

Nuclear structure oddities from ISOLTRAP mass measurements

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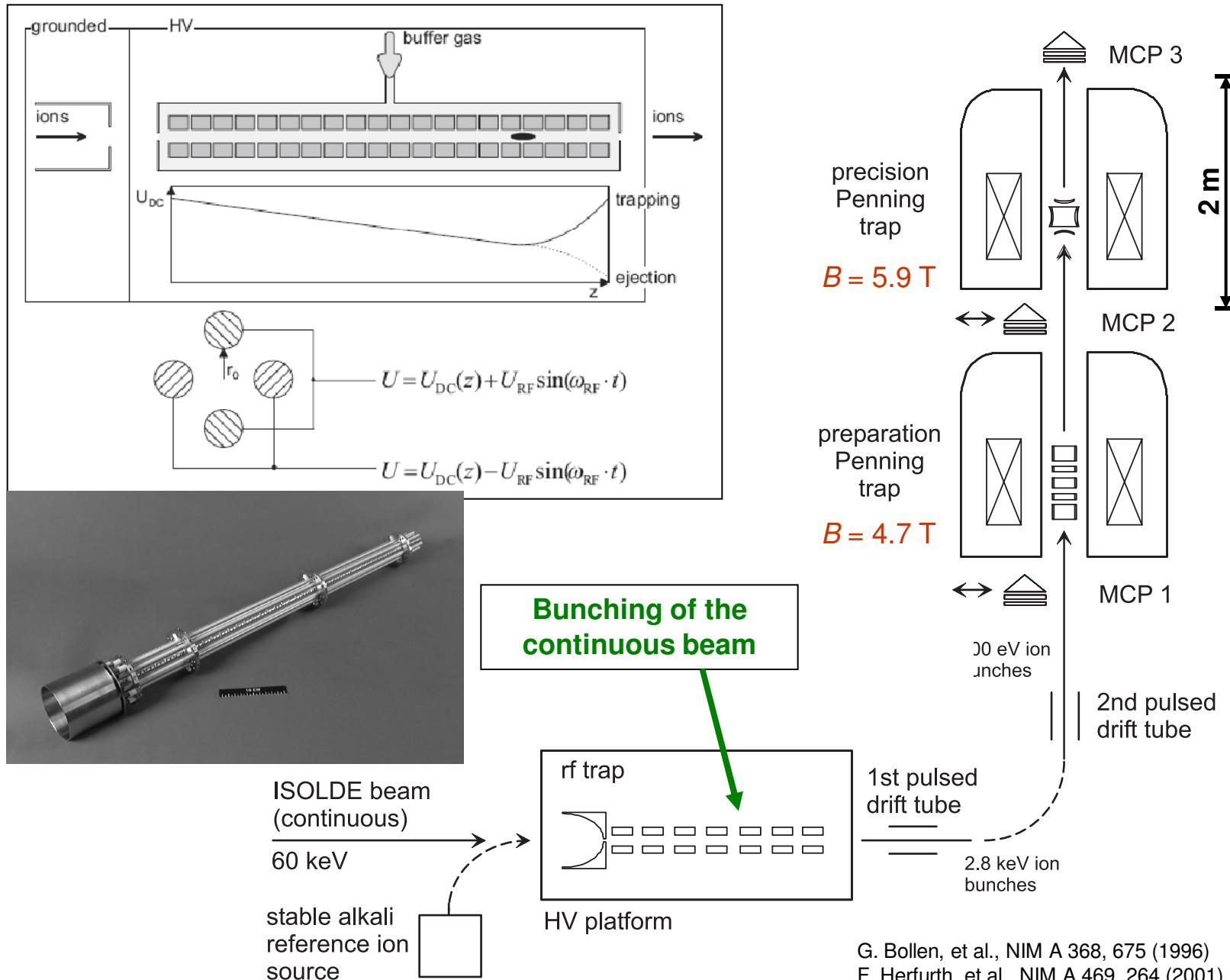


Plan

- Experimental setup
- Shell closure at $N = 40$
- Mn isotopes masses
- Kr isotopes : deformation from $N = 60$?
- Summary and outlook

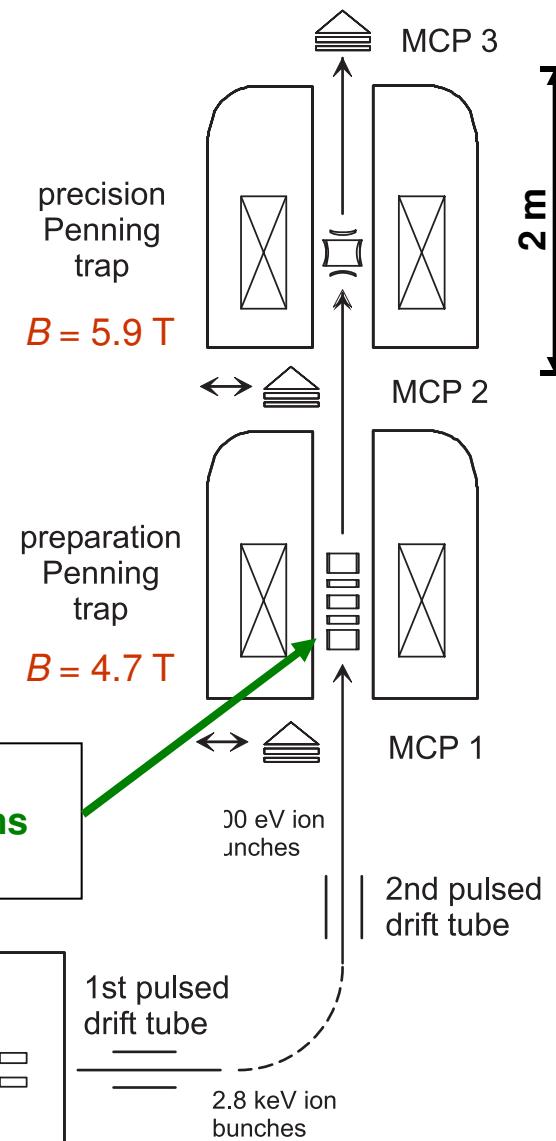
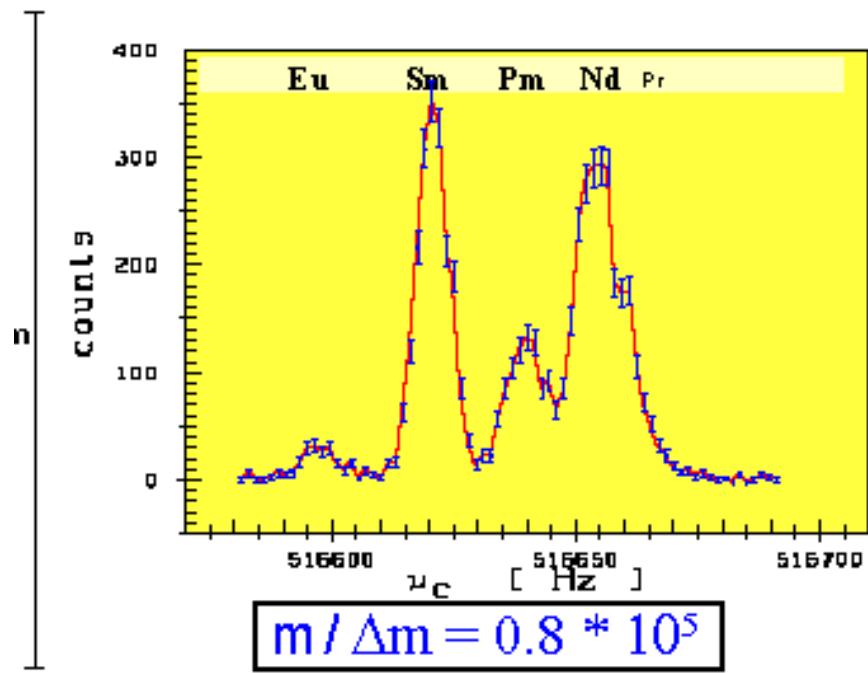


