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Isomeric states produced by fusion evaporation

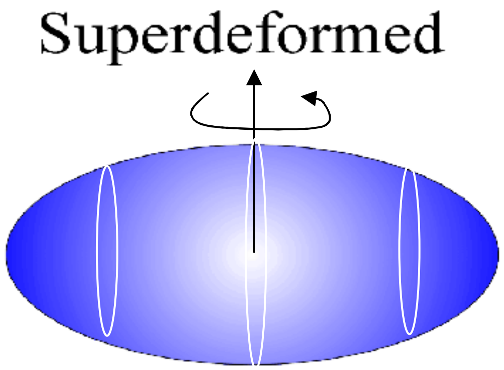
Example: Pb-region

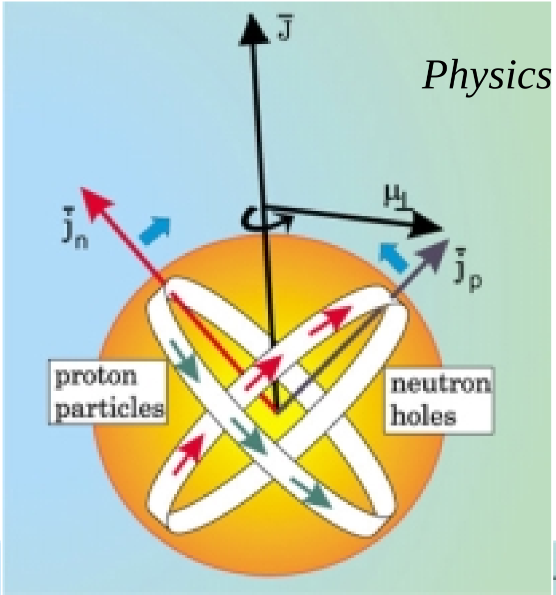
Lecture 1: moments can be easily understood assuming Pb as a core
allowing excitations of protons and neutrons

Open question: related to rotational bands discovered in some of these
neutron deficient Pb-nuclei
(M1-bands, shears bands, magnetic dipole bands)

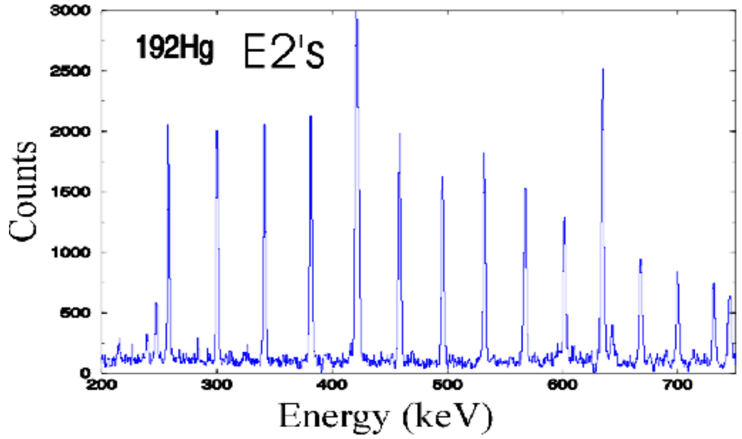
Rotational bands:
build on well-deformed nuclear states
→ E2 transitions

