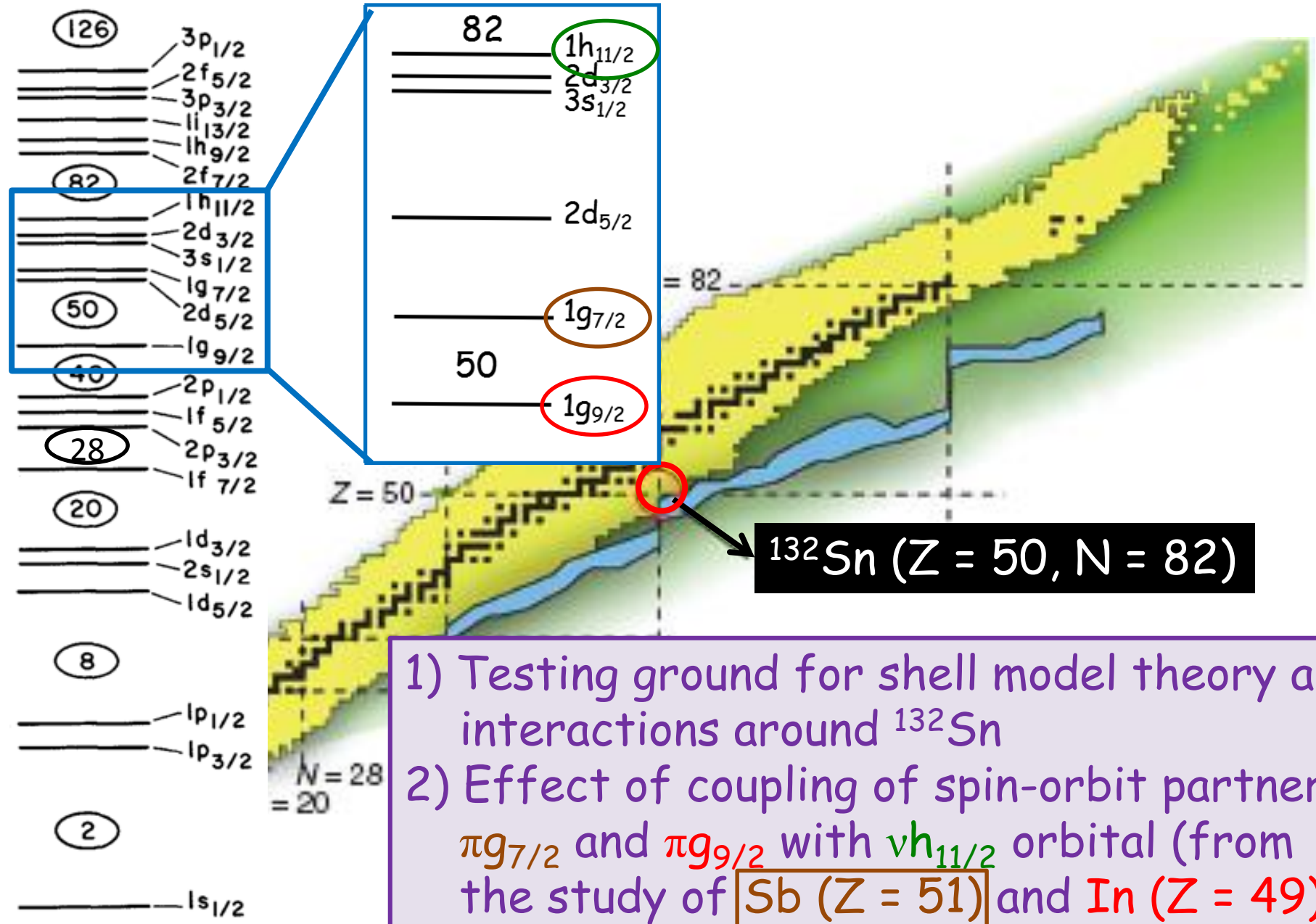


Neutron seniority and Angular momentum mixing in neutron-rich $^{122-131}\text{Sb}$ isotopes

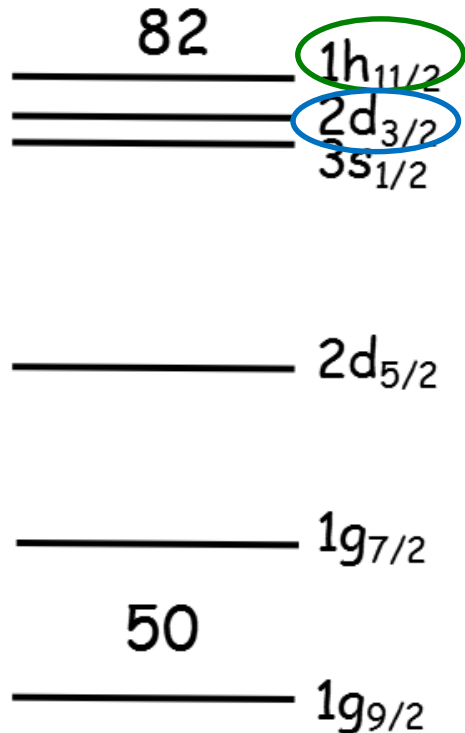
Sayani Biswas, GANIL
(on behalf of E661
collaboration)

XX1st Colloque GANIL 2019
Strasbourg, France
September 11, 2019

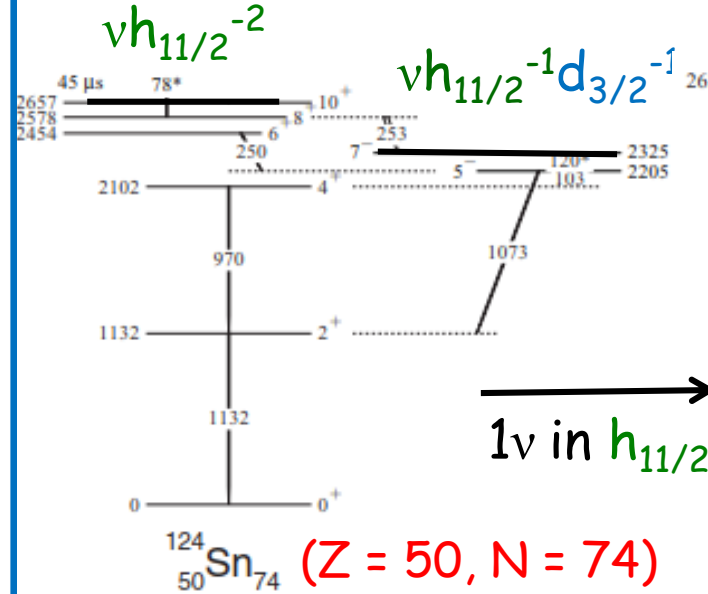
Overview of Nuclear Structure near $Z \sim 50, N < 82$



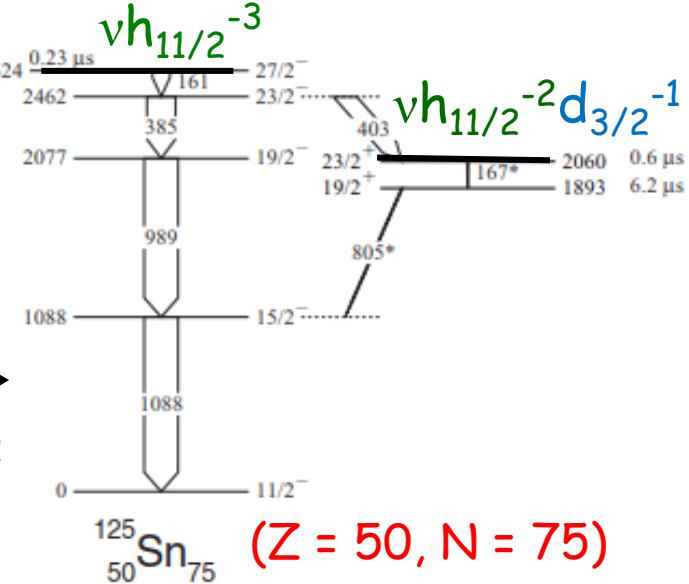
Overview of Nuclear Structure in $Z = 50, N < 82$



Even-A Sn (¹¹⁸⁻¹³⁰Sn):



Odd-A Sn (¹¹⁹⁻¹²⁹Sn):

