S. Frauendorf – EB meeting (1996); Nucl. Phys. A617 (1997) 131

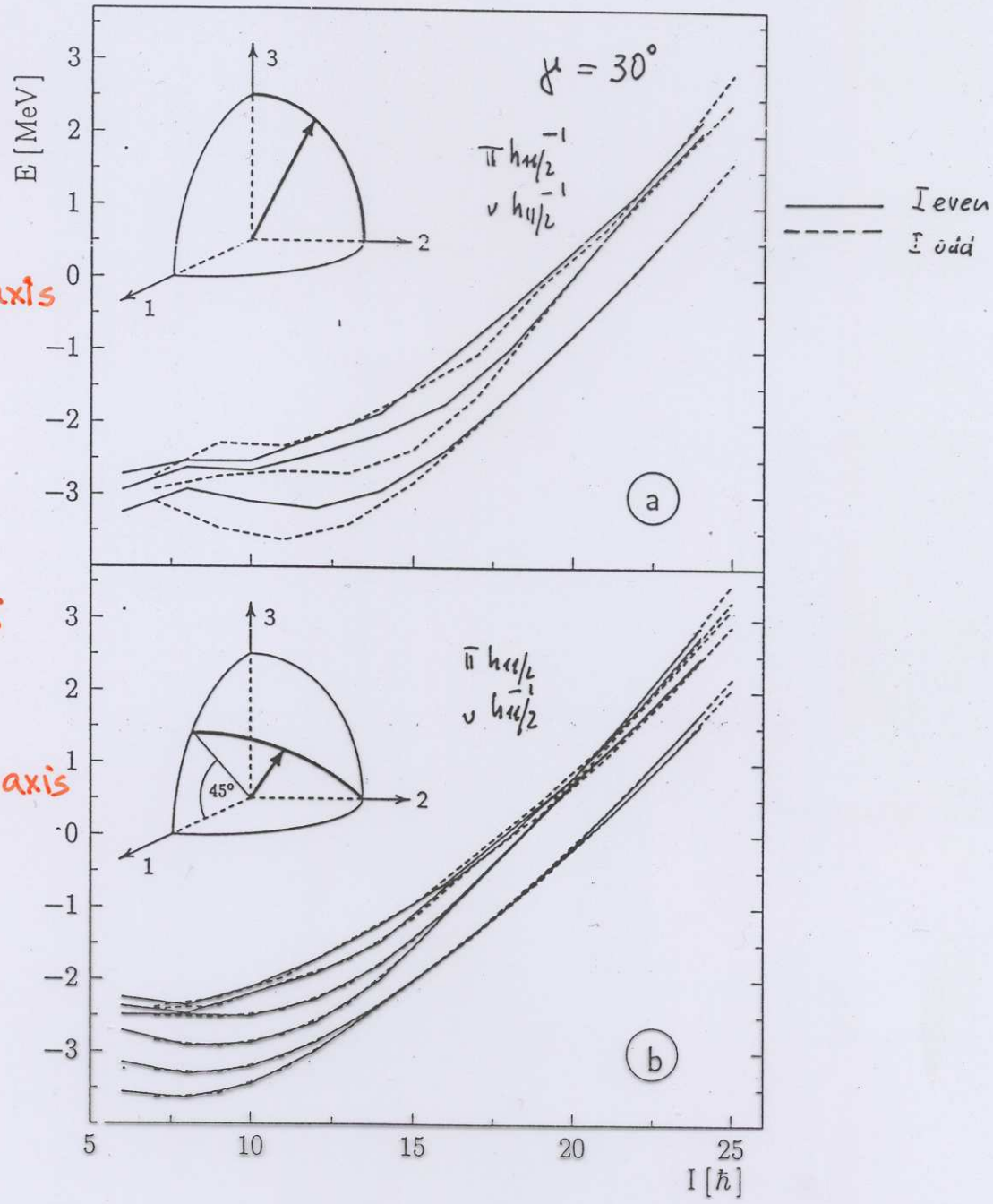
CORE → $\mathcal{J}_1 = \mathcal{J}_3 < \mathcal{J}_2$ → 2-axis

