

中国科学院
近代物理研究所

年報

ANNUAL REPORT 1986

Institute of Modern Physics

Academia Sinica

科学技术文献出版社重庆分社

1987.6

JUL 11 52/30

Foreword

This is the sixth issue of annual report of Institute of Modern Physics, Academia Sinica. It summarizes the research activities, technical developments and the progress of HIRFL project carried out during the year of 1986.

The project for construction of HIRFL has been progressed as intended in this year. The assembling of the main parts of SSC including the vacuum chamber, sector magnets and RF cavities was realized according to their designed position. The first pumping of the vacuum chamber has been completed smoothly. The pressure in the vacuum chamber was reached to 8×10^{-6} torr. The mechanical and physical parameters of the RF cavities and the control system of RF system have been tested. The south cavity was excited up to the rated 130KV dee voltage at 8.64MHZ. The construction of eight experimental equipments for nuclear physics and applied physics with heavy ions is progressing steadily, two of them i.e. the on-line isotope separator and the heavy ion time of flight spectrometer are almost ready for assembling. The construction of the measurement room and the experimental area is starting now and the NIM pool is setting preliminarily. The first stage work of the data acquisition and analysing system has been fulfilled.

52 scientific papers published in this annual report are concerning to the theoretical nuclear physics, experimental nuclear physics and nuclear chemistry with heavy ions. Through inland and international collaborations, significant progress has been made for our researches in several fields of experimental and theoretical nuclear physics. Among them I would like to mention that the collaboration with a number of institutions abroad in the theoretical research on the spin and configuration dependence of the nuclear shape and pairing correlation and the collaboration with KVI in Netherlands in the experimental research on the incomplete deep inelastic collision are quite successful. The first results of the experiment with KVI cyclotron and the Lanzhou filled position sensitive detectors on 11MeV/A $^{20}\text{Ne} + ^{16}\text{O}$ reaction are very promising.

Technical service to national economy has been developed such as the surface cleaning steel by chemical method etc.

The rebuilding of SFC which will be used as the injector of SSC is progressing, there is no major difficulty that would hinder its completion in 1987. The preparation of the experiments on it is being under progress.

The Director of Institute of Modern
Physics, Academia Sinica

B.W. Wei

中国科学院近代物理研究所 年报(1986年)

中国科学院近代物理研究所年报编委会	编 辑
科学技术文献出版社重庆分社	出 版
重庆市市中区胜利路132号	
新华书店重庆发行所	发 行
中国科学技术情报研究所重庆分所印刷厂	印 刷

开本: 787×1092毫米1/16	印张: 14.25	字数: 35万
1987年10月第1版	1987年10月第1次印刷	
科技新书目: 155—343	印数: 1500	