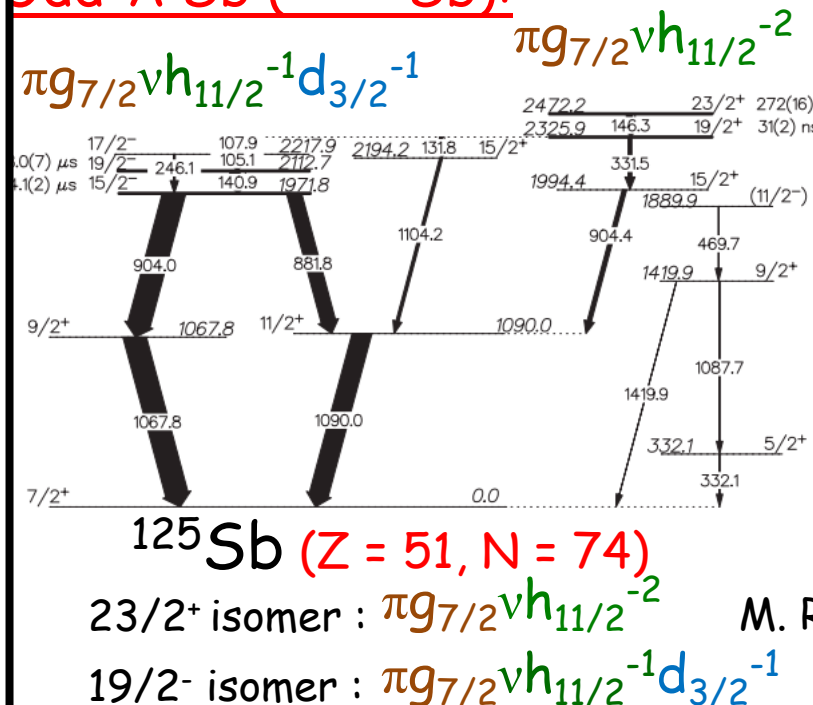


R. L. Lozeva et al, PRC, 77, 064313 (2008) A. Astier et al, PRC, 85, 054316 (2012)

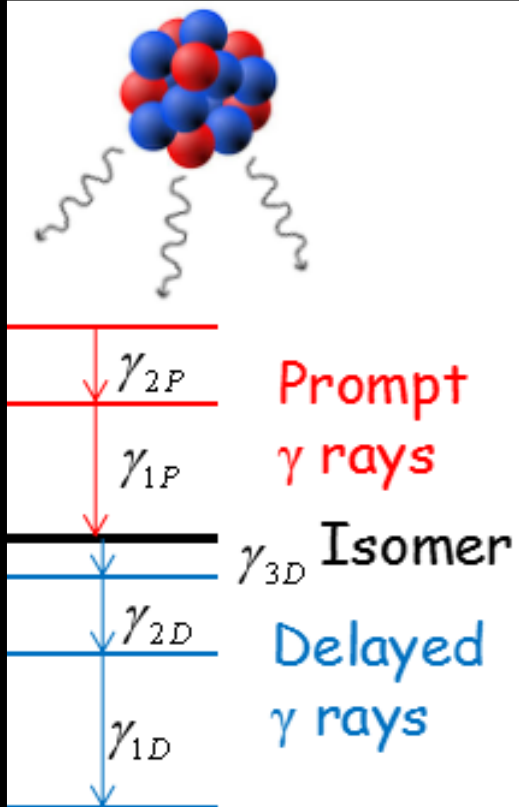
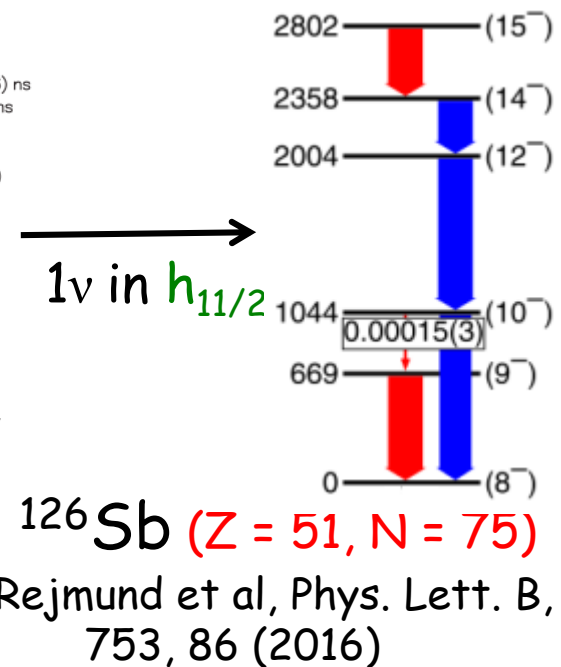
119Sb	120Sb	121Sb	122Sb	123Sb	124Sb	125Sb	126Sb	127Sb	128Sb	129Sb	130Sb	131Sb	132Sb	133Sb
118Sn	119Sn	120Sn	121Sn	122Sn	123Sn	124Sn	125Sn	126Sn	127Sn	128Sn	129Sn	130Sn	131Sn	132Sn
117In	118In	119In	120In	121In	122In	123In	124In	125In	126In	127In	128In	129In	130In	131In

Overview of Nuclear Structure in $Z = 51, N < 82$

Odd-A Sb ($^{121-131}\text{Sb}$):



Even-A Sb ($^{122-130}\text{Sb}$):



Prompt-Delayed gamma-ray Spectroscopy
 Fusion & transfer induced fission (inverse kinematics)

119Sb	120Sb	121Sb	122Sb	123Sb	124Sb	125Sb	126Sb	127Sb	128Sb	129Sb	130Sb	131Sb	132Sb	133Sb
118Sn	119Sn	120Sn	121Sn	122Sn	123Sn	124Sn	125Sn	126Sn	127Sn	128Sn	129Sn	130Sn	131Sn	132Sn
117In	118In	119In	120In	121In	122In	123In	124In	125In	126In	127In	128In	129In	130In	131In

The Experimental Setup

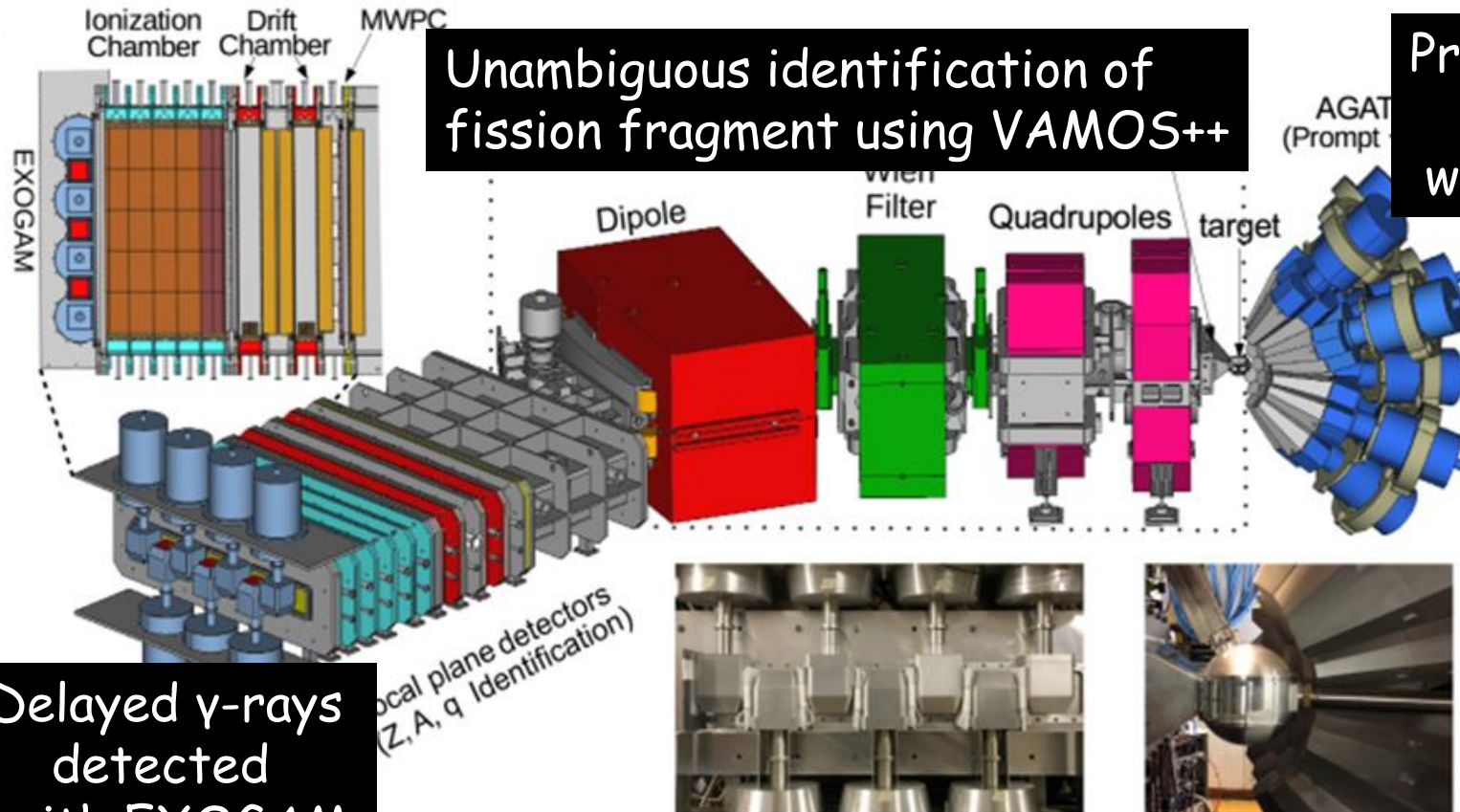
AGATA, VAMOS++ and EXOGAM @ GANIL:

Beam: ^{238}U (6.2 MeV/u, 0.3-1 pA) Target: ^9Be (1.6 & 5 μm thick)

Detectors: AGATA (32 crystals, 13.5 cm from target)

VAMOS++ (20° relative to beam axis, MWPC, 2 DCs, segmented IC)

EXOAM (7 HPGe Clover detectors)



Unambiguous identification of fission fragment using VAMOS++

Prompt γ -rays detected with AGATA

Correlate prompt & delayed gamma rays within a time range of 100 ns to 200 μs .

