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ISOLDE Winter Workshop December 2007

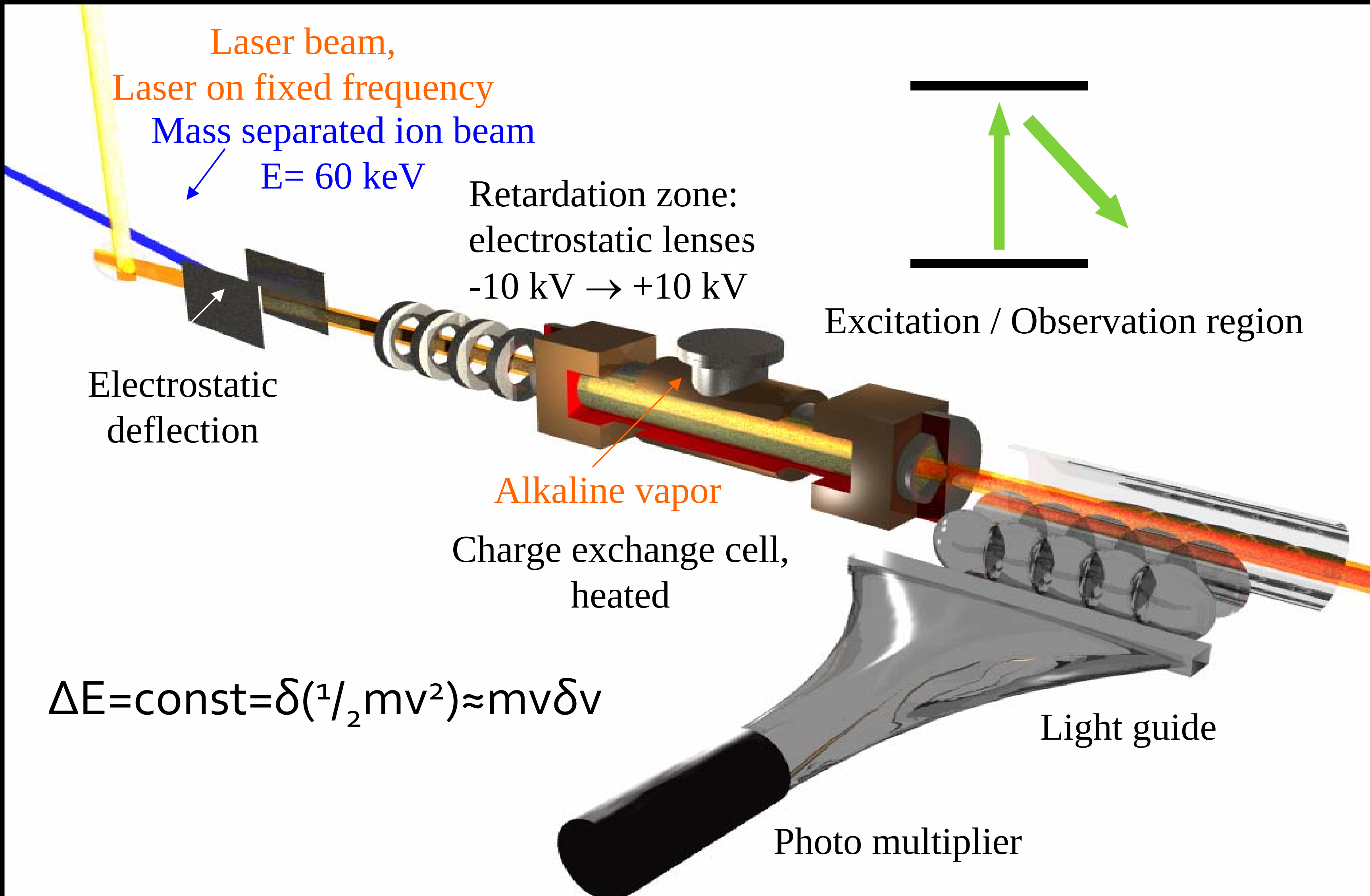
RECENT RESULTS FROM COLLAPS: SPIN DETERMINATION AND NUCLEAR MOMENT MEASUREMENTS OF ^{71}CU AND ^{72}CU

Laser spectroscopy of radioactive isotopes in 2007

- 3 on-line runs on COLLAPS in 2007, studying Mg (IS427) and Cu (IS439)
- g-factor and spin of ^{21}Mg (J. Kramer, GSI)
- Isotope shifts of ^{28}Mg and ^{30}Mg
- ^{71}Cu and ^{72}Cu