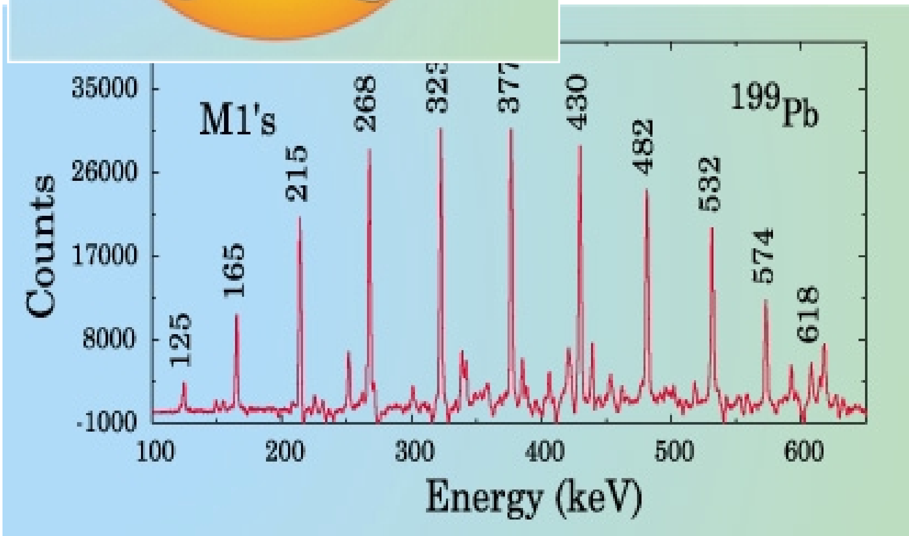
Other rotational bands:
decaying via M1 transitions
→ dipole bands