Delayed γ -rays detected with EXOGAM



The Experimental Results: Isotopic identification

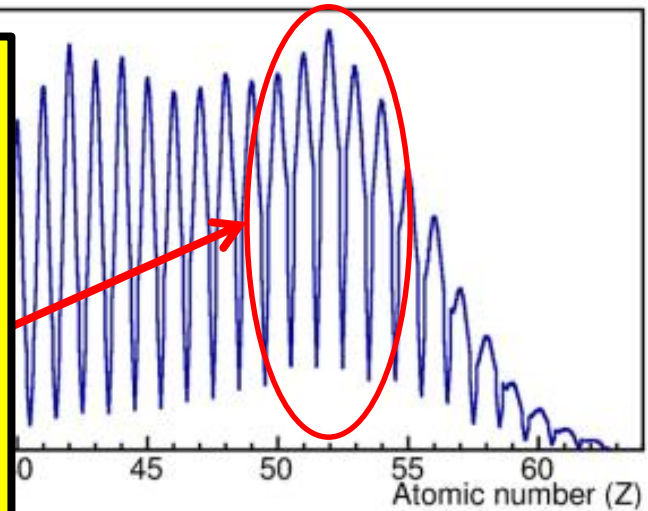
Performed gamma-ray spectroscopy of $^{122-131}\text{Sb}$ isotopes:

- 1) Prompt-prompt coincidence
- 2) Delayed-delayed coincidence
- 3) Prompt-delayed coincidence

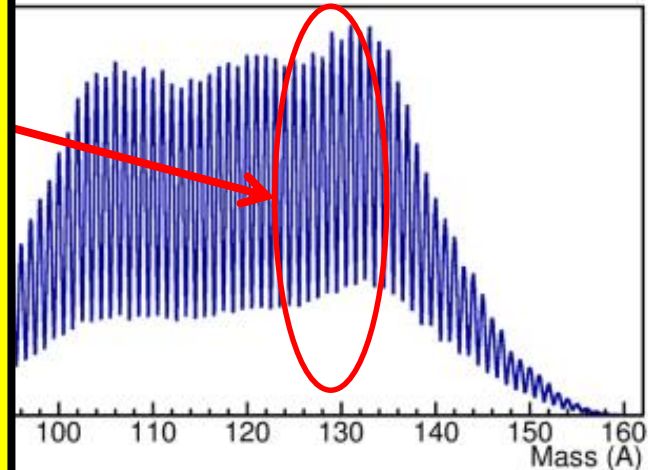
Even-A Sb: New prompt, delayed and isomers along with half-lives

Odd-A Sb: New prompt and confirmation of the isomeric half-lives

S. Biswas et al, Phys. Rev. C, 99, 064302 (2019)



$\Delta Z = 1.3\%$ (FWHM)

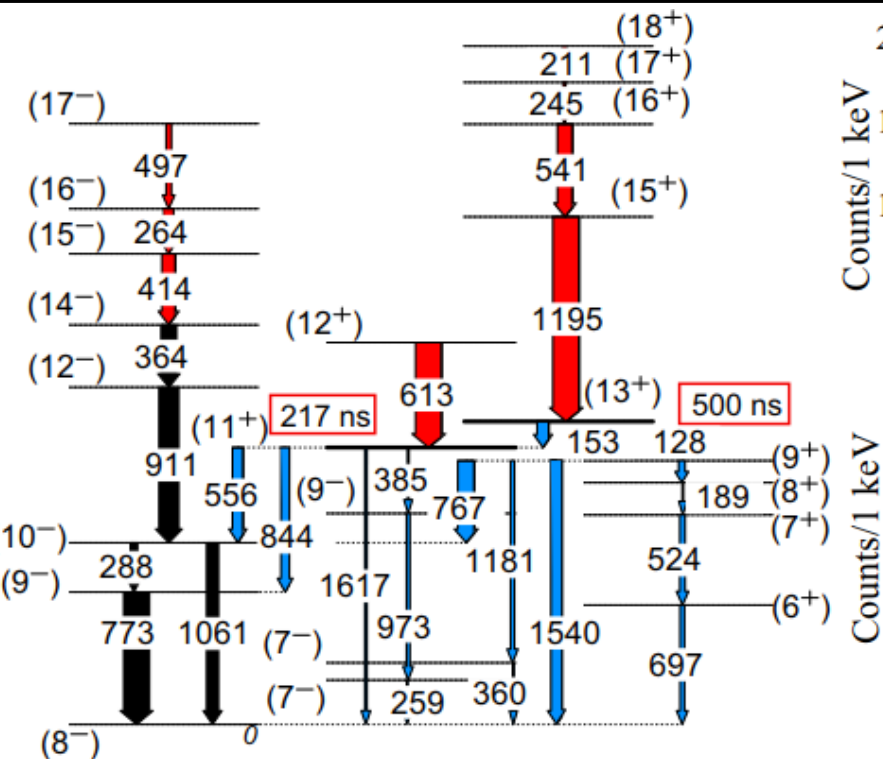


$\Delta A = 0.4\%$ (FWHM)

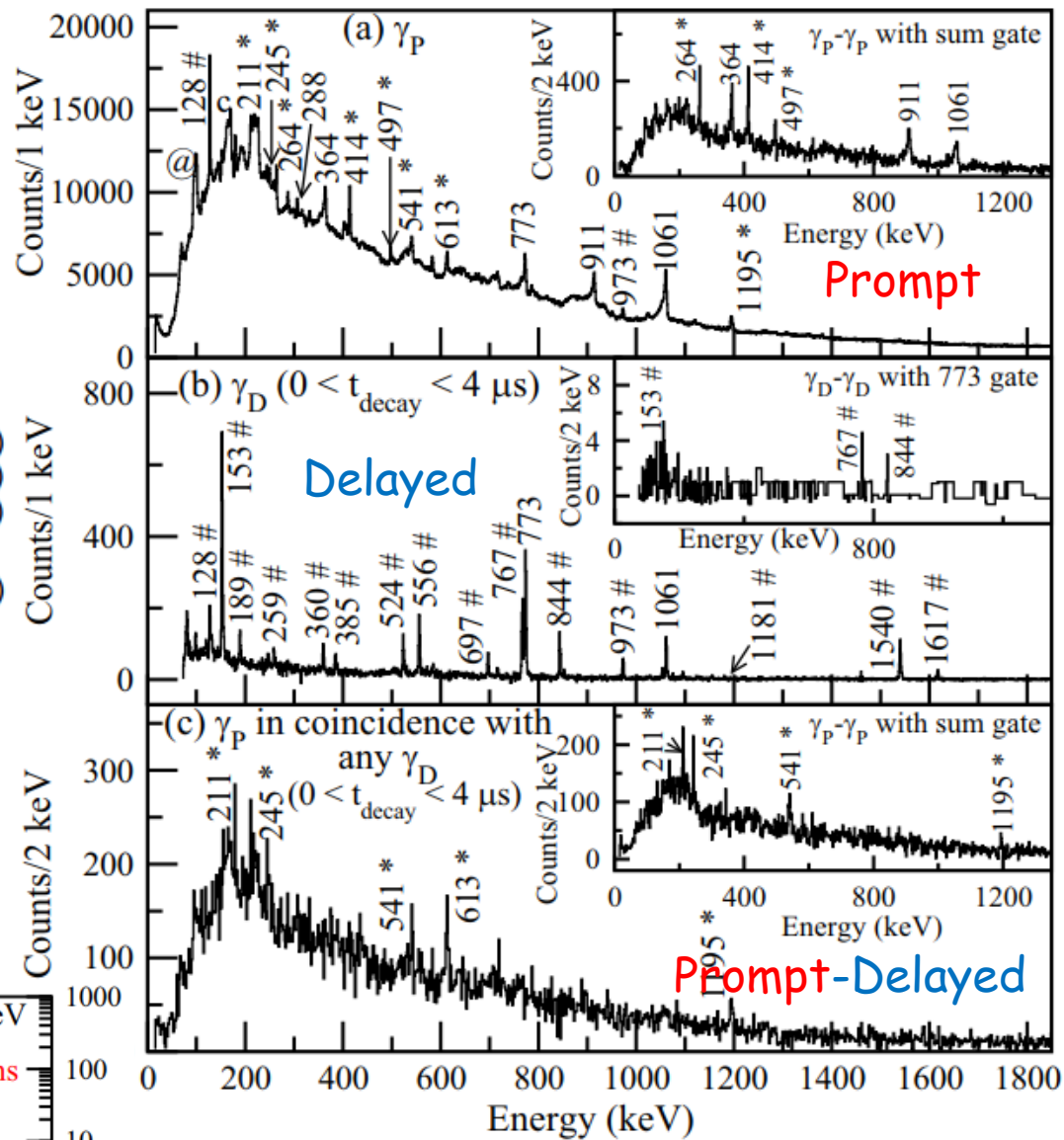
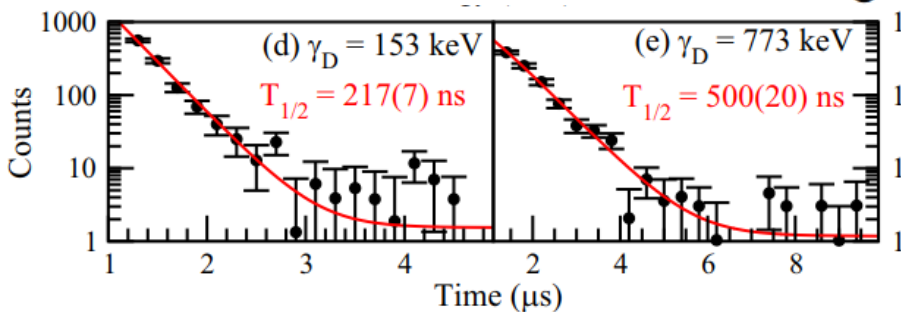
$\Delta q = 1.3\%$ (FWHM)

