

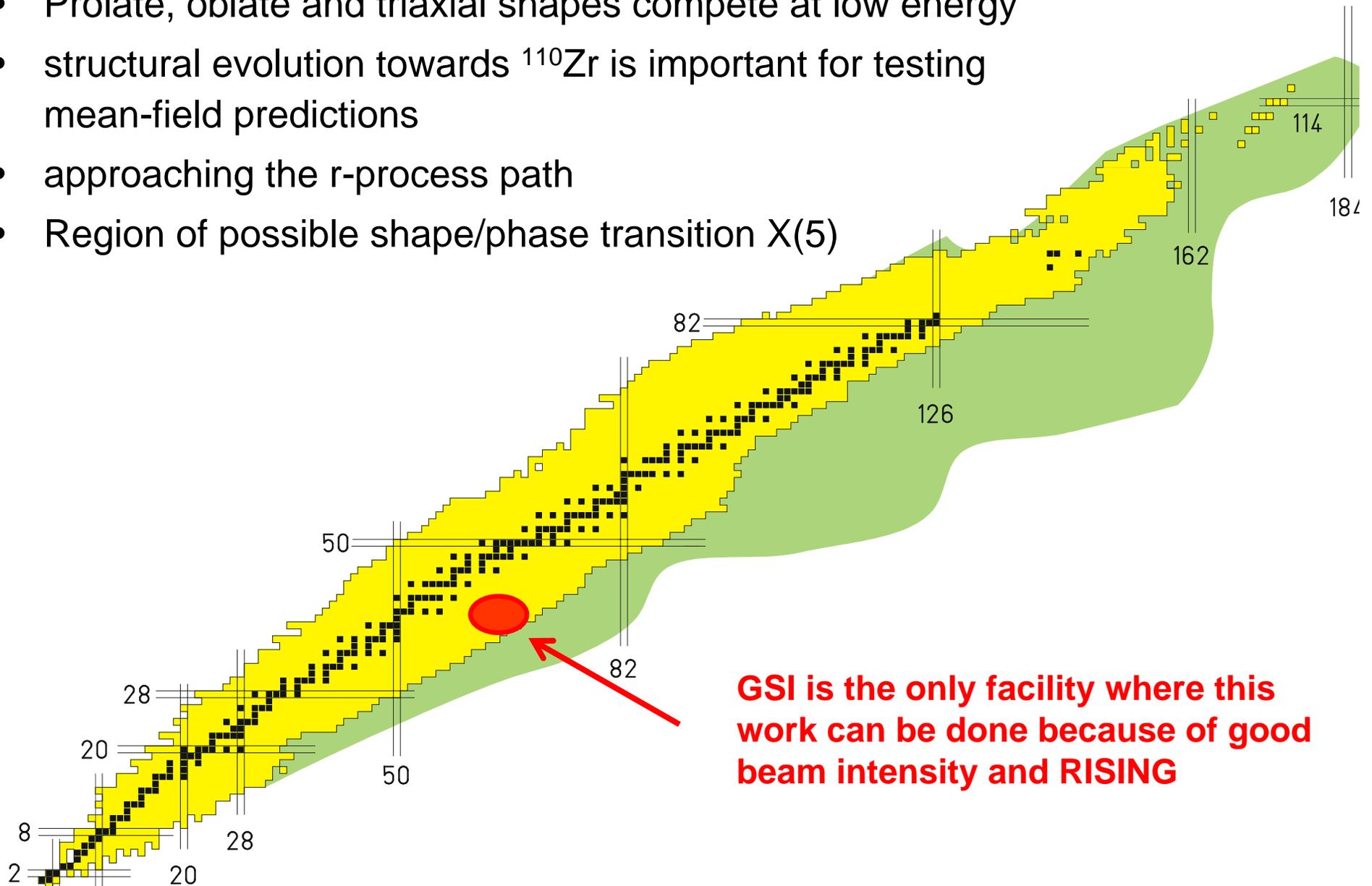
Experimental Proposal S361

- Title “Shape evolution near ^{106}Zr ”
- Spokesperson: **Alison Bruce**, University of Brighton
- GSI Contact Person: Magda Gorska, GSI
- Year of Approval: 2008
- Shifts: 20 approved (15 main + 5 parasitic)
0 used (main + parasitic)
20 left (15 main + 5 parasitic)