↳ Magnetic moments
Quadrupole moments
Spin assignment ^{72}Cu
Isotope shifts

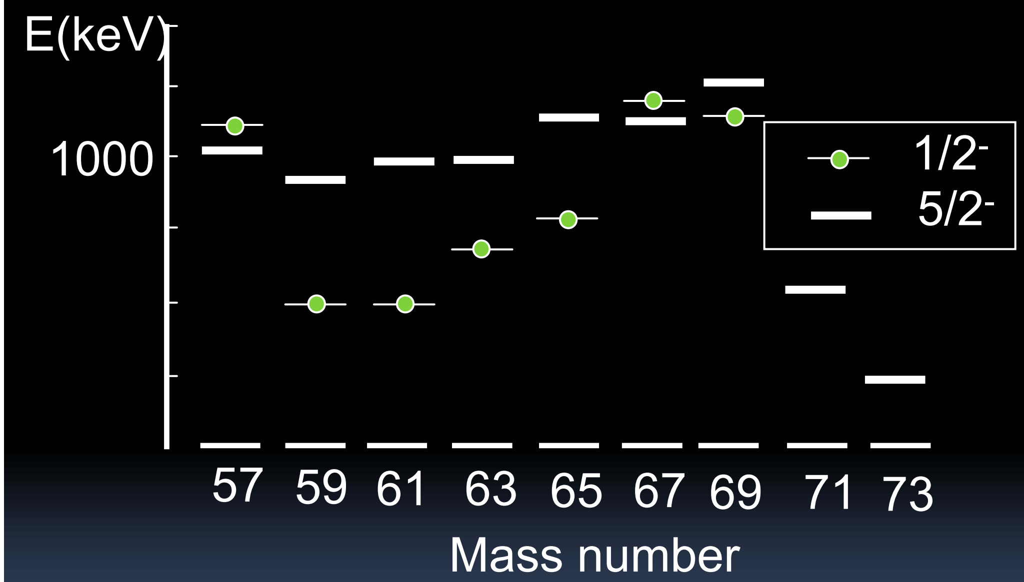
Collinear Laser Spectroscopy



$\Delta E = const = \delta(^1/_2 mv^2) \approx mv\delta v$

Systematic migration of nuclear states in copper isotopes

•5/2- level associated with the π(*f*5/2) orbital



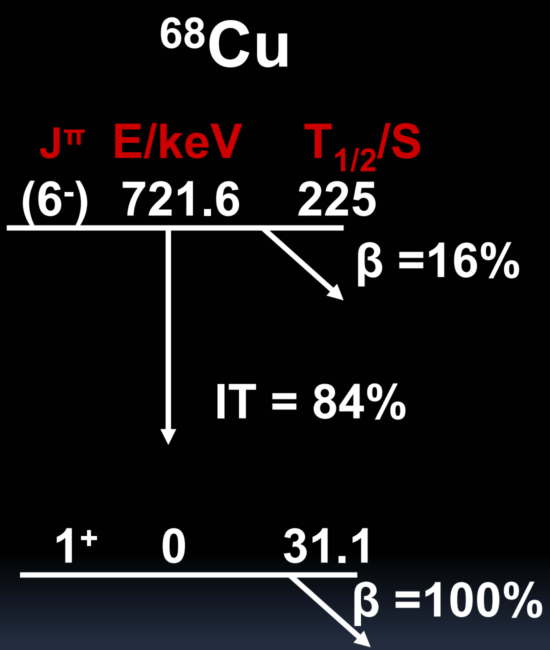
S. Franchoo et al. Phys. Rev. C 64 054308

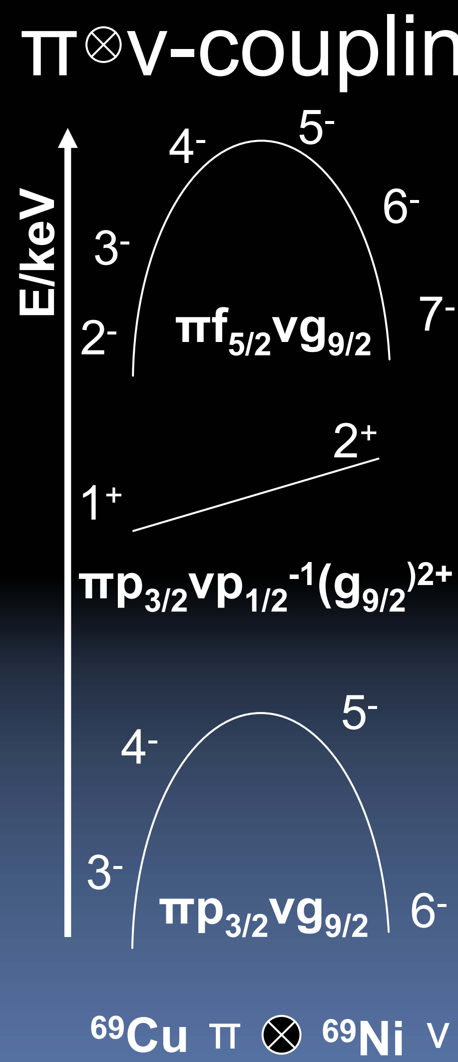
A.F. Lisetskiy et al. Eur. Phys. J. A, 25:95, 2005
N.A. Smirnova et al. Phys. Rev. C, 69:044306, 2004