Y-H. Kim et al, EPJA, 465, 430 (2017)

The Experimental Results: ^{128}Sb ($Z = 51, N = 77$)



Old Prompt transitions
 New prompt transitions
 New Delayed transitions

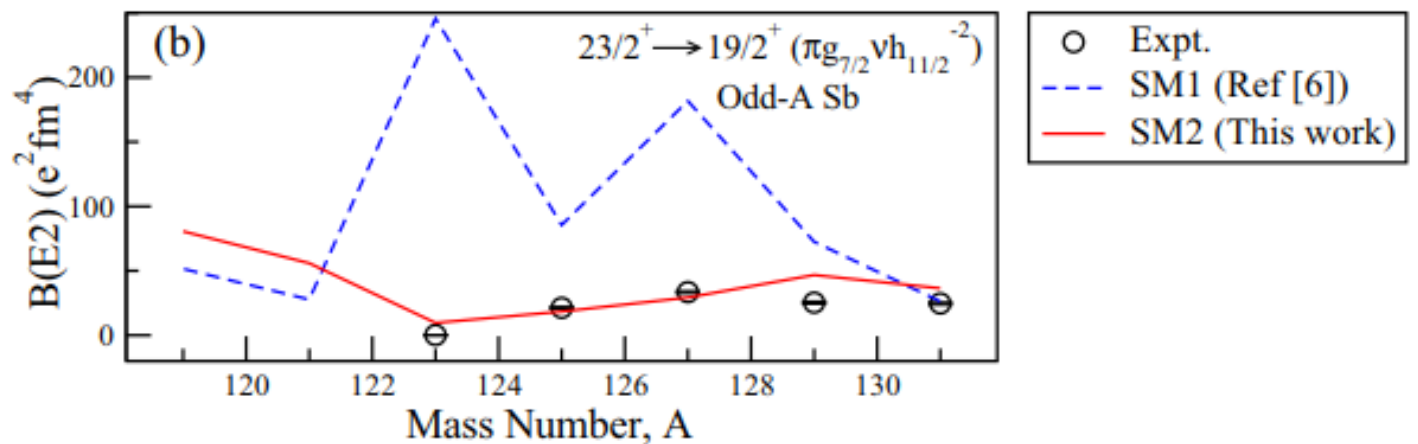
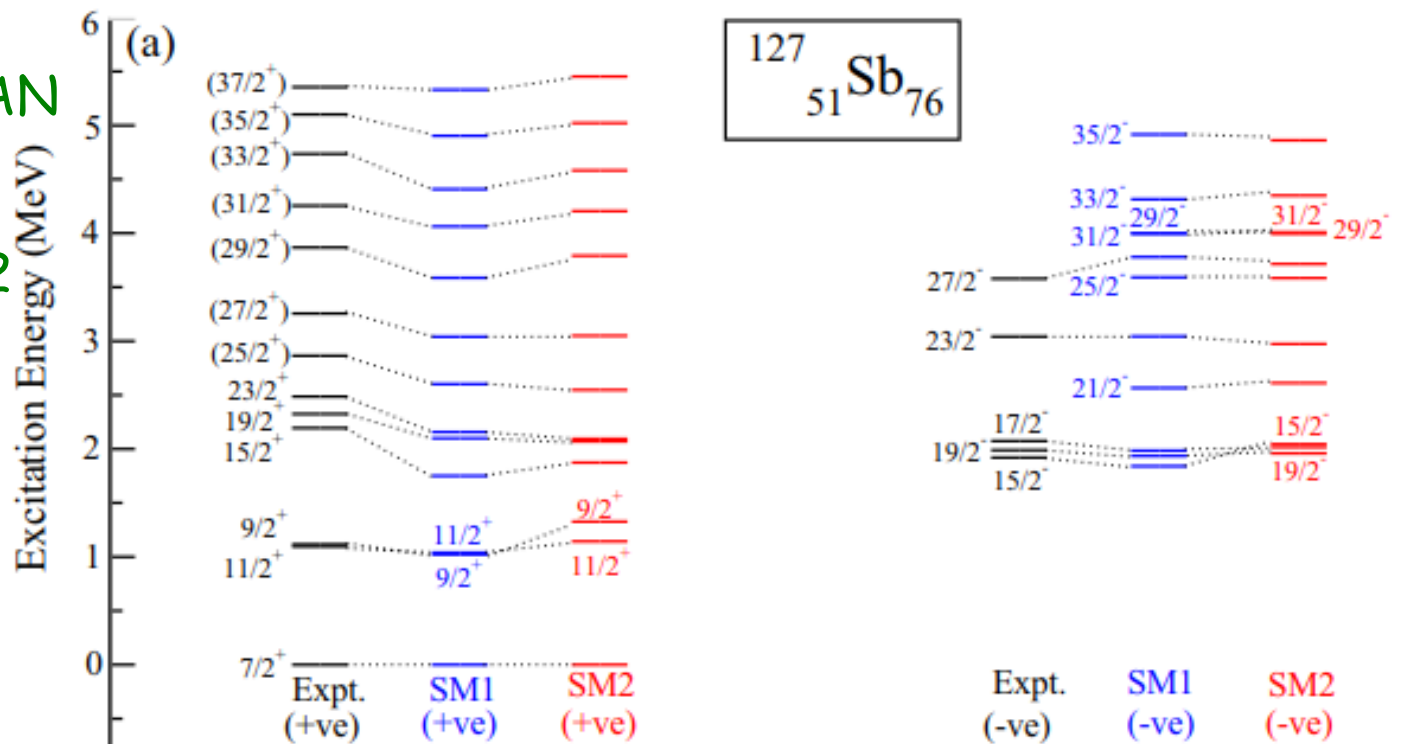
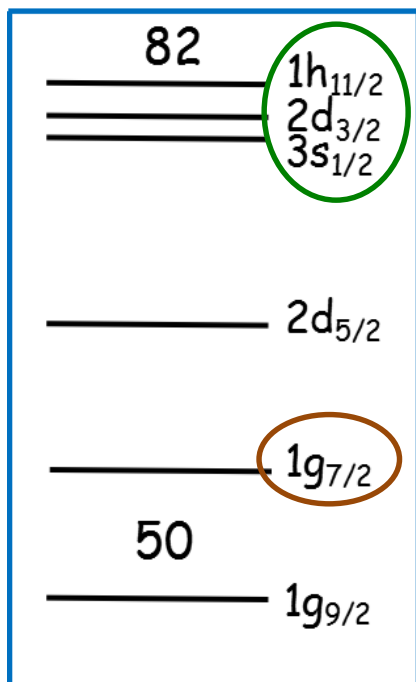


Comparison with theory: ^{127}Sb ($Z = 51, N = 76$)