Physics World 11(1998)25

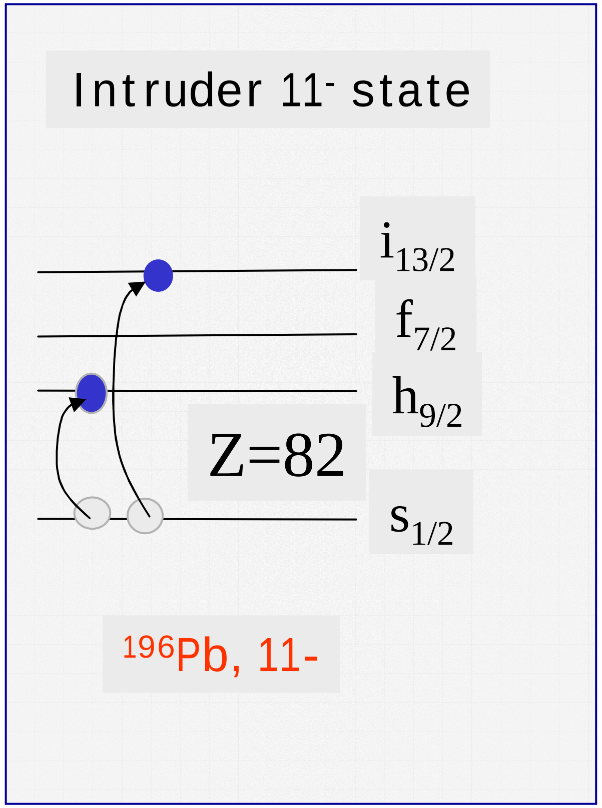


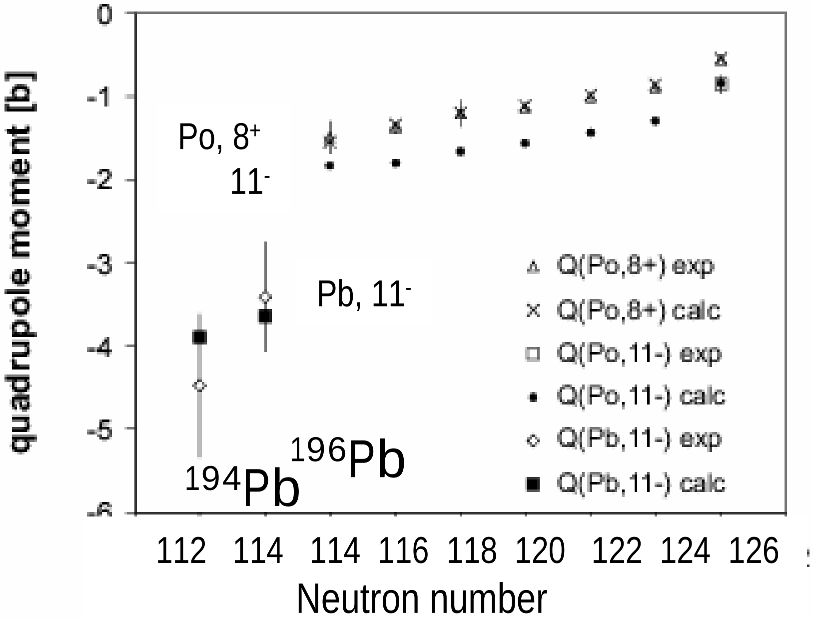


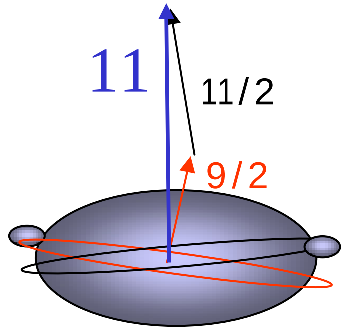
Do we really understand the 'shears' excitations in particular: is the bandhead deformed ?

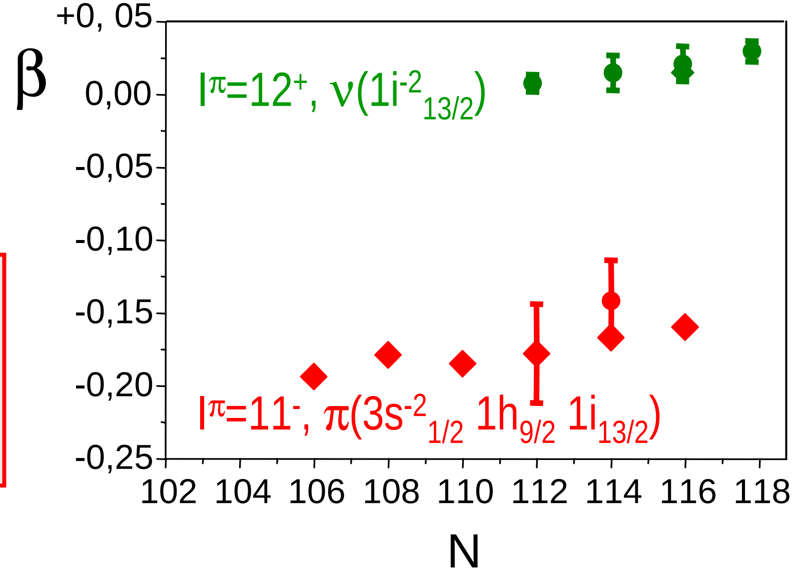
One of the building blocks of ‘shears’ band heads

The proton 2p-2h intruder configurations !









What is the influence of the

p(2p-2h) intruder configuration

on the deformation of shears band heads ?

The ‘shears’ band head

The band-head configuration:

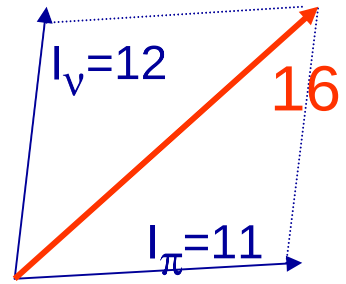
$$[(\pi s^{-2}_{1/2} h_{9/2} i_{13/2})_{11^-} \otimes (\nu i^{-2}_{13/2})_{12^+}]_{16^-}$$

${}^{196}Q_s(11^-) = -\,3.41(66)\ eb$ ${}^{196}Q_s(12^+) = 0.65(5)\ eb$

Additivity rule:

$Q_s({}^{196}\mathrm{Pb}\!: I^\pi = 16^-) = -\,0.32(10)\ eb$

→ has bandhead a small deformation ??
what is K ??



