Quadrupole moment of the 8^+ yrast state in ^{84}Kr

R. Schwengner[1], D. L. Balabanski[2], G. Neyens[2], N. Benouaret[2], D. Borremans[2], N. Coulier[2], M. De Rydt[2], G. Georgiev[2], S. Mallion[1,2] G. Rainovski[1,3] G. Rusev[1], S. Teughels[2], K. Vyvey[2]

[1] *Institut für Strahlenphysik, Forschungszentrum Dresden-Rossendorf, 01314 Dresden, Germany*
[2] *Instituut voor Kern- en Stralingsfysica, Katholieke Universiteit Leuven, 3001 Leuven, Belgium*
[3] *Faculty of Physics, St. Kliment Ohridski University of Sofia, 1164 Sofia, Bulgaria*

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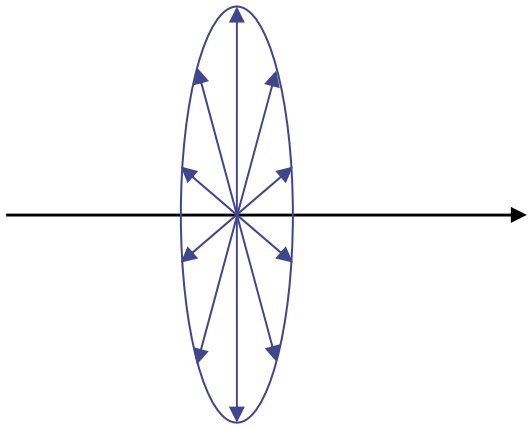
- Level Mixing Spectroscopy
- Results
- Systematics and interpretation

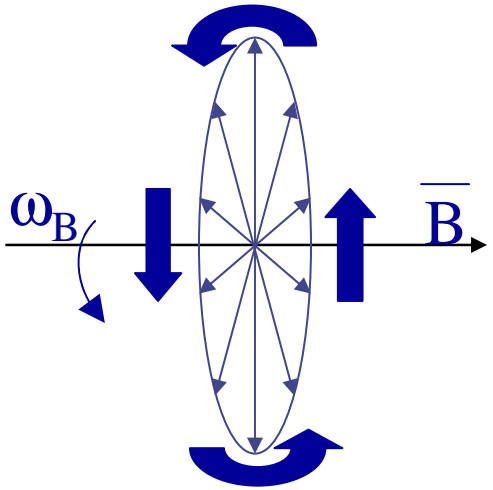
Supported by the European Commission

Measurement of nuclear moments

- Nuclear moments are very sensitive to the structure of nuclear states.
- Their measurement is a stringent test of nuclear models.
- States with a structure dominated by a few nucleons outside a closed shell are good candidates for tests of predictions of the shell model.
- Effective g factors and effective charges accounting for the influence of orbits not included in the model space may be examined.

Level-mixing spectroscopy



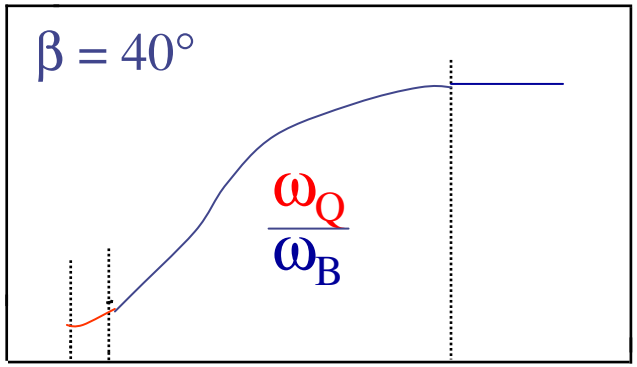


LEMS

B=0
pure quadrupole interaction

high magnetic field
pure magnetic interaction

Anisotropy
N(0º)/N(90º)