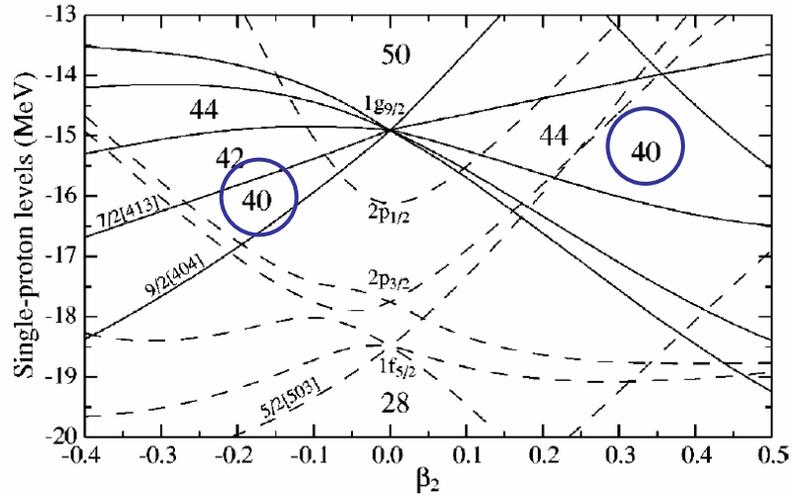
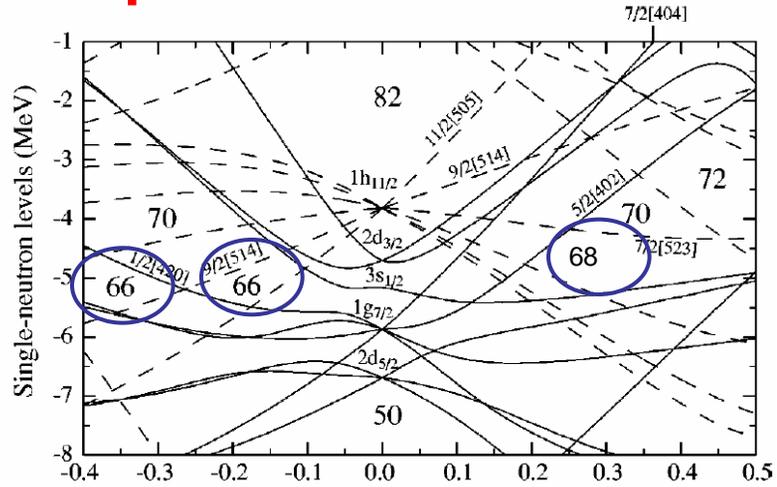


Physics motivation

- Prolate, oblate and triaxial shapes compete at low energy
- structural evolution towards ^{110}Zr is important for testing mean-field predictions
- approaching the r-process path
- Region of possible shape/phase transition X(5)