ISOLTRAP: Experimental setup



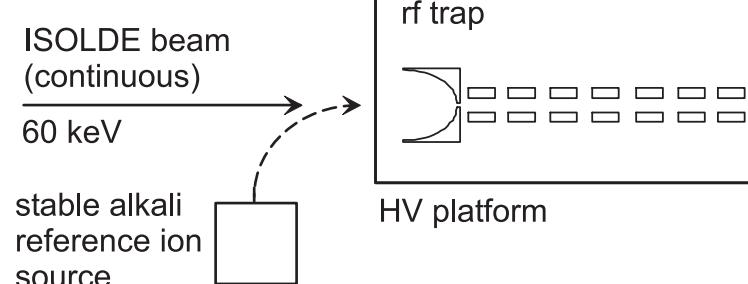
G. Bollen, et al., NIM A 368, 675 (1996)
 F. Herfurth, et al., NIM A 469, 264 (2001)

Removal of isobaric contaminants



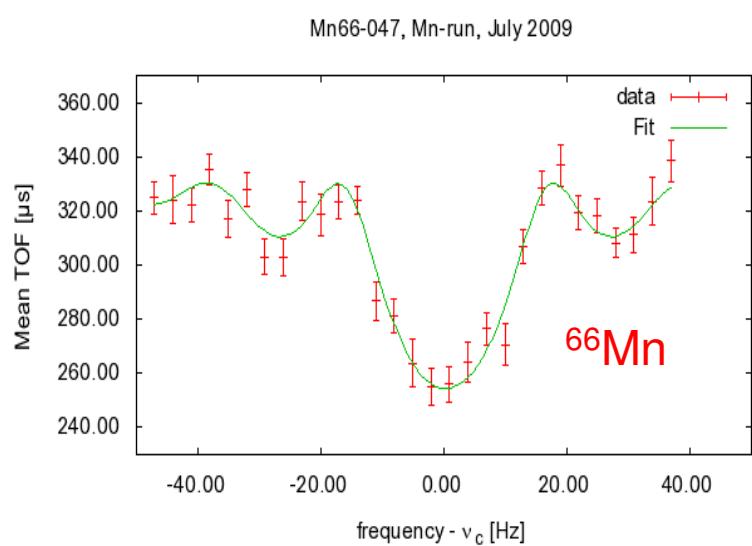
Buffer gas cooling with QP excitation:
Savard et al., Phys. Lett. A 158, 247 (1991)

removal of
contaminant ions
($R = 10^5$)



G. Bollen, et al., NIM A 368, 675 (1996)
F. Herfurth, et al., NIM A 469, 264 (2001)

ISOLTRAP: Experimental setup

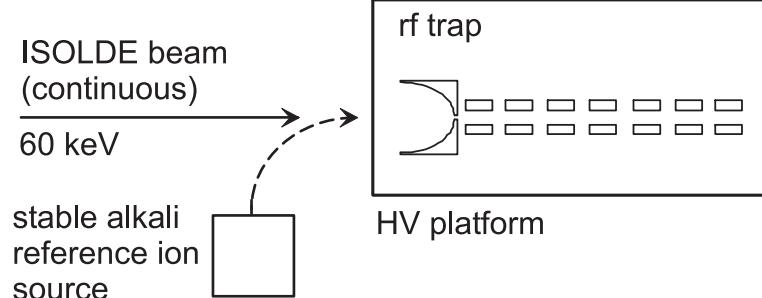
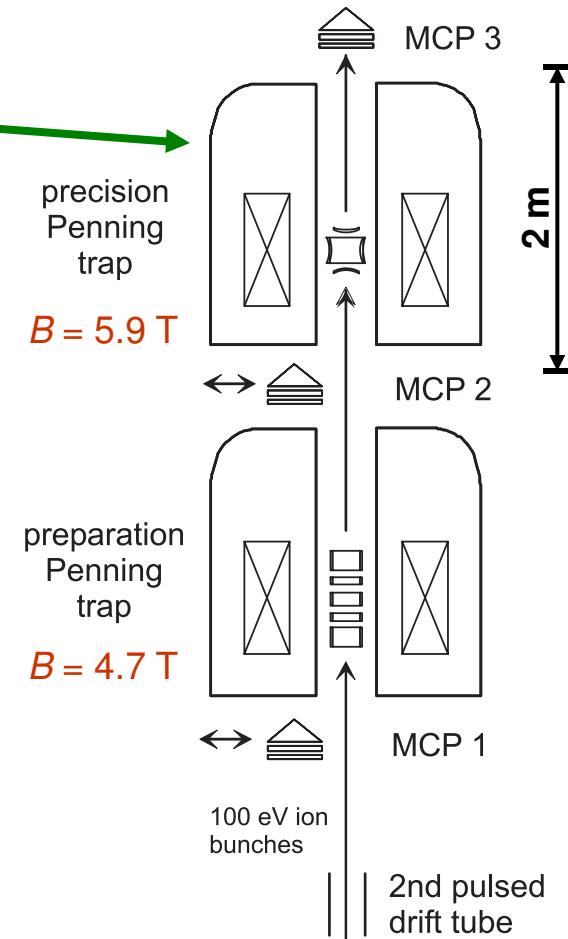


determination of
cyclotron frequency
($R = 10^7$)