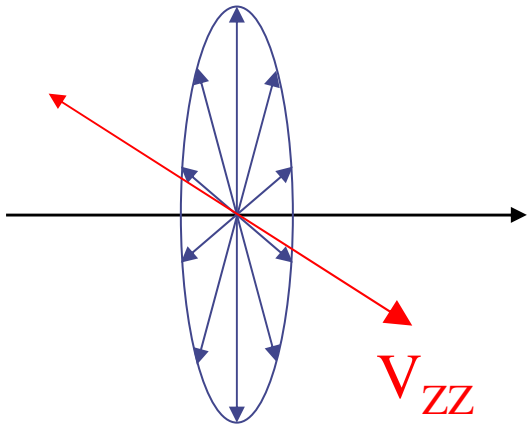
$\omega_Q \propto Q_s V_{ZZ}$

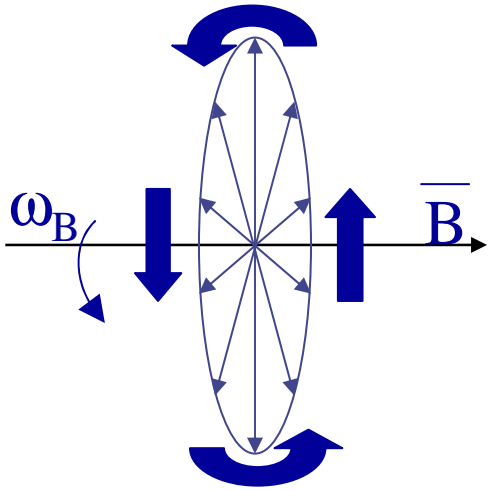
$\omega_Q \propto \mu B$

B low intermediate B high
competition

By courtesy of D. L.. Balabanski and G. Neyens

Level-mixing spectroscopy





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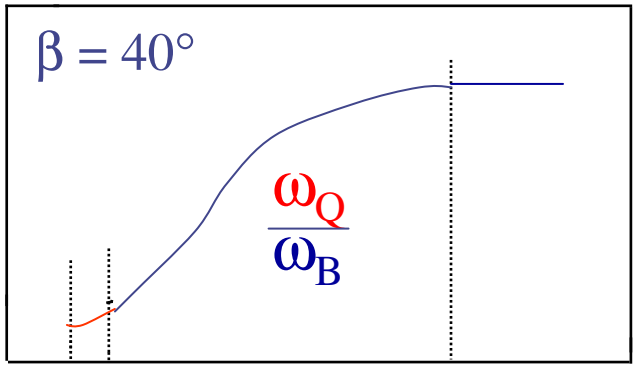

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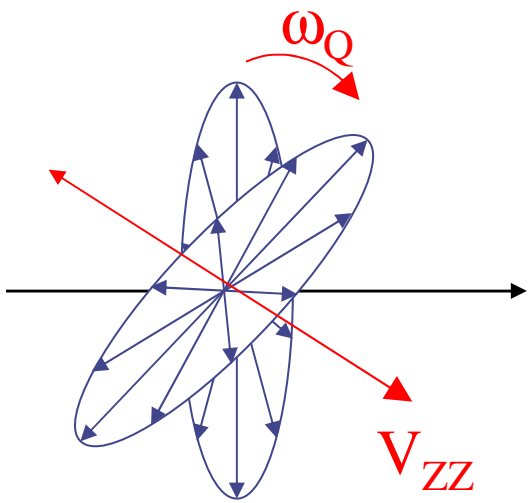

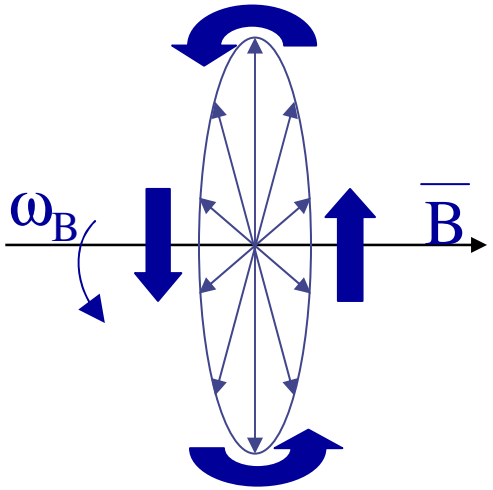

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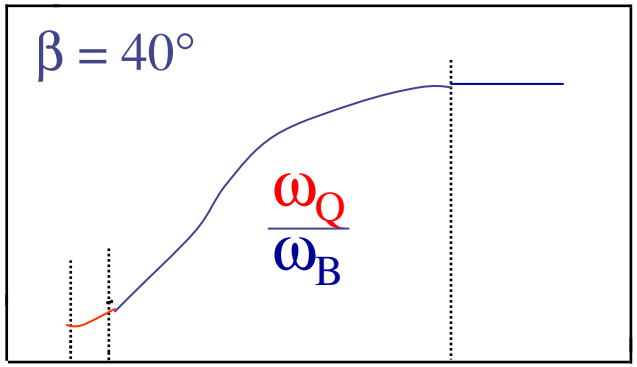