ISBN7-5023-0132-1/O·13

统一书号: 13176·187 定价: 3.20元

CONTENTS

1. Theoretical Nuclear Physics

1-1 α -backbending, nucleon-nucleon correlation and shape in nuclei.....	(3)
1-2 The odd-even staggering of $N_n/2$ of isotopes.....	(4)
1-3 The band 2 of nuclei ^{156}Er and ^{153}Er	(5)
1-4 An improved Nilsson parameter set in the Au-Pt region.....	(6)
1-5 On the quadrupole deformation in even-even rare-earth nuclei.....	(7)
1-6 On $\pi h_{9/2}$ alignment in Pt even isotopes.....	(8)
1-7 The deformation of the α -band in some rare-earth and actinide nuclei...	(9)
1-8 Two-body effect in heavy ion collision.....	(10)
1-9 Relaxation of single particle degrees of freedom in heavy ion collision...	(11)
1-10 Emission of light particles in the heavy ion collisions.....	(12)
1-11 Generalization of Cassinian ovals describing symmetric fission process...	(14)
1-12 Shell effect on nucleus-nucleus potential.....	(16)
1-13 Effect of nuclear structure on transport theory in heavy ion reaction...	(17)
1-14 The isospin dependent level decay width in compound nucleus ^{30}P	(18)
1-15 Calculation of one-body dissipation in heavy-ion reaction.....	(19)
1-16 Unified nuclear potential calculation on deformed nucleus in heavy-ion reaction.....	(20)
1-17 Calculation of neutron evaporation cross section for $^{40}\text{Ar} + ^{233}\text{U}, ^{235}\text{U}, ^{238}\text{U}$ reactions.....	(21)
1-18 Optimum shape in symmetry fission.....	(23)
1-19 Calculations of capture cross section and fusion cross section for $^{40}\text{Ar} +$ $^{233}\text{U}, ^{235}\text{U}, ^{238}\text{U}$ reactions	(25)
1-20 Simulation calculatoin of break up process.....	(27)
1-21 Calculation of the emission cross sections for various non-evaporation α particle.....	(29)
1-22 Calculation of overall shapes and absolute magnitudes of the angular distributions for various non-evaporation α particles	(31)
1-23 Monte-carlo analogue of the statistical evaporation process.....	(33)

2. Experimental Nuclear Physics

2-1 Projectile breakup followed by dissipative processes in the $^{20}\text{Ne} + ^{27}\text{Al}$ system	(37)
2-2 Carbon-ion radioactivity of ^{223}Ra	(40)
2-3 Energy dissipation and deformation of fragment for light system.....	(41)
2-4 Bremsstrahlung radiation in heavy ion reaction.....	(43)

2-5 Dynamics of dissipation collision for light system.....	(45)
2-6 Effect of nuclear structure on nucleon transport for light system.....	(47)
2-7 Measurements of angular momentum effect of fission barrier.....	(49)
2-8 $^{14}\text{N} + ^{27}\text{Al}$ DIC reaction and influence of nuclear structure effect.....	(50)
2-9 Reasearch of quasi-elastic reaction and dissipative mechanism in $^{14}\text{N} + ^{51}\text{V}$, $^{14}\text{N} + ^{59}\text{Co}$ system	(52)
2-10 First on-line test of the ISOL gas transport system.....	(54)
2-11 Production of pure ^{123}I from moderately enriched ^{124}Te with a combined cyclotron/negative-ion-mass-separation (NIMS) technique	(55)
2-12 Production of an accurate cylindrical electric field by computer simulation	(56)
2-13 The beta-delayed proton decay of ^{61}Ge	(57)
2-14 Dependence of $\bar{X}, \sigma_x^2, \rho$ and R on TKEL and the potential energy surface in $^{16}\text{O} + ^{27}\text{Al}$ dissipative reaction at 80.9MeV	(59)
2-15 A high uniform magnetic field produced by setting correction coils.....	(61)
2-16 The combination probability of particle emission in exciton model.....	(63)
2-17 Study of ^8Be detection efficiency.....	(64)
2-18 New progress in the systematization of moving source model para- meters	(65)
2-19 Calculation relating to the isotope separator and the on-line mass-spec- trometer (1)	(66)
2-20 Calculation relating to the isotope separator and the on-line mass-spec- trometer (2)	(67)
2-21 Systematics of the angular distribution in heavy ion induced fission...	(68)
2-22 A closed solution for exciton model.....	(70)
2-23 Monte-carlo calculation code of the statistical decay process.....	(71)

3. Nuclear Chemistry and Chemistry

3-1 Mass distribution for the reaction of 8.5MeV/A ^{139}La with ^{138}La	(75)
3-2 The decay scheme of ^{212}Pb	(76)
3-3 Transport efficiencies of the fission products in a gas-jet recoil-transport system.....	(77)
3-4 Analysis of β -delayed proton decay of ^{113}Xe precursor by statistical model	(79)
3-5 Research of antifreeze and coolant for an automorbile.....	(81)
3-6 Production of aluminium sulfate and poly aluminium sulfate using waste aluminium residue.....	(82)

