to particle mass splitting correspond to the QED radiative correction to large hadronic intervals seen in binding energies.

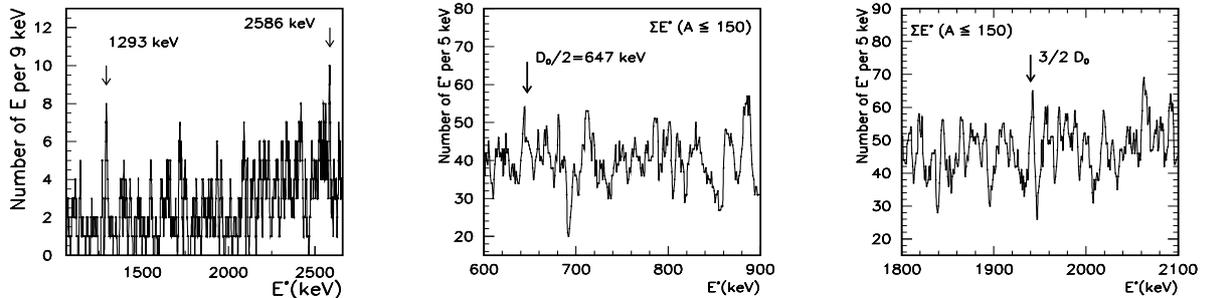


Fig.1 E^* -distribution in Z -odd ($Z \leq 29$) nuclei (left) and in all nuclei $A \leq 150$ (center, right).

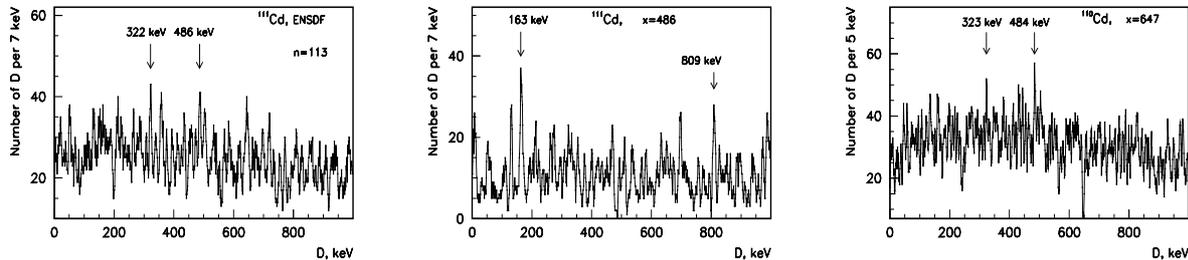


Fig.2 D -distribution in levels of ^{111}Cd (left) and distribution of intervals adjacent to $x=D=486$ keV in ^{111}Cd (center) and $x=D=647$ keV in ^{110}Cd (right).

We report also other results on correlations in data for very unstable nuclei (from CRF).

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- [4] S.I.Sukhoruchkin, Proc. ISINN-13, Dubna, 2005, JINR publication, in press.