Competing excitation modes in A ~ 80 region

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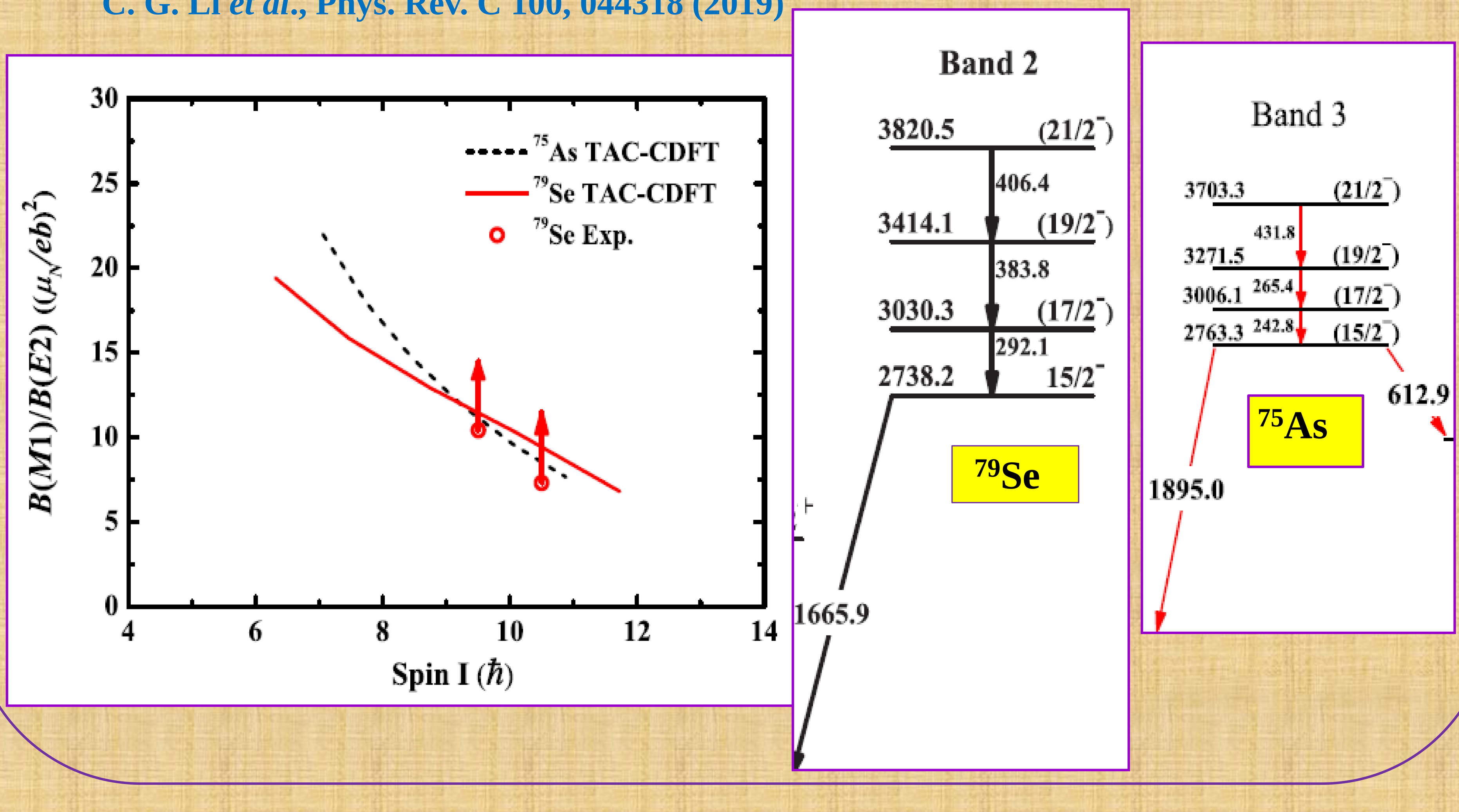
Poster Presentation (# 137)