HOLE

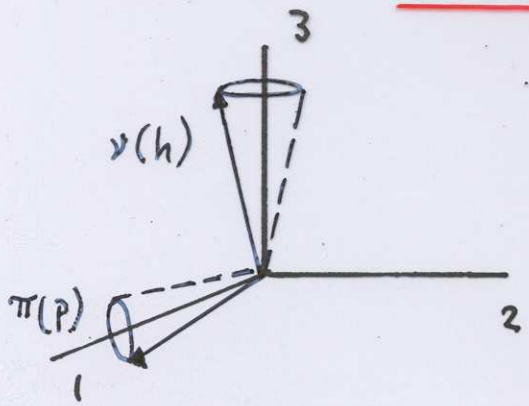
3-axis

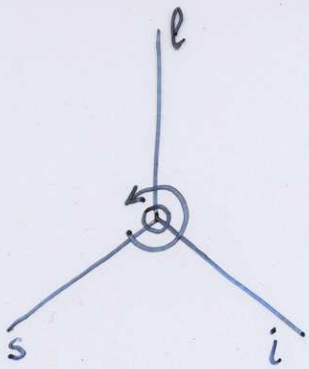
PARTICLE

1-axis

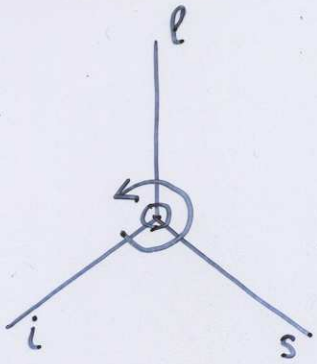


Chiral doublets of ΔI=1 bands





sil right handed

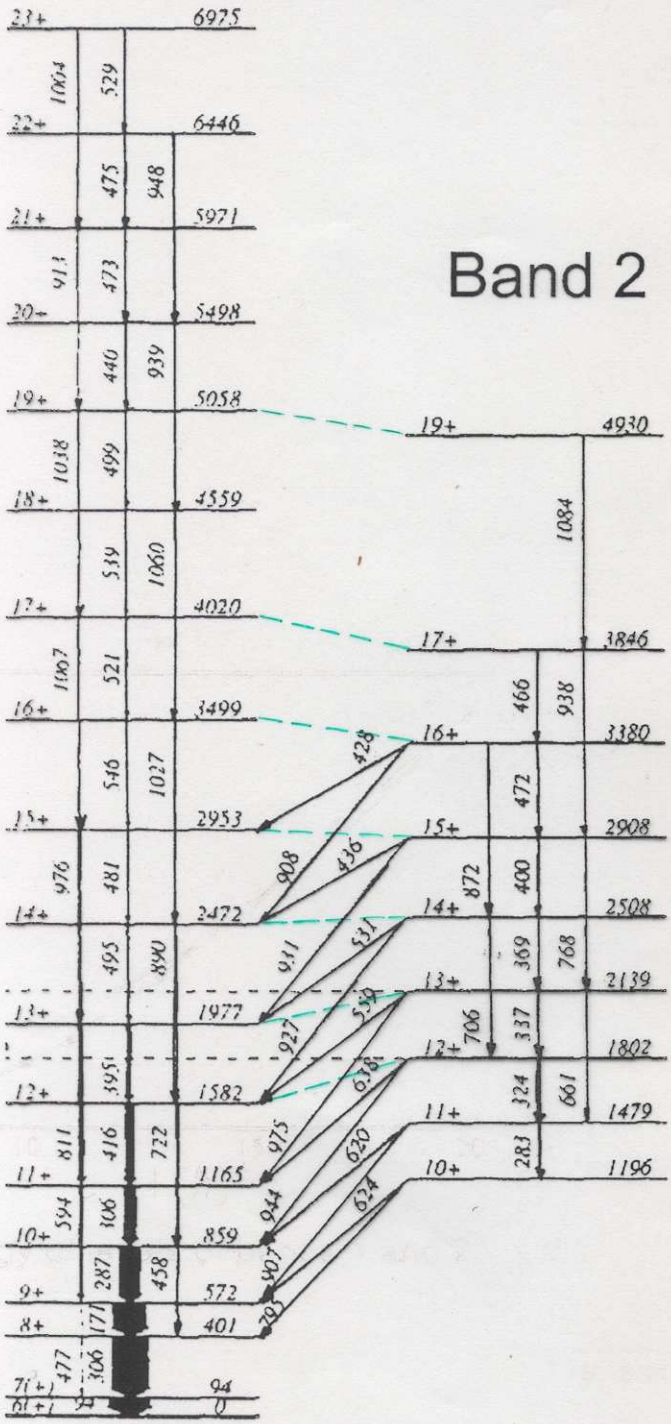


sil left handed

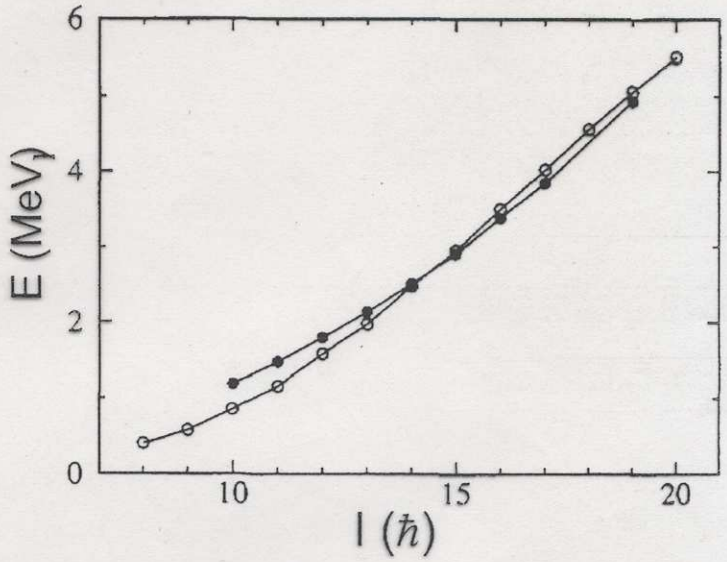
^{134}Pr

Band 1 $\tilde{\pi}h_{11/2} \otimes \tilde{\nu}h_{11/2}$

Band 2

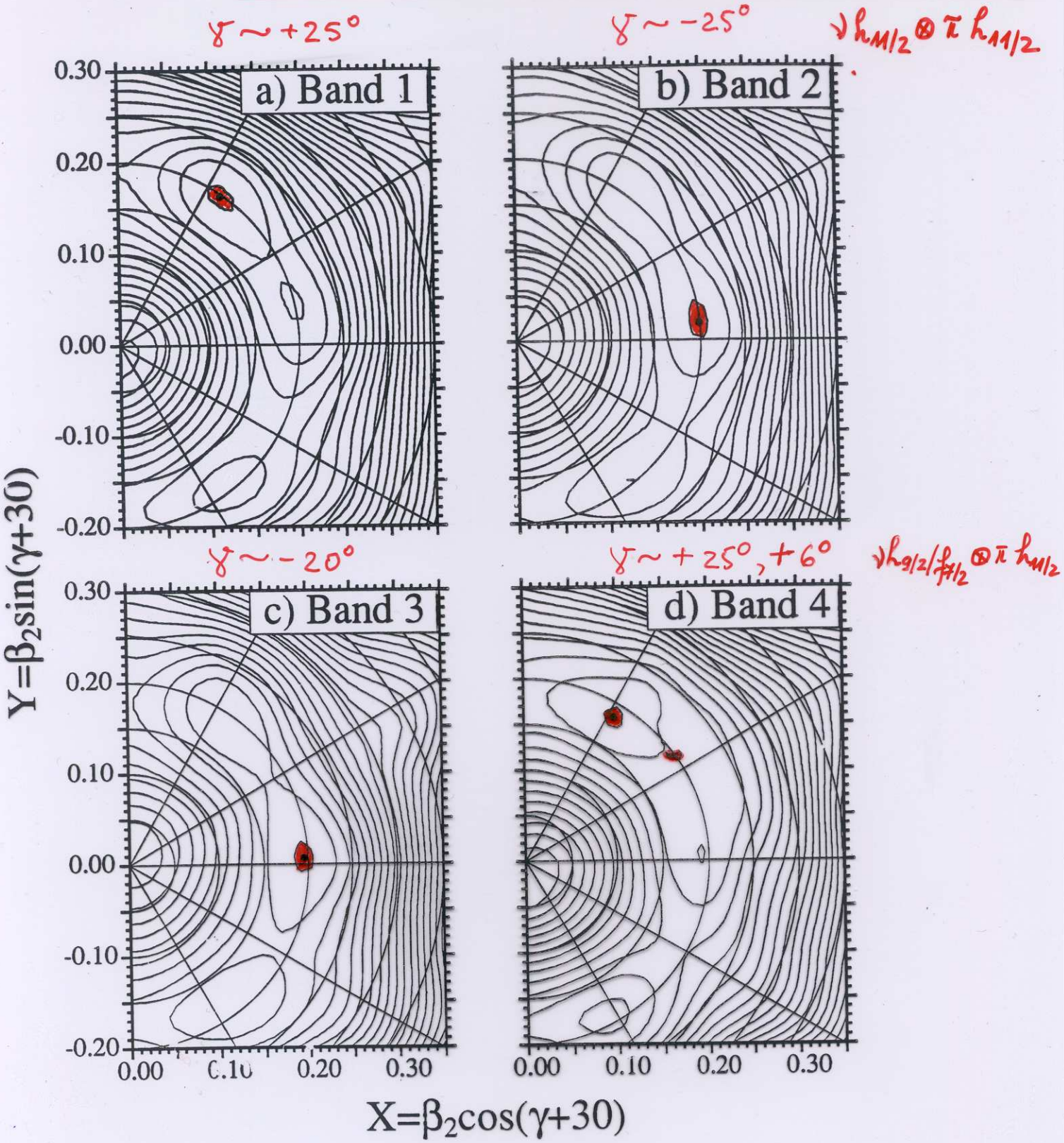


Partial level scheme of ^{134}Pr
(C.M.Petrache *et al.* Nucl. Phys. A 597 (1996) 106)



Energy of levels of bands 1 and 2.