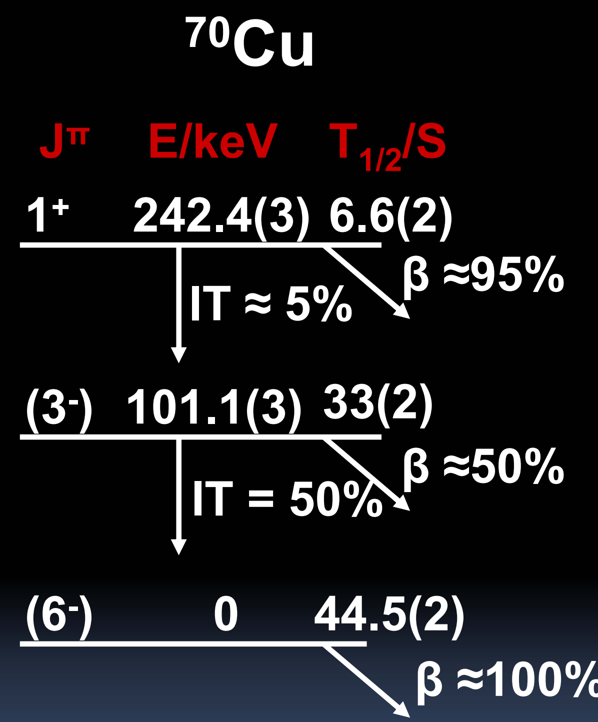
I=5/2^{-} level:

- **Remains static between $^{57\text{-}69}$Cu at ~1MeV**
- **Systematically drops in energy as the ν(g9/2) shell begins to fill**
- **Predictions on the inversion of the ground state lie between ^{73}Cu and ^{79}Cu.**
- **Experimental evidence for the inversion to occur at ^{75}Cu.**