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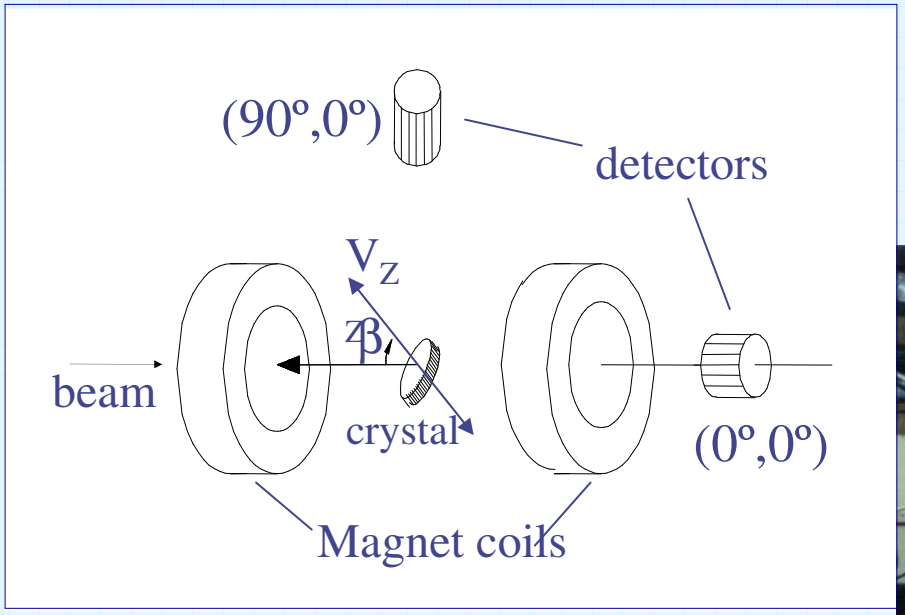
By courtesy of D. L.. Balabanski and G. Neyens

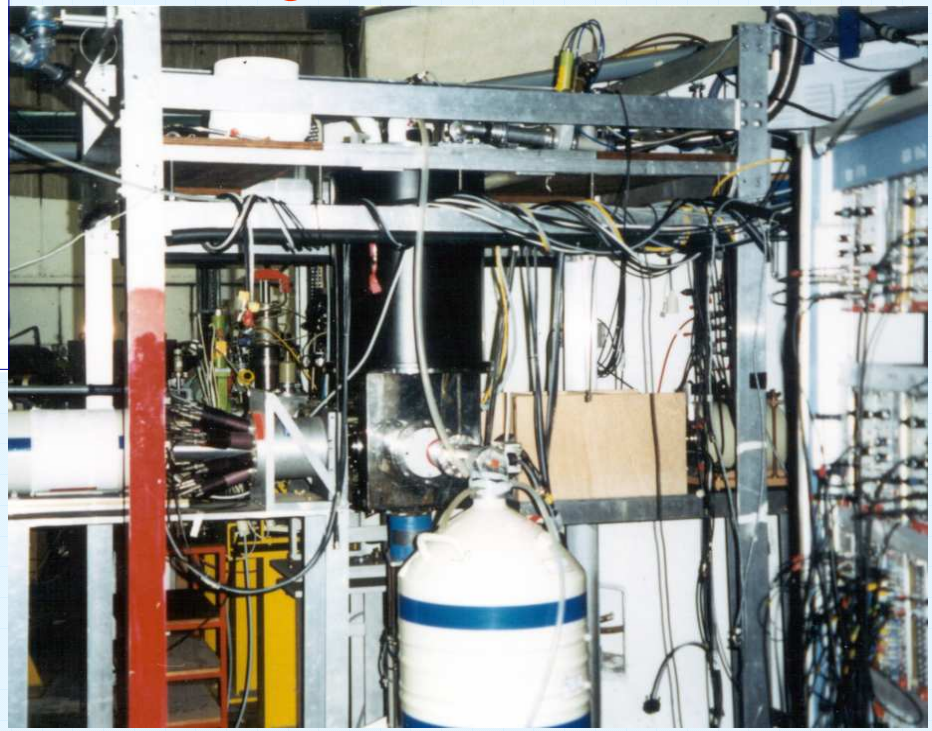
Quadrupole moments measurements : the Level-mixing spectrometer