Tilted Axis Cranking model: ***Magnetic rotation***

TAC: $Q_s({}^{196}\mathrm{Pb}\!: 16^-) = -1.2\ eb$

$\beta = -\ 0.13$

Is the additivity valid ??
(required: weak coupling
between π and ν

K. Vyvey et al., Phys. Rev. Lett. 88 (2002) 102502

The test:
*Quadrupole moment of an **isomeric** 'shears' state in ^{193}Pb*

$$[(\pi s^{-2}_{1/2} h_{9/2} i_{13/2})_{\mathbf{11^-}} \otimes (\nu i^{-1}_{13/2^-})]_{\mathbf{29/2^-}}$$

The experiment: measure Q-moment of 29/2- state by TDPAD method

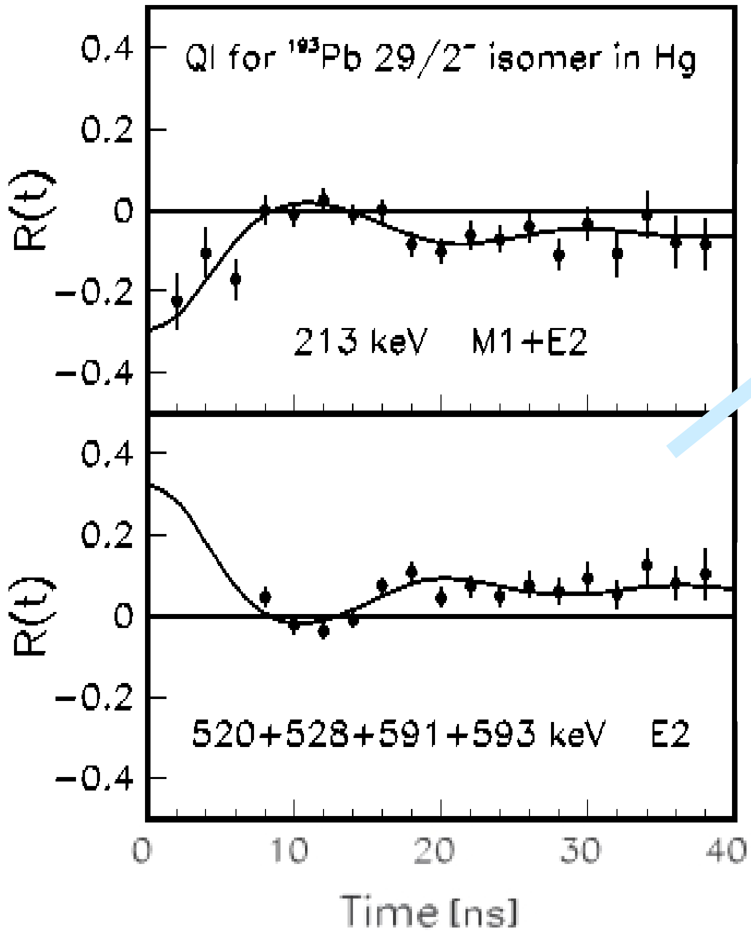
$t_{1/2}$ = 9 ns !

production and orientation : fusion-evaporation **^{170}Er + ^{28}Si @ 143 MeV**

at the Legnaro National Laboratory

- **in-beam implantation in Hg at 170 K**; $|V_{ZZ}|$ =17.4(9) 10^{17} V/cm^2 !
- 40 nA **pulsed beam with 800 ns repetition rate**

The result:



D. Balabanski et al., Phys. Rev. Lett. submitted

TDPAD spectra for several γ-rays in the decay of the 29/2 isomer are analyzed

$$R(t) = 0.75\, A_2\, \Sigma[s_{2n} \cos(n w_0 t)]$$

$$w_0 = 3\pi \nu_Q / I(2I-1)$$

$\nu_Q = 1.20(9)$ GHz

$\lvert Q_s^{exp} \rvert$	Q_s^{TAC}	Q_s^{add}
2.84(26)	–2.86	–3.2(6)

