Approximate SU(3) in heavy nuclei

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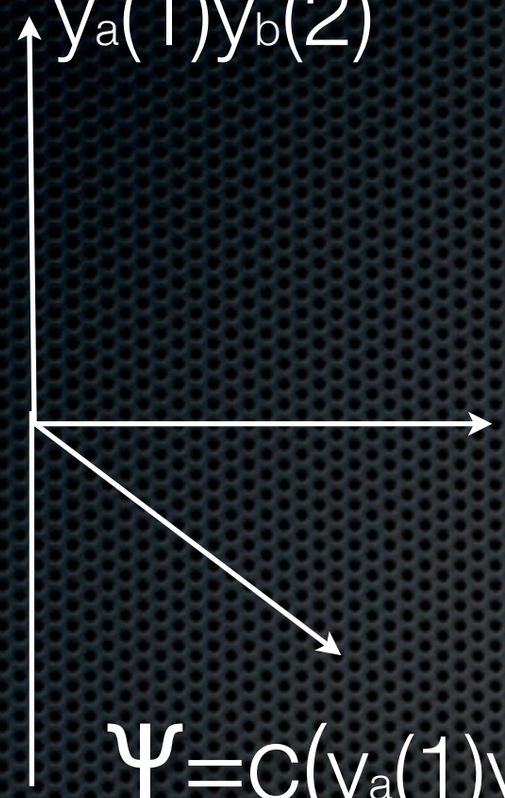
U(n) Symmetry



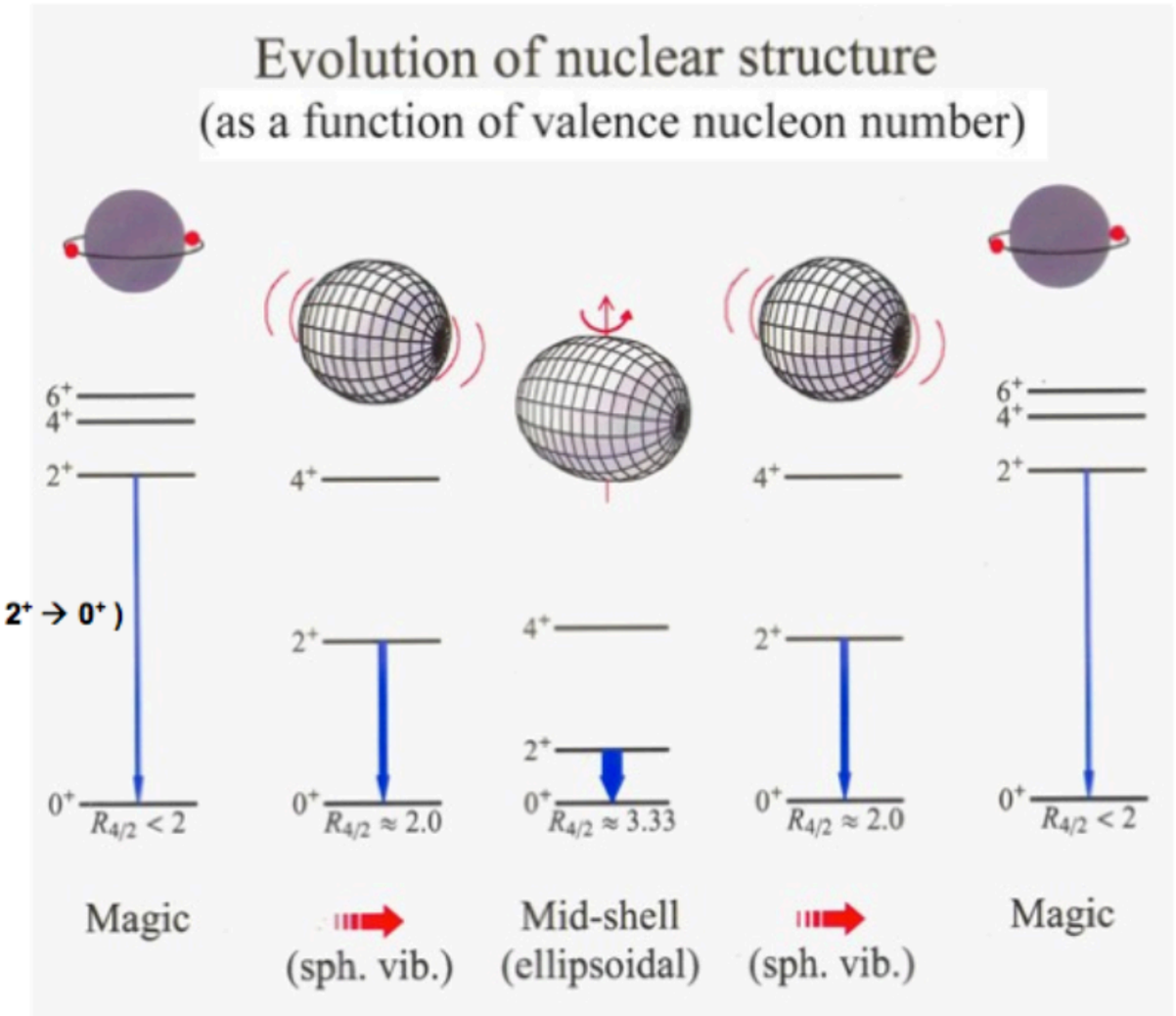
$$\Psi = c(y_a(1)y_b(2) - y_a(2)y_b(1))$$