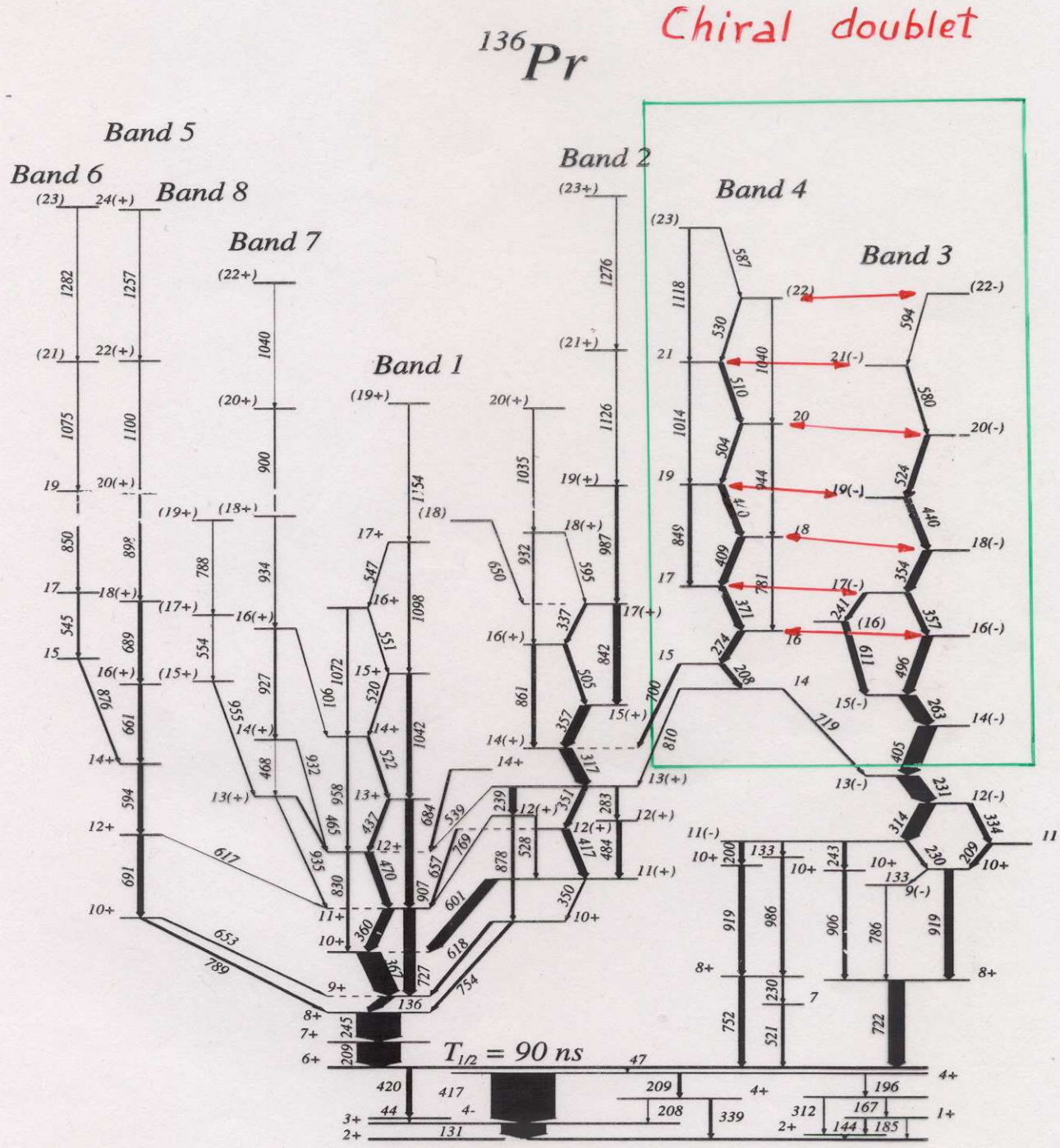
Total routhian surfaces for ^{134}Pr

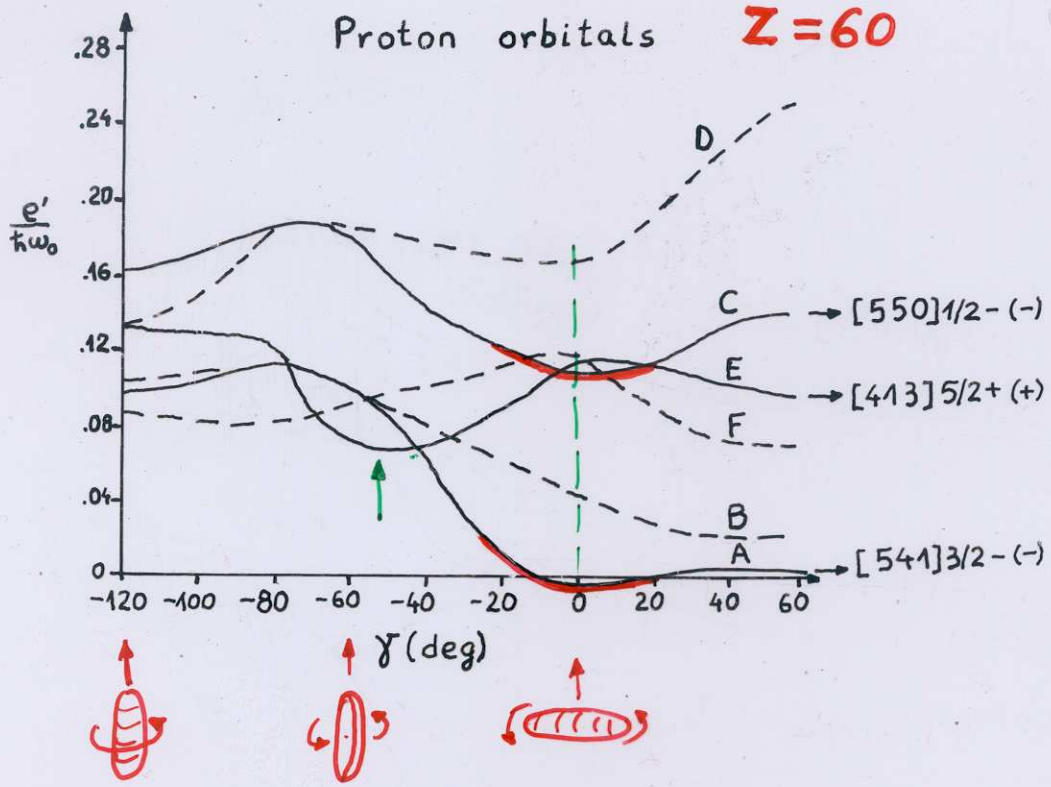


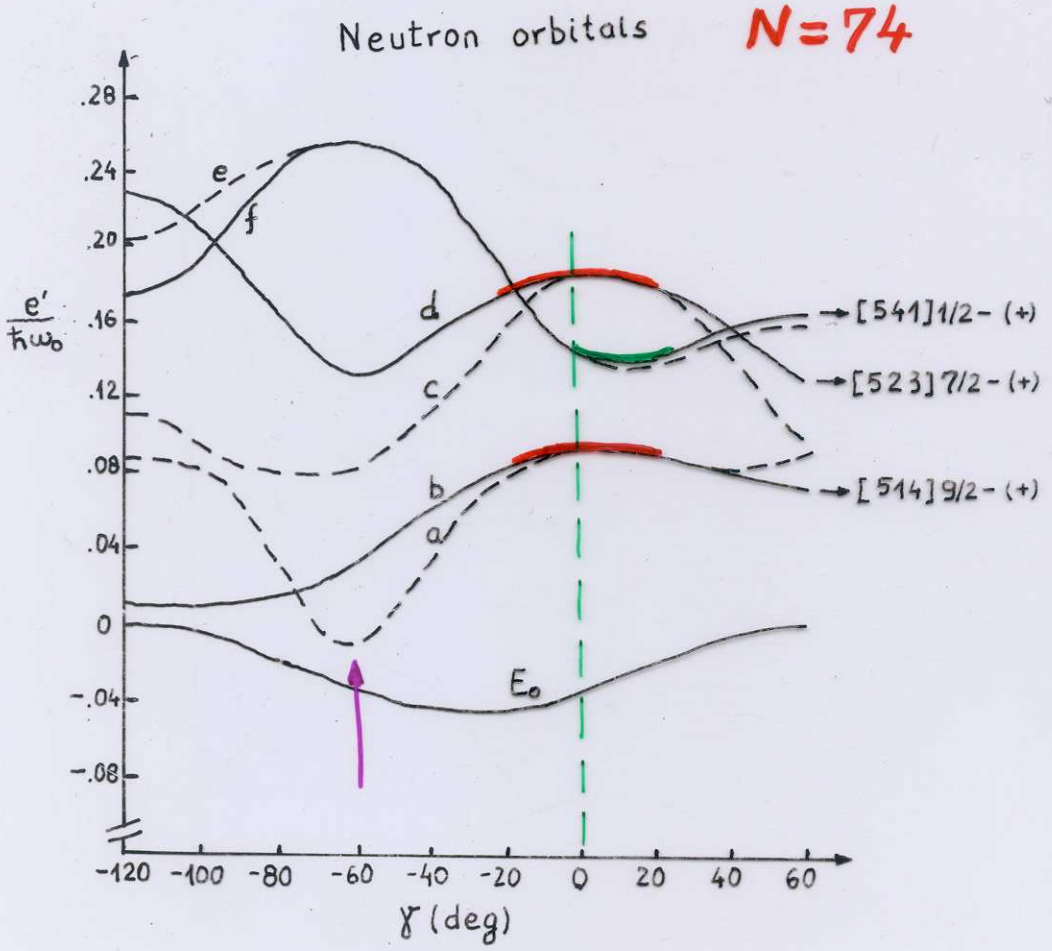
C.M.P. et al.

Nucl. Phys. A 603 (1996) 50

Chiral doublet





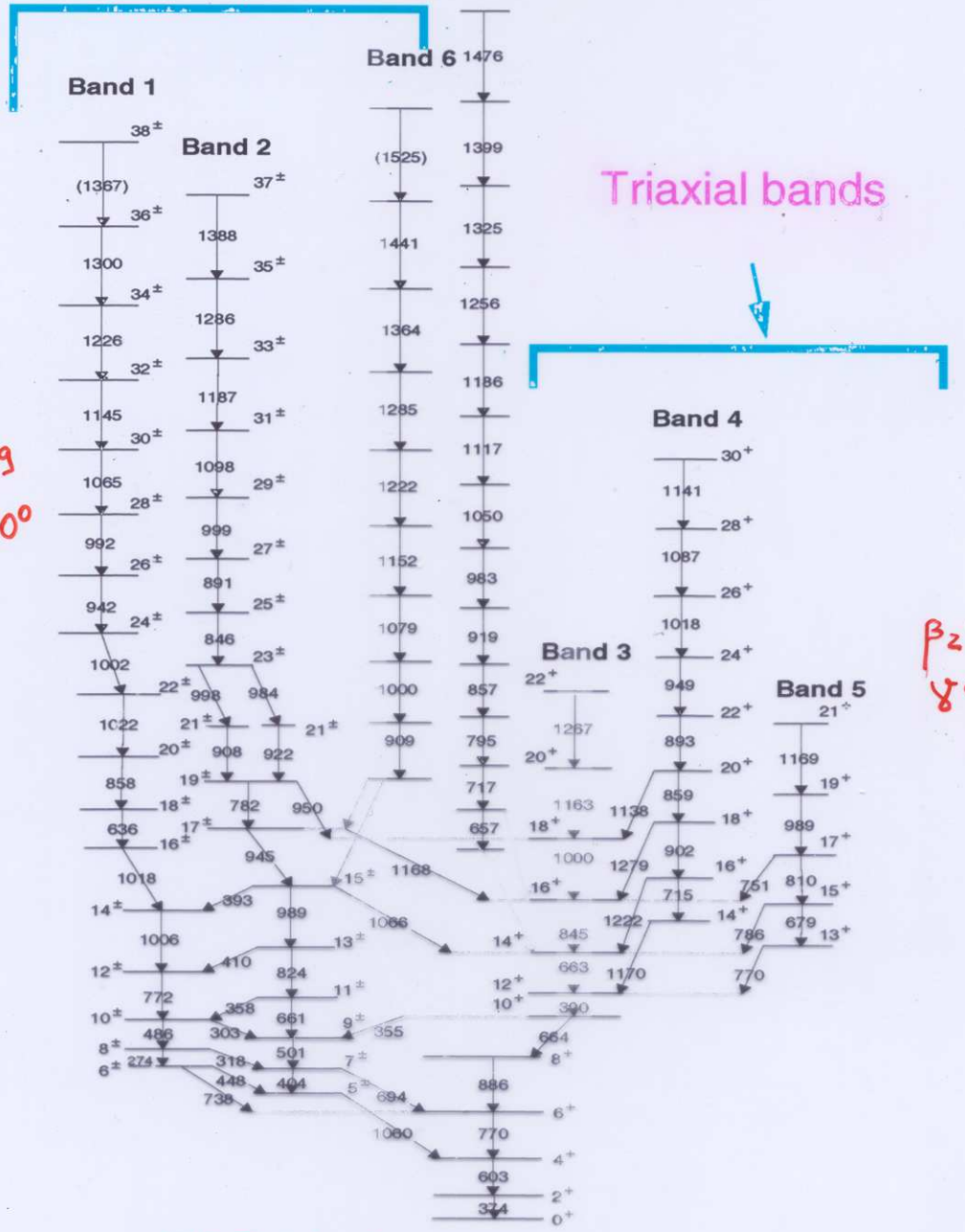


$\varepsilon_2 = 0.2$

^{136}Nd E2 bands

Triaxial bands $\beta_2 = 0.31$

Yrast SD band



C.M.P. et al.