❑ Observation of novel stapler band in ^{75}As

C. G. Li *et al.*, Phys. Lett. B 766, 107 (2017)

❑ Stapler mechanism for a dipole band in ^{79}Se

C. G. Li *et al.*, Phys. Rev. C 100, 044318 (2019)



Results from VECC-INGA campaign

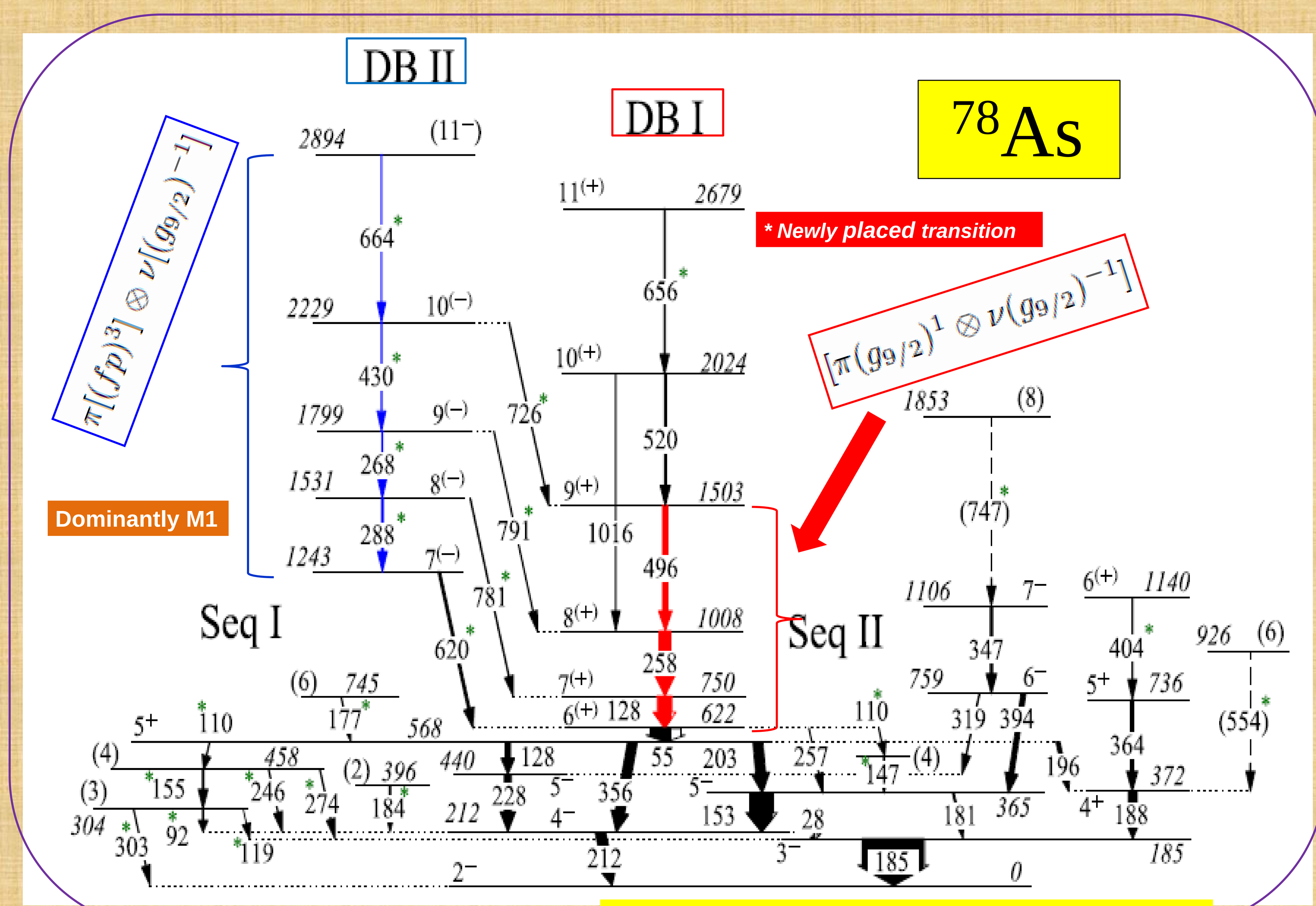
- ✓ α @ 30 – 40 MeV + ^{76}Ge → ^{80}Se* → ^{78}As (1p1n channel)
- ✓ Beam Energy: 30, 35 and 40 MeV
- ✓ De-excited gamma rays were detected using the Indian National Gamma Array (INGA) @ VECC, Kolkata
- ✓ The array was comprised of seven Clover detectors and one LEPS.