Note: intruder $Q(11^-) = -3.4(6)$ eb

Isomeric states produced by projectile fragmentation

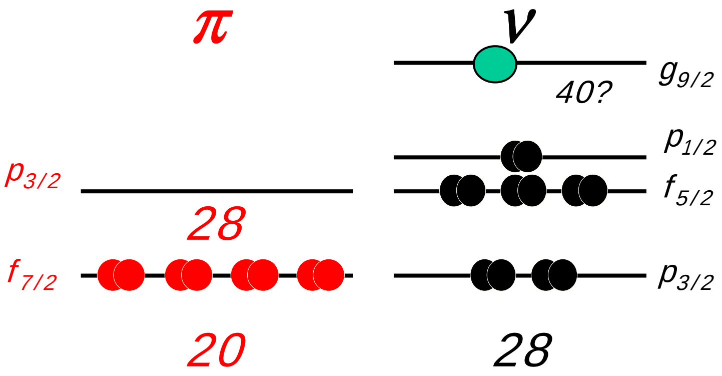
First such experiments **to study g-factors of isomers in exotic nuclei**

→ at GANIL

→ using TDPAD method on aligned fragments

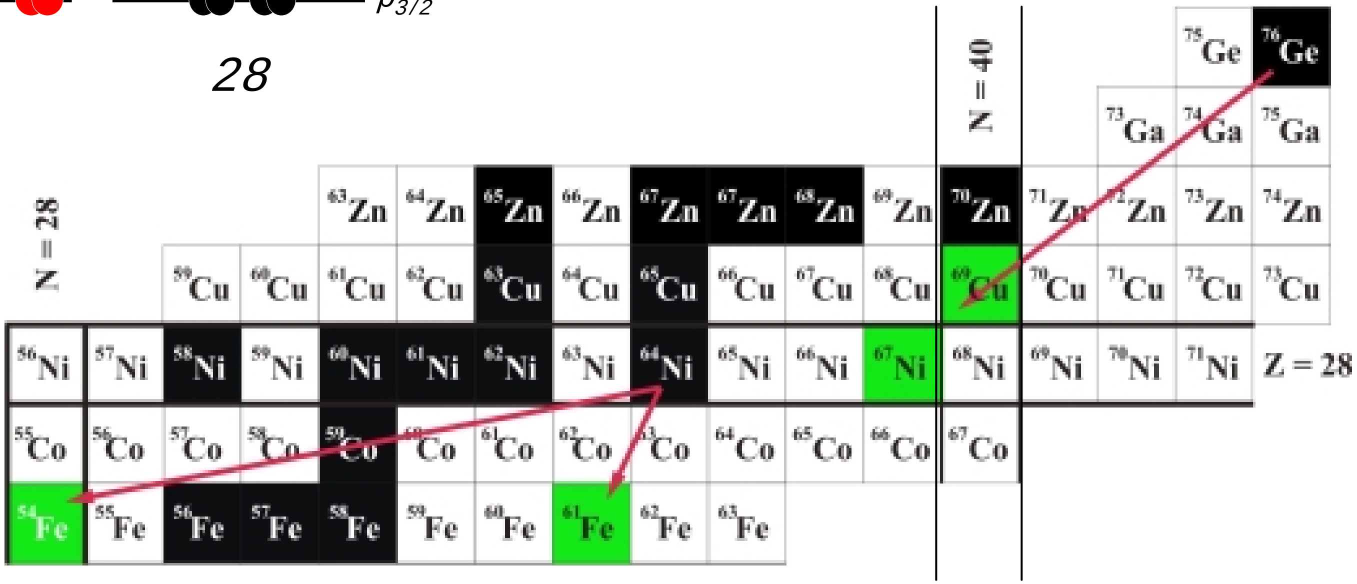
→ structure of isomeric states near Z=28 shell closure