Ground and excited state spin assignment





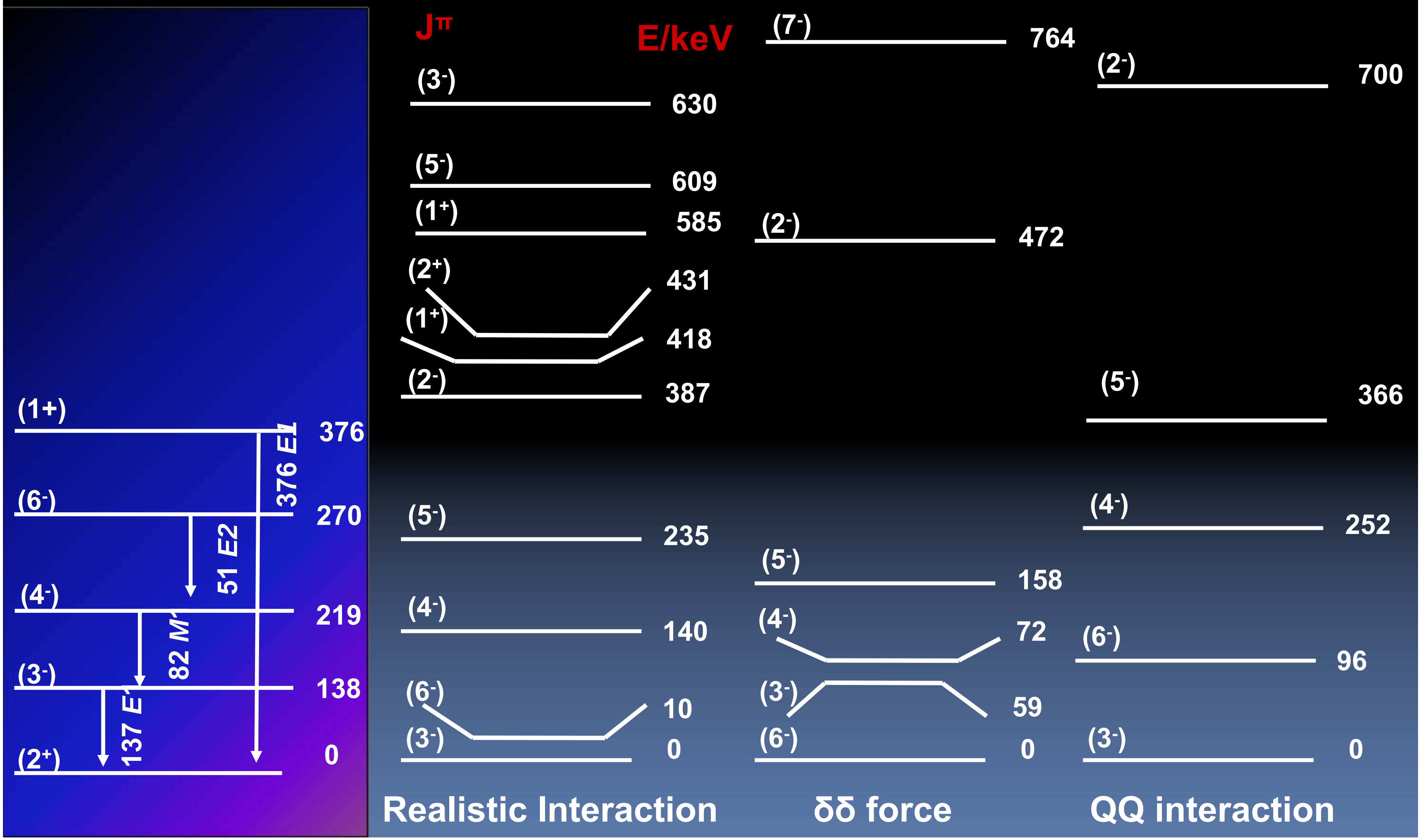


J. Van Roosbroeck
Phys. Rev. Lett. 92:112501 2004

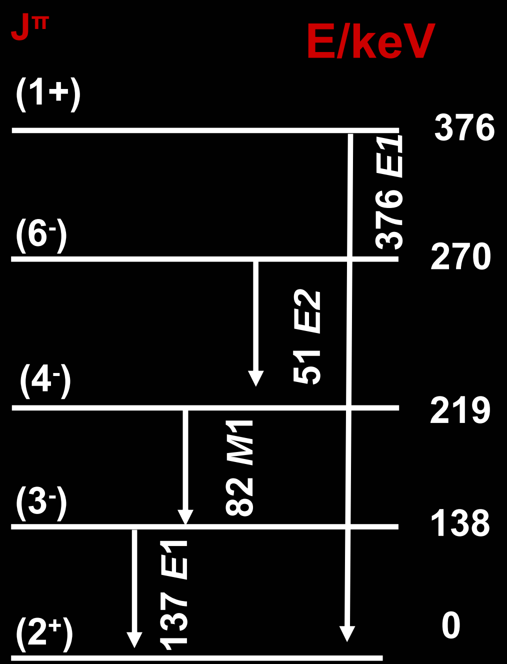
J. Van Roosbroeck
Phys. Rev. C 69:034313 2004