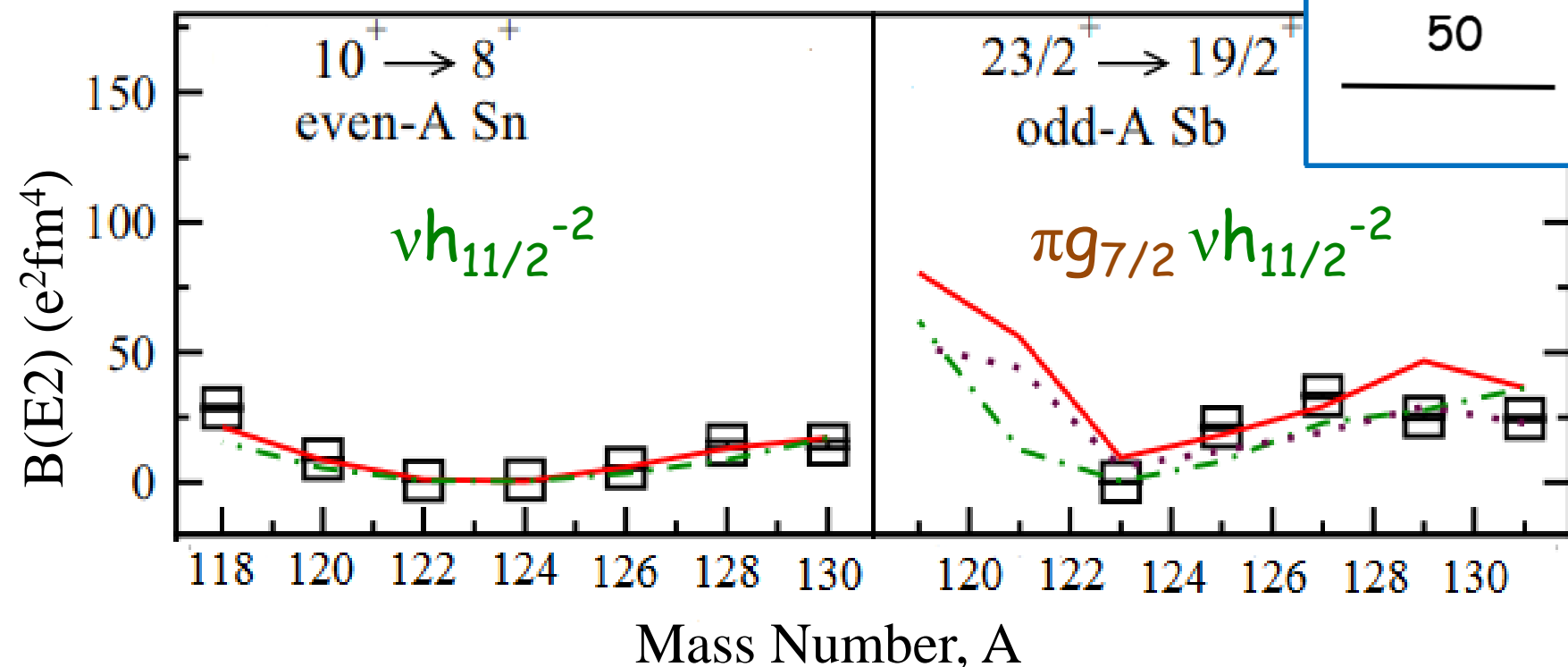
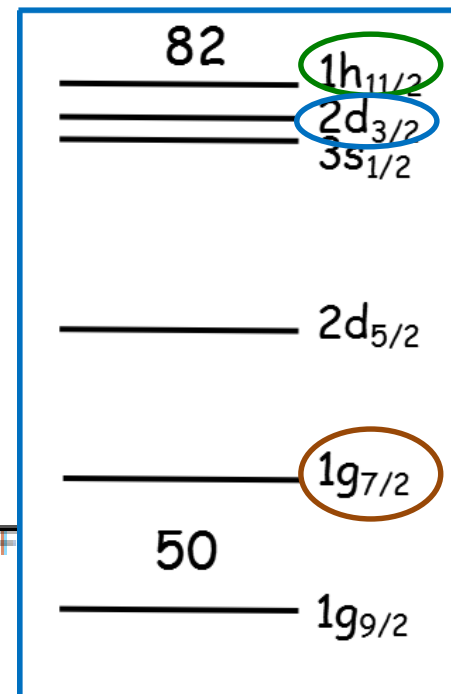
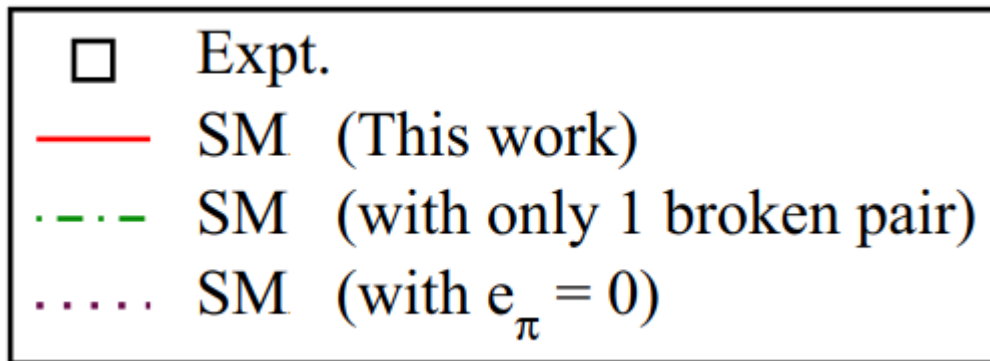
Shell model using
jj55pn and NATHAN
(SM1):

ν $s_{1/2}, d_{3/2}, h_{11/2}$
 π $g_{7/2}$

M. Rejmund et al,
Phys. Lett. B,
753, 86 (2016)

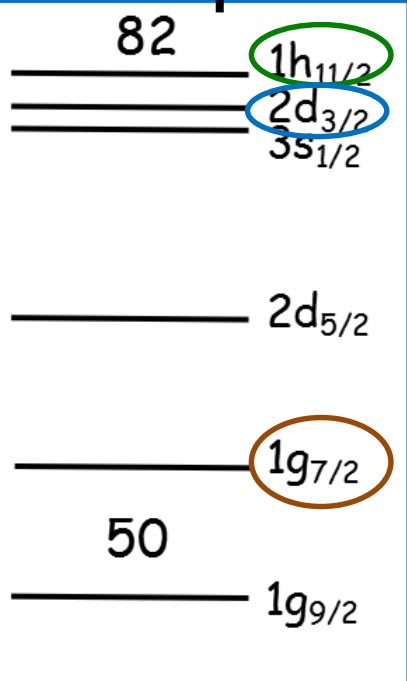
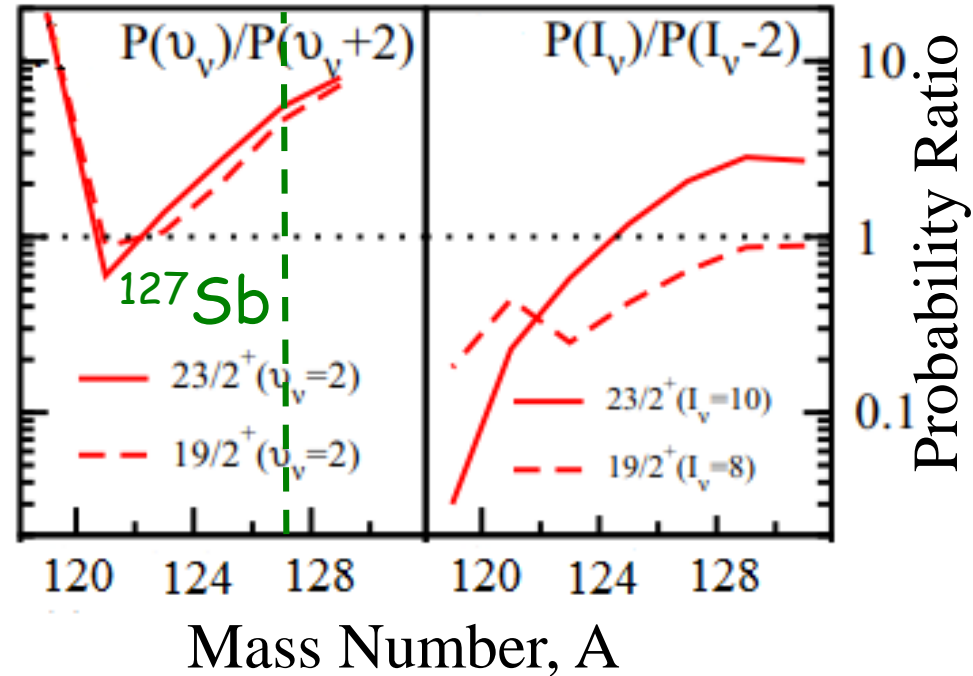
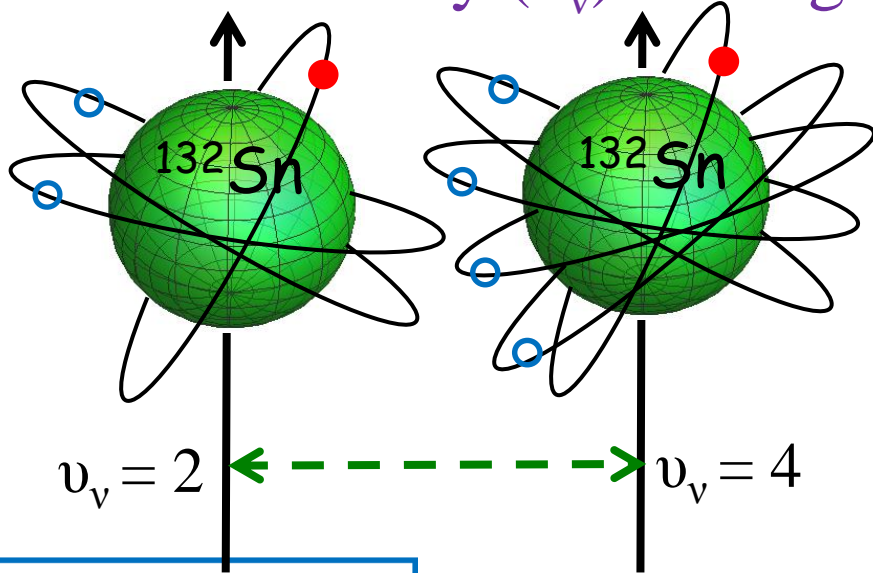