Detector Configuration:

4 Clover @ 90° 2 Clover @ 125° 1 Clover @ 40° 1 LEPS @ 40°

- ✓ Digital DAQ developed by UGC-DAE CSR, Kolkata was used

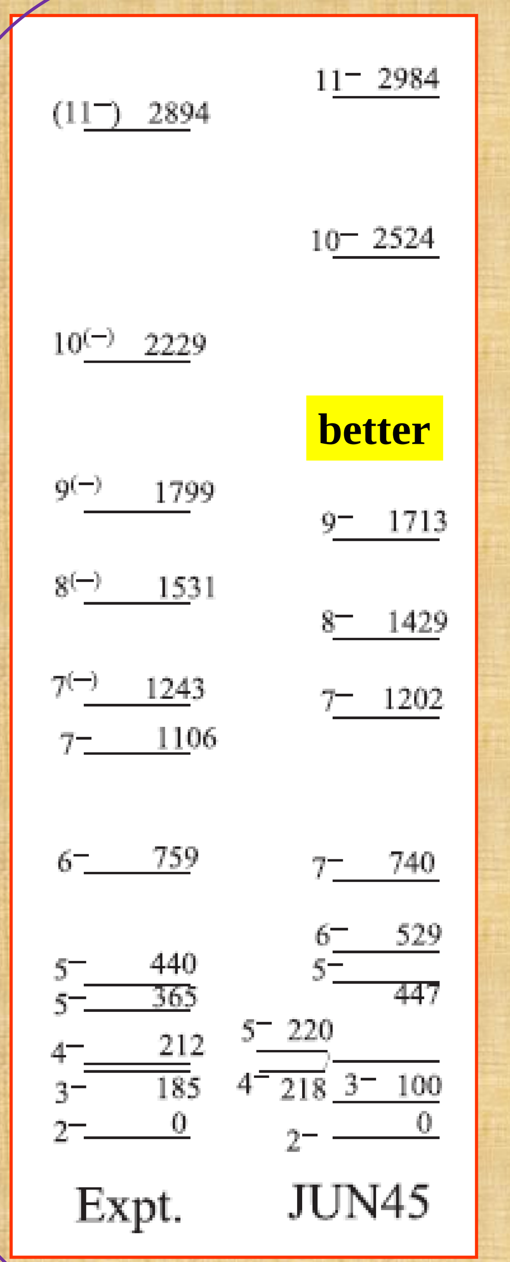
S. Das *et al.*, Nucl. Instrum. Methods Phys. Res. A 893 (2018) 138