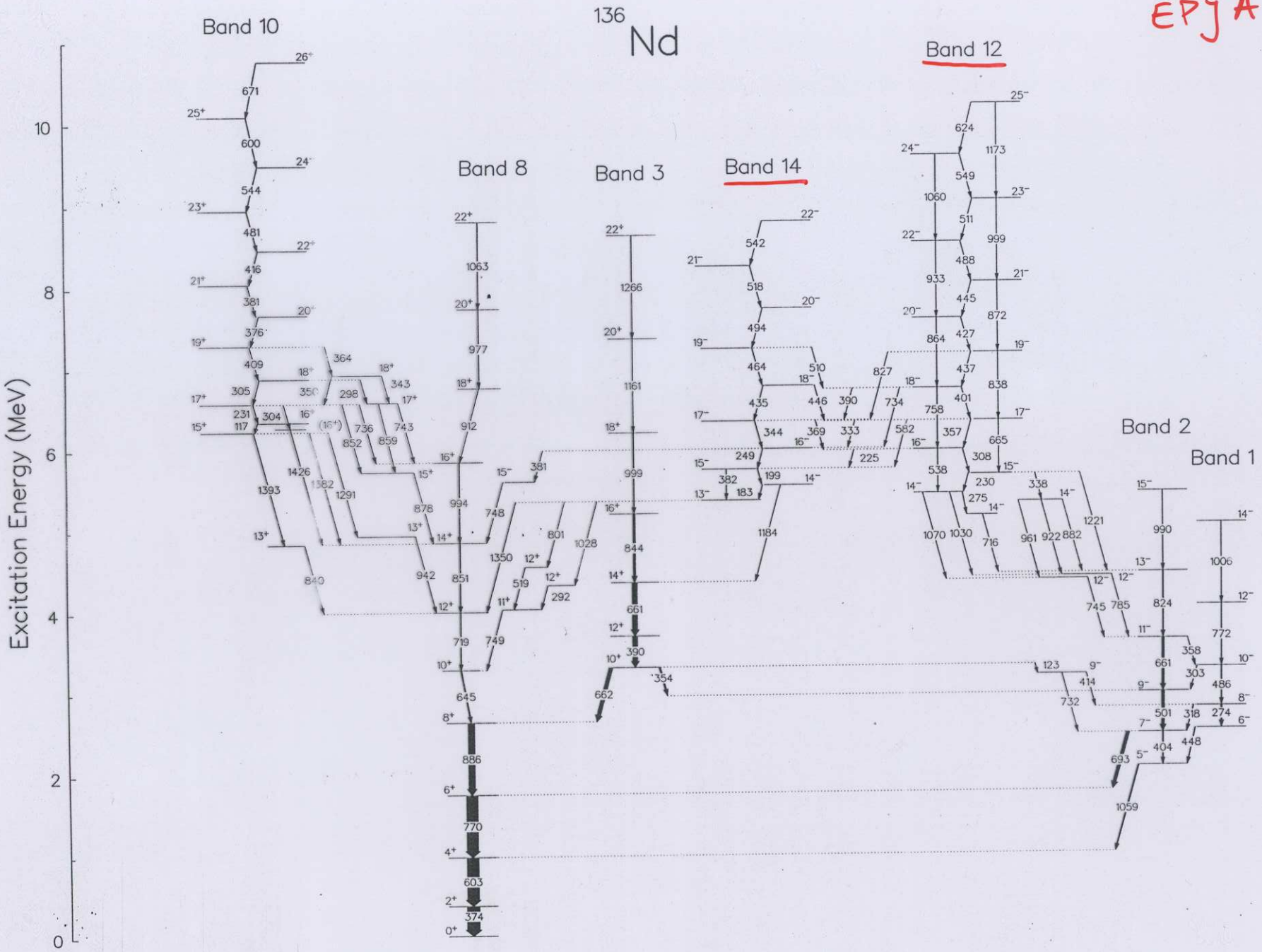
Phys. Lett. B 373 (1996) 275

E.S. Paul et al., Phys. Rev. C 36 (1987) 153

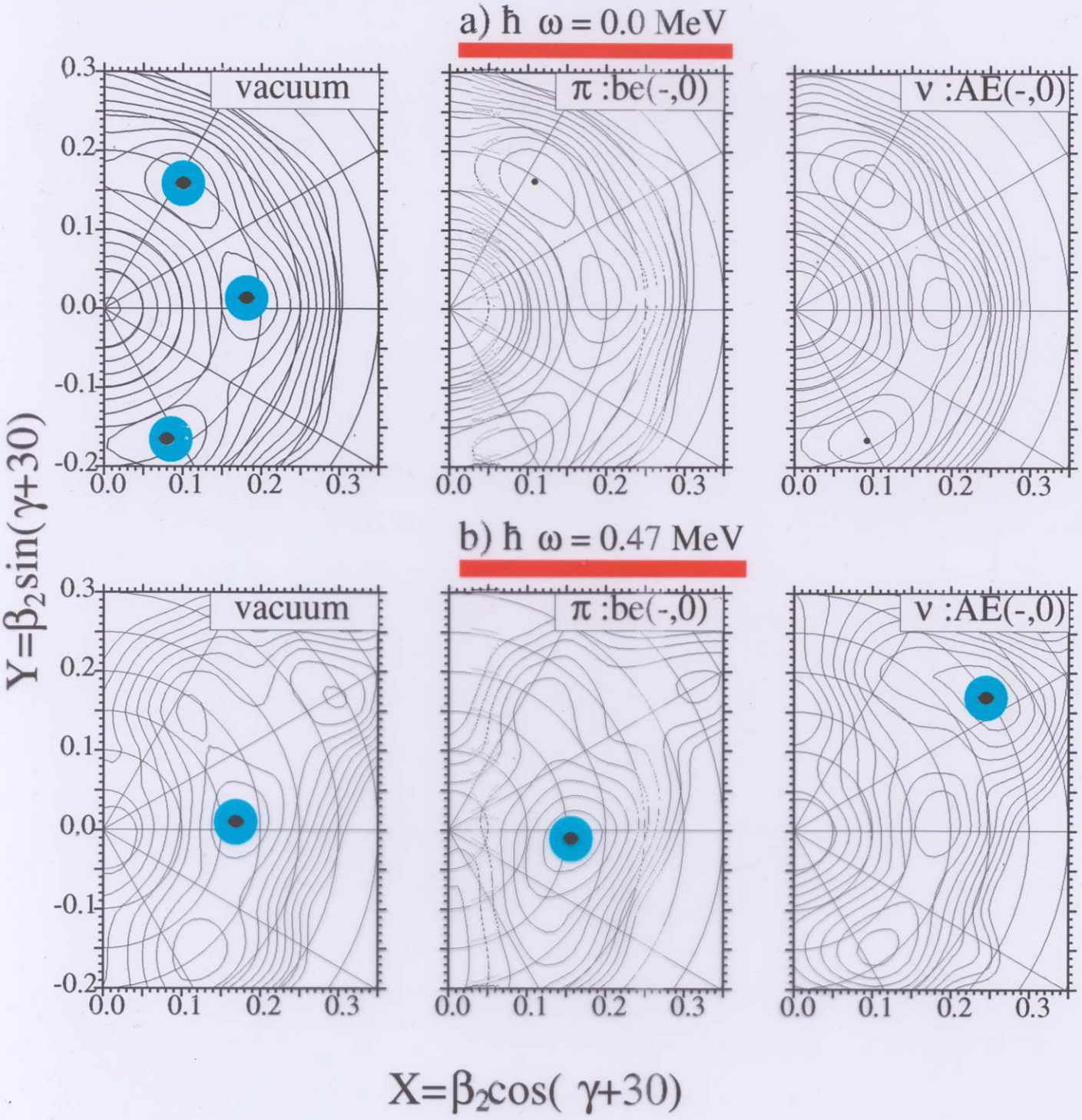
R.M. Clark et al., Phys. Lett. B 343 (1995) 59