Discussions: Case 1 -> Even-A Sn and Odd-A Sb



Discussions: Case 1 -> Odd-A Sb ($Z = 51$)

neutron seniority (ν_n) mixing



$N = 76$

$\nu_n = 0$



$\nu_n = 2$

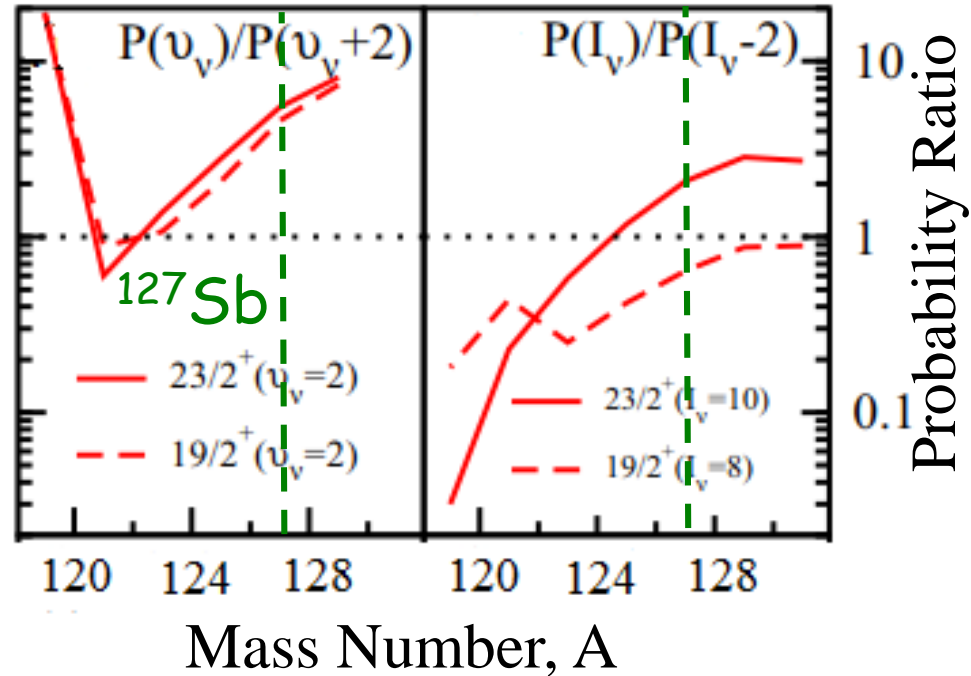
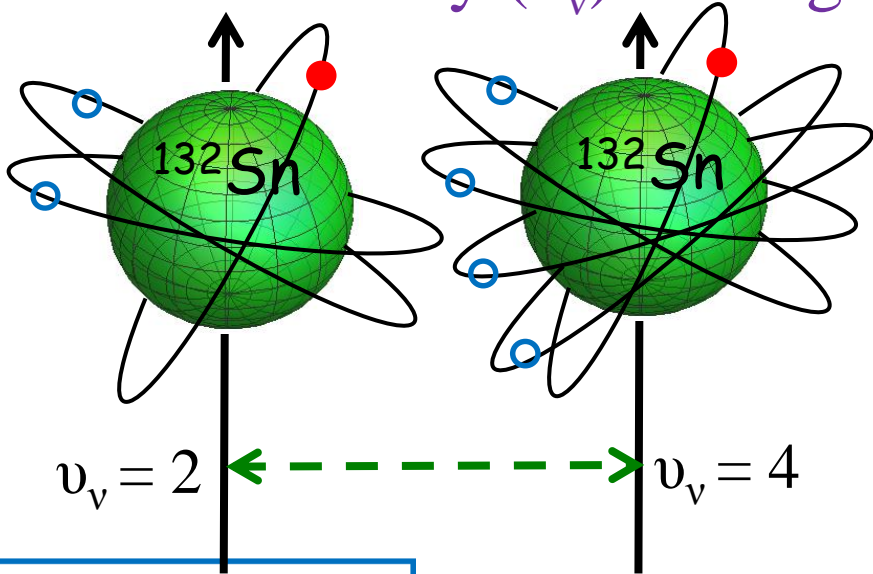


$\nu_n = 4$

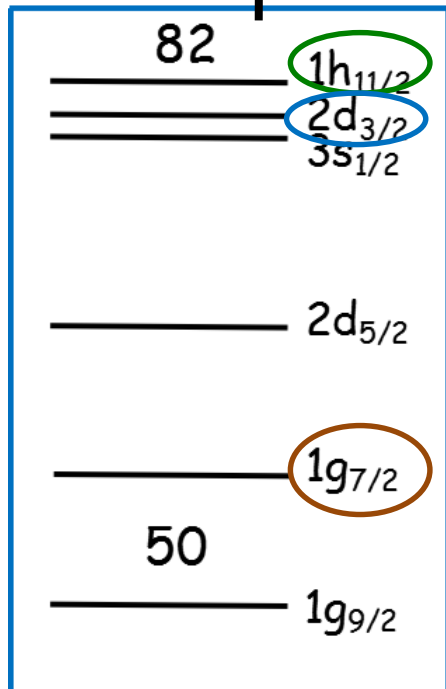
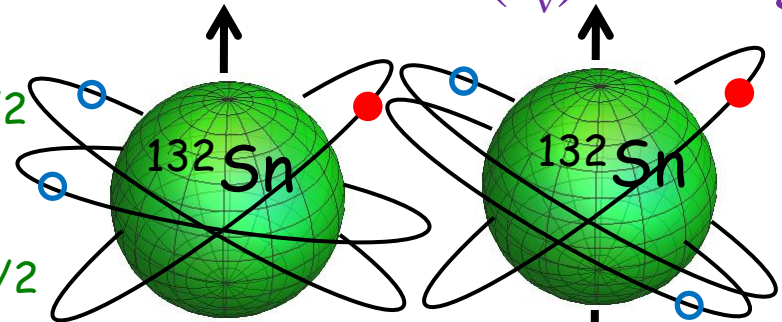
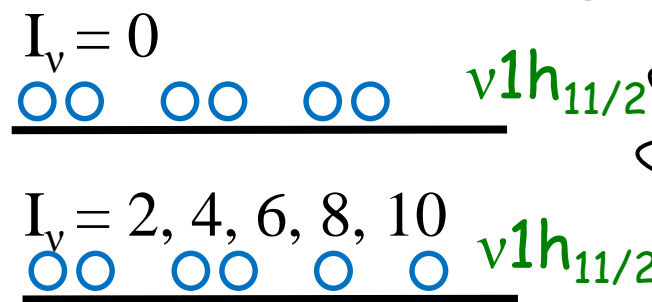


Discussions: Case 1 -> Odd-A Sb ($Z = 51$)

neutron seniority (ν_v) mixing

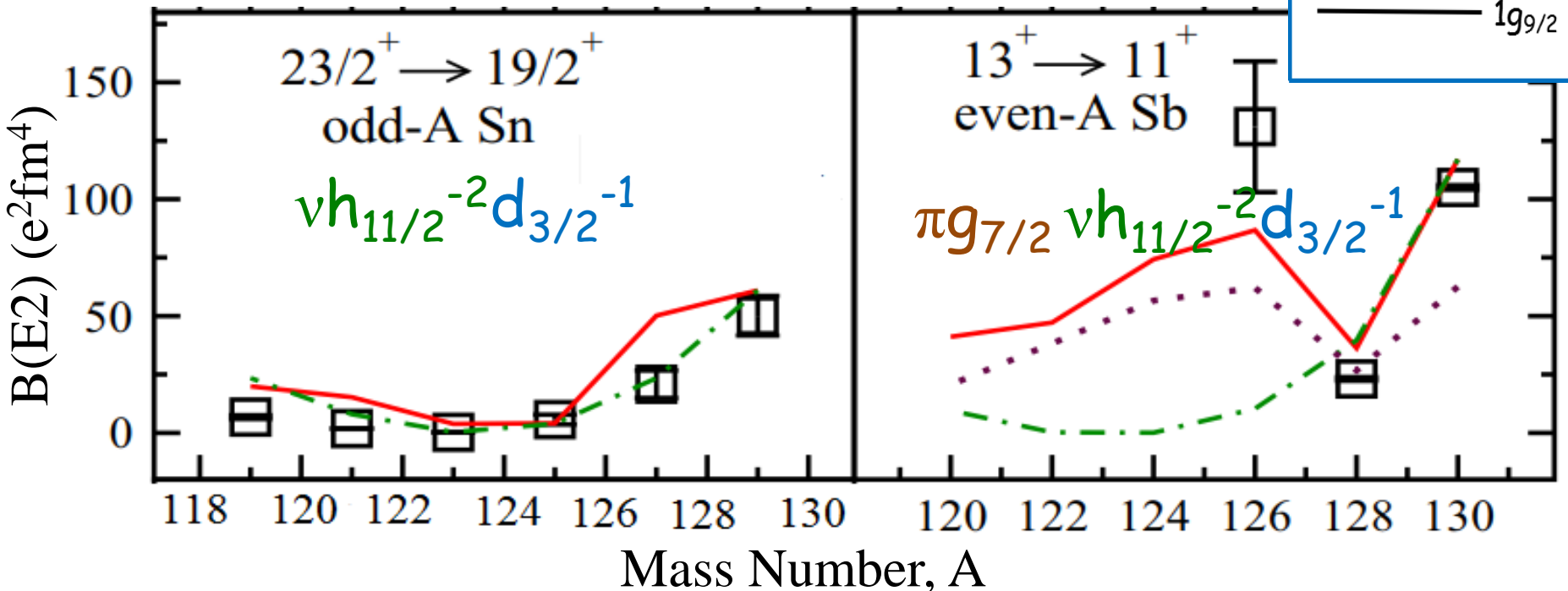
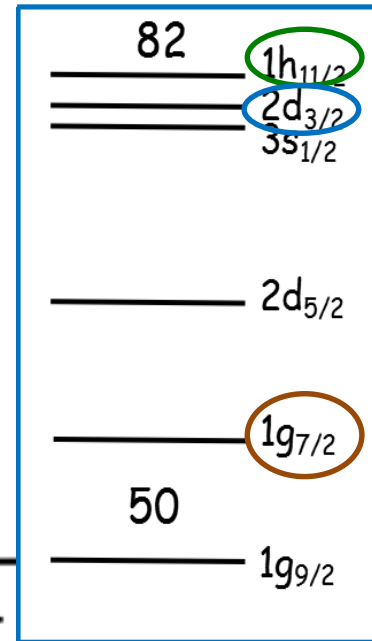
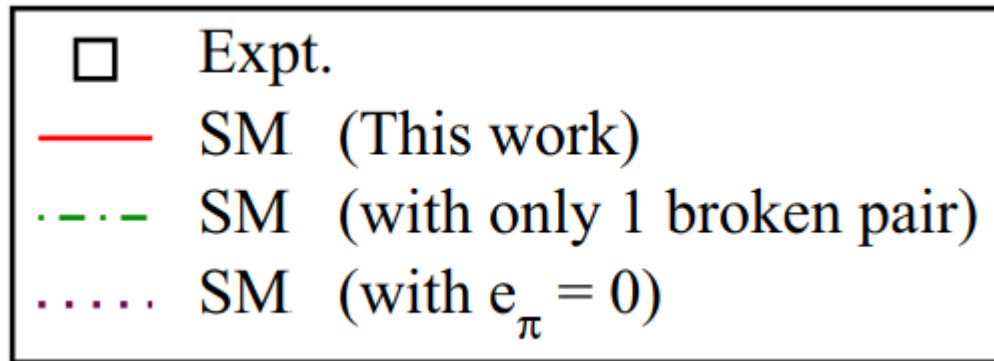


