GT MATRIX ELEMENTS IN T=1/2 MIRROR NUCLEI IN DFT-ROOTED NO-CORE METHODS

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COMEX5
Collective Motion in Nuclei under Extreme Conditions
Kraków, 16.09.2015

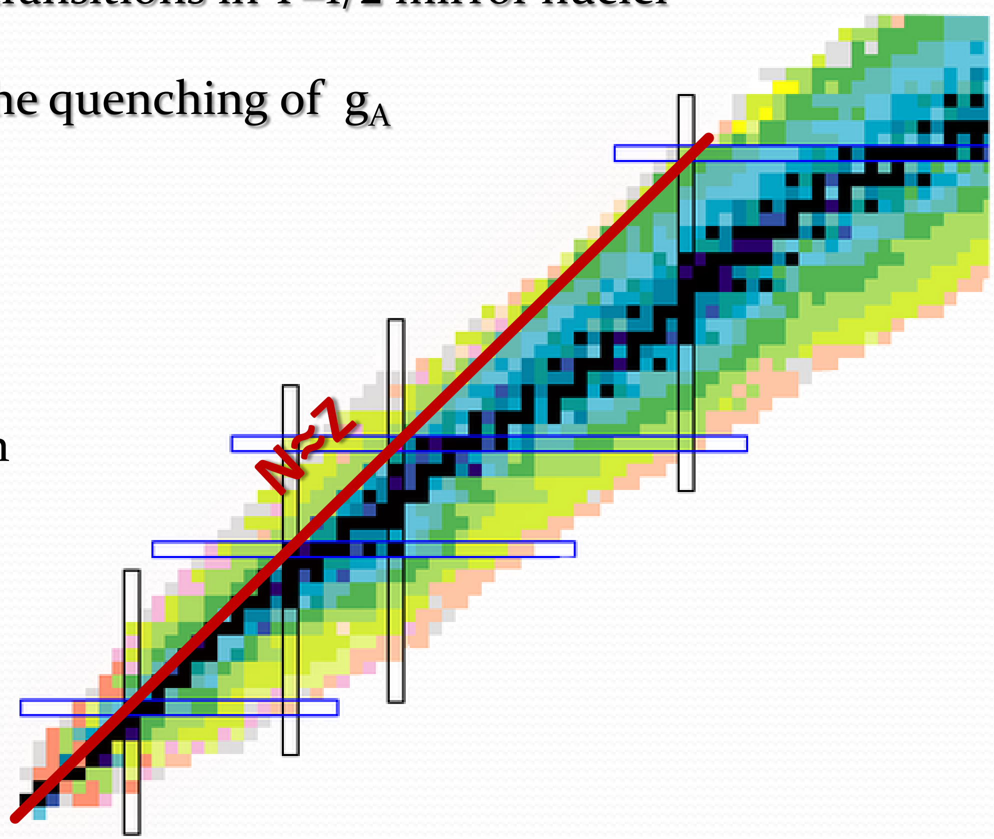
Outline

1 The No-Core Configuration Interaction (NCCI) model

2 Gamow-Teller matrix elements of transitions in T=1/2 mirror nuclei

3 An attempt to account for the quenching of g_A

Restoration of Angular Momentum
and Isospin symmetries



W. Satuła, J. Dobaczewski, M. Konieczka, *NCCI model rooted in double projected MR-DFT theory* – in preparation

Multireference DFT (MR-DFT)

SV – Skyrme interaction

$$\hat{P}^{T}_{T_z T_z} \quad |\varphi_1\rangle$$
$$\ldots |\varphi_i\rangle \ldots$$
$$\hat{P}^{I}_{MK} \quad |\varphi_N\rangle$$

SR-DFT ph
Slater determinants

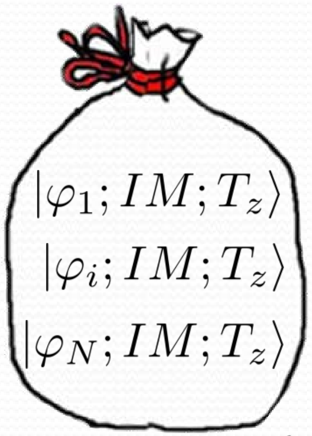
Simultanous projection on good I and T

$$|\varphi_i; IMK; TT_z\rangle = \frac{1}{\sqrt{\mathcal{N}}} \hat{P}^{T}_{T_z T_z} \hat{P}^{I}_{MK} |\varphi_i\rangle$$