space rotation $a \leftrightarrow b$

particle permutation $1 \leftrightarrow 2$

- U(n) symmetry means that the length of the vectors remains the same after rotation.
- **Space Rotation is equivalent to particle permutation.**
- Probabilities of each many particle state do not change after permutation, when H has U(n) symmetry.

U(n)⊃SU(3)



- Deformation evolves as valence nucleon number differs perceptibly from magic numbers.

↕

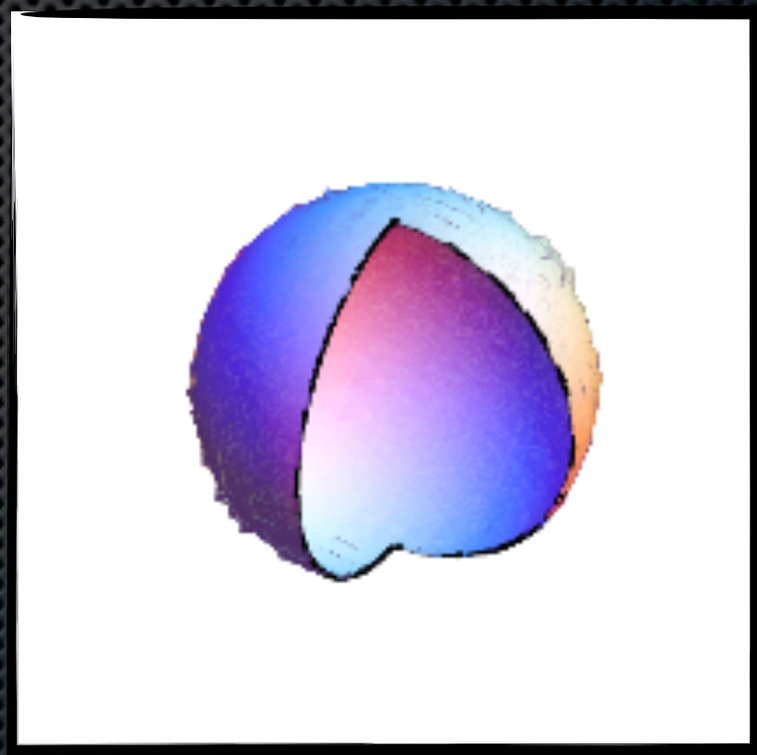
SU(3)=Deformed rotor

Similar orbitals

- Valence nucleons with the same alignment in space have big overlaps.