LEMS

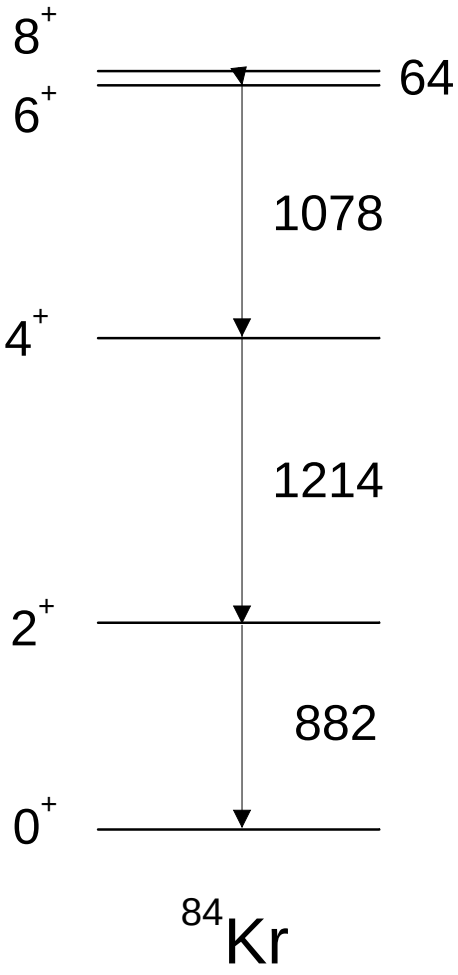
at the CRC

Louvain-la-Neuve, Belgium



By courtesy of D. L. Balabanski and G. Neyens

LEMS experiment for ^{84}Kr



8^+ yrast isomer:

Energy: $E_x = 3236.2$ keV

Lifetime: $\tau = 2.65(6)$ μs

Magnetic moment: $\mu = -1.968(16)$ μ_N

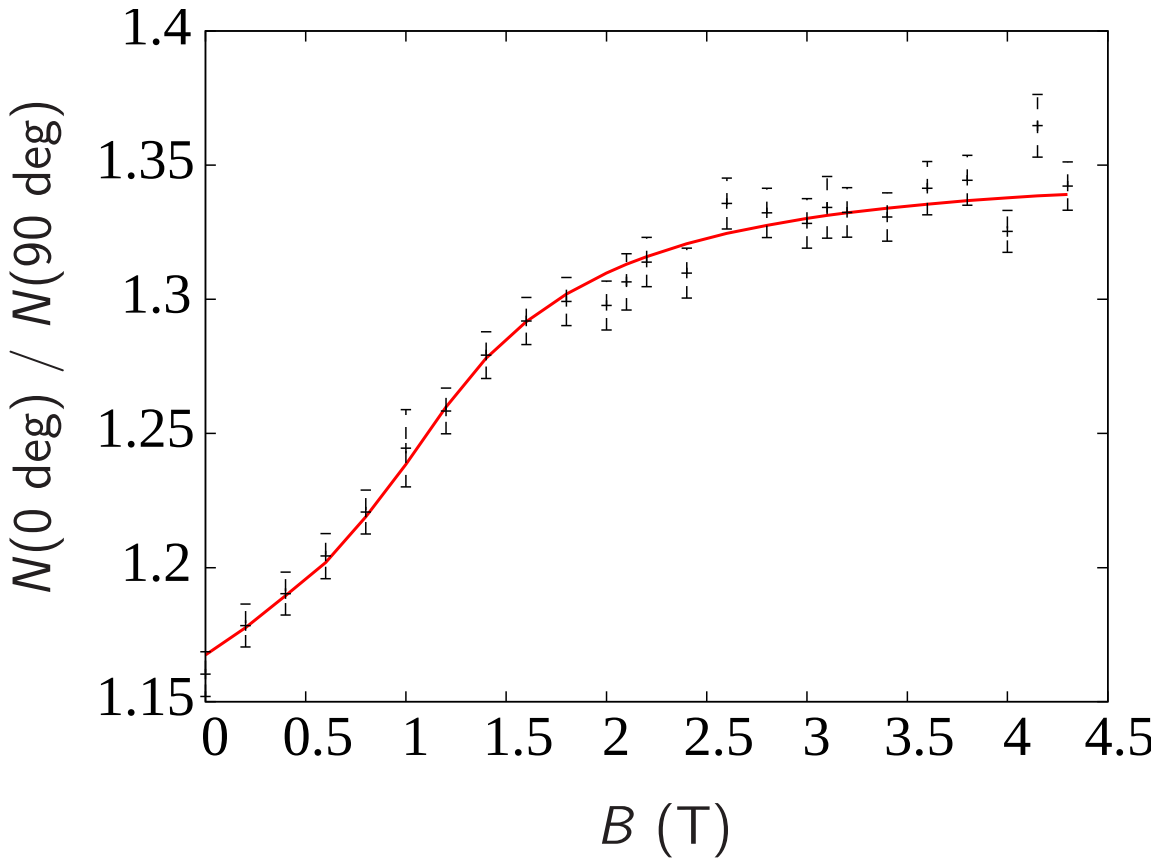
Main configuration: $\nu(0g_{9/2}^{-2})$