K and T mixing

$$|\varphi_i; I_n M; T_z\rangle = \sum_{n,K,T\geq|T_z|} a^{\varphi_i}_{nIT} |\varphi_i; I^\pi MK; TT_z\rangle$$

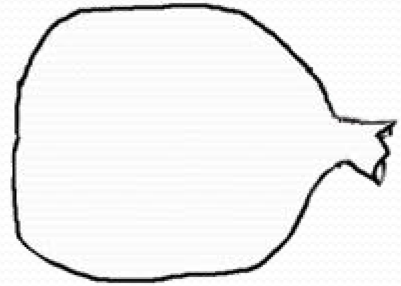
No-Core Configuration Interaction (NCCI)

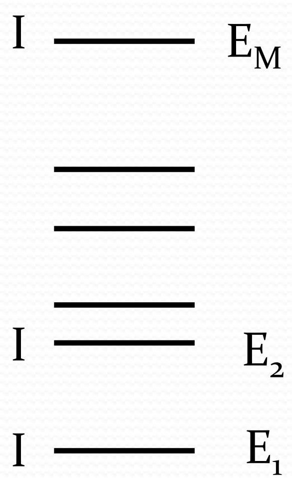


SV – Skyrme interaction

$$\mathcal{H}u = E\mathcal{N}u$$

Hill-Wheeler equation





Gamow – Teller matrix elements in the MR-DFT frame

$g_A = -1.2701$

$g_A |M_{GT}|$

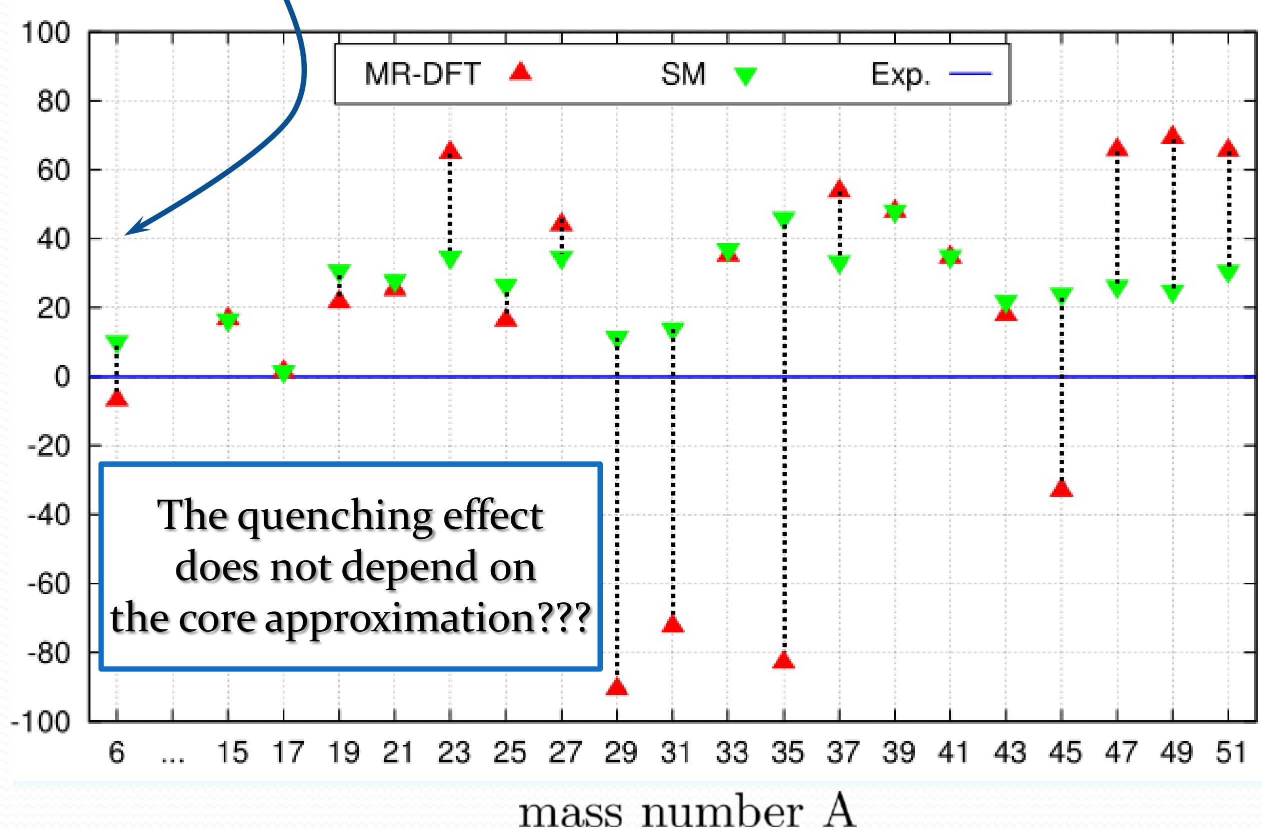
A	DFT	SM	EXP
6	2.559	2.775	2.749
15	1.037	1.038	0.889
17	3.677	3.684	3.626
19	2.808	3.022	2.310
21	1.805	1.846	1.442
23	1.830	1.496	1.110
25	2.328	2.537	2.003
27	2.469	2.310	1.715
29	0.070	0.840	0.753
31	0.208	0.860	0.755
33	0.821	0.833	0.608
35	0.097	0.833	0.570
37	1.825	1.585	1.188
39	1.964	1.969	1.329
41	4.066	4.083	3.023
43	3.168	3.279	2.688
45	1.216	2.254	1.816
47	1.569	1.196	0.947
49	2.327	1.718	1.375
51	2.414	1.907	1.459