Nuclear Structure of ^{72}Cu

π⊗ ν-coupling ^{72}Cu

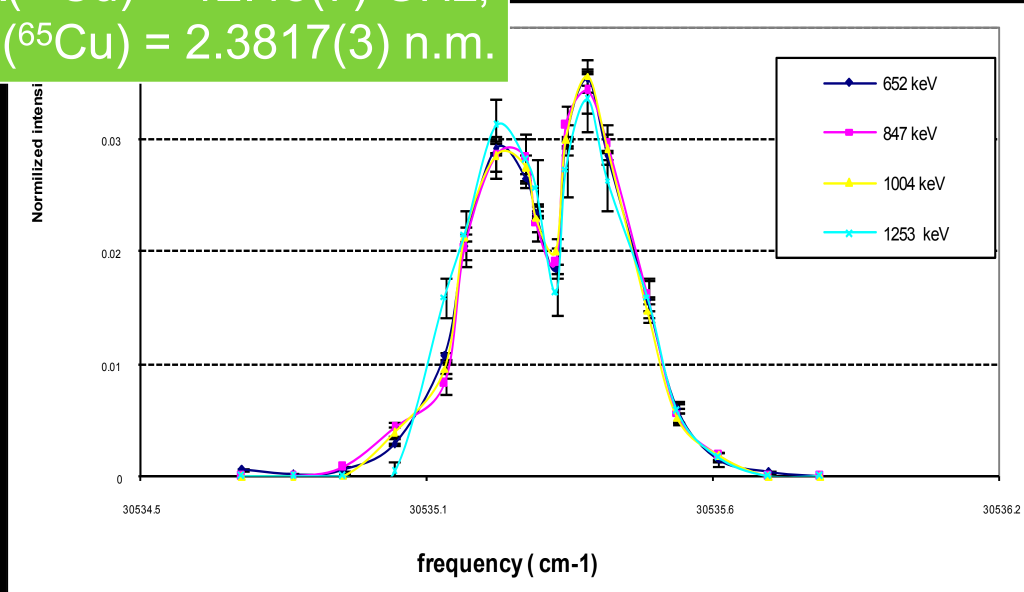


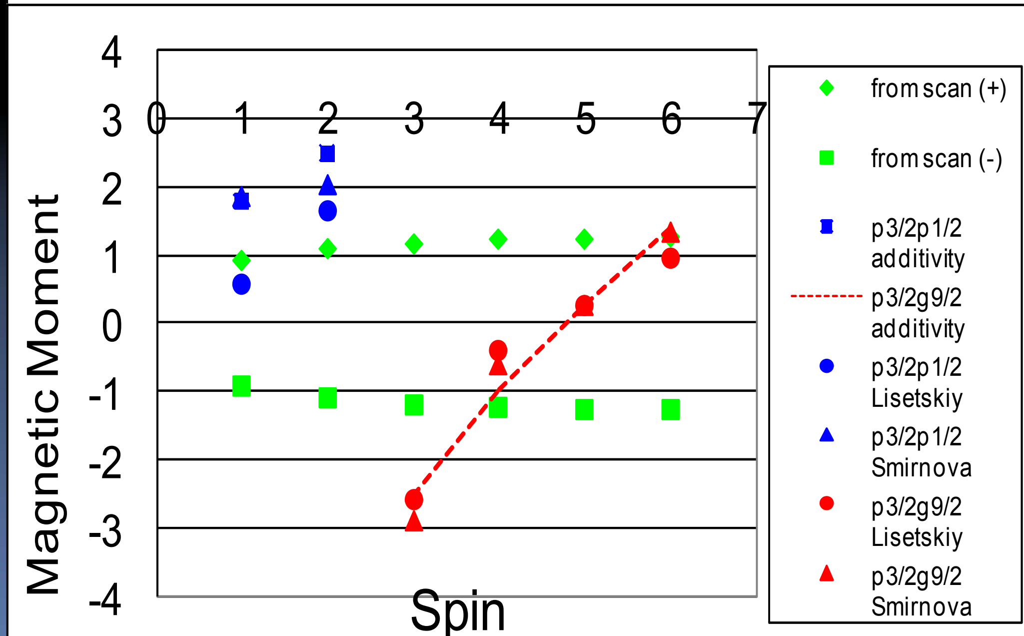
^{72}Cu



$A(^{72}Cu) = 5.4(1)$ GHz
$A(^{65}Cu) = 12.48(7)$ GHz,
$\mu(^{65}Cu) = 2.3817(3)$ n.m.

Cu I $S_{1/2} - P_{1/2}$





β-decay and γ-ray spectroscopy studies

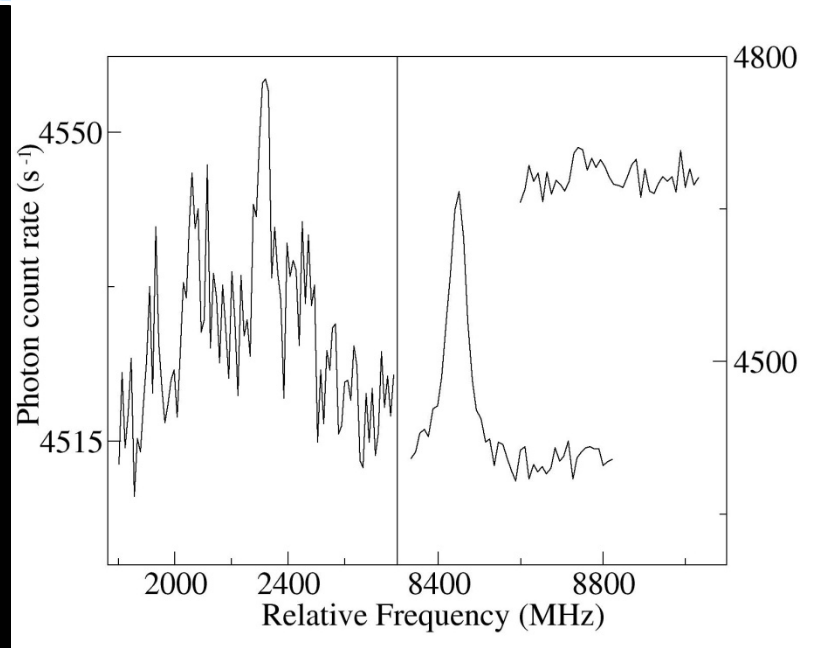
H. Mach, Symposium on Nuclear Structure Physics University of Göttingen, 2001