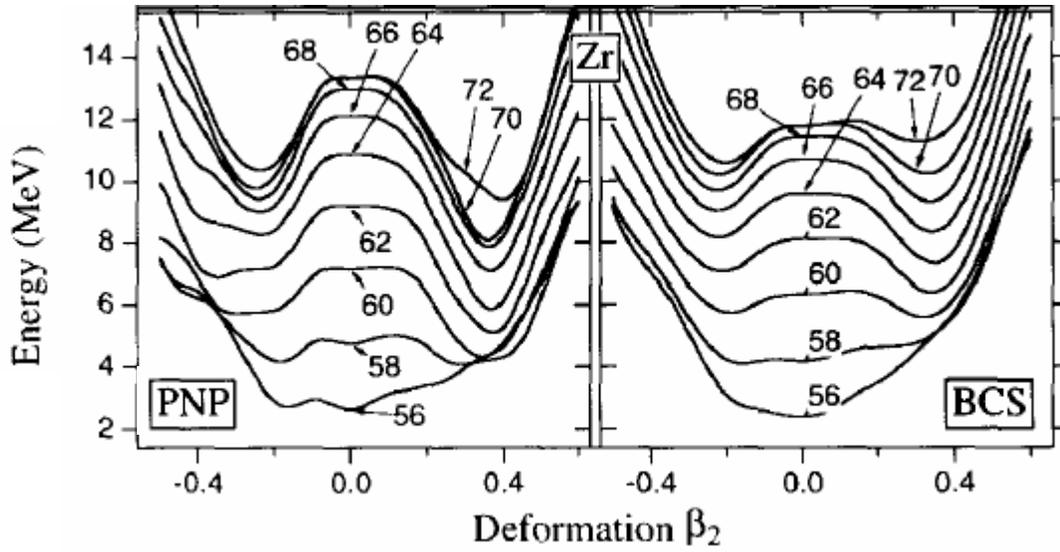


Shape coexistence in n-rich Zr isotopes



FRLD calculations

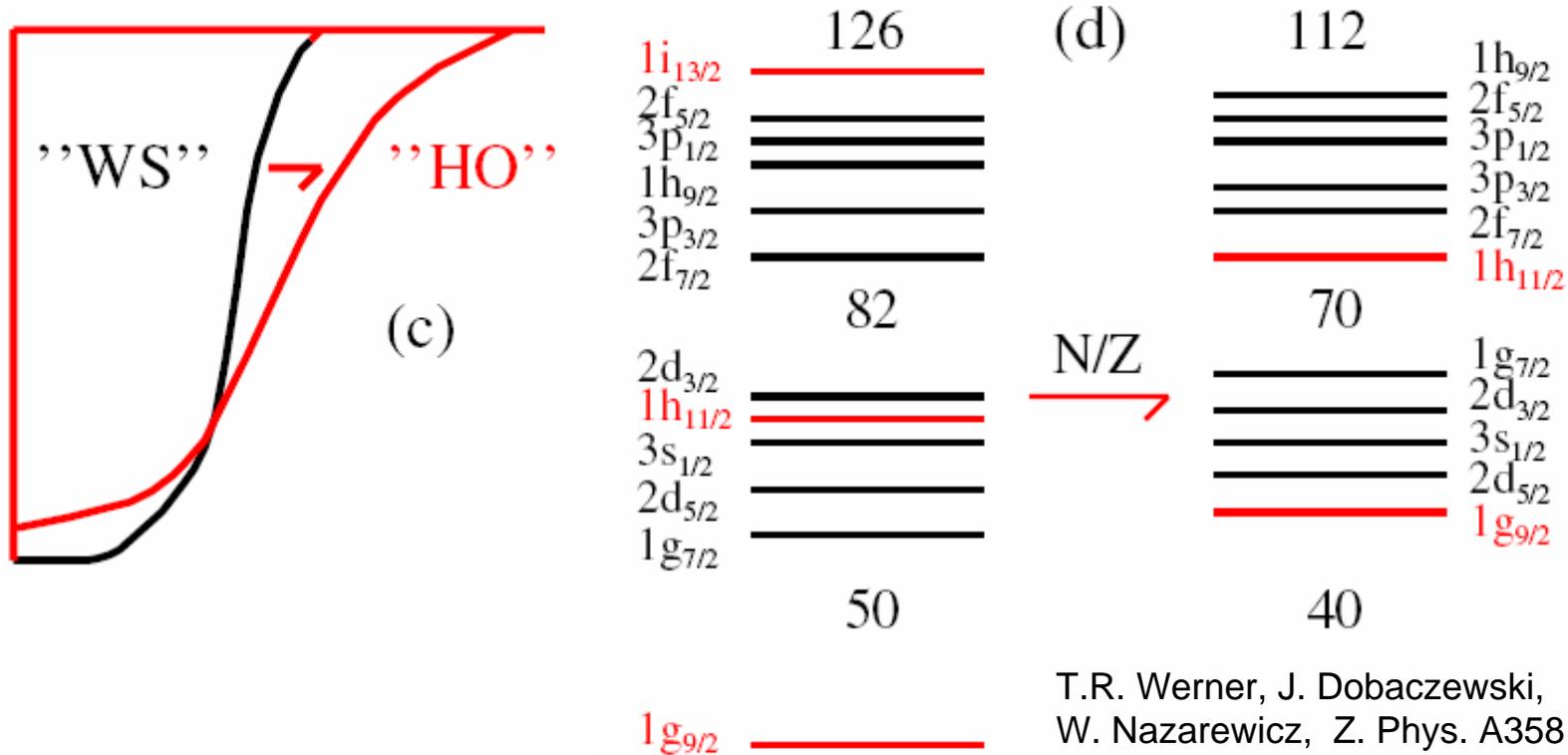
F.R. Xu et al.,
Phys. Rev. C65



J. Skalski
Nucl. Phys. A 617

Prolate ground state and oblate O_2^+ below 1.5 MeV predicted for $^{104,106}\text{Zr}$