Experiment:

Reaction: ^{82}Se(α,2n) at $E_\alpha = 24$ MeV

Target: ^{82}Se (96 μg/cm^2)
+ Cd (432 μg/cm^2) (Host)
+ Au (154 μg/cm^2)

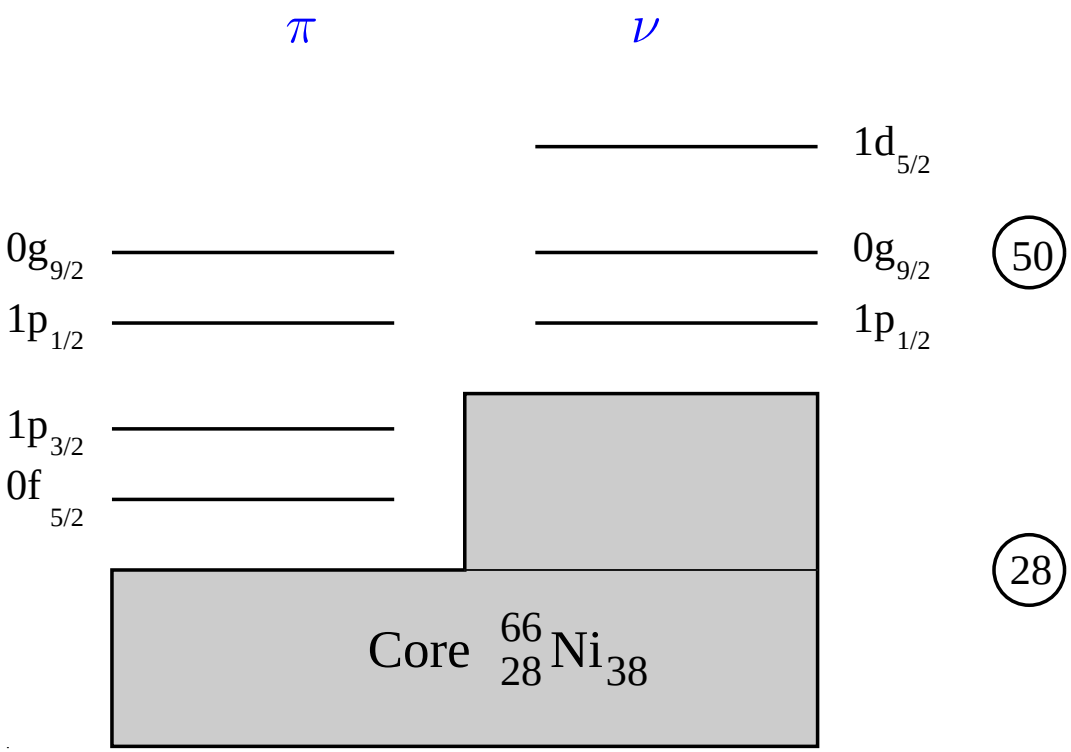
LEMS experiment for ^{84}Kr



Quadrupole moment of the 8^+ yrast isomer: $Q = 36(4)$ efm^2

Shell-model calculations

Configuration space:



Two-body matrix elements:

$\pi\pi$:
empirical from fit to N=50 nuclei, ^{78}Ni core;
X. Ji, B.H. Wildenthal, PRC 37 (1988) 1256

$\pi\nu, \nu\nu$ $(0g_{9/2}, 1p_{1/2})$:
emp. from fit to N=48,49,50 nuclei, ^{88}Sr core;
R. Gross, A. Frenkel, NPA 267 (1976) 85

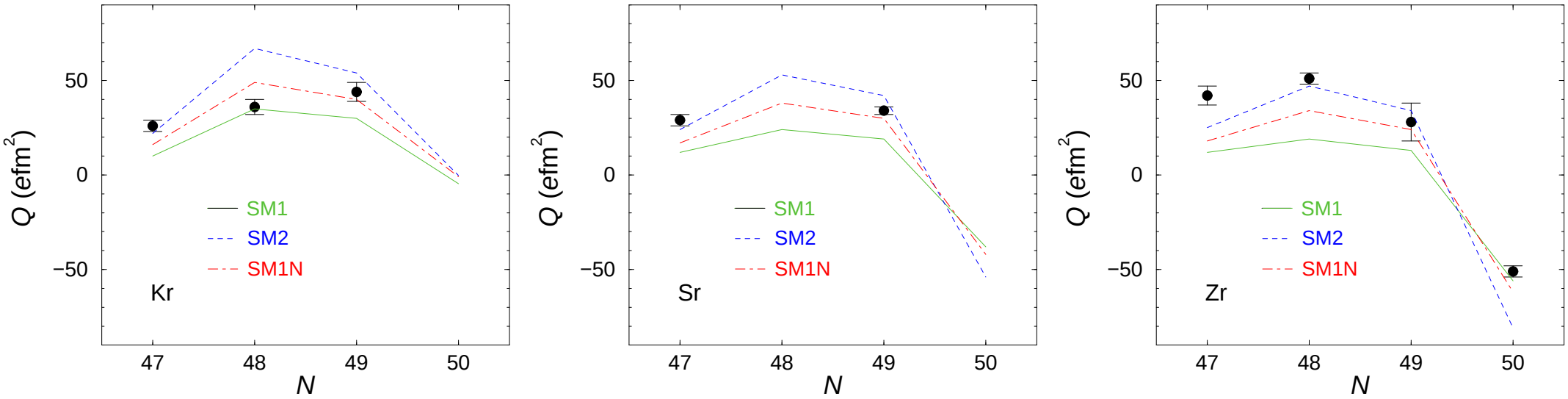
$\pi\nu$ $(\pi 0f_{5/2}, \nu 0g_{9/2})$:
experimental from transfer reactions;
P.C. Li et al., NPA 469 (1987) 393

$\nu\nu$ $(0g_{9/2}, 1d_{5/2})$:
exp. from energies of the multiplet in ^{88}Sr;
P.C. Li, W.W. Daehnick, NPA 462 (1987) 26

remaining:
MSDI;
K. Muto et al., PLB 135 (1984) 349

Code: RITSSCHIL

Quadrupole moments of $9/2^+$ and 8^+ states in Kr, Sr and Zr isotopes



SM1 : $e_\pi = 1.35\ e$, $e_\nu = 0.35\ e$ (M.K. Kabadiyski et al., ZPA 343 (1992) 165)

SM2 : $e_\pi = 1.72\ e$, $e_\nu = 1.44\ e$ (D.H. Gloeckner, F.J.D. Serduke, NPA 220 (1974) 477)

SM1N: $e_\pi = 1.35\ e$, $e_\nu = 1.00\ e$

Summary

- Quadrupole moment of the 8_1^+ state in ^{84}Kr measured for the first time by using the LEMS technique: $Q = 36(4)$ $e$fm^2.
- Experimental quadrupole moment compared with predictions of the shell model. The quadrupole moment is very sensitive to model space and to effective charges.
- Tendencies of quadrupole moments with changing neutron numbers in Kr, Sr and Zr isotopes with $N = 47 - 49$ are qualitatively reproduced by calculations using common sets of effective charges.
- The overall agreement between experimental and calculated quadrupole moments of neutron-dominated states in those nuclides is improved with a modified effective charge for neutrons.