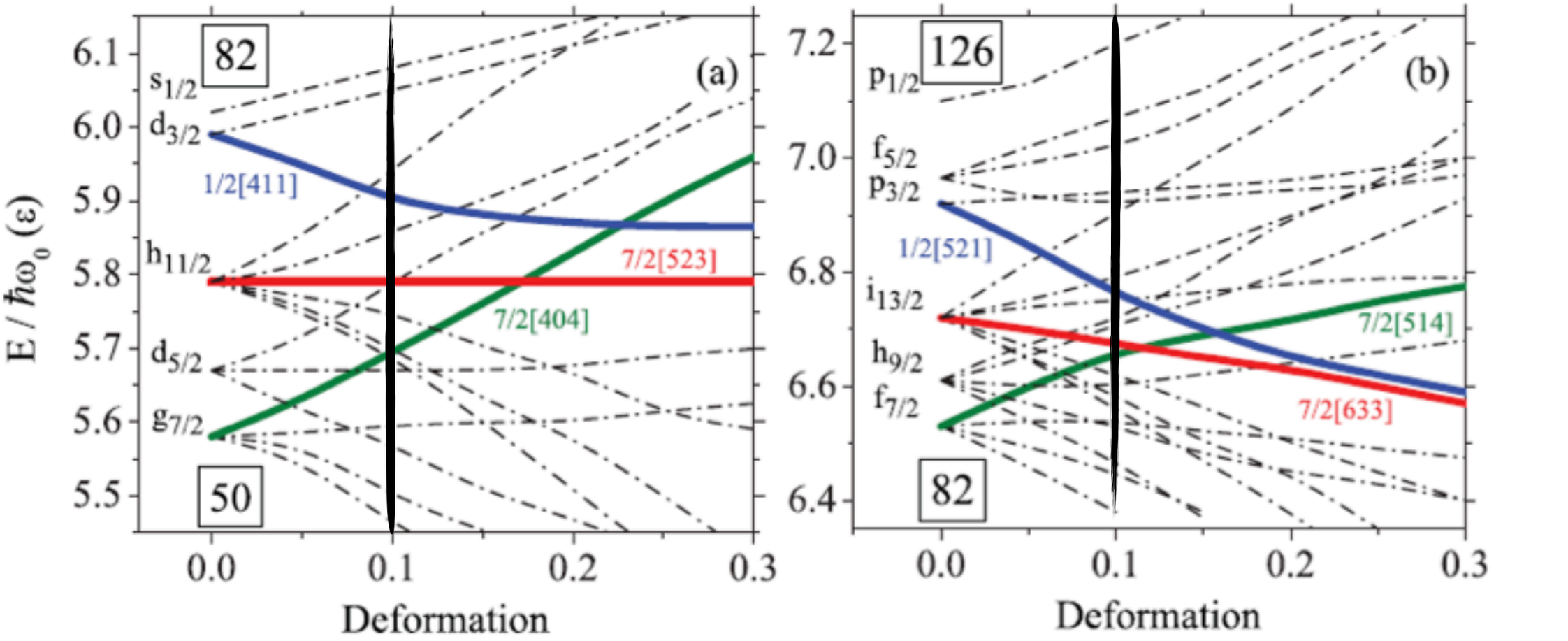
Spatial overlap

$$\int \left(\chi^{*}_{N_1\Omega_1}\chi_{N_1\Omega_1}\right)\left(\chi^{*}_{N_2\Omega_2}\chi_{N_2\Omega_2}\right) dV$$



D. Bonatsos, S. Karampagia, R.B. Cakirli, R.F. Casten, K. Blaum, L. Amon Susam PRC88, 054309(2013)

Nilsson orbitals



- Similar orbitals can replace one another

$$\Delta K[\Delta N\ \Delta n_z\ \Delta\Lambda]=0[110]$$

Replacing orbitals

- The resulting clump of orbitals has SU(3) symmetry.

50-82 p	50-82 p	sdg p	sdg p
3s1/2	1/2[400]	3s1/2	1/2[400]
2d3/2	1/2[411]	2d3/2	1/2[411]
	3/2[402]		3/2[402]
2d5/2	1/2[420]	2d5/2	1/2[420]
	3/2[411]		3/2[411]
	5/2[402]		5/2[402]
1g7/2	1/2[431]	1g7/2	1/2[431]
	3/2[422]		3/2[422]
	5/2[413]		5/2[413]
	7/2[404]		7/2[404]
1h11/2	1/2[550]	1g9/2	1/2[440]
	3/2[541]		3/2[431]
	5/2[532]		5/2[422]
	7/2[523]		7/2[413]
	9/2[514]		9/2[404]
	11/2[505]		

82-126 n	82-126 n	pfh n	pfh n
3p1/2	1/2[501]	3p1/2	1/2[501]
3p3/2	1/2[521]	3p3/2	1/2[521]
	3/2[512]		3/2[512]
2f5/2	1/2[510]	3f5/2	1/2[510]
	3/2[501]		3/2[501]
	5/2[503]		5/2[503]
2f7/2	1/2[541]	3f7/2	1/2[541]
	3/2[532]		3/2[532]
	5/2[523]		5/2[523]
	7/2[514]		7/2[514]
1h9/2	1/2[530]	1h9/2	1/2[530]
	3/2[521]		3/2[521]
	5/2[512]		5/2[512]
	7/2[503]		7/2[503]
	9/2[505]		9/2[505]
1i13/2	1/2[660]	1h11/2	1/2[550]
	3/2[651]		3/2[541]
	5/2[642]		5/2[532]
	7/2[633]		7/2[523]
	9/2[624]		9/2[514]
	11/2[615]		11/2[505]
	13/2[606]		