Shell quenching for very neutron-rich nuclei

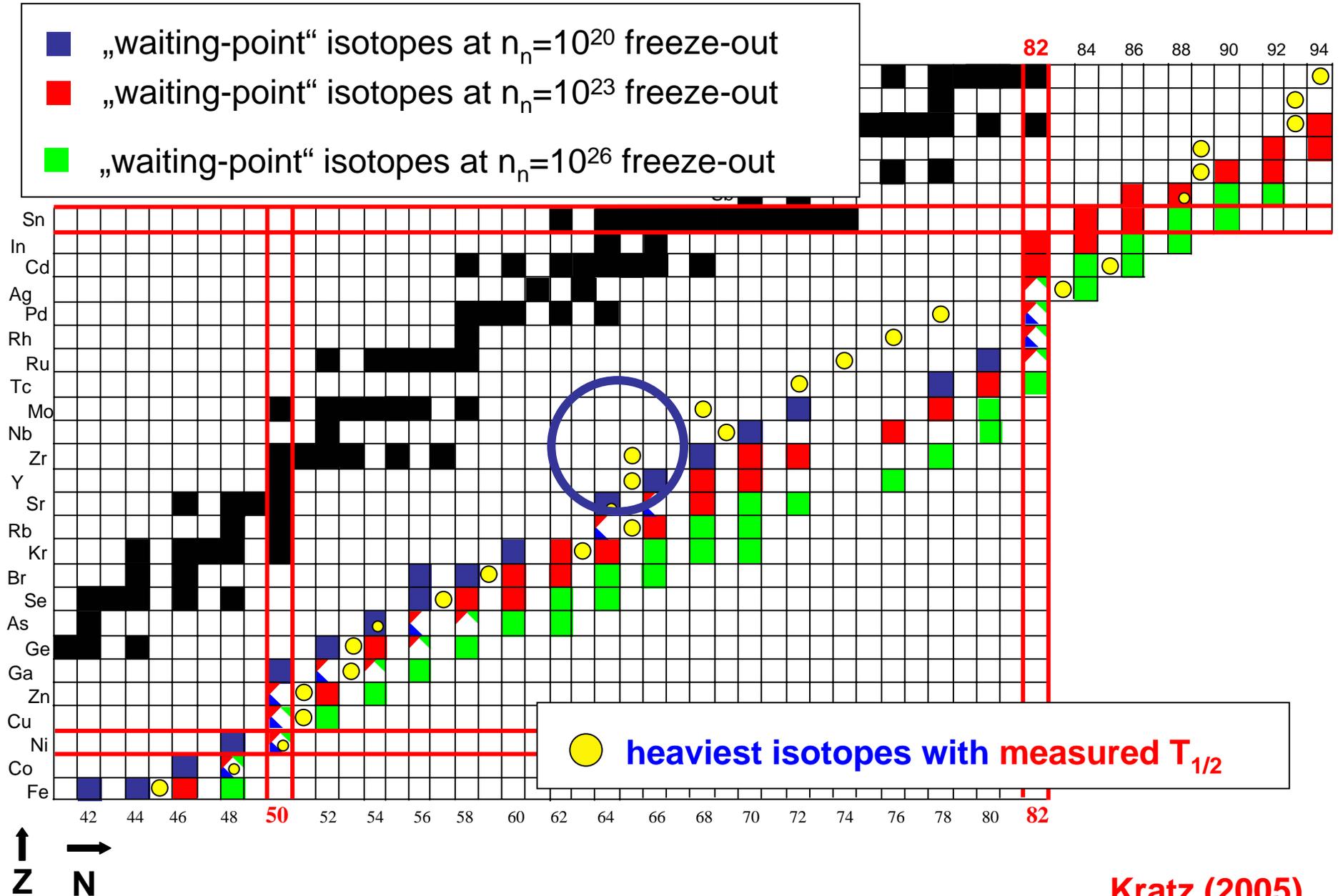


T.R. Werner, J. Dobaczewski,
W. Nazarewicz, Z. Phys. A358 (1997) 169

Transition from Woods-Saxon to Harmonic Oscillator like potential

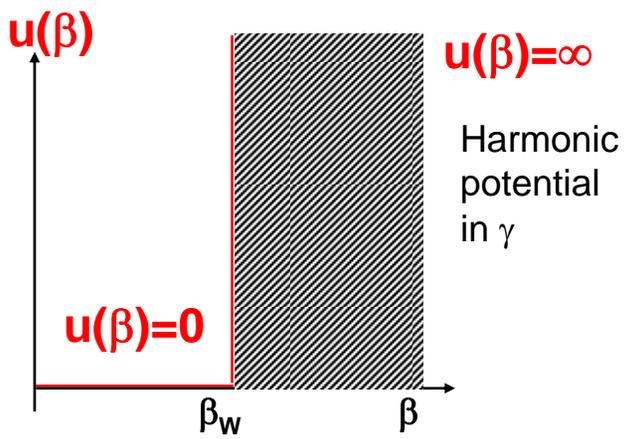