C.M.P. et al., Phys. Rev. C 53 (1996) R2581

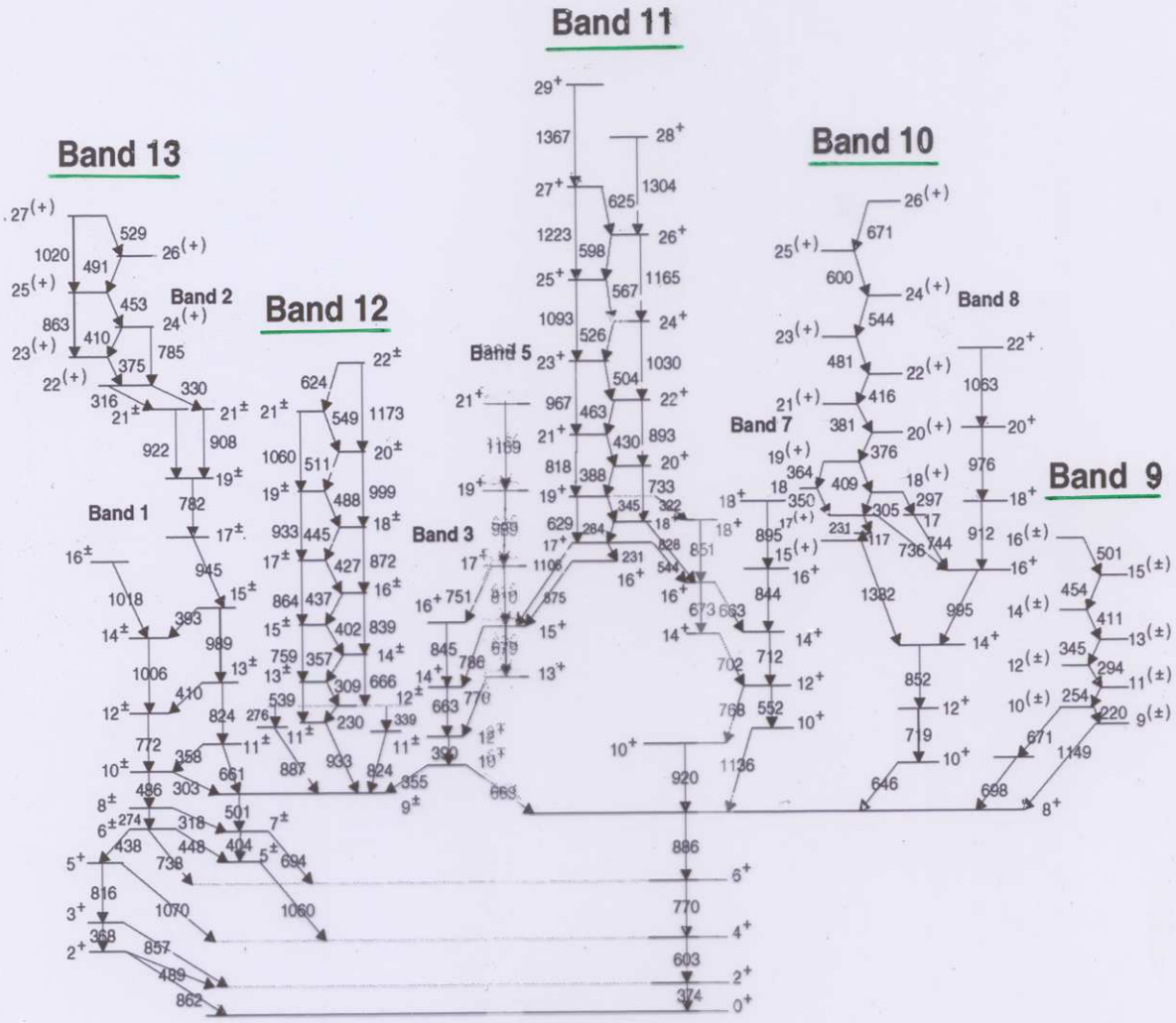
E. Mergel et al., EPJA last issue



Total routhian surfaces for different configurations in ^{136}Nd



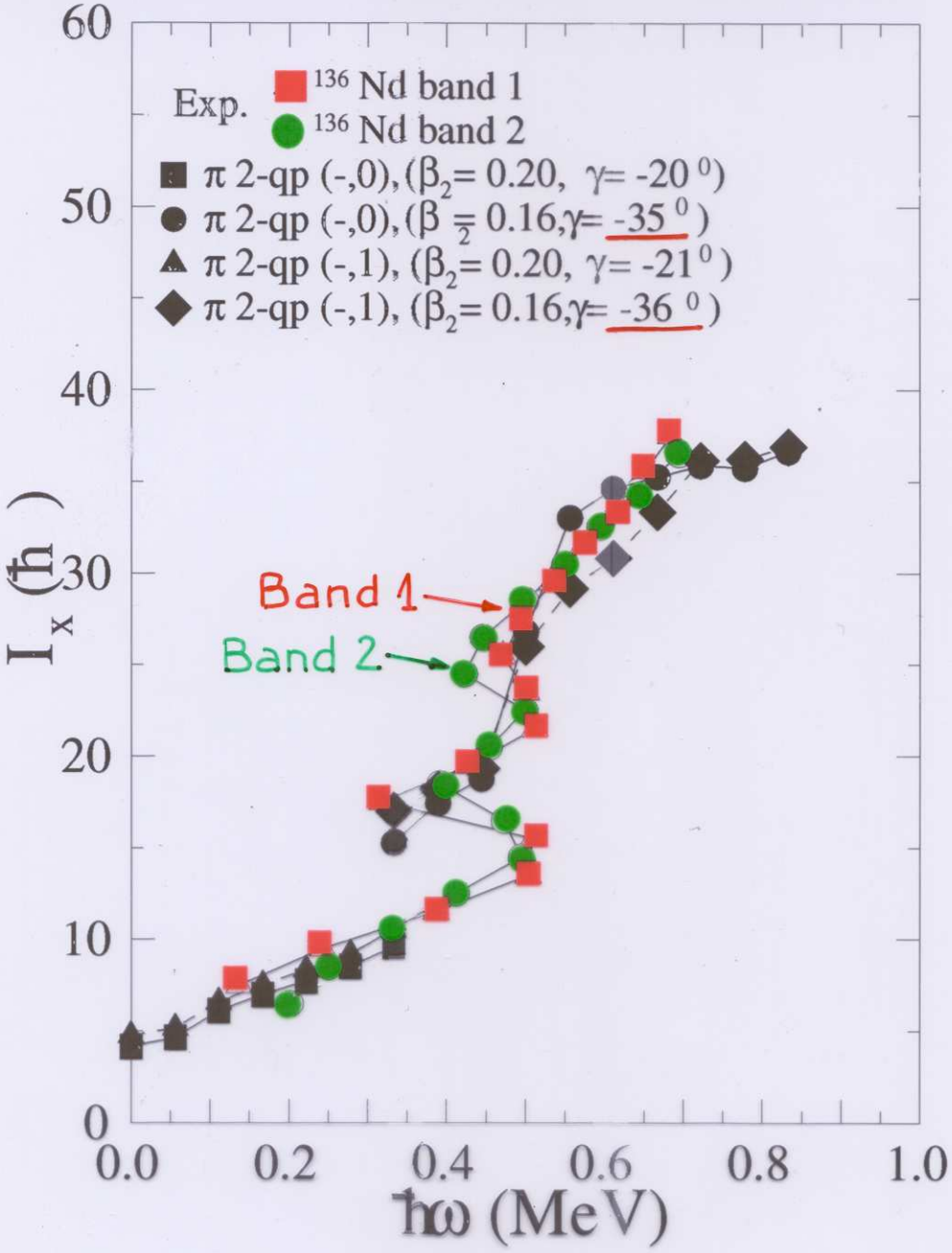
^{136}Nd M1 bands

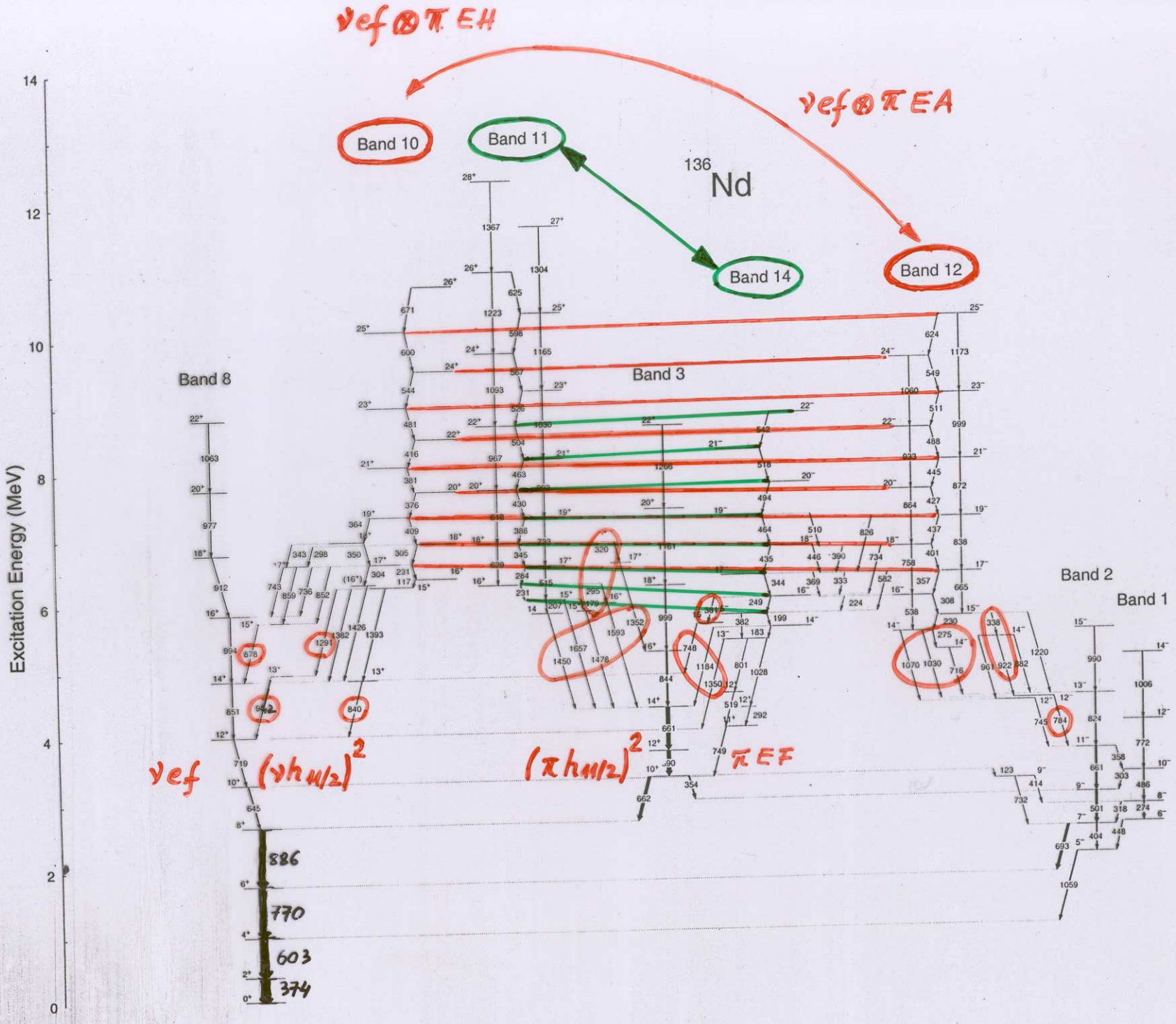


C.M.P. et al.