region of the N=40 subshell closure

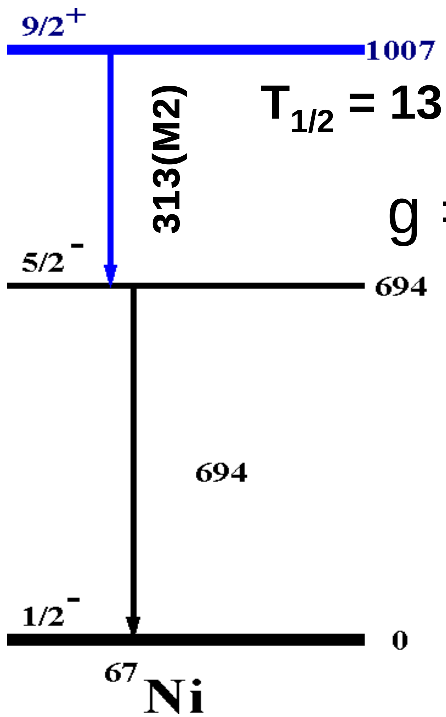


isomeric states: $I^{\pi}=9/2^{+}$

suggested: $\nu g_{9/2}$ configuration

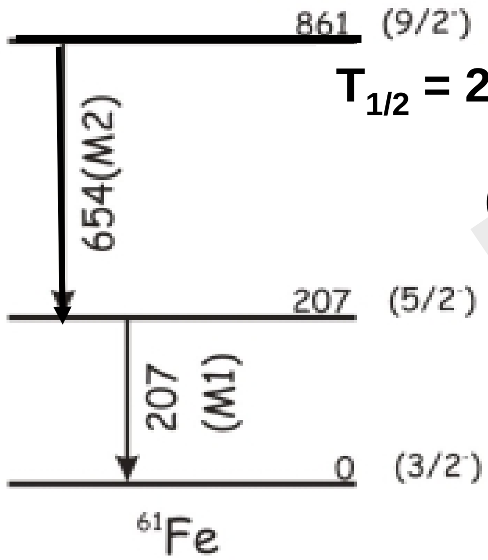


Results: g-factor of 9/2$^+$ isomers in ^{67}Ni and ^{61}Fe



$T_{1/2}$ = 13.3 µs

g = -0.125(6)

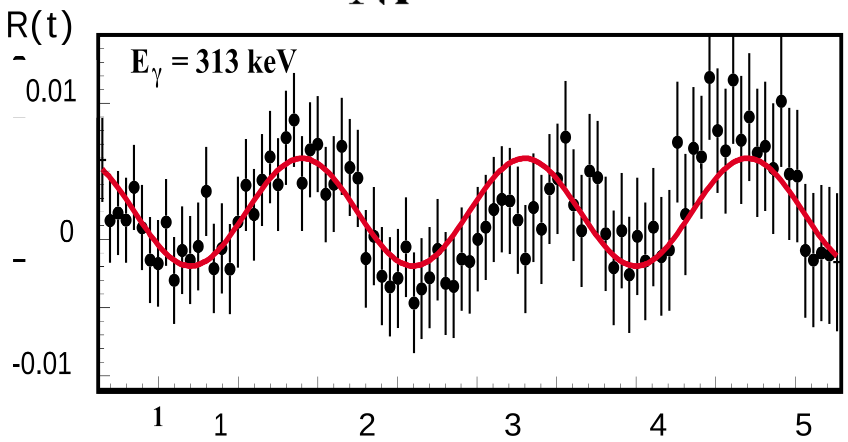


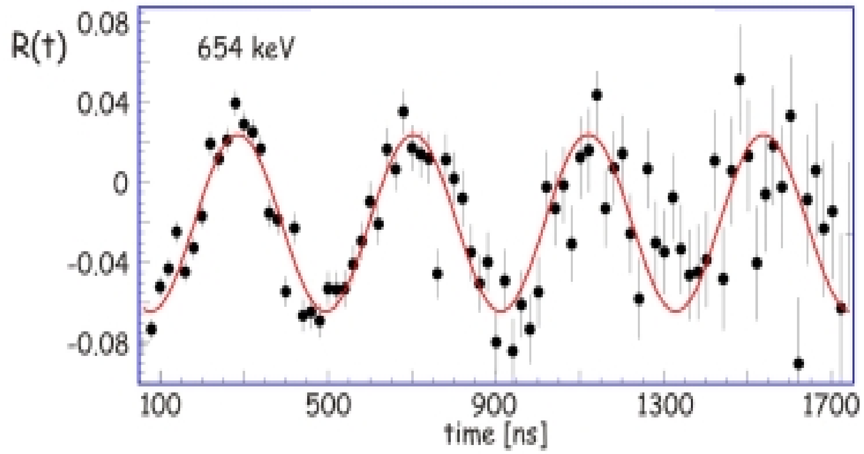
$T_{1/2}$ = 250 ns

g=-0.23(1)