A. Knecht, R. Hong, D. Zumwalt, et al., Phys. Rev. Lett. **108**, 122502 (2012).

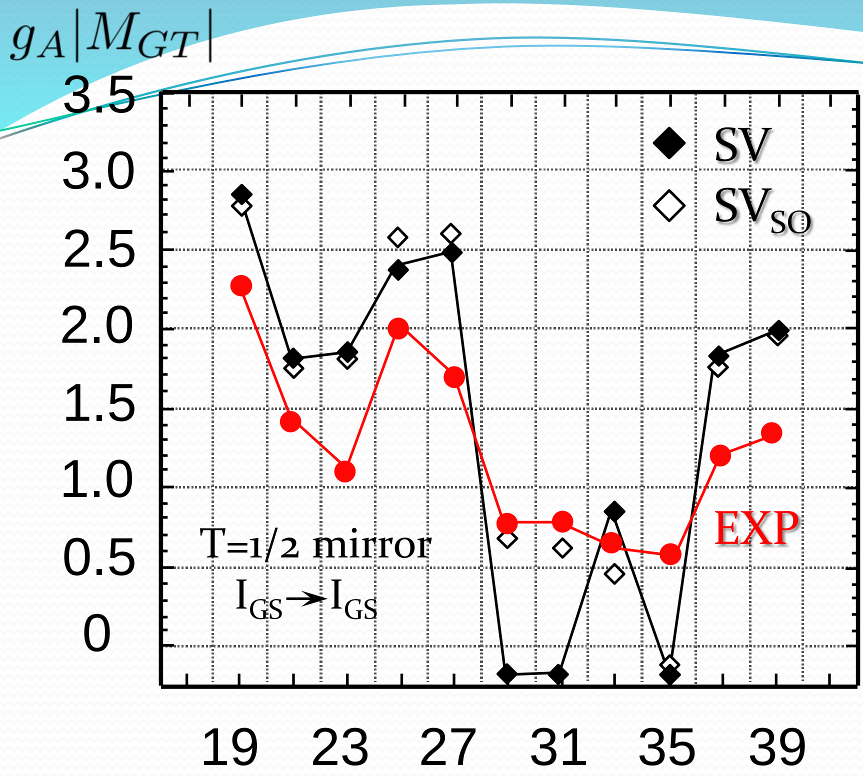
B.A. Brown and B.H. Wildenthal, Atomic Data and Nuclear Data Tables **33**, 347-404 (1985).