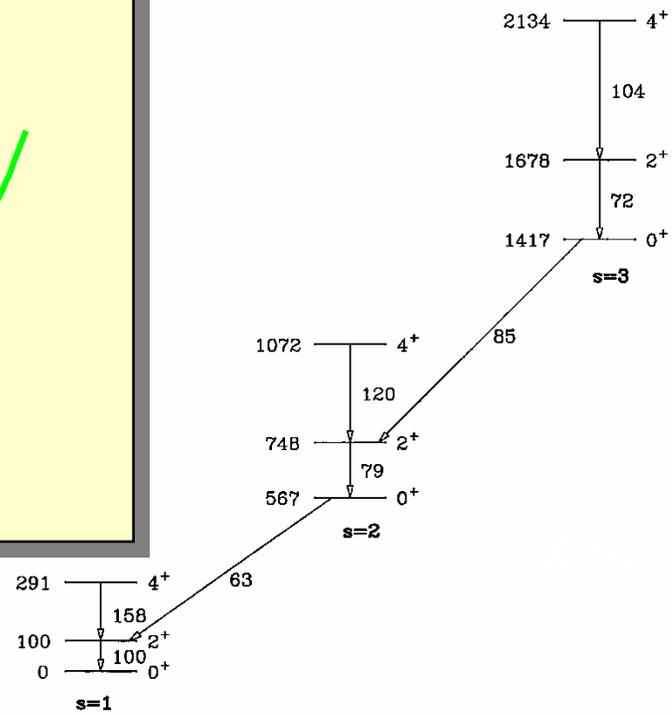
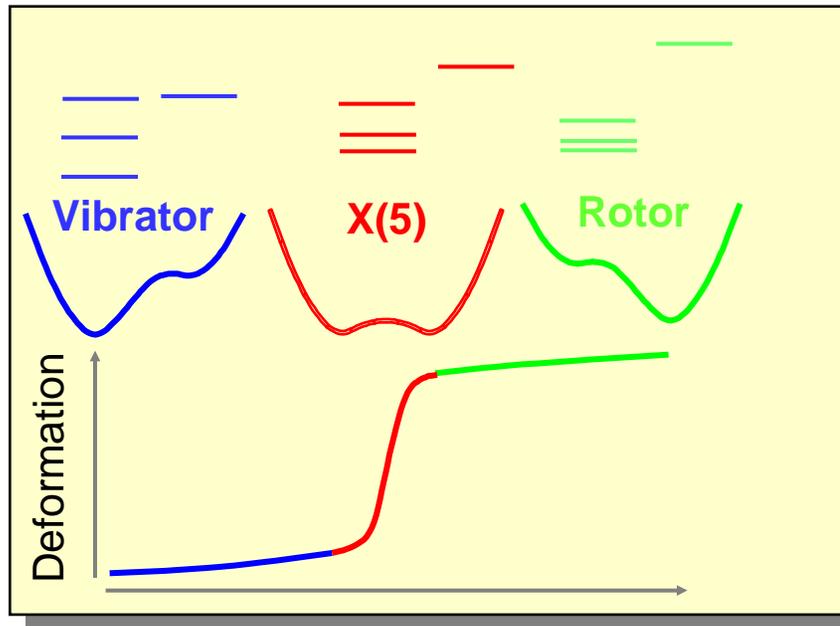
- reduction of spin-orbit splitting in neutron-rich nuclei
- new shell gaps (e.g. N=70 in ^{110}Zr)
- increased neutron skin

r-Process paths for $n_n=10^{20}$, 10^{23} and 10^{26}



Kratz (2005)

