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SIMPLE PARAMETRIZATION OF NUCLEAR DEFORMATION PARAMETERS FOR NUCLEI IN THE ACTINIDE REGION

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Since several years a considerable amount of data concerning multipole deformation parameters (β_2, β_4, β_6) describing nuclear shape, has been obtained mainly by inelastic scattering experiments using various probes (α,p,n,e, etc...) but also through coulomb excitation or X-ray emission of muonic atoms.

These studies concern mainly nuclei in the s-d shell,(1) or in the rare earth region (2)as well asfor several nuclei in the actinide region (3). In addition a considerable amount of theoretical calculations has been performed in order to reproduce the experimental measured deformation parameters (4).

These theoretical calculations which include HF or HF + BCS type or the Nilsson model etc. were in general able to reproduce some of the experimental data (β_2 and β_4) at least for some nuclei in the rare earth region. However the question of the exact value of multipole deformation in the actinide region has still to be investigated since the results have been found to be dependant of the type of particle used as probe in the scattering experiment (5). Large discrepancies among the values reported for the nuclear deformation parameters (mainly β_4) by the different experiments were indeed observed. Besides these theoretical calculations recently a simple semi-empirical expression derived by J. Jänecke (6) from previous work by Bertsch (7) was surprisingly able to reproduce the trend as well as the variation with A of β_2, β_4 (hexadecapole) as well as the β_6 (hexacontatetrepole) deformations for nuclei in the rare earth region.

This simple analytical semi classical expression has been used (6) to obtain the trend of the β_2, β_4, β_6 nuclear deformation parameters around A = 232 (Thorium) and A = 238 (Uranium).

Figure 1 present the comparison between this new semi-classical expression (full line) and some available proton data (3,4,5). As can be seen from this figure this equation discribes well the monotonic variation of β_2 with A as well as the slow decrease of β_4 with A and the strong decrease of β_6 in this mass region.

In conclusion we can say that this new analytical equation represents remarkably well the deformation parameters (β_2, β_4, β_6) around A = 232 - 238 obtained by means of inelastic scattering of protons while the experimental data obtained through other probes (α,e) are not so-well reproduced by this formulation. Further calculations (these are only preliminary) as well as more extended experimental deformation parameters (mainly β_4,β_6) are obviously needed to check this simple parametrization of nuclear deformation parameters, parametrization which should however be useful in the discussions of global nuclear properties.

Références

(1) - R. de Swiniarski et al. Phys. Rev. Lett. 23, 317, 1969.
and Nucl. Phys. A261, 111, 1976.

(2) - D.L. Hendrie et al. Phys. Rev. Lett. 31, 478, 1973.

(3) - L.F. Hansen et al. Phys. Rev. 25C, 189 (1982) and references therein.
- R.M. Ronningen et al. To pe published.

(4) - P. Quentin, PhD. Thesis, Paris (1975) unpublished.
and J. Liebert P. Quentin, Phys. Rev. 25C 571, 1982 and reference therein

(5) - P. Quentin, I. Brissaud and R. de Swiniarski. Zeit. f. Physik A298 37, 1980.

(6) - J. Janecke
Phys. Lett. 103B, 1, 1981 and private commutication

(7) - G.F. Bertch, Phys. Lett. 26B 130, 1968.

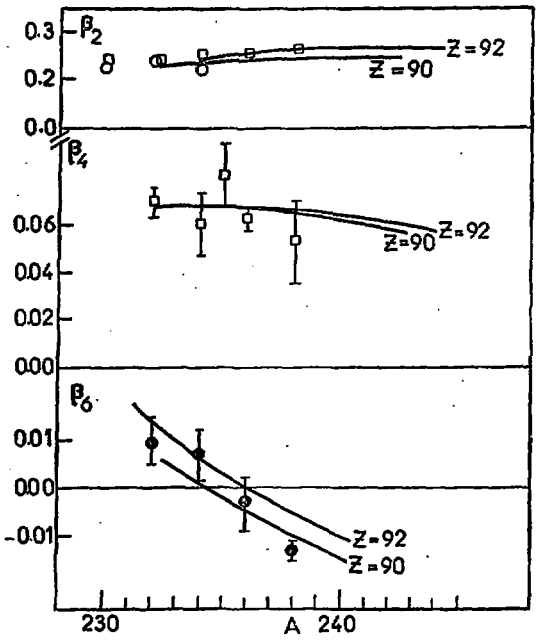
0.3
β_2
0.2
0.0
Z=92
Z=90
β_4
0.06
0.04
0.02
0.00
Z=92
Z=90
β_6
0.01
0.00
-0.01
Z=92
Z=90
230
A
240

Figure 1