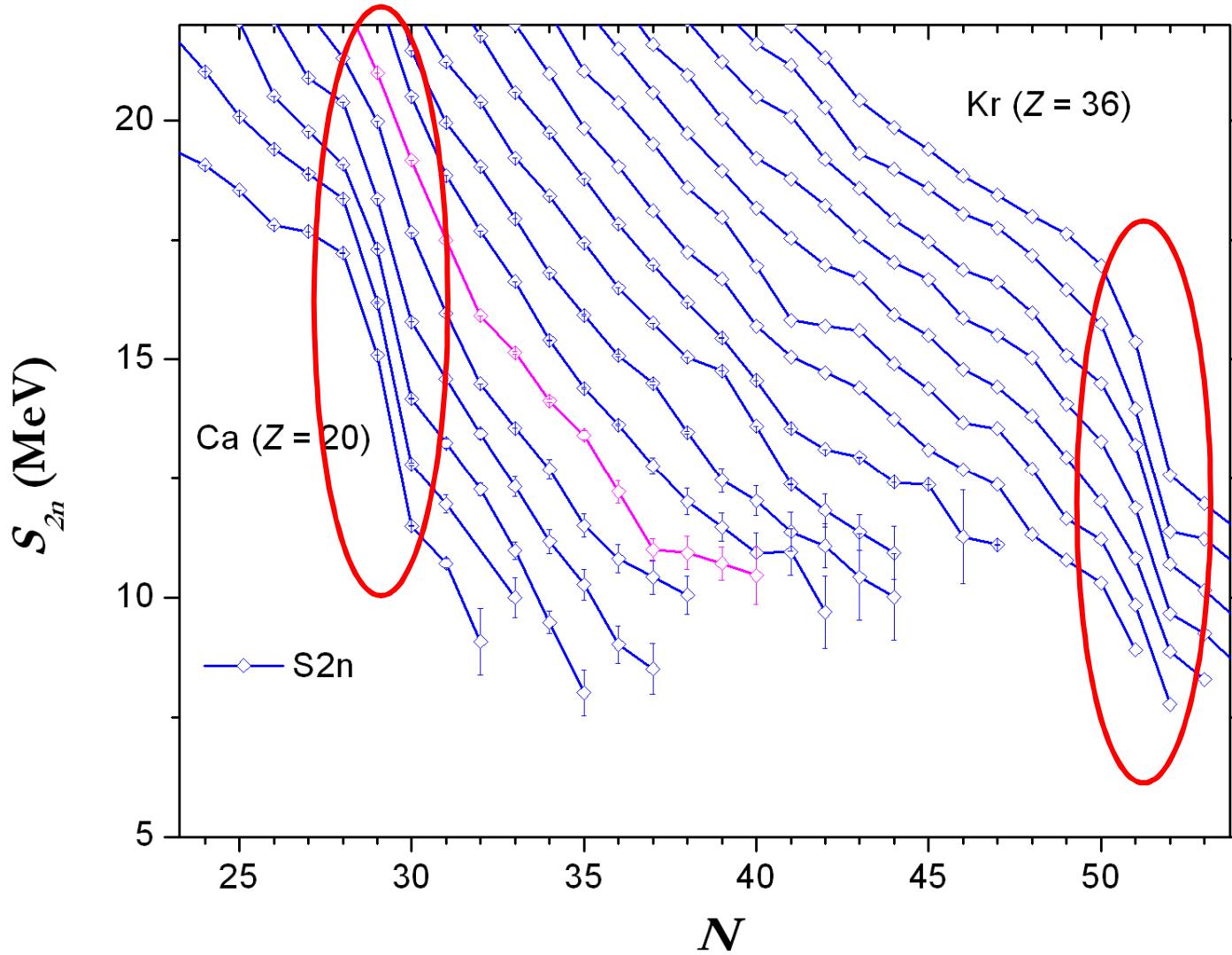
$$v_c = \frac{1}{2\pi} \frac{q}{m} B$$

^{97}Kr : 63(3) ms (*preparation trap*)

^{66}Mn : 64.4(1.8) ms (*Record at Isoltrap!!!*)



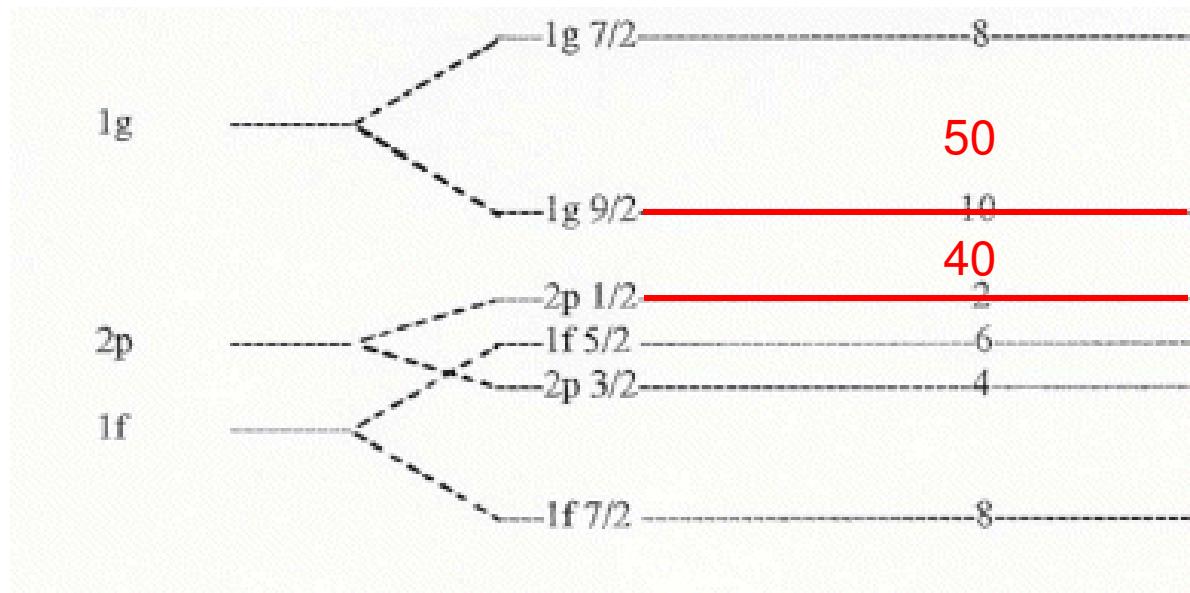
Introduction : Masses and nuclear structure



Shell closure at $N = 40$?