4. Applications of Nuclear Technique

4-1 Energy calibration of 2×2 MV tandem using resonance reactions.....	(85)
---------------------------------------------------------------------------------	------

4-2	X-ray diffraction analysis of nitrogen implanted 9Cr18 stainless steel...	(86)
4-3	Radiation effect of polyethylene.....	(88)
4-4	The analysis system of PIXE and its data acquisition equipment in IMP.....	(90)
4-5	The studies of the action of Cr_2O_3 in solid solution of the iron series catalysts using Mössbauer effect and X-ray diffraction methods.....	(92)
4-6	Mössbauer effect and X-ray diffraction analysis of the solid solution formed from the mixtures of different metal oxides by 800°C activation.....	(94)
4-7	The accurate measurement of the density for irradiated samples.....	(96)
4-8	Verification of quality for PIXE data acquisition and processing system...	(97)
4-9	Preparation of Al Ti Cr B films for research on ion beam mixing mod- ification.....	(98)
4-10	The measurement of elements contents in an ancient coin by single standard element 14MeV NAA method.....	(99)
4-11	Study on radiation preservation technology of the baihe(lily).....	(101)
4-12	The measurement of sensitivity curve for XRF.....	(102)
4-13	Using fast Fourier transform to realize calculation of convolution and reverse convolution in discrete function.....	(104)
4-14	The determination of 14MeV neutrons production from D-D neutron generator.....	(106)
4-15	The measurements of separate γ -spectrum cross section ratio induced by 2.5MeV and 14MeV neutrons	(108)
4-16	The data reduction programme for the determination of the mean life- times of atomic energy levels in beam foil spectroscopy experiments.....	(110)

5. Experimental Technique (including terminal)

5-1	An ionization chamber-plastic scintillator telescope.....	(113)
5-2	A plastic scintillator phoswich telescope.....	(114)
5-3	In the progress of large area position sensitive ionization chamber.....	(115)
5-4	An improvement on the large area position sensitive ionization chamber.....	(116)
5-5	ΔE ionization chamber with longitudinal electrical field.....	(117)
5-6	Monte-carlo method in light guide design.....	(118)
5-7	The large area parallel plate avalanche counter for time-of-flight measurement.....	(119)
5-8	Double grid position sensitive avalanche chamber.....	(121)
5-9	A test experiment with the position sensitive heavy ion telescope.....	(122)
5-10	A quad fast timing amplifier.....	(124)
5-11	Experimental improvement of the resolution of an ISOLDE-type isotope separator	(126)

5-12	A new leak date calibration system.....	(127)
5-13	An improvement of the negative surface ionization ion source.....	(128)
5-14	A systematic test of FEBIAO ion source.....	(129)
5-15	Microcomputer timing control system for the fast chemistry separator...	(130)
5-16	The present situation of the heavy-ion TOF system.....	(131)
5-17	PO-64 output expander.....	(132)
5-18	A measurement instrument for the electromagnetic valve.....	(133)
5-19	Ionization chamber telescope with position sensitive Si detector.....	(134)
5-20	Low pressure multiwire proportional chamber.....	(135)
5-21	Optimum condition of pulse voltage in circuit of pulse dipole magnet...	(136)
5-22	A versatile three-dimensional scattering chamber for research on heavy ions nuclear reactions	(137)
5-23	The preparation of high reverse voltage Au-Si surface barrier with large area.....	(140)
5-24	Heavy ion telescope with a mini ionization chamber.....	(141)
5-25	The improvement of large area ion implanted detector.....	(142)
5-26	Calculation of detection efficiency, suitable for the He-jet and rotating caught wheel system	(144)
5-27	Improvements to the Helium-jet couple on-line mass separator RAMA...	(145)
5-28	The BGO anti-compton HpGe detector of in-beam γ detection array.....	(147)
5-29	An automatic control system interface and applied program for the fast chemical separation apparatus (FCSA).....	(148)
5-30	The BGO hexagonal detector of in-beam γ detection array.....	(150)
5-31	Large solid angle bragg-curve spectrometer.....	(152)
5-32	An irradiation chamber for PIXE analysis.....	(153)
5-33	A method of repairing semiconductor(Si)detectors.....	(154)
5-34	Building up of clean rooms	(155)