M. Stanoiu, PhD thesis, Université de Caen 2003

J.C Thomas, et al. Phys. Rev. C 2006

Collinear laser spectroscopy 2007

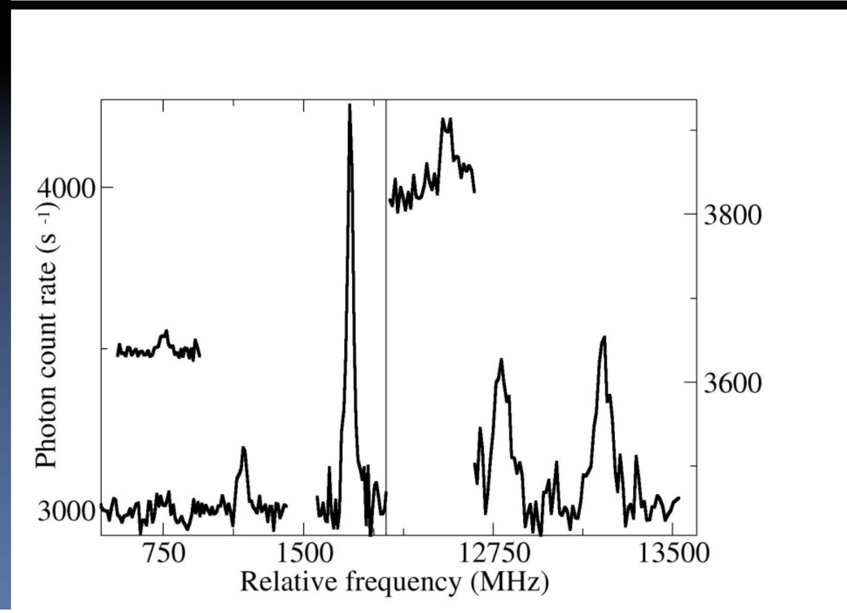
- ^{72}Cu
  - I=2 >99.73% confidence
  - $A(S_{1/2})$ =-2661(1)MHz
  - $B(P_{3/2})$ = +28(3) MHz



→ **μ= -1.345(1)n.m.**
Q=+0.21(4)b

- ^{71}Cu

$A(S_{1/2})$ =+5998(2)MHz
$B(P_{3/2})$ = -25(2) MHz



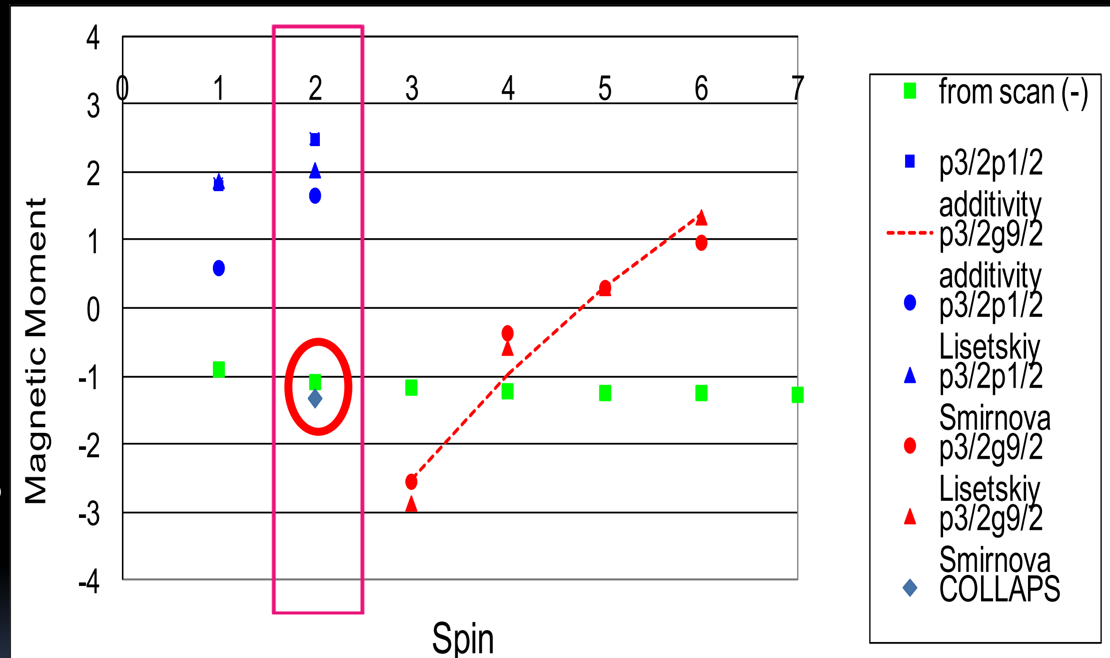
→ **μ= +2.273(1)n.m.**
Q=+0.18(3)b

Interpretation in terms of the monopole migration of the $\pi f_{5/2}$

Consider $\pi f_{5/2} \otimes \nu g_{9/2}$

Schmidt = -2.13 nm

COLLAPS= -1.345 (1) nm



Compare to ^{84}Rb which has a ground state structure of $\pi f^{-1}_{5/2} \otimes \nu g^{-3}_{9/2}$