A. K. Mondal *et al.*, Phys. Rev. C 102 (2020) 064311

Shell Model

^{78}As



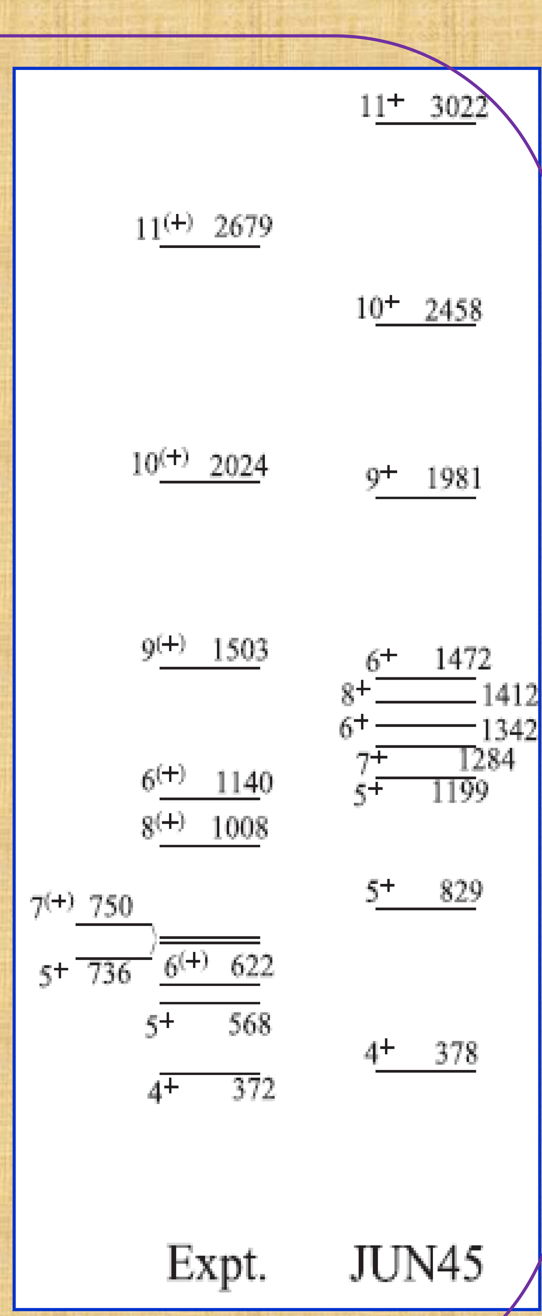
5 π	17 ν
Z = 28	N = 28

^{56}Ni core (^{56}Ni + 5π + 17ν)

- ✓NUSHELLX code
- ✓fpg-model space

❖Negative parity states: No role of $\pi(1g_{9/2})$

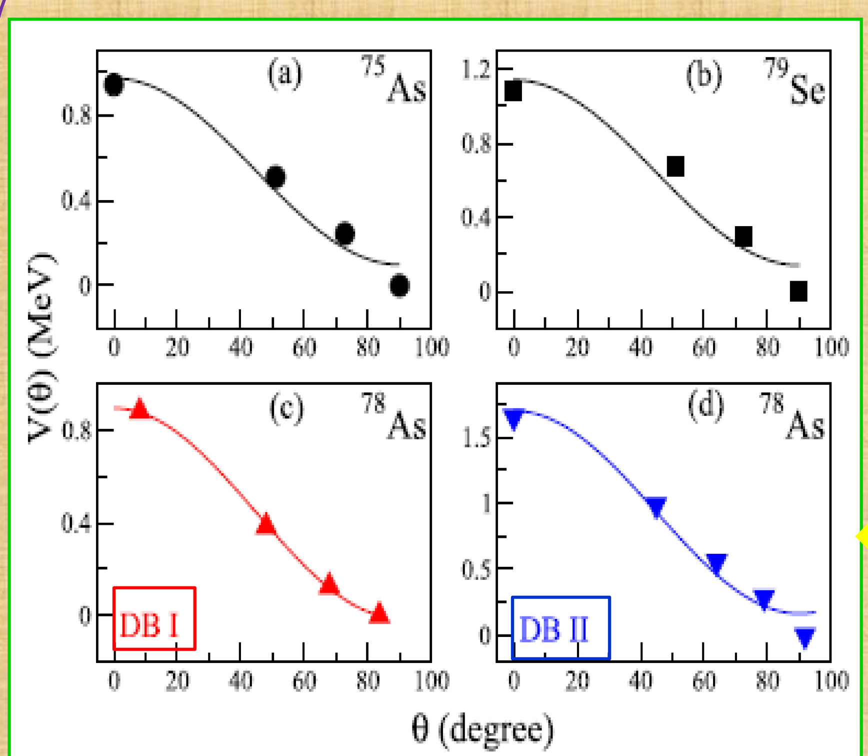
❖Positive parity states: Occupancy in both $\pi(1g_{9/2})$ & $\nu(1g_{9/2})$