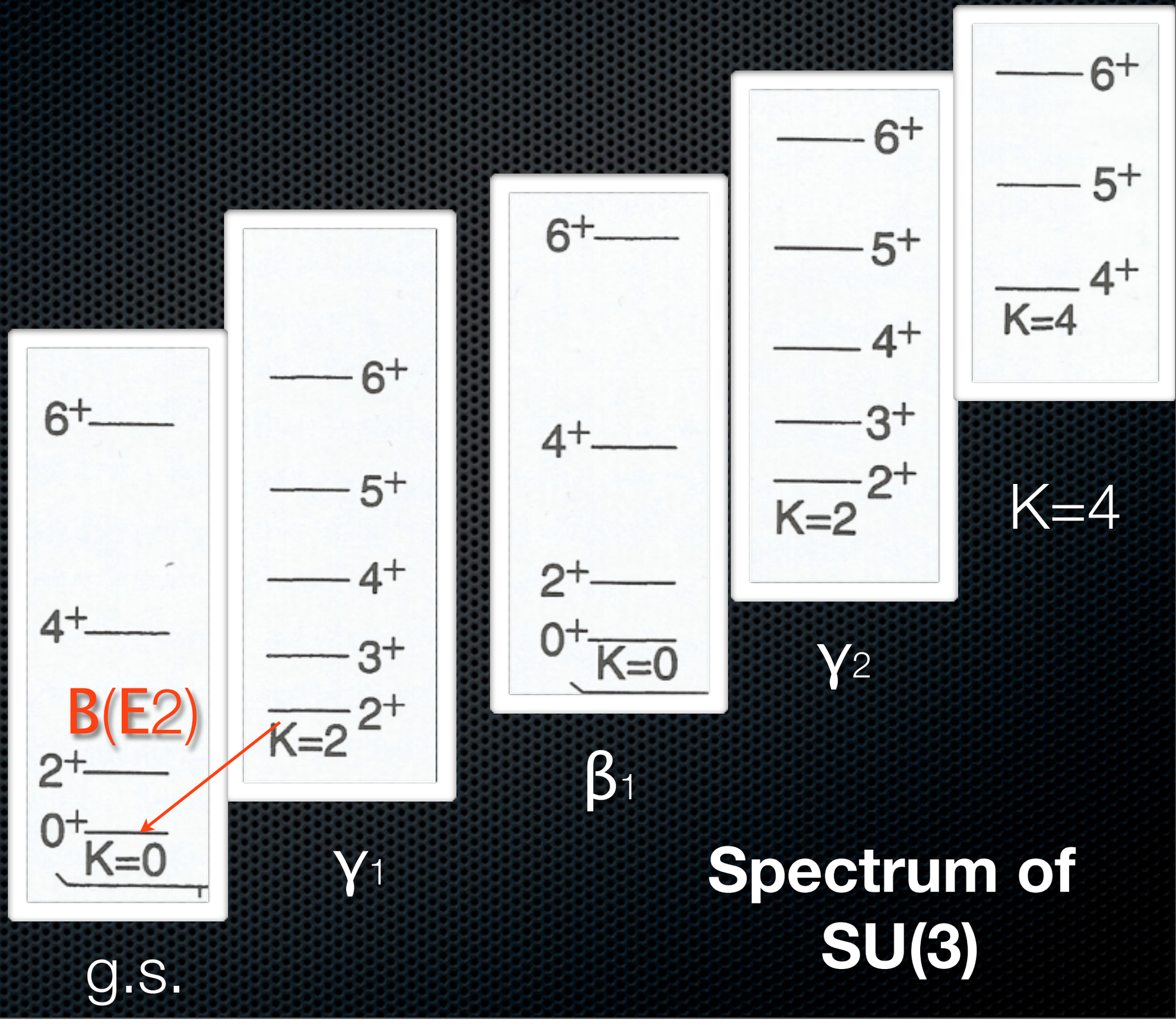
Hamiltonian of the nucleus

$$\hat{H} = \hat{L}^2 + c_1\hat{\Omega} + c_2\hat{Q}\cdot\hat{Q}$$

- **Ω**: three body interaction operator which conserves the SU(3) symmetry and breaks the degeneracy between the first β and the first γ band.
- **Q**: quadrupole operator
- A two parameter model.

Anticipated spectrum

- β_1 and γ_1 bands are no longer degenerate.
- Large B(E2) transition probabilities between γ_1 and ground state band.

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