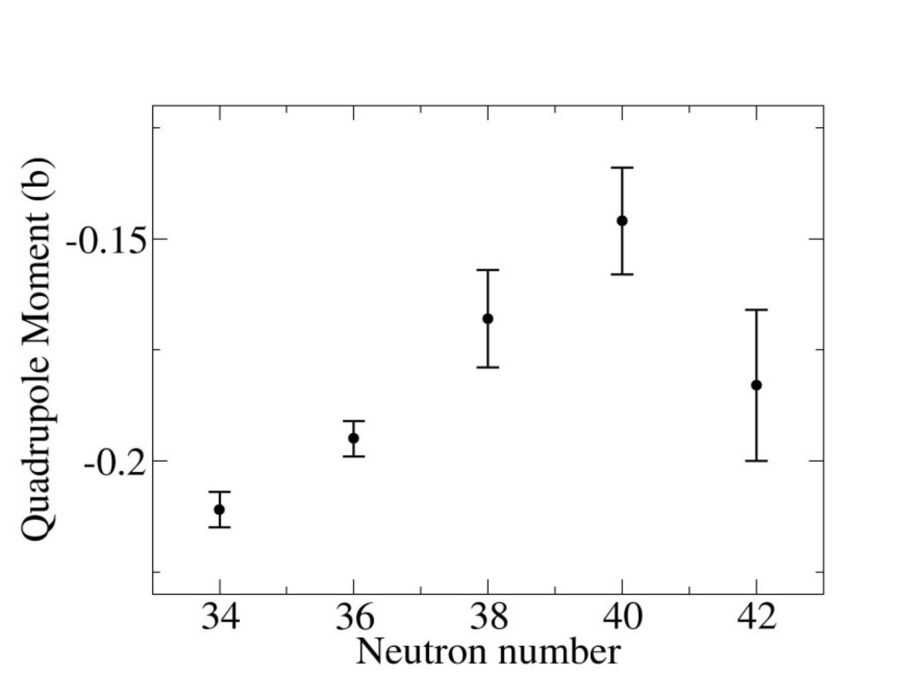
ABMR= -1.324116(1) nm

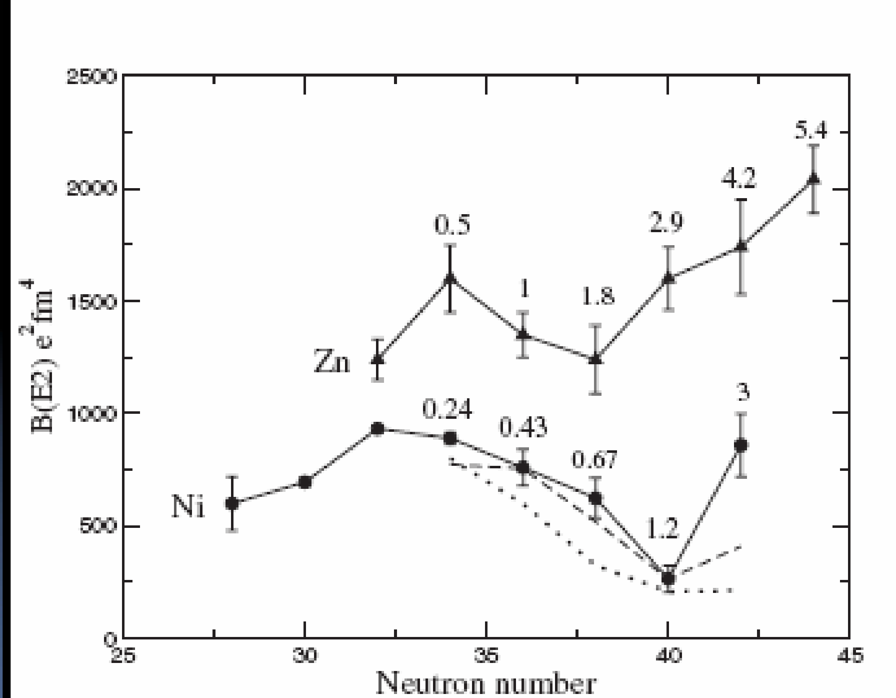
Large scale shell model calculations predict a 2^- arising from $\pi f_{5/2} \otimes \nu g^3_{9/2}$ (with a 33% contribution) and $\pi p_{3/2} \otimes \nu g^3_{9/2}$ (with a 10% contribution)

Core Polarization

Quadrupole moments of ^{63}Cu-^{71}Cu

Minimum in static deformation at N=40.