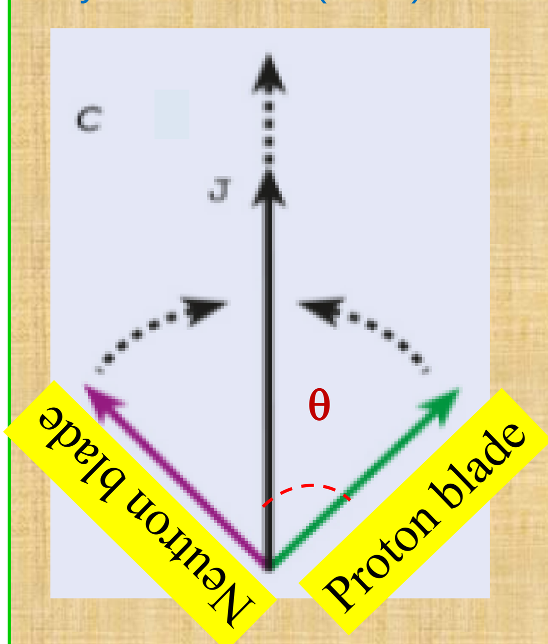


$J_i^\pi \to J_f^\pi$	$B(E2)_{expt}^{a}$ (W.u.)	$B(E2)_{theory}$ (W.u.)
$4^- \to 2^-$	7.2 ± 1.5	6.2
$5^- \to 3^-$	3.0 ± 0.6	2.9