$N = 76$ neutron angular momentum (I_v) mixing



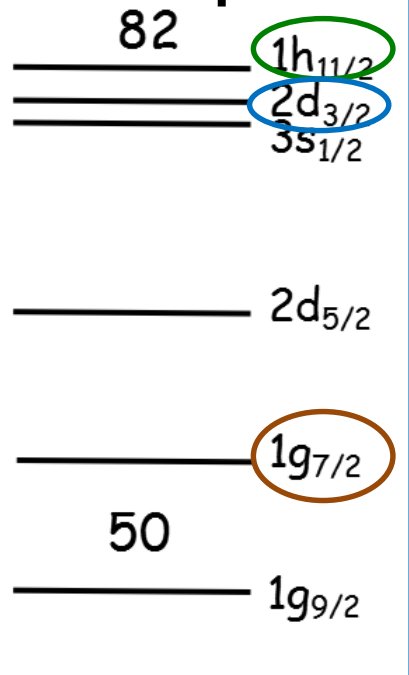
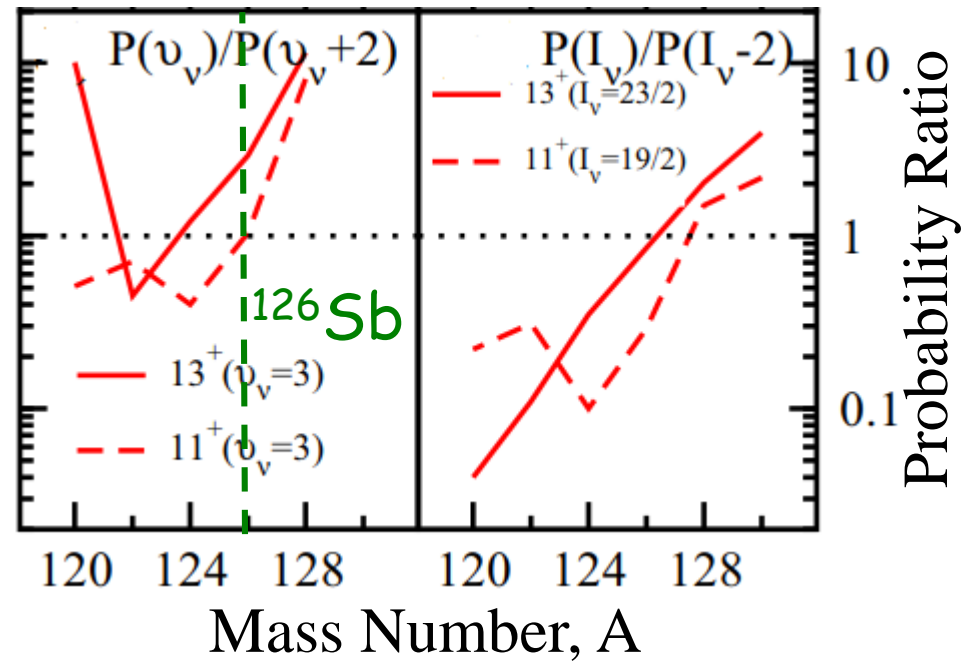
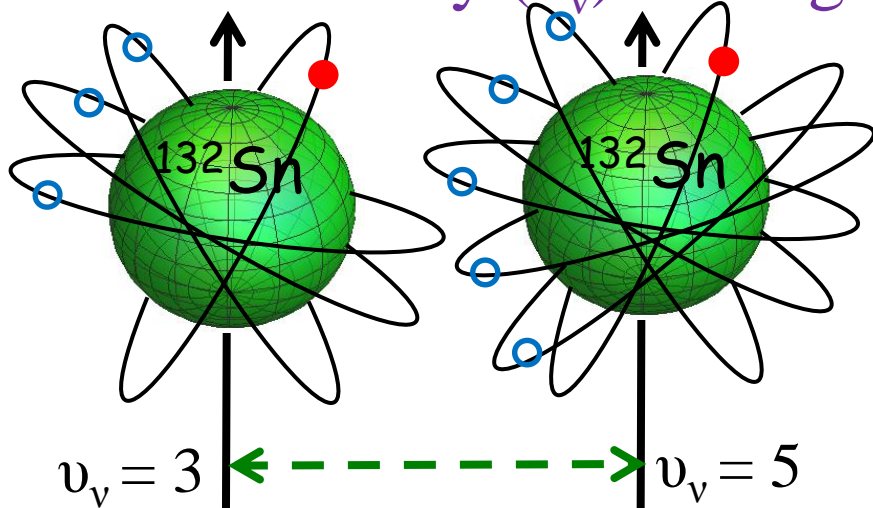
$I_v = 8$ \leftarrow \rightarrow $I_v = 10$

Discussions: Case 2 -> Odd-A Sn and Even-A Sb



Discussions: Case 2 -> Even-A Sb (Z = 51)

neutron seniority (ν_v) mixing



$N = 75$

$\nu_v = 1$



$\nu 1h_{11/2}$

$\nu 2d_{3/2}$

$\nu_v = 3$



$\nu 1h_{11/2}$

$\nu 2d_{3/2}$

$\nu_v = 5$

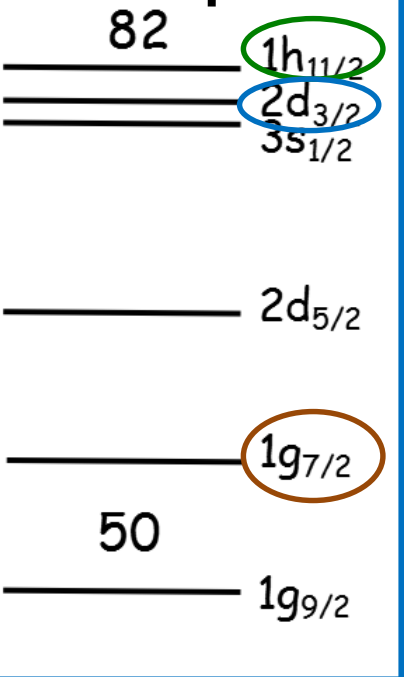
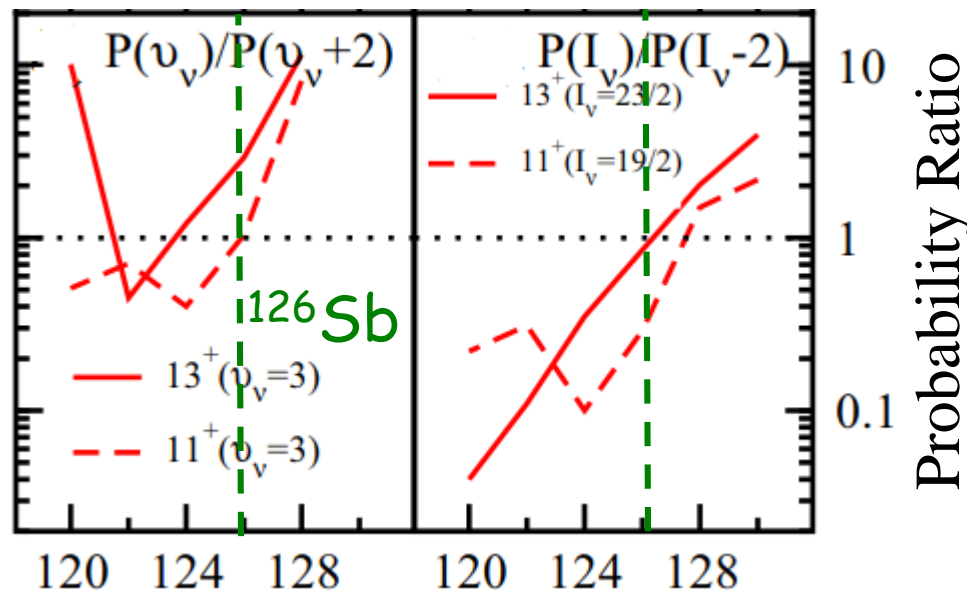
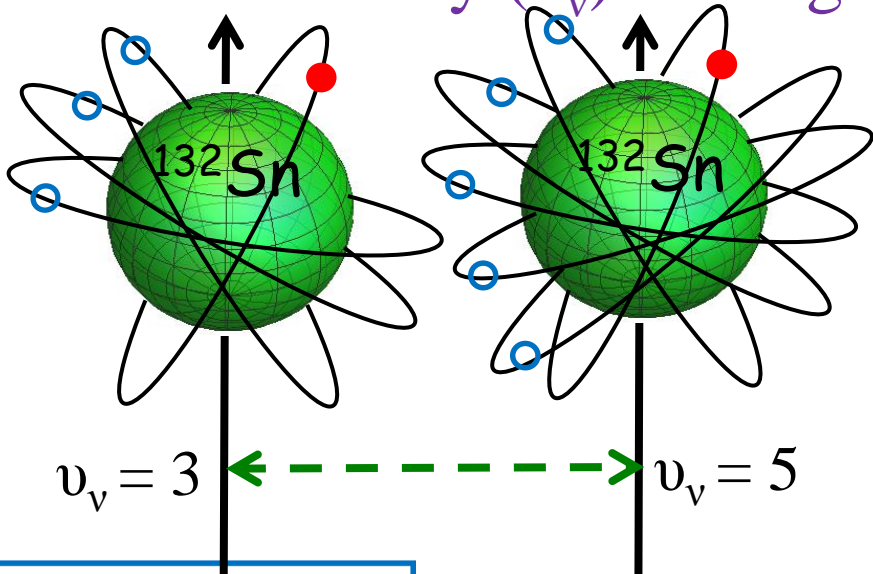