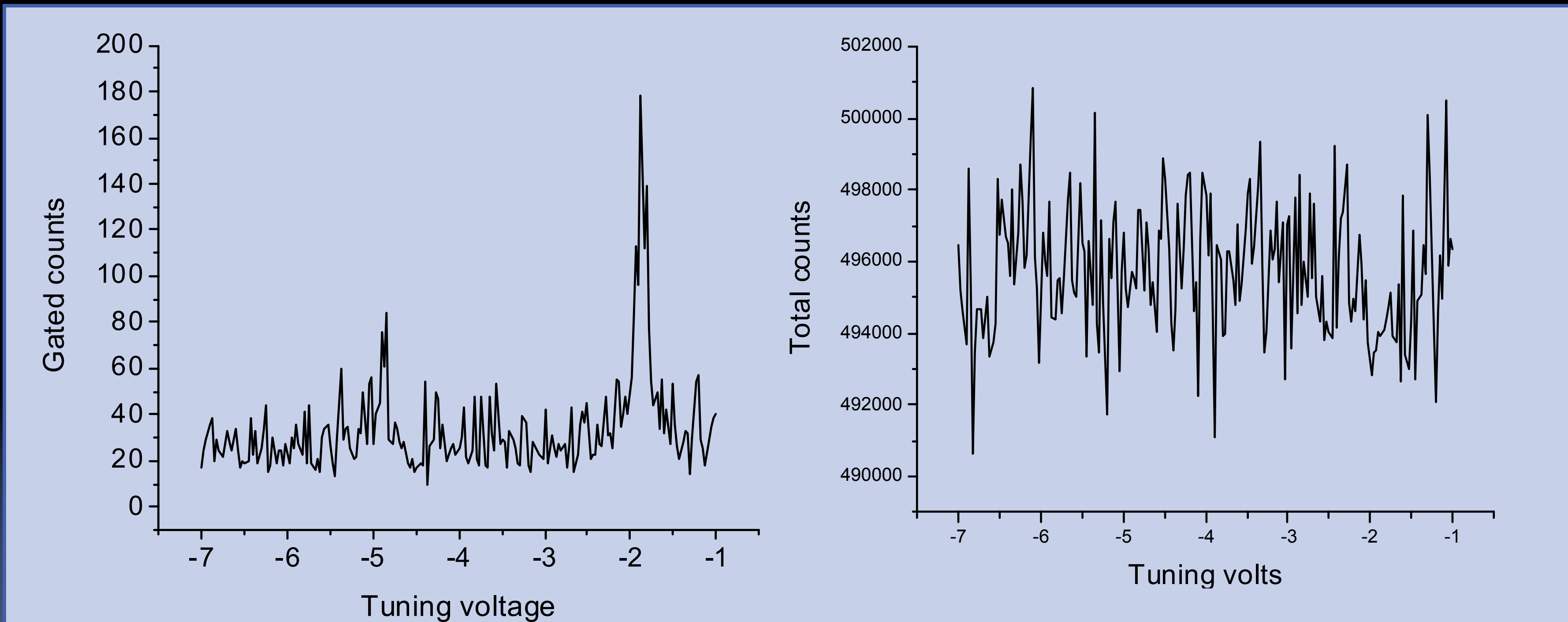




O. Perru PRL 232501 (2006)

Measurements in 2008

To ^{73}Cu and beyond.....
Background suppression from ISCOOL of 10^4
Beam quality improvements (E. Mane)



Lowest yields of Cu now possible are 10^3 ions/μC
In other words from ^{57}Cu (3.10^3 ions/μC) to ^{77}Cu (2.10^3 ions/μC)
(P. Vingerhoets)

Collaboration

K.U. Leuven: K. Flanagan, P. Lievens G. Neyens, M. De Rydt
P. Vingerhoets

The University of Birmingham: D. Forest, G. Tungate.

GSI: C. Geppert, J. Kramer

Universität Mainz: K. Blaum, M. Kowalska, R. Neugart,
W. Nörtershäuser , D. Yordanov. .

New York University: H.H. Stroke

The University of Manchester: J. Billowes, P. Campbell,
B. Cheal, E. Mane.

Thank you and Merry Christmas