Validity of Shears Mechanism

Semi-classical approach of Macchiavelli *et al.*, Phys. Rev. C 57 (1998) R1073



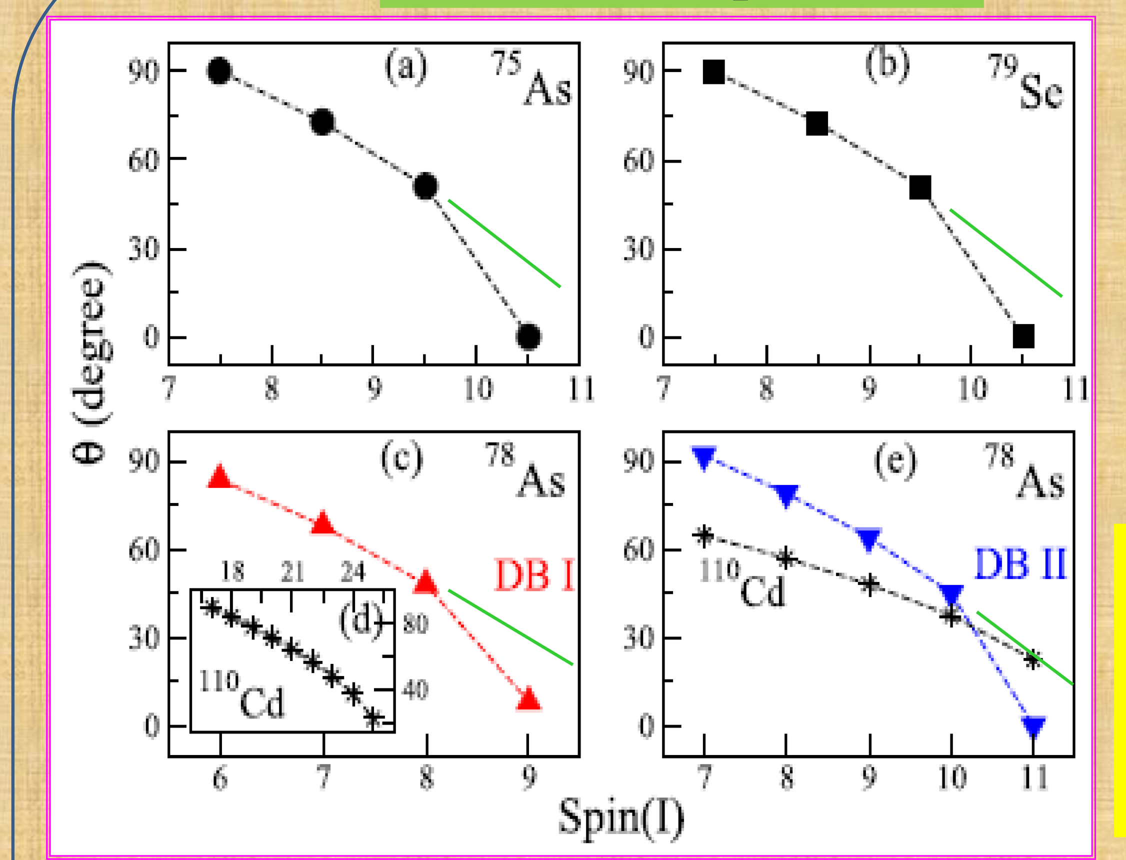


$$V(\theta) = V_0 + [(1/2) \times V_2(3cos^2(\theta) - 1)]$$

V_2: strength of interaction
θ: shears angle

A. K. Mondal *et al.*, Phys. Rev. C 102 (2020) 064311

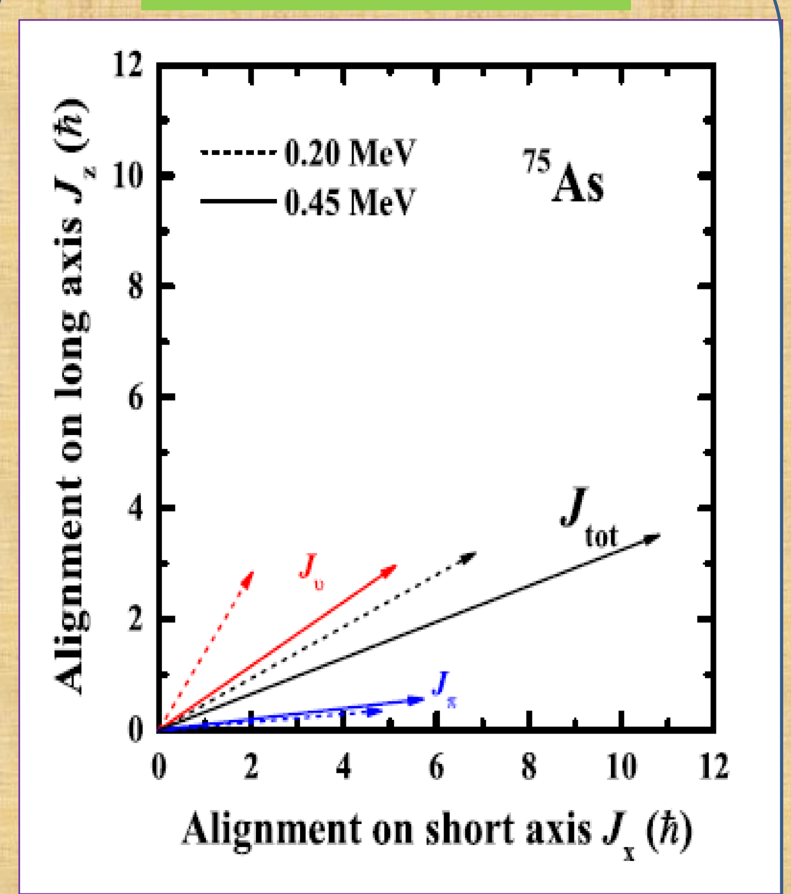
Scissor vs Stapler band



^{75}As: Physics Letters B 766 (2017) 107; ^{79}Se: Phys. Rev. C 100 (2019) 044318
^{110}Cd: Phys. Rev. Lett. 82 (1999) 3220

^{78}As: A. K. Mondal *et al.*, Phys. Rev. C 102 (2020) 064311

TAC-CDFT results



C. G. Li *et al.*, Phys. Lett. B 766, 107 (2017)

Experimental and theoretical $B(M1)/B(E2)$ values for the transitions belonging to DB-I and DB-II of ^{78}As.

	E_x (keV)	J^π	$B(M1)/B(E2)$(expt) $(\mu_N/eb)^2$	$B(M1)/B(E2)$(SM) $(\mu_N/eb)^2$
DB-I	1008	$8^{(+)}$	>31	101950
	1503	$9^{(+)}$	>26	772
DB-II	1799	$9^{(-)}$	>19	20
	2229	$10^{(-)}$	>6	4
	2894	(11^-)	>5	1

TRS

ħω = 0.3 MeV

DB-I: $\beta_2 = 0.18$, $\gamma = 6$
Prolate

DB-II: $\beta_2 = 0.09$, $\gamma = -11$
Prolate

Summary

^{78}As:
- ❖ dominance of single-particle excitation mode at low energy regime ($E_x < 600$ keV)
- ❖ on set of regular M1 band-like structures at medium energy region ($E_x > 600$ keV)
- ❖ Possible on set of stapler like mechanism based on semi-classical results.

^{75}As, ^{79}Se:
- ❖ on set of stapler-mechanism gets confirmed from detail TAC-CDFT calculations.

A ~ 80 region:
- ❖ possibility to look for competing scissor vs stapler mechanism.
- ❖ detail lifetime data is required for elucidating the two different modes of excitation.

Acknowledgements:
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