Harmonic oscillator :
2, 8, 20, **40**, 70...

Spin orbit :
2, 8, 20, 28, **50**, 82...



O. Sorlin et al, PRL. 88, 092501 (2002): ^{68}Ni

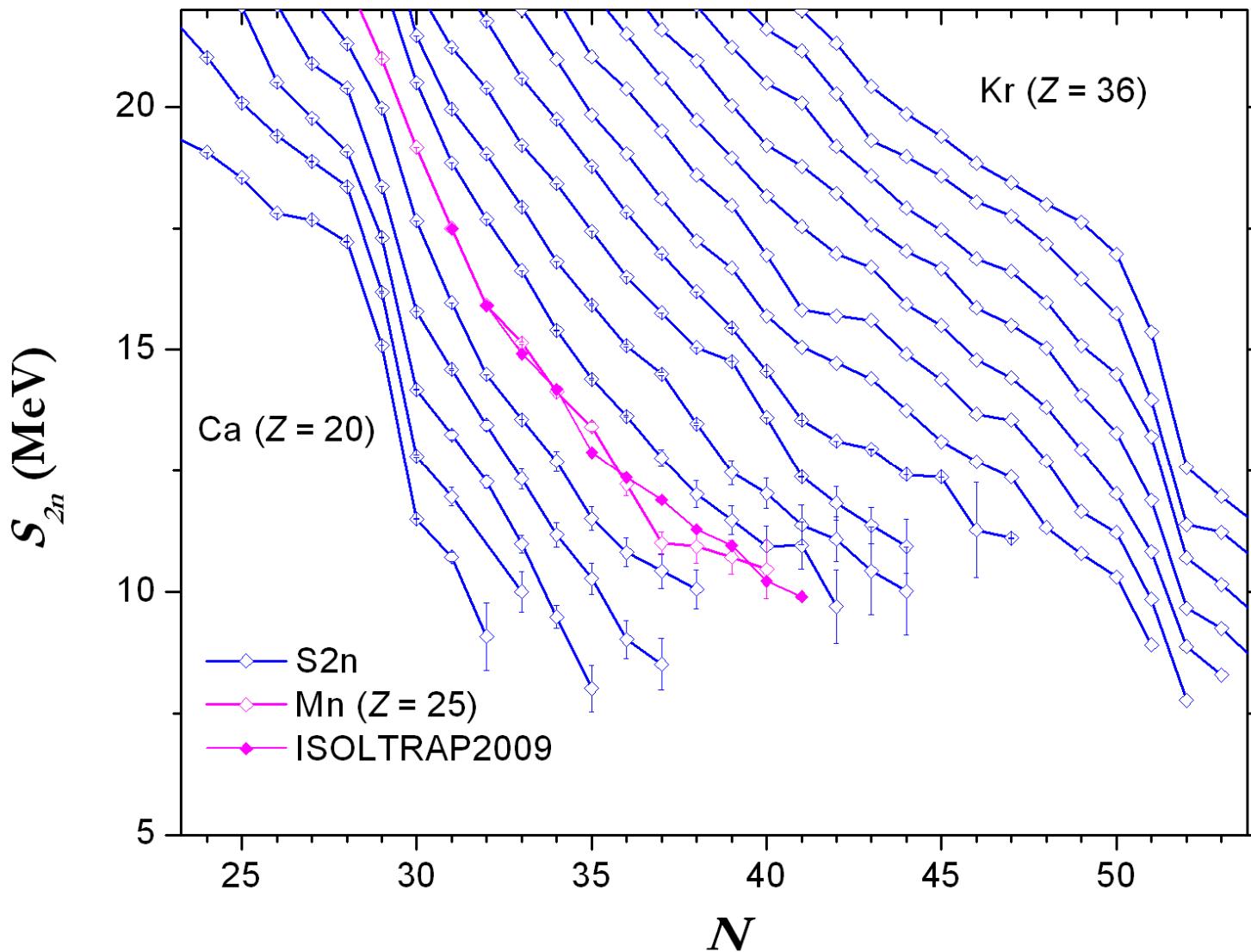
→ possibility of new magic number at $N = 40$

C. Guénaut et al, PRC 75, 044303 (2007) :

neutron rich Ni, Cu, Ga mass measurements at Isoltrap

→ No evidence of shell closure at $N = 40$

Shell closure at $N = 40$?



$A \approx 100$ Region

Large deformation in the Zr region

Quantum nuclear phase transition
Iachello, PRL, 87, 5 (2001)