preliminary

I. Matea





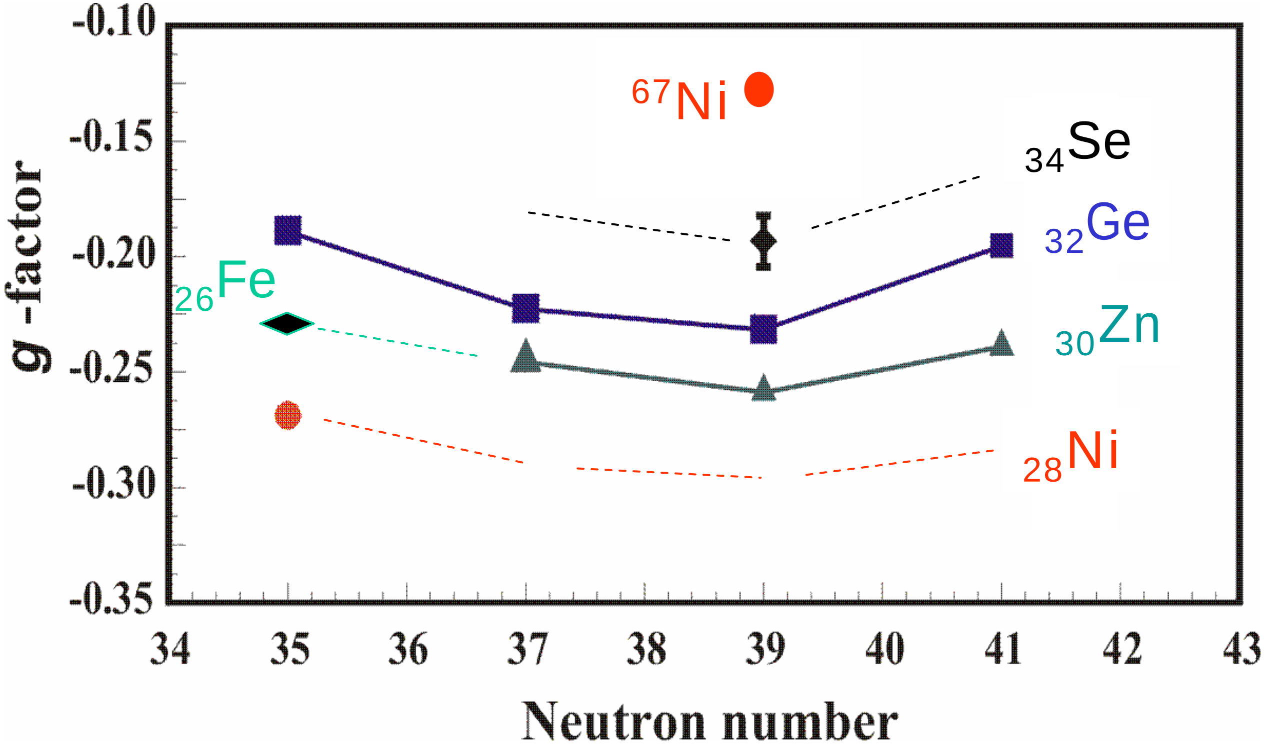
G. Georgiev et al., J. Phys. G 28 (2002) 2993

Results: comparison to other measured 9/2$^+$ g-factors

Schmidt value:

g_{free} = - 0.42

g_{eff} = - 0.27



M1-core polarizing effect could explain the ^{67}Ni result

Thanks for your interest
Questions remain welcome

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