6. Computer

6-1	DTC-a CAMAC module for multi-parameter acquisition system.....	(159)
6-2	SORTANU-a program sorting the data from 7 ADCs.....	(160)
6-3	SORT88-a program sorting data from 3 ADCs.....	(162)
6-4	The program PROCESS for processing sorted spectra.....	(164)
6-5	μ c system as remote terminal of a host.....	(167)
6-6	An improved nonlinear programming program FLEXIPLEX.....	(168)
6-7	Implantation of ALI82 code in computer VAX 11/780.....	(169)
6-8	A treat program for beta-spectra.....	(170)
6-9	A batch progressing method for PIXE data with the same fitting input parameters.....	(172)
6-10	The innovation of DJS-6 computer main memory.....	(173)

7. HIRFL

7-1 HIRFL progress in 1986.....	(177)
7-2 The progress of SSC main magnet system.....	(179)
7-3 The status report on the RF system.....	(180)
7-4 Vacuum seal for HIRFL SSC.....	(181)
7-5 Installation of RKP 800 cryopump for HIRFL SSC.....	(182)
7-6 Acceptance test of TPH 5000 TMP.....	(183)
7-7 Vacuum system of the second beam line for HIRFL.....	(184)
7-8 Machining control of the monolithic vacuum chamber of SSC.....	(185)
7-9 The optical coordinate system of HIRFL.....	(186)

8. 2×2 MV Tandem Electrostatic Accelerator

8-1 The 2×2 MV tandem accelerator.....	(189)
8-2 Easy disassemble high voltage terminal.....	(191)

9. Radiation Protection

9-1 The health physics aspects of the 1.5m cyclotron.....	(195)
9-2 Environment surveillance of HIRFL(1985).....	(196)
9-3 The system of radiation warning device of HIRFL.....	(197)
9-4 The area monitoring system of HIRFL.....	(198)
9-5 The spectral distribution of neutrons outside the shielding of K-600 neutron generator.....	(199)
9-6 Radiation dose distribution on 2×2 MV tandem.....	(200)
9-7 Adjustment of a FJ-2603 type α β low radioactive measurement apparatus.....	(201)
9-8 The skyshine measurement of neutron generated by the K-600 neutron generator.....	(202)
9-9 The physical design of radiation shield of electron accelerator in 2MeV, 20KW.....	(203)
9-10 The monitoring stations of environmental radiation of gamma and neutron.....	(205)
9-11 Performance and applications of GR-200 type LiF(Mg, P, Cu)TLD...	(206)

10. Appendix

10-1 International scientific exchanges in 1986.....	(211)
10-2 Publications.....	(216)

1. Theoretical Nuclear Physics

1-1 α -Backbending, Nucleon-Nucleon Correlation and Shape in Nuclei

Gu Jinnan

The relation between α -backbending¹⁾, nucleon-nucleon correlation and shape in nuclei has been discussed. In general the pairing backbending behavior in gauge space are related to the quadrupole shape transition. However α -backbending is not only related to the quadrupole shape transition which just corresponds to the backbending region of α -backbending plot, but also may related to other kind of shape transition. For example, there are two backbendings for $T_3=17$, the first one ($A \approx 190$) corresponds to the quadrupole shape transition from oblate to prolate, the second one ($A \approx 180$) corresponds to the hexadecapole shape (β_4) transition from $-\beta_4$ to $+\beta_4$.