D. A. Arseniev et al, Nucl. Phys. A139, 269 (1969)

P. Federman and S. Pittel, PRC, 20, 820 (1979)

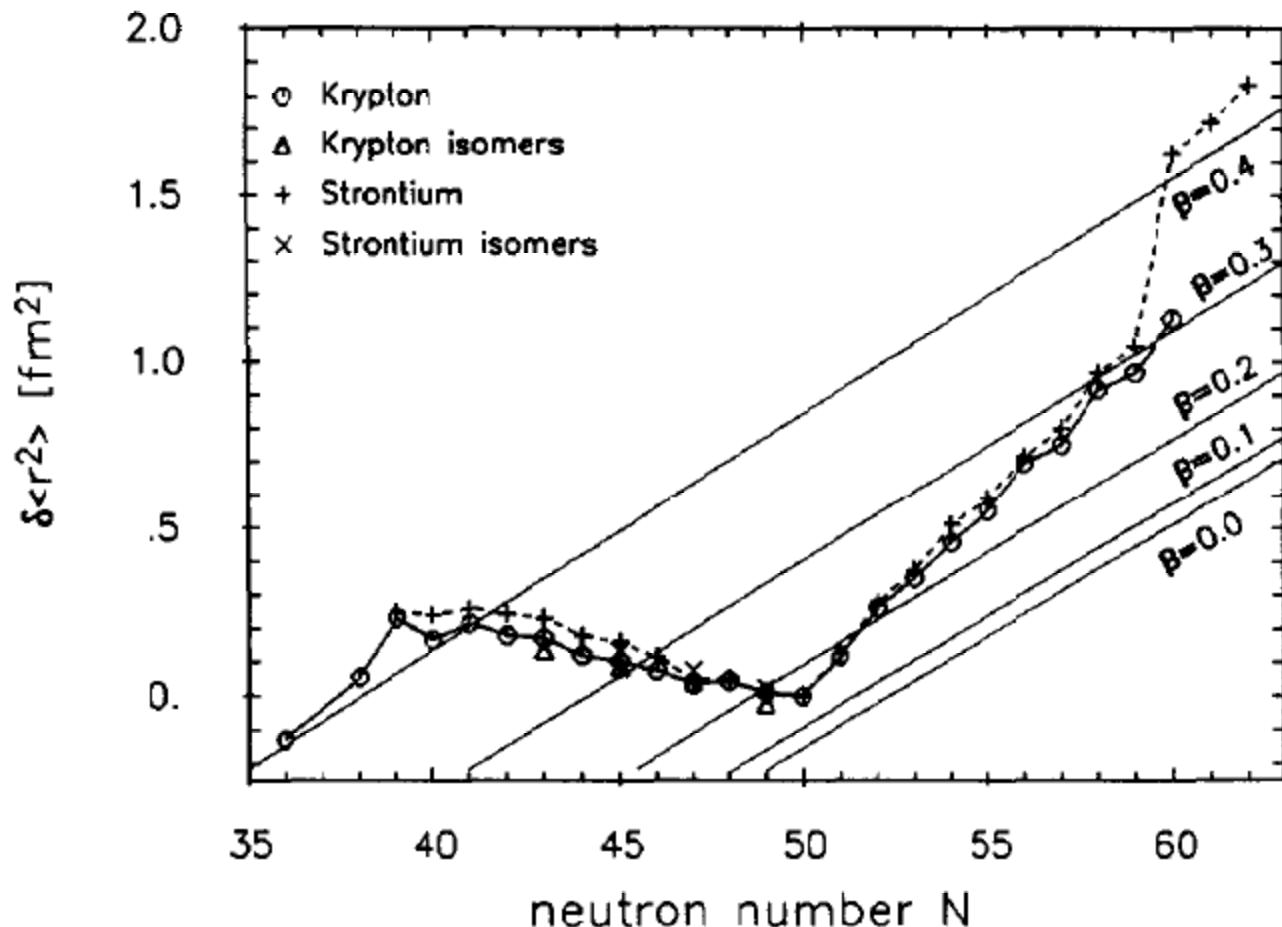


$N = 60$

Kr: deformation from $N = 60$?

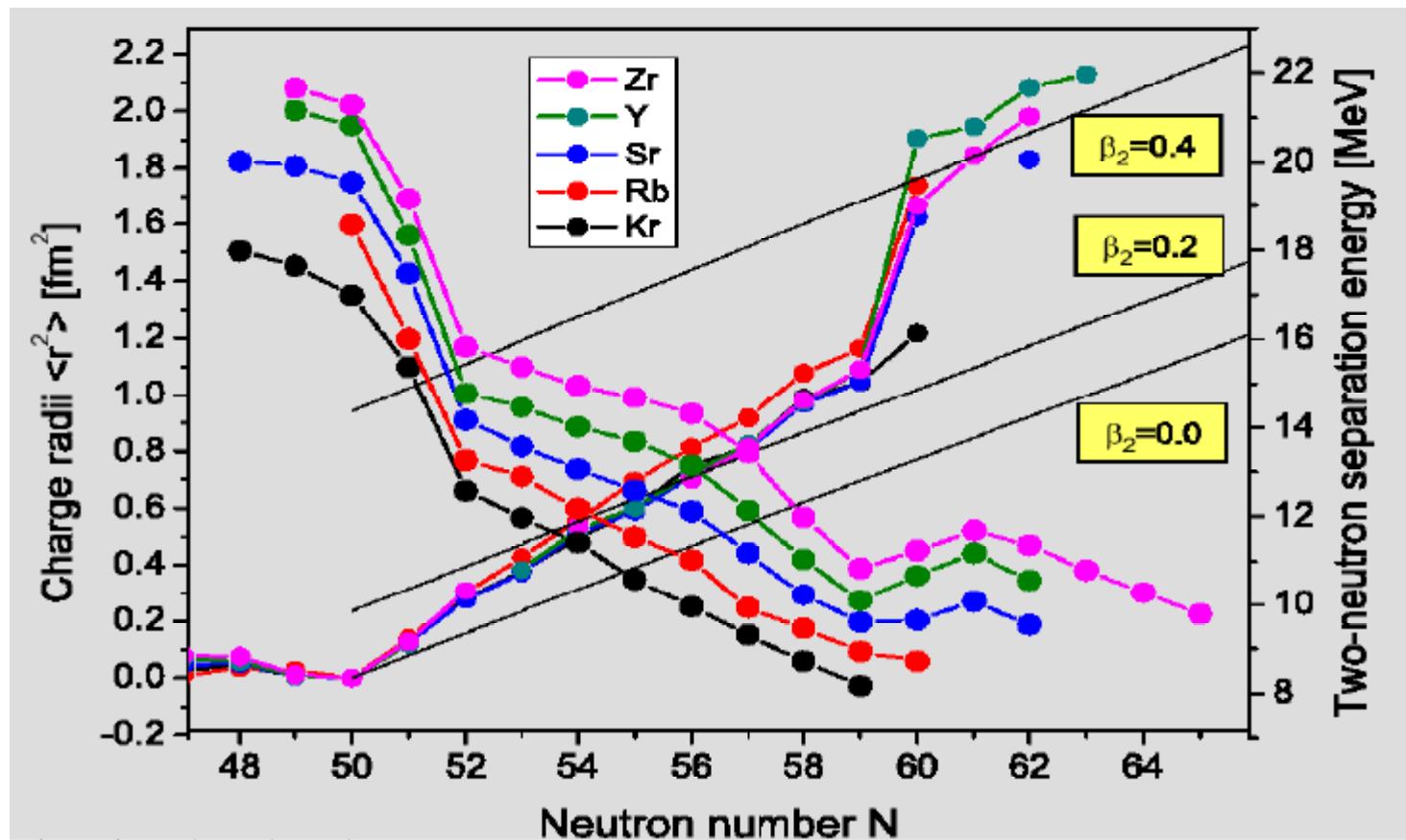
M. Keim et al. / Nuclear Physics A586 (1995) 219–239

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Kr: deformation from $N = 60$?