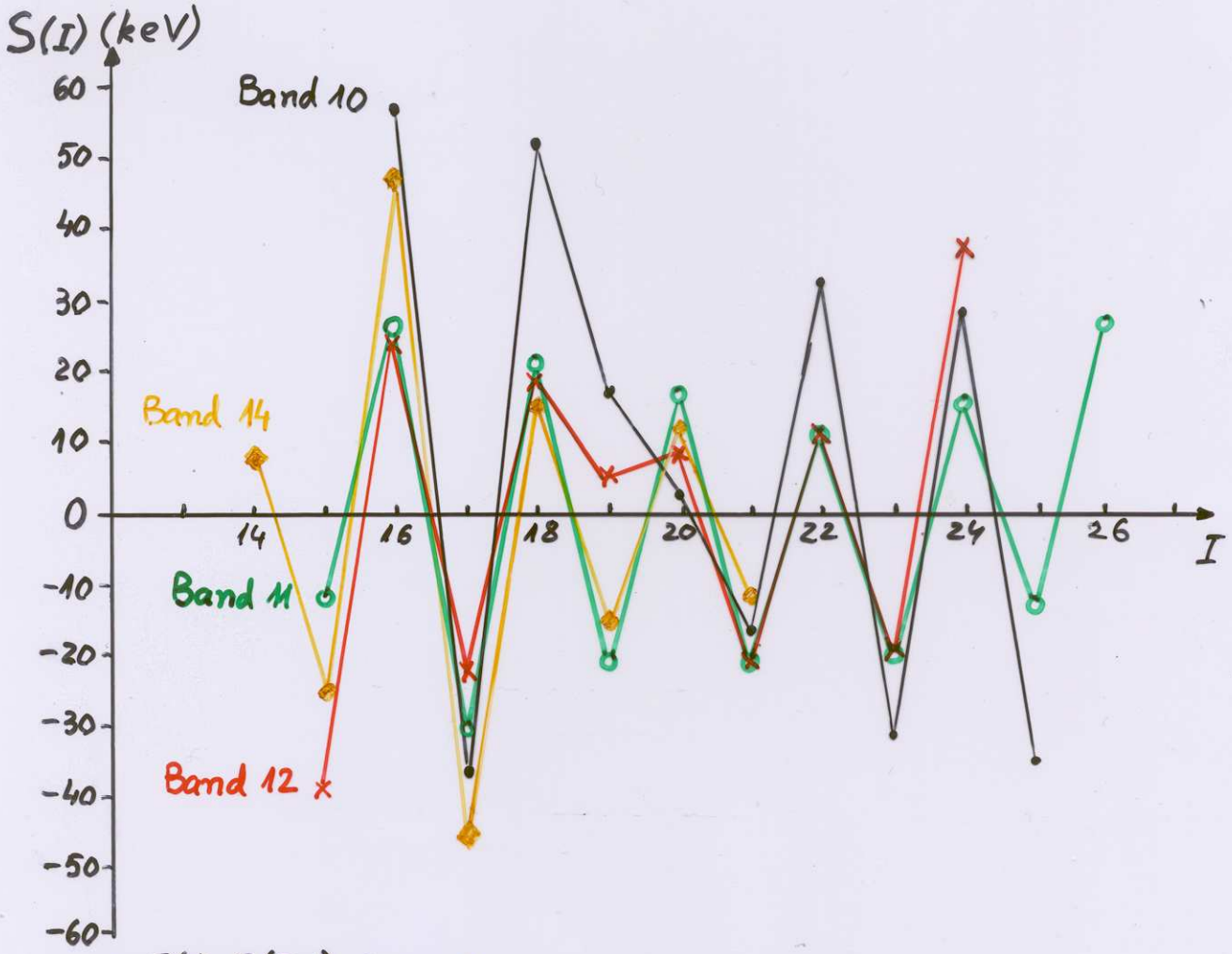
Phys. Rev. C53 (1996) R2581

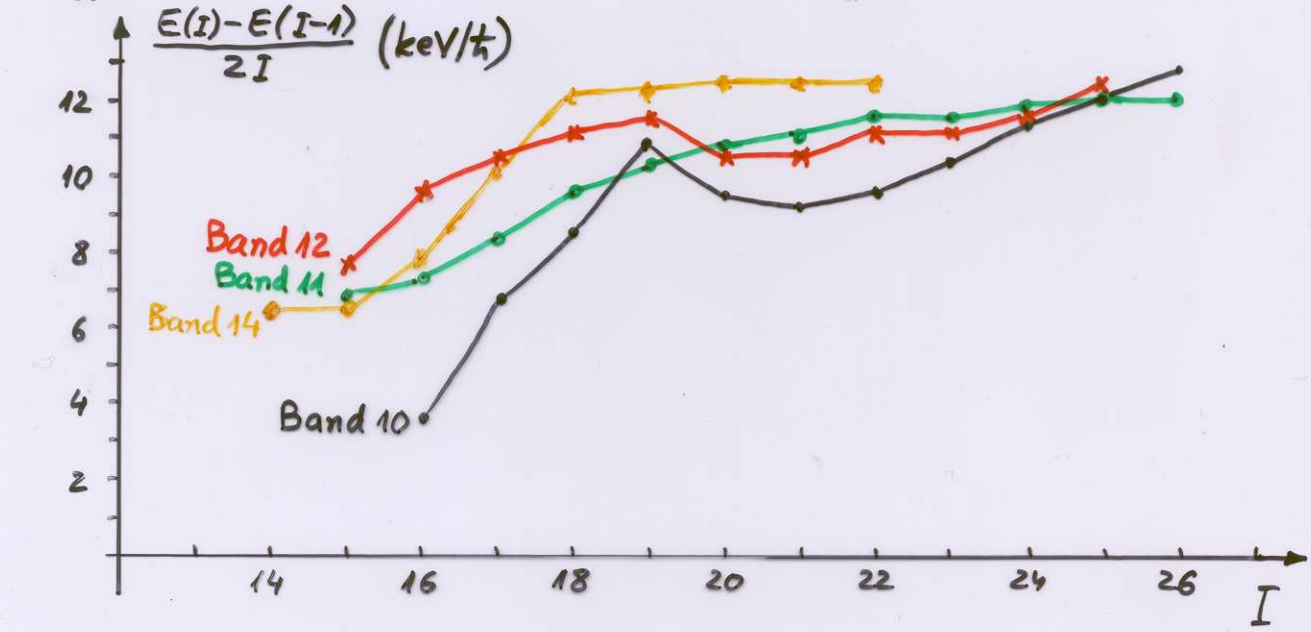
Spin along the rotational axis for bands 1 and 2




νef ⊗ π EH
νef ⊗ π EA
Band 10
Band 11
Band 14
Band 12
136 Nd
Band 8
Band 3
Band 2
Band 1
Excitation Energy (MeV)
νef
(νh11/2)2
(πh11/2)2
πEF
886
770
603
374

$$S(I) = \frac{E(I+1) - E(I-1)}{2} - E(I)$$





Nuclear Tetrahedral Symmetry
J. Dudek, June 2002

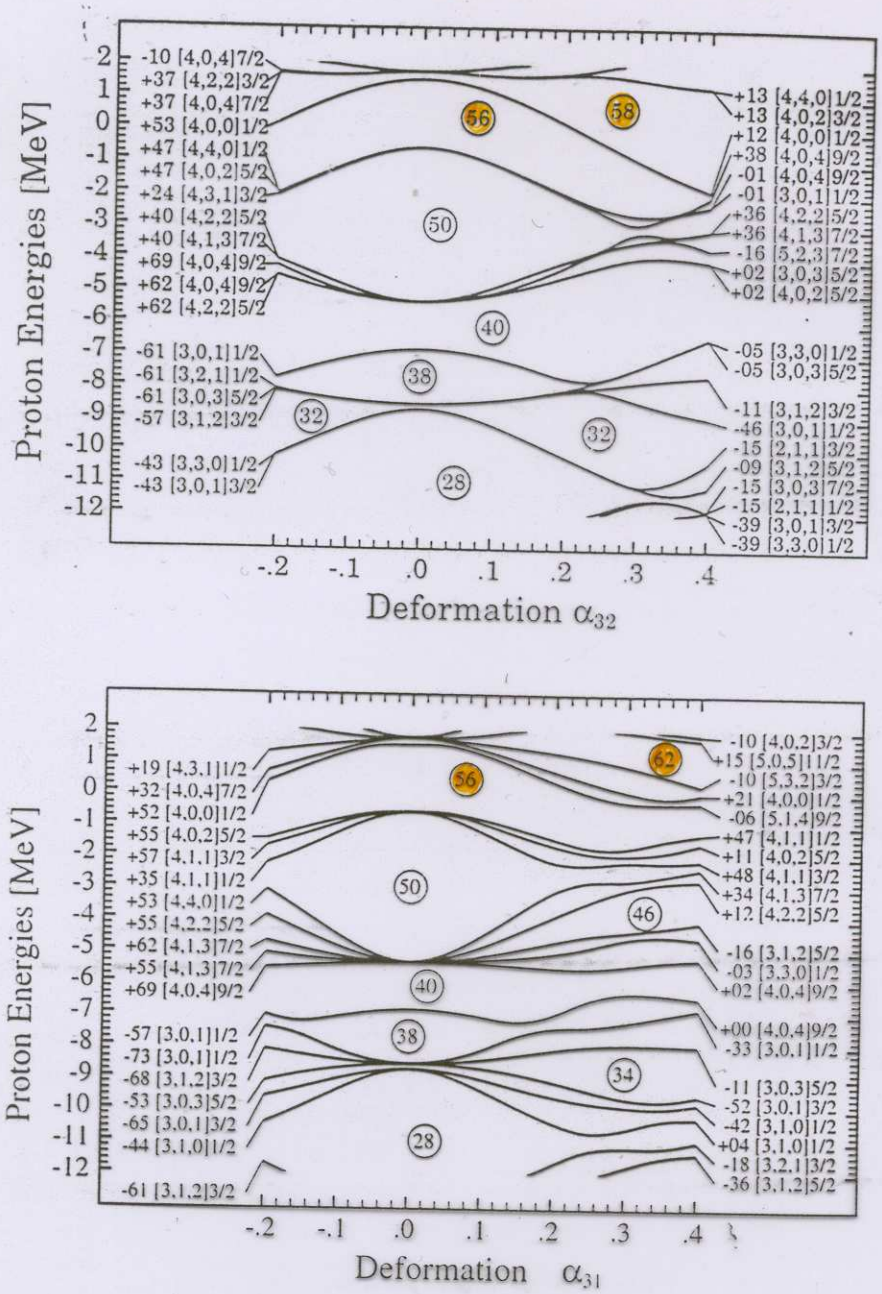


FIG. 1. Results of the realistic calculation of the proton single-particle energies in function of the α_{32} deformation corresponding to the T_d^D symmetry (top) compared to the analogous dependence in function of α_{31} (bottom, C_{2v}^D group). The numbers in front of the Nilsson labels give the expectation values of parity at the extremes of the deformation axes. None of the Nilsson quantum numbers is a good quantum number at tetrahedral deformations: Each label gives the full set of quantum numbers of the strongest basis state. (Results were obtained using a standard deformed Woods-Saxon potential.)

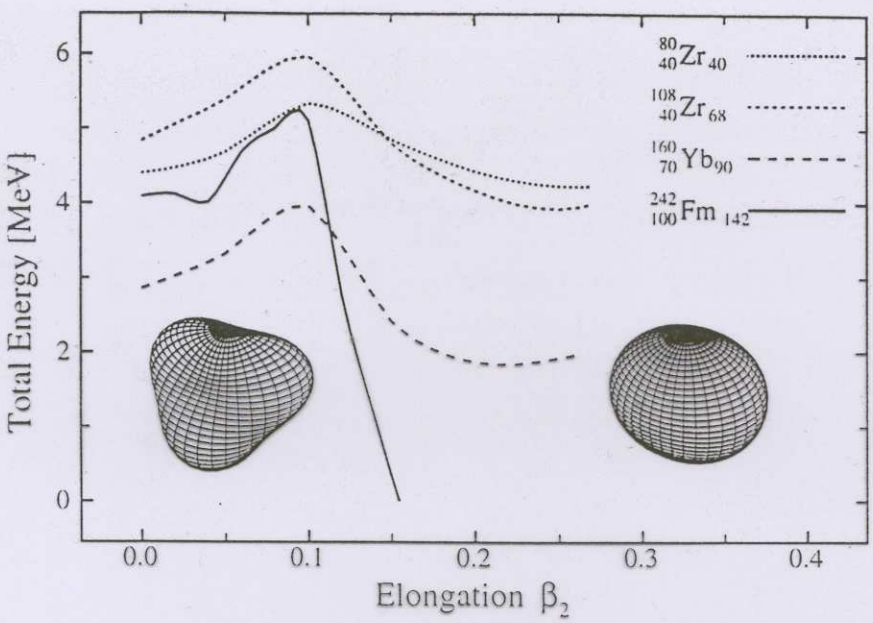


FIG. 2. Results of the multidimensional minimization of the total nuclear energies projected on the quadrupole deformation axis. The gamma deformation as well as all other deformations vary along the β_2 axis following the minimization, for each curve separately. The left-hand side inset shows an exaggerated (for better visibility) view of the tetrahedral shape at $\alpha_{32} = 0.3$, roughly twice the calculated equilibrium deformation. The right-hand side inset shows for comparison an oblate shape surface at $\beta_2 = 0.20, \gamma = 60^0$, i.e., roughly at the calculated equilibria.