The α -backbending behavior also largely depends on the competition between the n-p, as well as the p-p and the n-n effective interaction energy (W_{np} , W_{pp} , W_{nn}) calculated by unified shell model. Fig.1 shows the results for $T_3=12,13,14$. One sees that the deformation sets in when $W_{np}/(W_{nn} + W_{pp}) \geq 1$ and α -backbending appears when $W_{np}/(W_{nn} + W_{pp}) \leq 1$. Therefore n-p interaction is a necessary condition for producing deformation. Similarly n-p interaction is also responsible for combining n-n pair with p-p pair, i. e. for forming α -cluster in heavy even-even nuclei. So it is due to nucleon-nucleon correlation, especially n-p correlation that the change of shape is close related to the α -backbending phenomena. These seem to tell us the change of nuclear shape with increasing nucleon number and the α -backbending behavior can be fundamentally described by unified shell model.

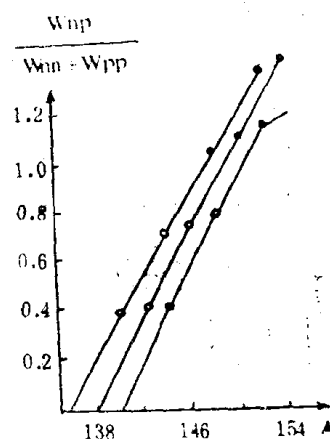


Fig.1 $\frac{W_{np}}{W_{nn} + W_{pp}}$ vs. A plot.

Reference

- 1) Gu Jinnan, Science Bulletin (in English) 30 No11 (1985) 1459

1-2 The Odd-Even Staggering of $N_n/2$ of Isotopes

Gu Jinnan Gao Yuanyi

With increasing neutron number N_n outside closed-shell, there is an odd-even staggering of $N_n/2$ in the parameter C of VMI model for well-deformed isotopes in the rare-earth and actinide region.

As is well known, the two-parameter formula of VMI model is given by

$$E(I) = \frac{I(I+1)}{2J(I)} + \frac{1}{2}C(J(I) - J_0)^2 \quad (1)$$

where J_0 is the moment of inertia of ground state, C is stiffness parameter which can be determined from a least-squares adjustment of the experimental spectra data of ground band in even-even nuclei. Obviously there is an odd-even staggering of $N_n/2$ of C value in Fig.1 in well-deformed actinide nuclei. The odd-even mass difference of $N_n/2$, i.e. pair energy for neutron pairs may be define as²⁾

$$\Delta_{2n}(N, Z) = -\frac{1}{4} \{ S_{2n}(N+2, Z) - 2S_{2n}(N, Z) + S_{2n}(N-2, Z) \} \quad (2)$$

where S_{2n} is the separation energy of a couple of neutrons. Similar to Fig.1, there is an odd-even difference of $N_n/2$ of Δ_{2n} value in Fig.2. But the trend is just opposite, while Δ_{2n} is relatively small (so the nucleus is a little stiff) corresponding C value is relatively large. Therefore the staggering of $N_n/2$ of C values may originate from the neutron-pair correlation, mainly the pair correlation of neutron pairs and their response on rotation.

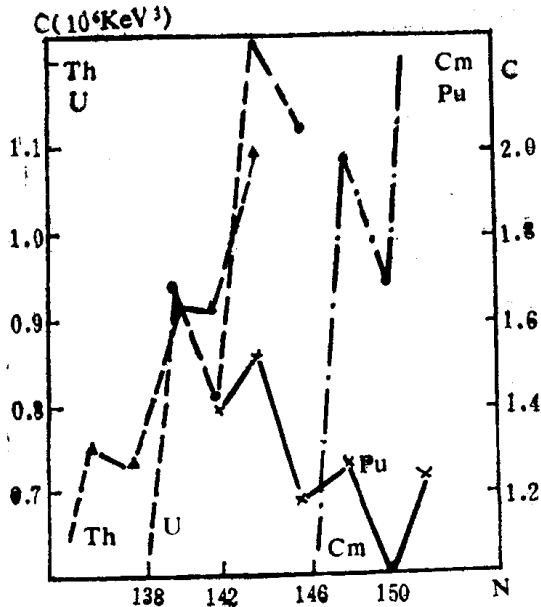


Fig.1 C vs. N plot for actinide nuclei.