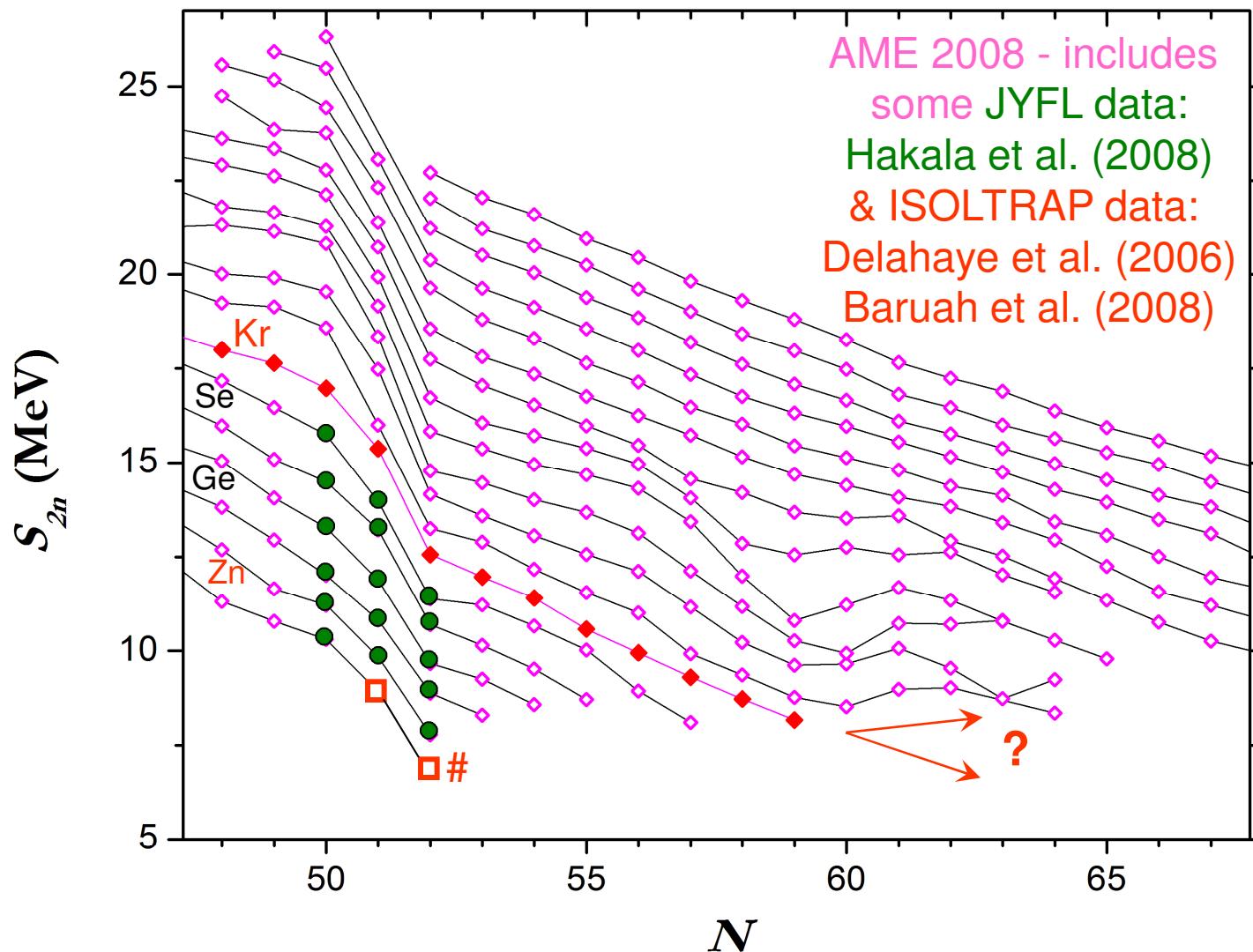
S_{2n} and charge radii correlation



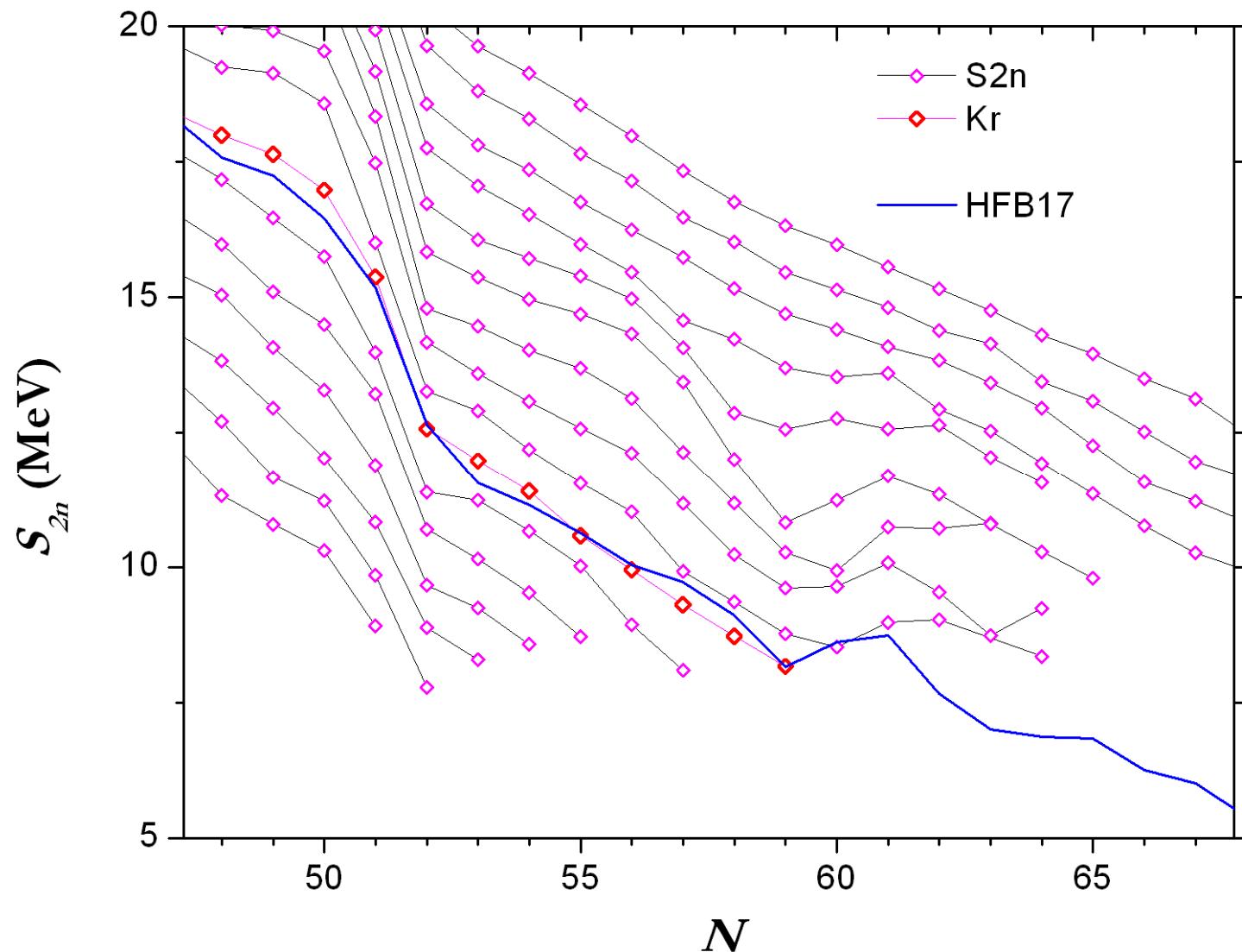
$^{95-101}\text{Y}, ^{101-107}\text{Nb}$ mass measurements by JYFL group: U. Hager *et al*, Nuclear Physics A 793 (2007) 20–39