G. Martinez-Pinedo, A. Poves, E. Caurier, A. Zuker, Phys. Rev. **C 53**, 2602(R) (1996).

$$\frac{|M_{GT}|_{th} - |M_{GT}|_{exp}}{|M_{GT}|_{exp}} \%$$

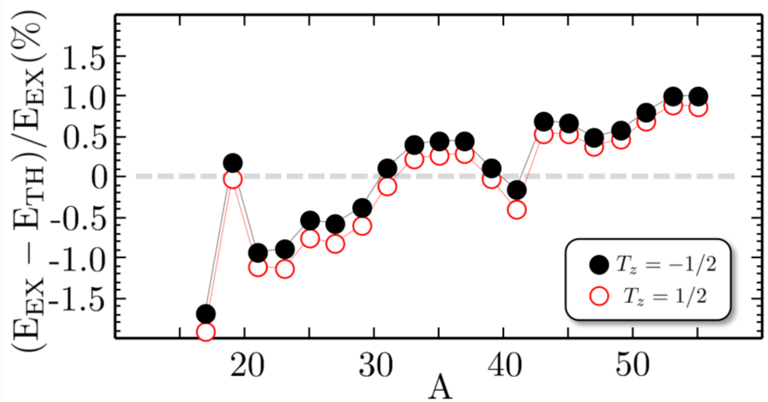


Gamow-Teller matrix elements in the MR-DFT frame

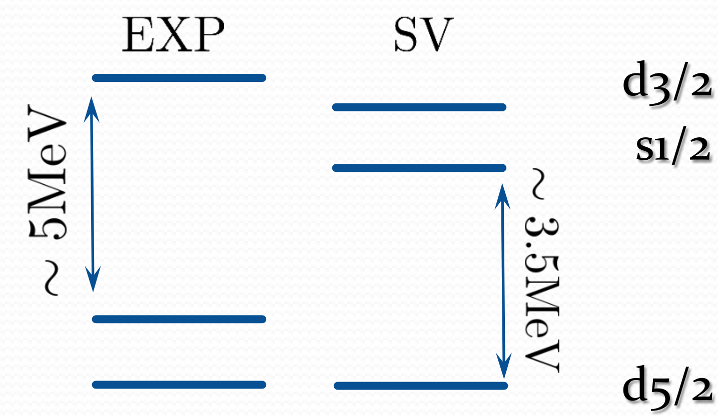


destructive interference of $1s_{1/2}$ and $0d_{3/2}$ subshell

SV_{SO} - Spin- orbit tunning



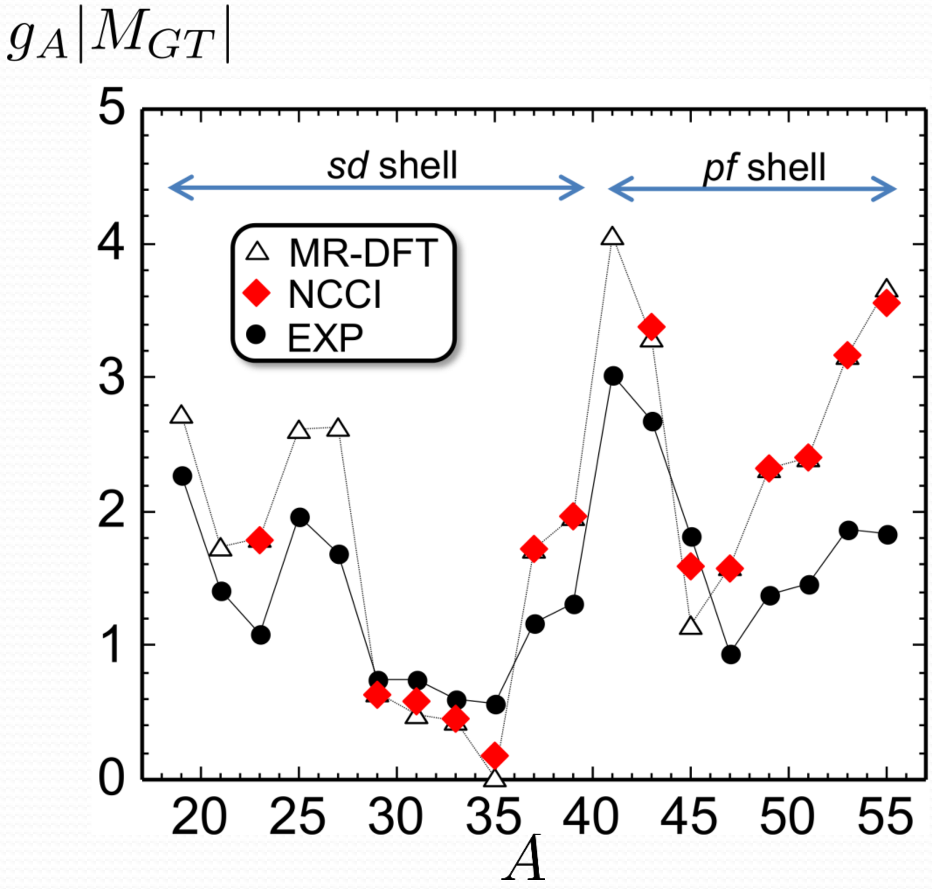
Single particle energies (sd shell) in ^{17}O