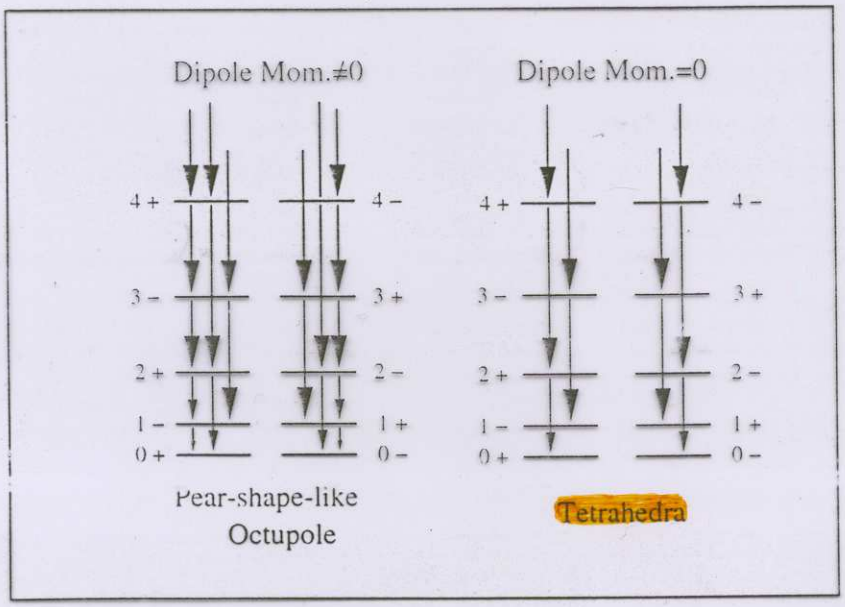


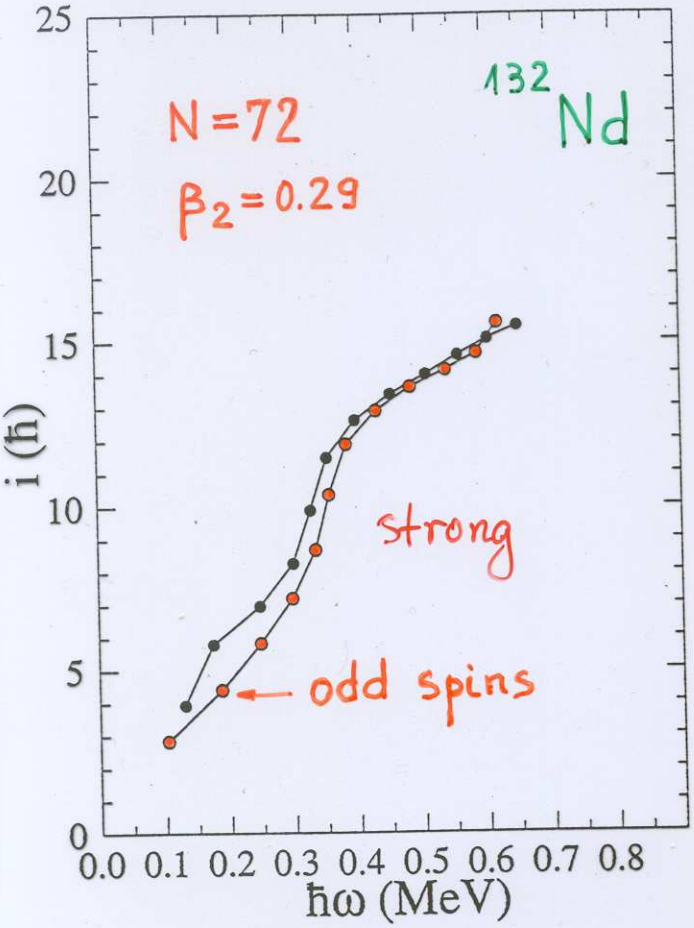
FIG. 3. Qualitative comparison of the electromagnetic transitions in a "pear-shape" nucleus, left, and a tetrahedral nucleus, right. In the former case, the static dipole moments are often strong, thus implying a presence of the collective interband $E1$ transitions in addition to the $E2$ ones. Tetrahedral nuclei generate no static dipole moments and, thus the $E1$ transitions should be absent in this case.

Experimental identification of T_d^D

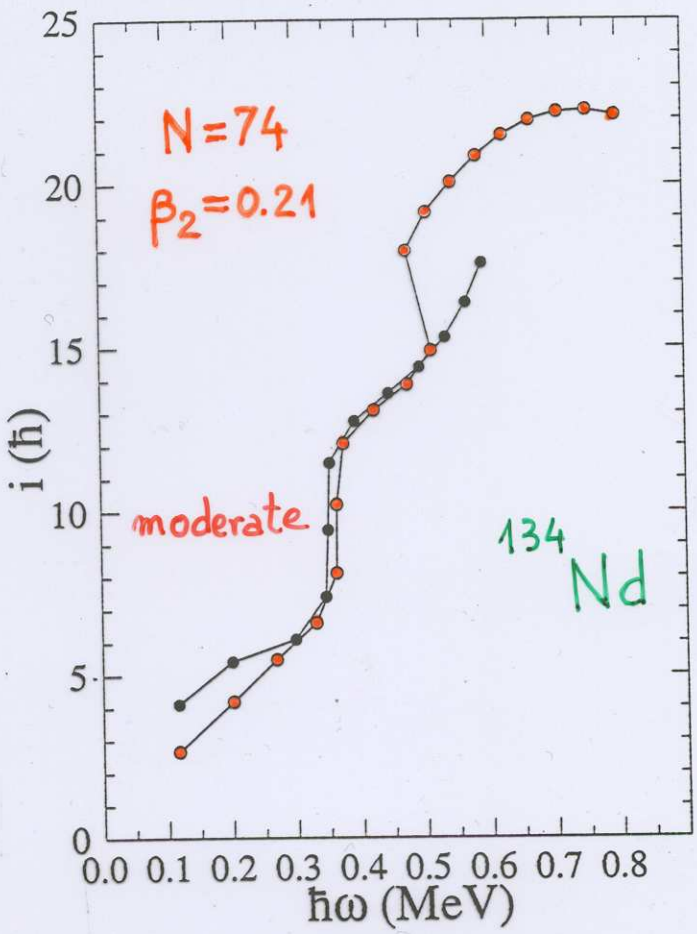
1. Within the class of single-particle excit., the 4-fold degeneracies ⇒
   multitude of particle-hole transitions of close-lying energies
   in some cases ⇒ 16-fold degenerate multiplet of transitions

2. Within the class of low-lying collective rotational excitations ⇒
   simplex symmetry ⇒ parity-doublet bands without E1 interband transitions

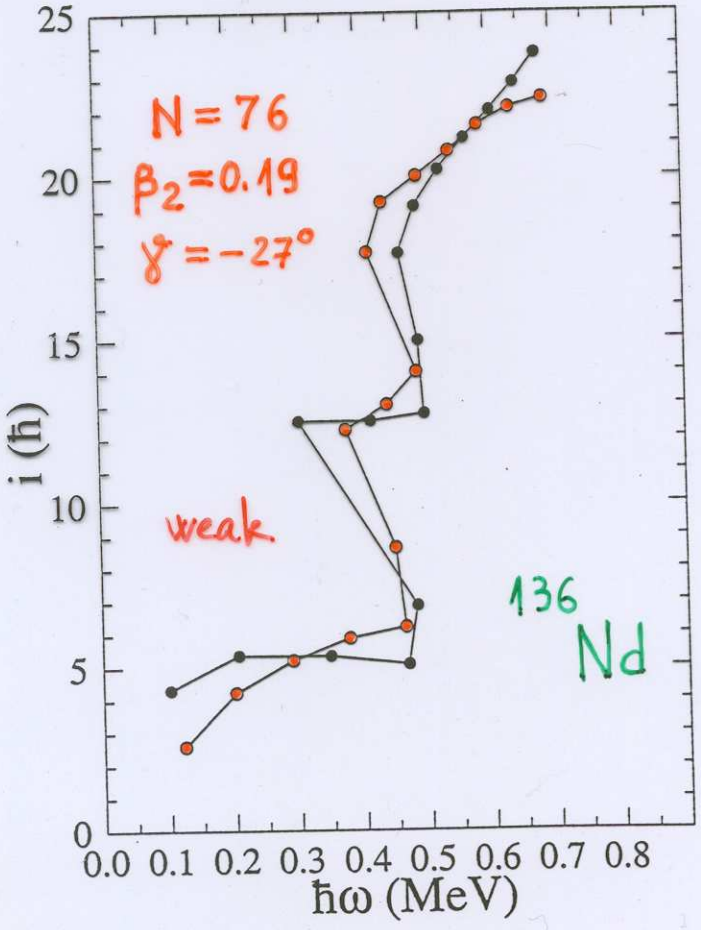
Alignments of the Bands 1 and 2 in ^{132}Nd



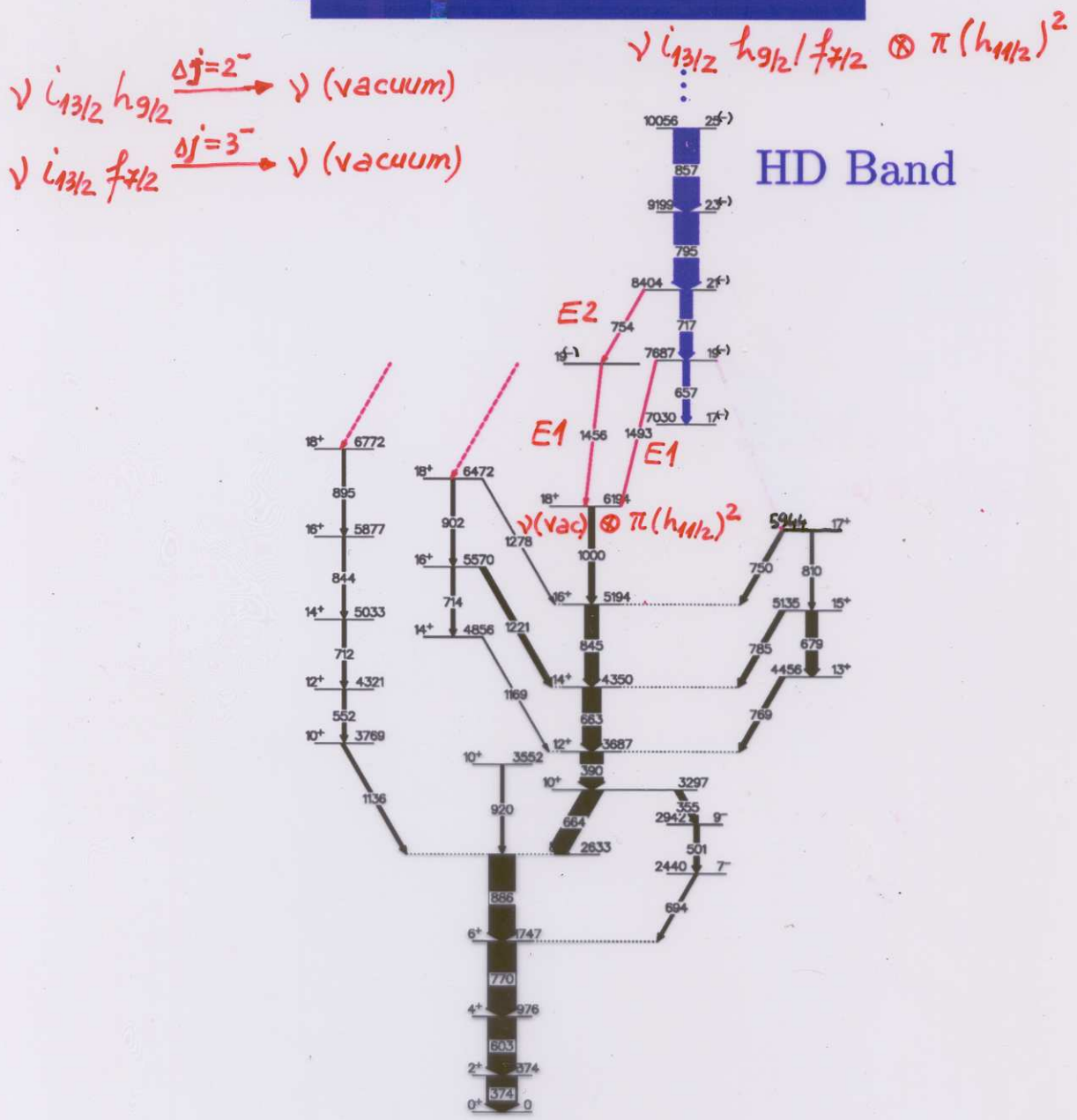
Alignments of the Bands 1 and 2 in ^{134}Nd