$\nu 1h_{11/2}$

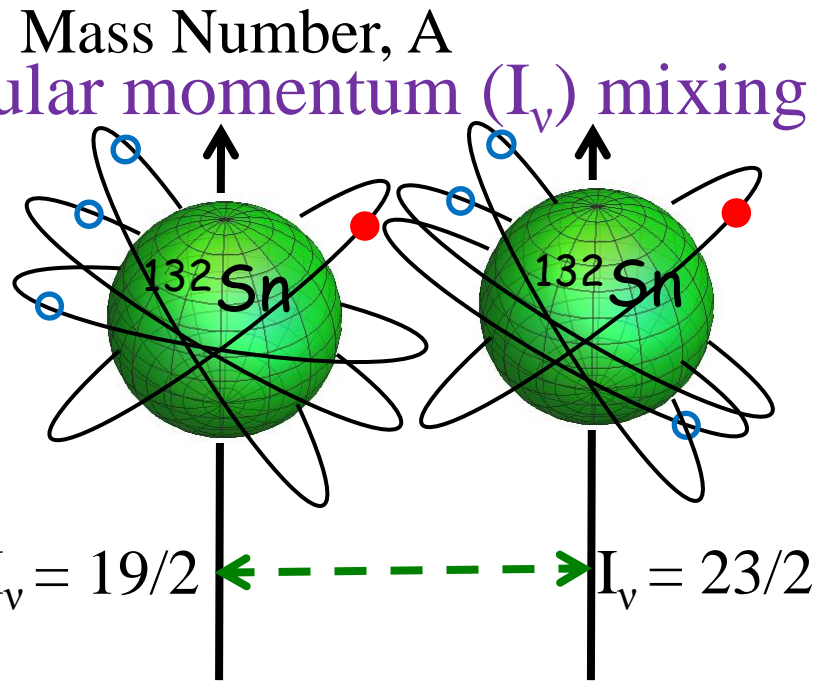
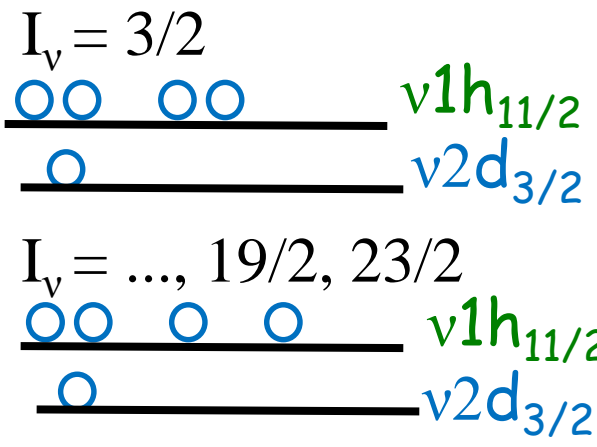
$\nu 2d_{3/2}$

Discussions: Case 2 -> Even-A Sb (Z = 51)

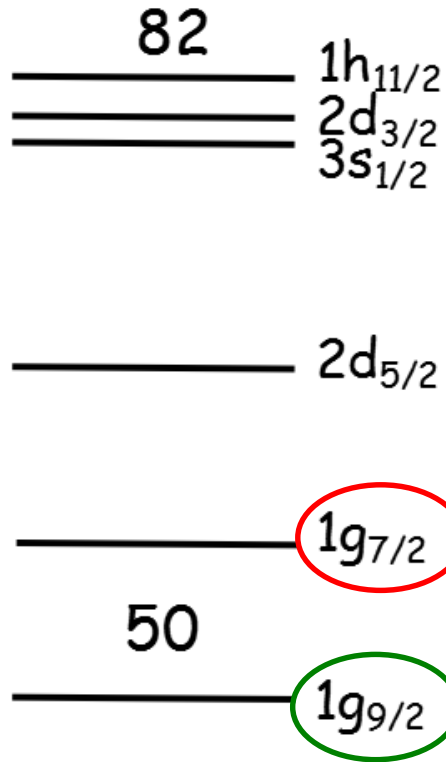
neutron seniority (ν_v) mixing



$N = 75$ neutron angular momentum (I_v) mixing



Summary and Future Scope

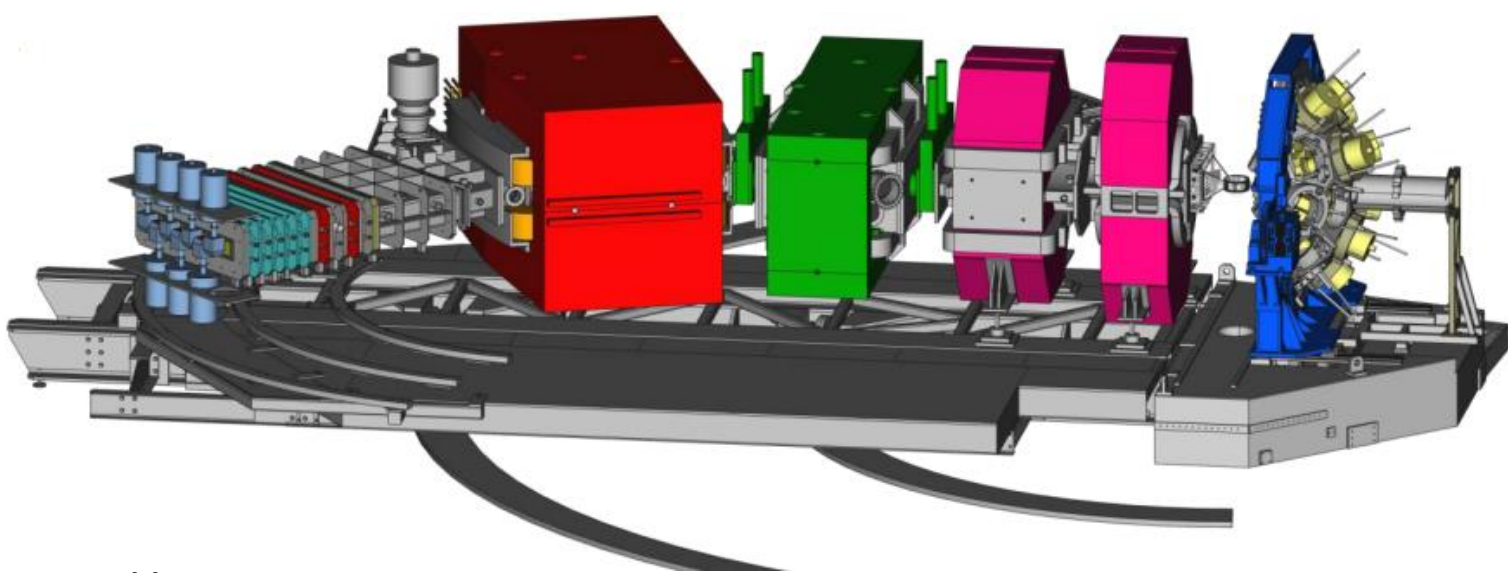


Performed prompt-delayed gamma-ray spectroscopy for the neutron-rich $^{122-131}\text{Sb}$ ($Z = 51$) isotopes

Comparison with shell model calculations provided information on the effect of the $g_{7/2}$ proton on neutron seniority and neutron angular momentum.

To look into a similar kind of effect due to the spin-orbit partner, $g_{9/2}$

Perform prompt-delayed gamma-ray spectroscopy for the neutron-rich $^{120-129}\text{In}$ ($Z = 49$) isotopes



E661 collaboration

GANIL: M. Rejmund, A. Navin, A. Lemasson, Y. H. Kim, C. Michelagnoli, E. Clement, G. de France, J. Goupil, B. Jacquot, H. J. Li, L. Menager, V. Morel, J. Ropert, C. Schmitt

TIFR: R. Palit

IPNO: I. Stefan

VECC: S. Bhattacharya, S. Bhattacharyya, R. Banik

IFJ PAN: P. Bednarczyk, A. Maj

LBNL: A. O. Macchiavelli, P. Fallon, H. L. Crawford

CSNSM: J. Ljungvall

IFIC: R. M. Perez-Vidal

AGATA collaboration

Thank You