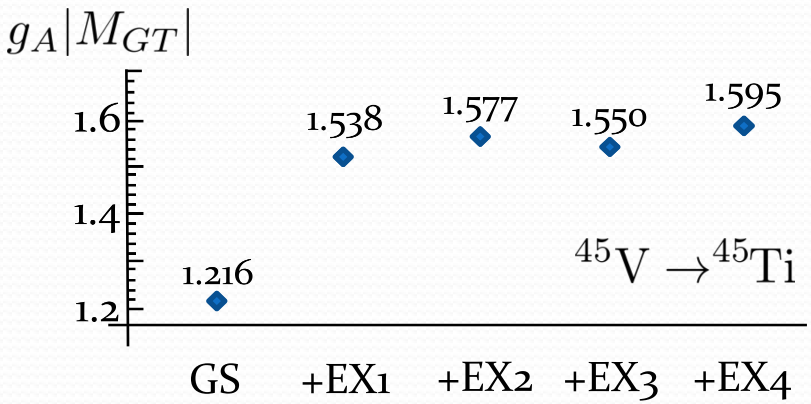
$$\mathcal{M}^{sp}_{GT}(1s_{1/2}1s_{1/2}) = \sqrt{2} \approx 1.4$$

$$\mathcal{M}^{sp}_{GT}(0d_{3/2}0d_{3/2}) = -\frac{2}{\sqrt{5}} \approx -0.9$$

Gamow – Teller matrix elements in the NCCI frame



NCCI calculations usually with
3 -5 configurations included

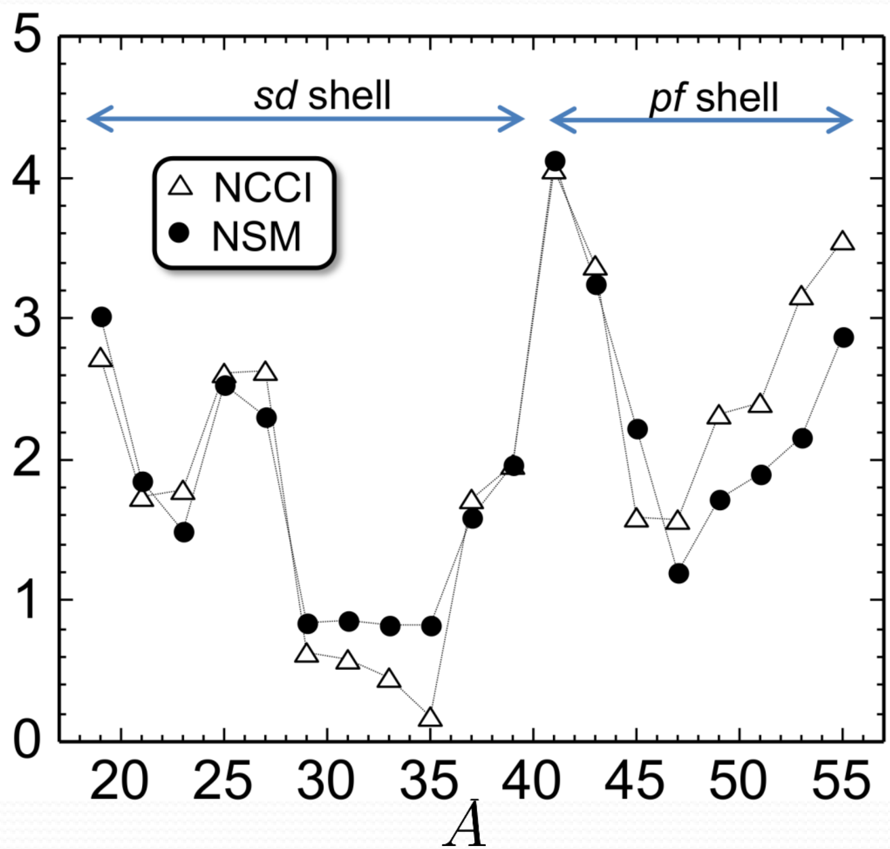


Slater determinants are deformed !!!

Except for A=45 transition configuration mixing
does not change the MR-DFT result !!!