$^{86-90,92-102}\text{Y}$, isomeric states $^{87-90,93,96,97,98}\text{Y}$ Laser spectroscopy: B. Cheal, et al., Phys. Lett. B 645 (2007) 133

Kr: deformation from $N = 60$?



Kr: deformation from $N = 60$?

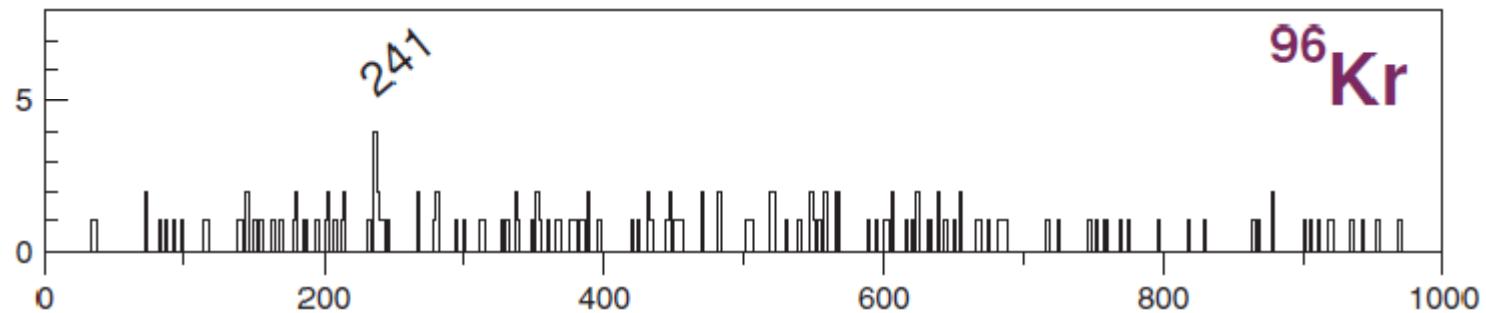


HFB17 : S. Goriely, N. Chamel, and J.M. Pearson

Kr: deformation from $N = 60$?