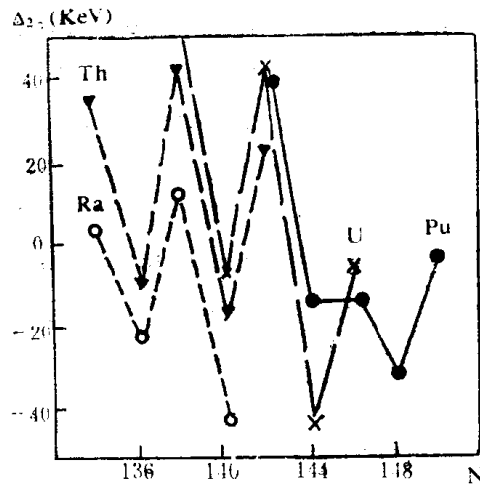


Fig.2 Δ_{2n} vs. N plot for actinide nuclei.

References

- 1) M. A. J. Matisotti et al., Phys. Rev. 178(1969)1864
- 2) A.S.Jensen et al., Nucl.Phys, A431(1984)393

1-3 The Band 2 of Nuclei ^{156}Er and ^{158}Er

Gao Yuanyi

With increasingly improving detection technique we can not only measure the high spin levels of the yrast band of the nuclei ^{156}Er and ^{158}Er , but also a new band called as the band 2 with even spin and positive parity for both of them.

Using VMI model, namely variable moment of inertia model, we calculated the rotational aligned momentum $i=8.4$ and the ground-state moment of inertia $J_0=0.015$. The value of J_0 is close to the ground state band and the value of i is large enough to reveal that the band 2 of nucleus ^{168}Er is a neutron-pair-rotational aligned band, but differs from the superband. Simultaneously, we got the band 2 of nucleus ^{158}Er $i=3.3$, $J_0=0.02$. Using the method of band mix, we got effective aligned momentum $i\approx 4$ for some nuclei of shape transition with increasing I , by contrast to ground-state moment of inertia $J_0=0.0033$, $J_0=0.022$ is very large. Zhang Jingye et al.,¹⁾ mentioned the deformation of ^{168}Er is about $e_2=0.26$ around $I=16^+$. So we considered the band 2 of ^{158}Er result from a shape transition with increasing I ²⁾.

References

- 1) Zhang Jingye, Invited Talk at Brasov International School(1984)P17
- 2) Gao Yuanyi PEFEON to be published

1-4 An Improved Nilsson Parameter Set in the Au-Pt Region

Zhang Jingye A.J.Larabee* L.L.Riedinger*

Recent data on ^{185}Au indicate that previously published Nilsson (κ, μ) parameter sets for the Au-Pt-Hg region are not able to reproduce either the bandhead energies for the odd proton configurations or the single-particle structure of the higher-spin states in ^{185}Au . A new set of (κ, μ) parameters are deduced for the $N=5$ and $N=6$ proton shell as follows. The neutron (κ, μ) parameters are the same as that in reference ¹⁾.

N	protons		neutron	
	κ	μ	κ	μ
0	0.120	0.00	0.120	0.00
1	0.120	0.00	0.120	0.00
2	0.105	0.00	0.105	0.00
3	0.090	0.30	0.090	0.25
4	0.065	0.57	0.70	0.39
5	0.060	0.54	0.062	0.43
6	0.060	0.52	0.062	0.34
7	0.054	0.69	0.062	0.26

Such a new set of (κ, μ) parameters can give better agreement between the calculated and experimental results not only for ^{185}Au itself but also for neighboring nuclei. For instance the closely location of the alignment frequencies of proton $h_{9/2}$ pair and neutron $i_{13/2}$ pair in ^{184}Pt observed recently²⁾. The Nilsson proton single-particle orbits obtained using the new (κ, μ) parameter are close to the Woods-Saxon results for this region.