M. Konieczka, et al, *Beta-decay study within multi-reference DFT* –**arXiv: 1509.04480**

Quenching of g_A



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$$g_A^{\text{eff}} = q g_A$$

q	MR-DFT	NCCI	NSM
sd-shell	0.77	0.78	0.77
pf-shell	0.75	0.69	0.74

NCCI

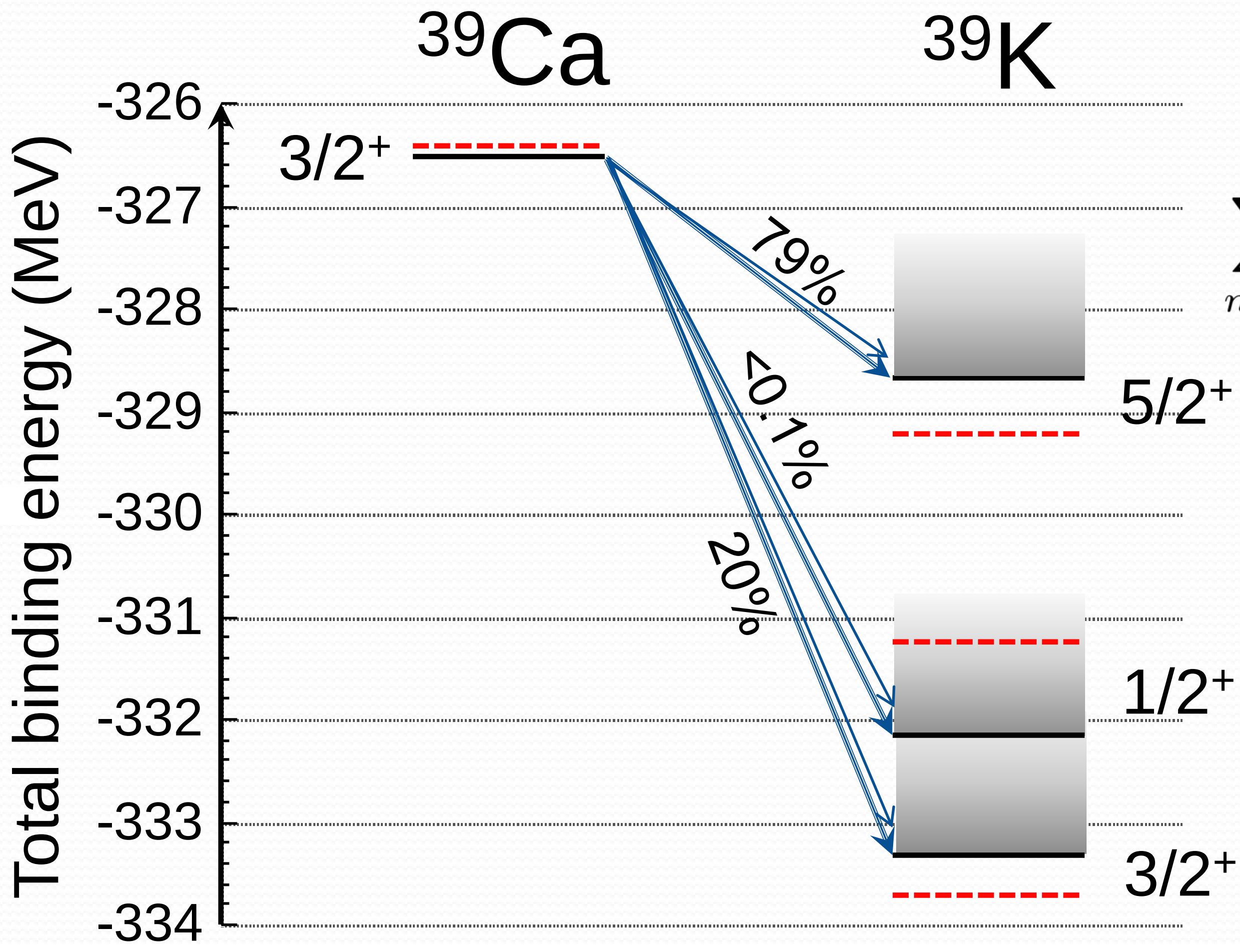
- takes into account core polarization effects
- accounts for correlations in a different way than NSM
- uses functionals, which were not optimized for configuration mixing
- uses compeletely different model space

The quenching effect may not depend on the core approximation!!! *

*This statement is preliminary and requires further studies in entire valence spaces!

Thank you
for your attention !!!

The Ikeda sum rule



Ikeda sum rule for
T=1/2 mirrors

$$\sum_{n',I'} B(O_+; I \to n', I') = 3$$