Alignments of the E2 Bands in ^{136}Nd



^{136}Nd decay-out level scheme



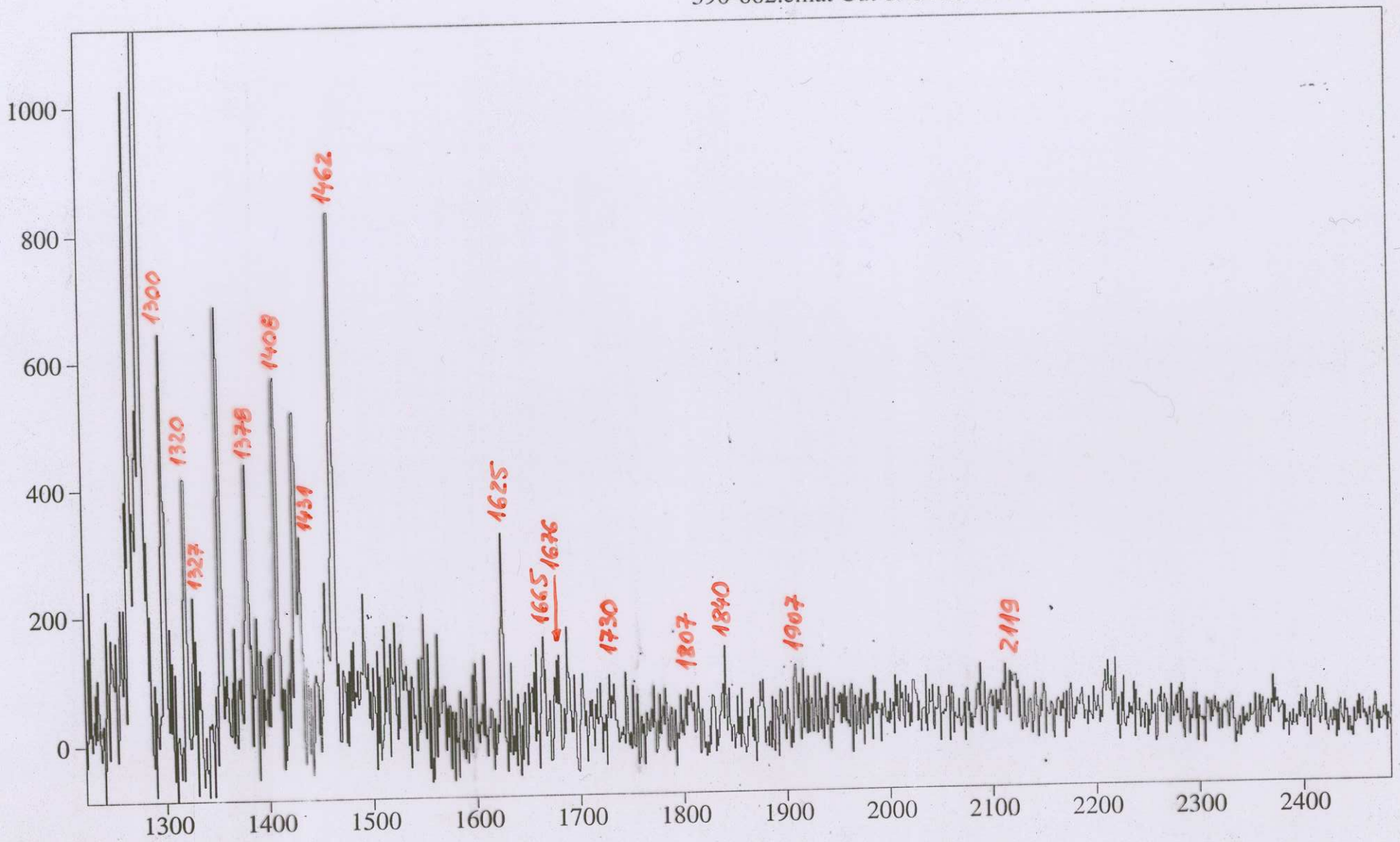
DCO measurements ⇒ 1456 keV ΔI=1

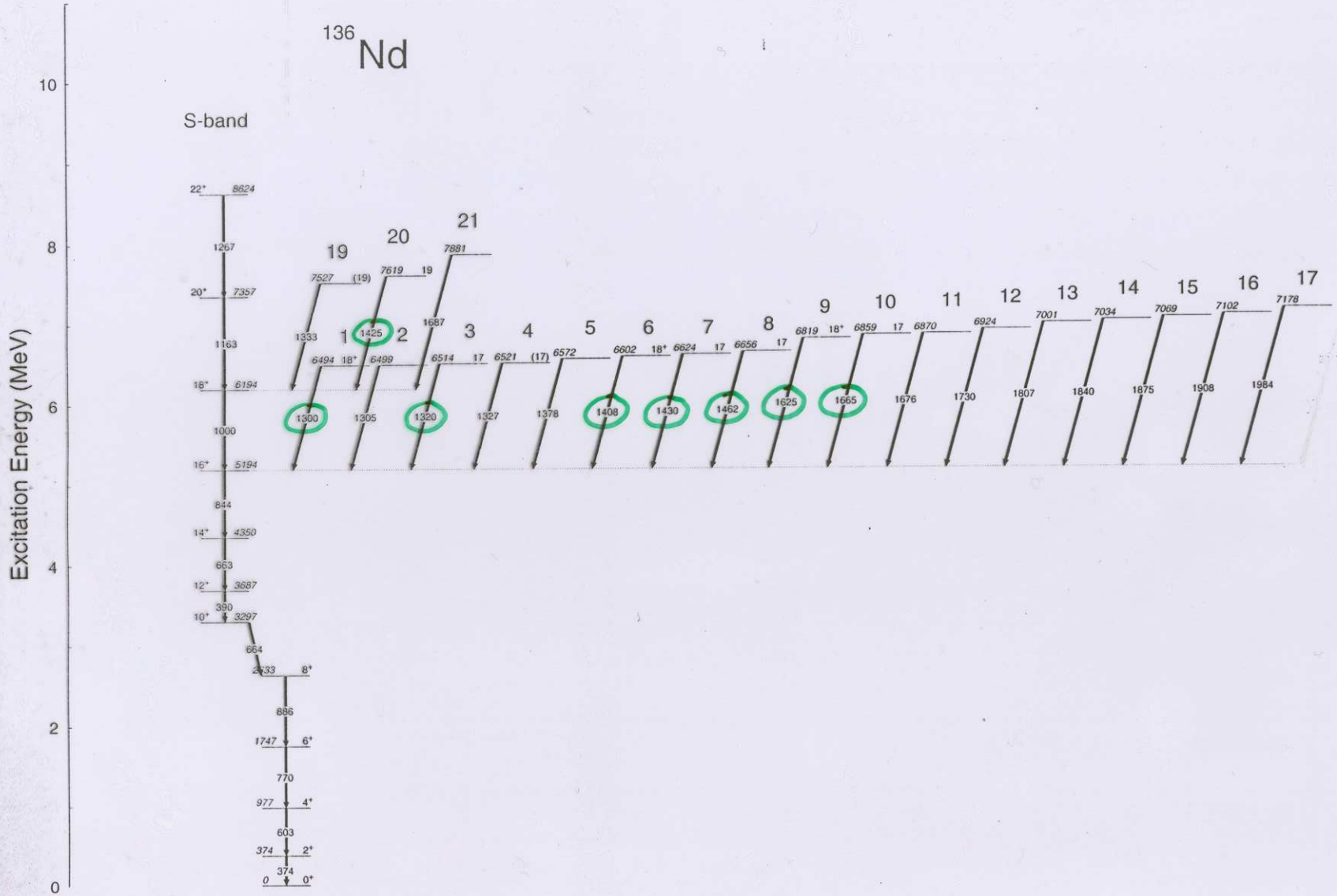
754 keV ΔI=2

↪The band disappears at spin 17^- with an excitation energy of 7030 keV

↪Decay-out pattern similar to ^{134}Nd

390-662.cmat Cut of 844.0 keV




136Nd
S-band
Excitation Energy (MeV)
0
2
4
6
8
10
22+ 8624
1267
20+ 7357
1163
18+ 6194
1000
16+ 5194
844
14+ 4350
663
12+ 3687
390
10+ 3297
664
2633 8+
886
1747 6+
770
977 4+
603
374 2+
374
0 0+
1 7527 (19)
2 7619 19
3 7881
4 6494 18+
5 6499
6 6514 17
7 6521 (17)
8 6572
9 6602 18+
10 6624 17
11 6656 17
12 6819 18+
13 6859 17
14 6870
15 6924
16 7001
17 7034
18 7069
19 7102
20 7178
21
1333
1425
1687
1300
1305
1320
1327
1378
1408
1430
1462
1625
1665
1676
1730
1807
1840
1875
1908
1984