References

- 1) T.Bengtsson and I.Ragnarsson, Nucl. Phys. A436(1985)14
- 2) Jing-ye Zhang, Ji-quan Zhong, "High Energy and Nuclear Physics" (1987) to be published

* Department of Physics and Astronomy. The University of Tennessee, Knoxville, TN 37996-1200, USA

1-5 On the Quadrupole Deformation in Even-even Rare-earth Nuclei

Zhang Jingye Zhong Jiquan Liao Bicheng

Deformation of e-e rare-earth nuclei has been studied fairly carefully so far from both theoretical and experimental aspects. It is well known, the moment of inertia is closely related to the deformation and pair correlation existed in nucleus. In this paper by comparing the theoretical and experimental value of the moment of inertia, quadrupole deformations are extracted systematically for the ground states of most e-e rare-earth nuclei, which are in good agreement with the values read out from the quadrupole moments data and in agreement with Möller and Nix's calculations¹⁾ (neglecting ϵ_4). It tells, the approximate estimation of the strong dependence of the moment of inertia on the pair correlation given by Bohr and Mottelson²⁾ is quite reasonable.

As an example, Fig.1 shows the results extracted from the experimental moment of inertia (solid line), from the quadrupole moment measurement (open circles) and the Möller and Nix's calculations (dashed line).

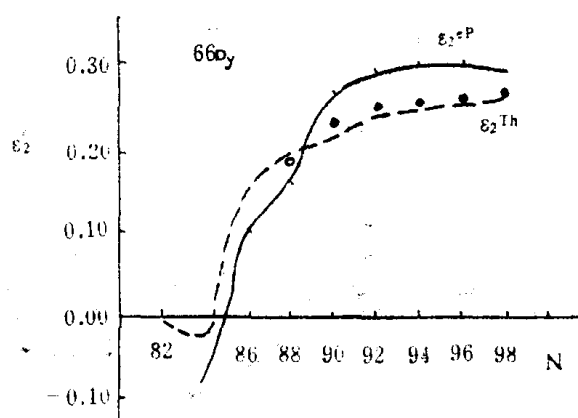


Fig.1

References

- 1) P.Möller and R.Nix. Private Communication
- 2) A.Bohr and B.Mottelson. "Nuclear Structure", V.II. (1975) P.82

1-6 On $\pi h_{9/2}$ Alignment in Pt Even Isotopes

Zhang Jingye Zhong Jiquan

$\pi h_{9/2}$ alignment in Pt even isotopes has been calculated and discussed systematically. It is found that $\Delta h\omega_c \equiv h\omega_c(\pi h_{9/2}) - h\omega_c(\nu i_{13/2})$ approaches the minimum, about 75KeV, for $^{184}\text{Pt}_{106}$ by using modified Nilsson's parameters $k, \mu^1)$. This result is in agreement with the experimental evidence that the big up-bend observed in the yrast band of ^{184}Pt is caused by the close alignment of $\pi h_{9/2}$ and $\nu i_{13/2}$, while the standard Nilsson's k, μ can not give out such a result. As shown in Fig.1. Where the solid line corresponds to the new k, μ parameters set, while the dashed line corresponds to the standard k, μ . The problem of the order of $\pi h_{9/2}$ and $\nu i_{13/2}$ alignments needs further investigation. Theoretical prediction about the $\pi h_{9/2}$ alignment frequency for neighboring Pt even isotopes should be checked by new experiments.