Experimental results spectra from CLARA and PRISMA spectrometer

N. Mărginean et al. PHYSICAL REVIEW C 80, 021301(R) (2009)

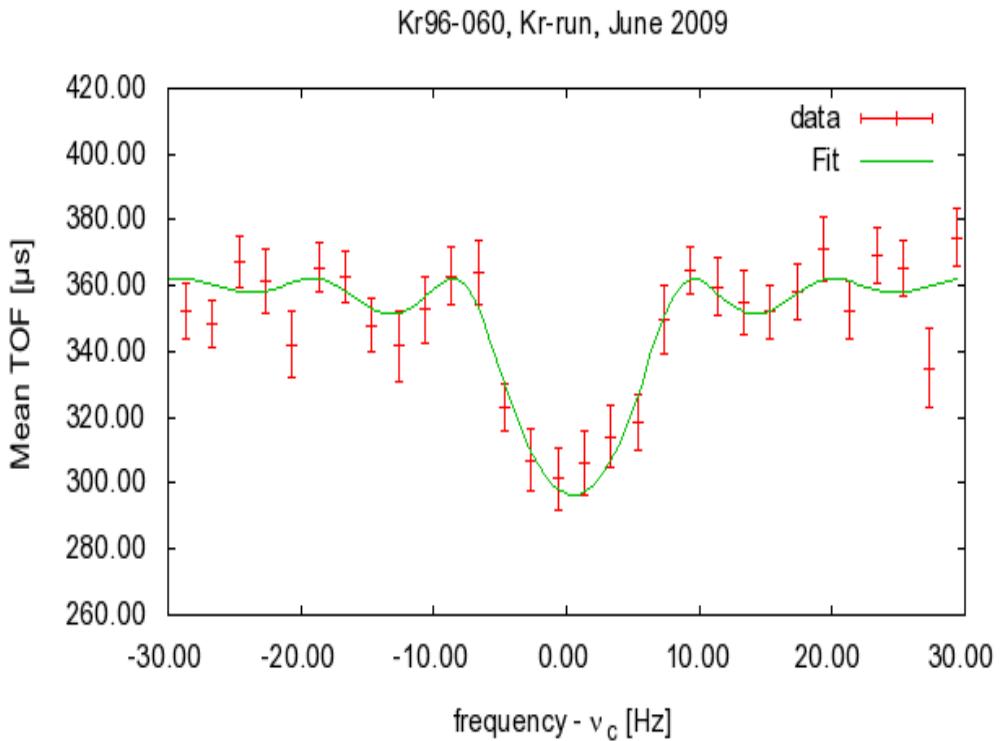


241-keV gamma ray : $2^+_1 \longrightarrow 0^+_{\text{g.s}}$ transition

Moderate deformation

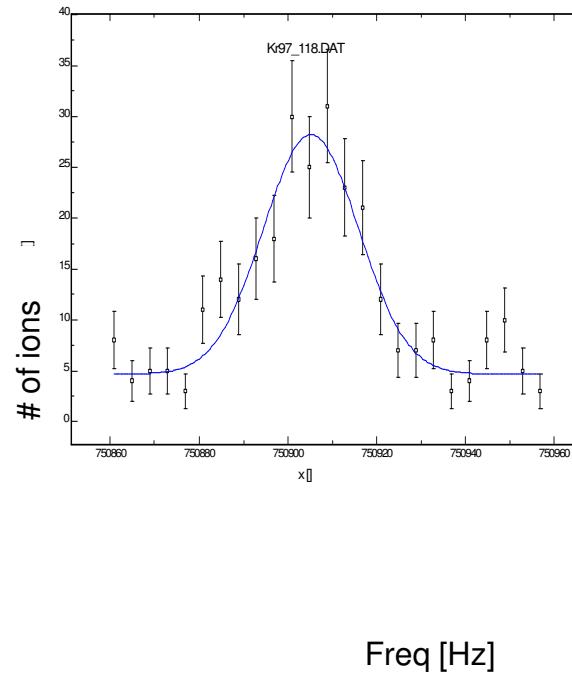
Kr: deformation from $N = 60$?

Mass measurements experimental results



^{96}Kr

Time of flight resonance in the precision trap

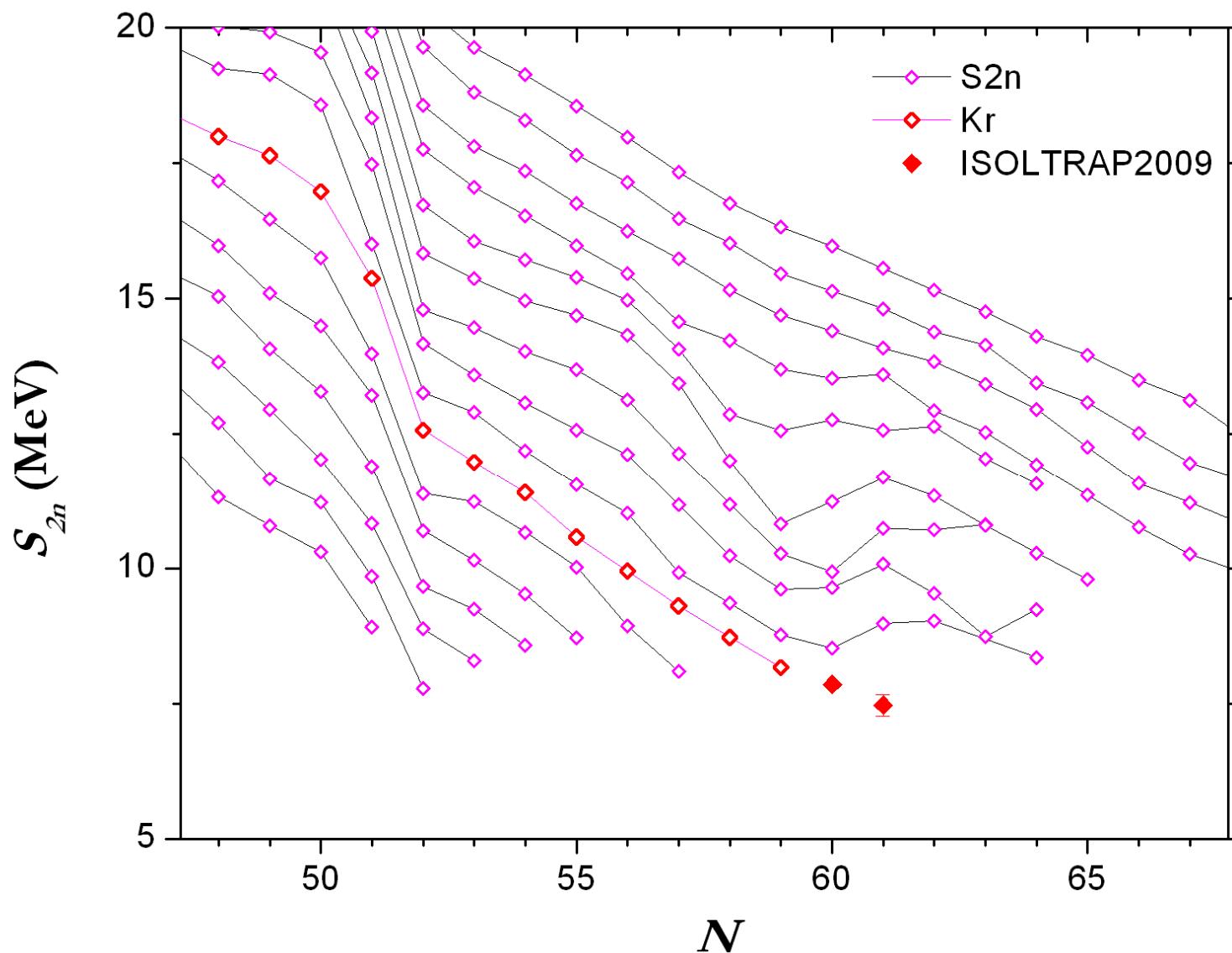


^{97}Kr

Cooling resonance in the preparation trap

Kr: deformation from $N = 60$?

Mass measurements experimental results



Summary

- From the Mn isotopes masses
 - No evidence on shell closure at $N = 40$
- Mass measurements of ^{96}Kr and ^{97}Kr showed no strong sudden deformation at $N = 60$
 - The end of quantum nuclear phase transition in the $N = 60$ region



Outlook

- Re-measure the ^{97}Kr in the precision trap to reduce the error bars
- Go further $^{98}\text{Kr} \rightarrow$ proposal 2009 on noble gases
INTC-P-263
- More study on the n-rich medium masses



Collaborators:

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