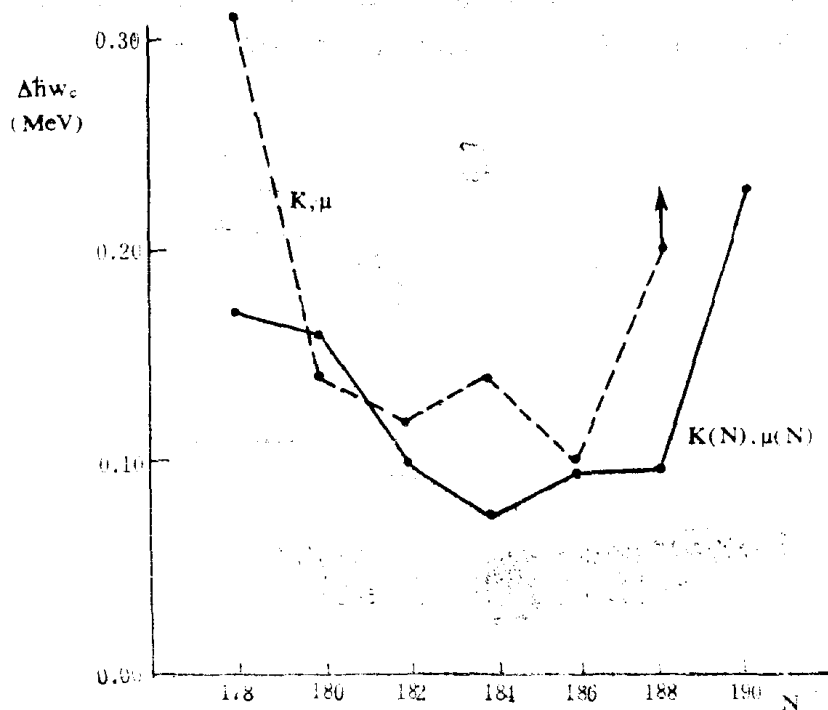


Fig.1

Reference

- 1) Zhang Jingye, Zhong Jiquan, PEFEPN(1987) to be published

1-7 The Deformation of the α -band in Some Rare-earth and Actinide Nuclei

Zhang Jingye Zhong Jiquan

Recently, it is found there is probably a new band (some people call " α -band"), in some actinide and rare-earth nuclei. Such α -band has larger moment of inertia than that of ground-, β - and γ -band. Besides there observed a negative parity band with approximate triplet structure and the groups of the negative parity states have roughly the same splitting as the α -band. These phenomena, together with the large α -decay in probabilities suggests that α -clustering effects may play a role in heavy nuclei as important as that played in light nuclei¹⁾.

Two schools of thought have been developing regarding the observation mentioned above: (i) α -clustering effects are important¹⁾, and (ii) static or dynamical octupole deformation occurs²⁾. It seems, more experimental tests and theoretical calculation are still needed before the final judgement between these two approaches can be down.

In this paper, some estimation about the deformation of these α -band was done based on an intuitive geometrical picture. Supposing an α -cluster is formed on the surface of a core nucleus (as shown in Fig.1) for some period of rotations, which corresponds to the formation of α -band. In order to reproduce the moment of inertia of the α -band, the polarization of α -cluster on the core should be assumed, especially for the soft core.

Table 1 tells the deformation of the core nucleus without and with polarization of α -cluster. Such polarization effects, if exist, should show up on the effect of the nonspherical part of the Coulomb field, and can be measured through the angular dependence of the wave function imposed by the penetration of the non-spherical barrier³⁾.

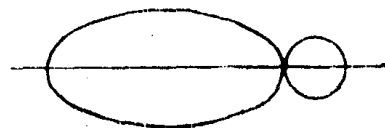


Fig.1

References

- 1) H.J.Daley and B.R.Barrett, Nucl. Phys A449(1986)256
- 2) G.A.Leander and R.K.Sheline, Nucl. Phys. A413(1984)375
- 3) A.Bohr and B.Mottelson, "Nuuclear Structure", V.II. (1975) p.269

(Continued on P.13)