X(5) critical point symmetry



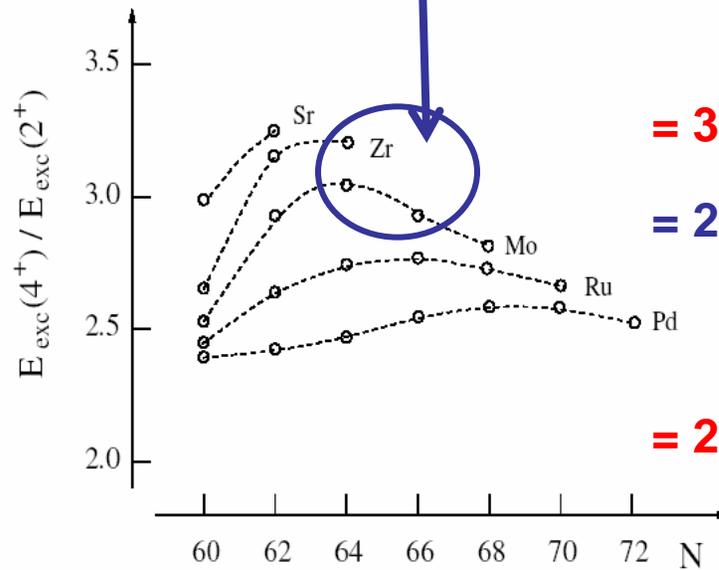
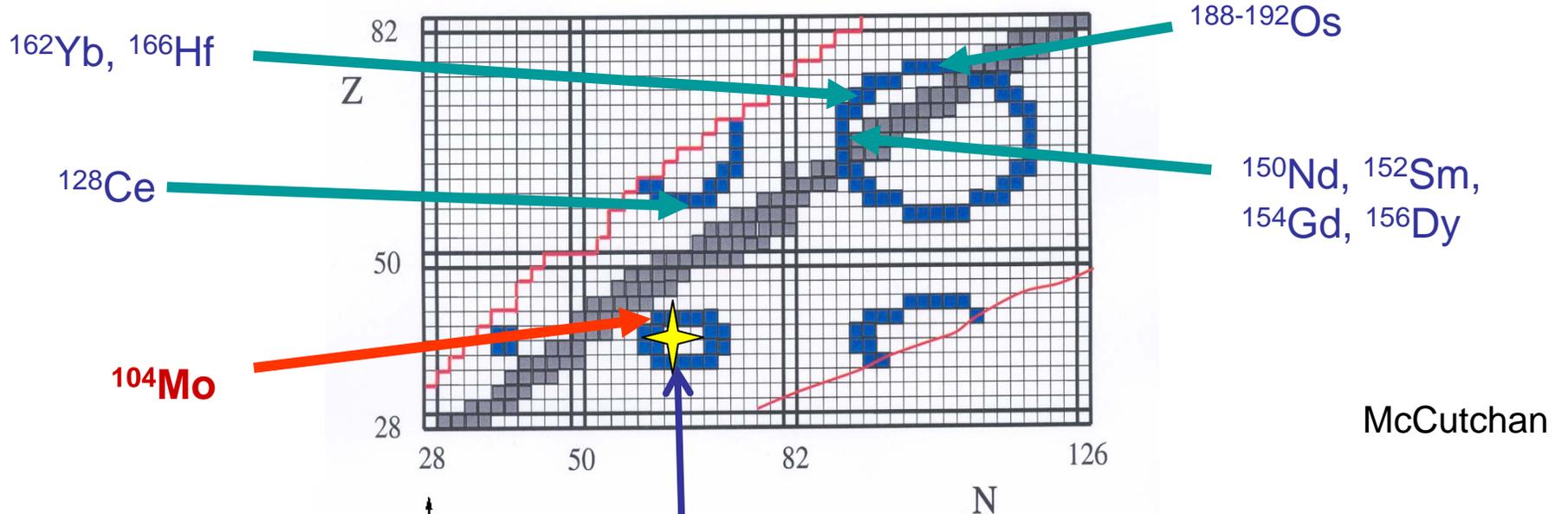
$$E(s, L, n_\gamma, K, M) = E_0 + B(x_{s,L})^2 + An_\gamma + CK^2$$

$(x_{s,L})$: s-th zero of Bessel function $J_\nu(z)$

Parameter free (except for scale) prediction of excitation energies and transition probabilities

2) X(5) limit $\frac{N_p N_n}{N_p + N_n} = 5$

Established cases

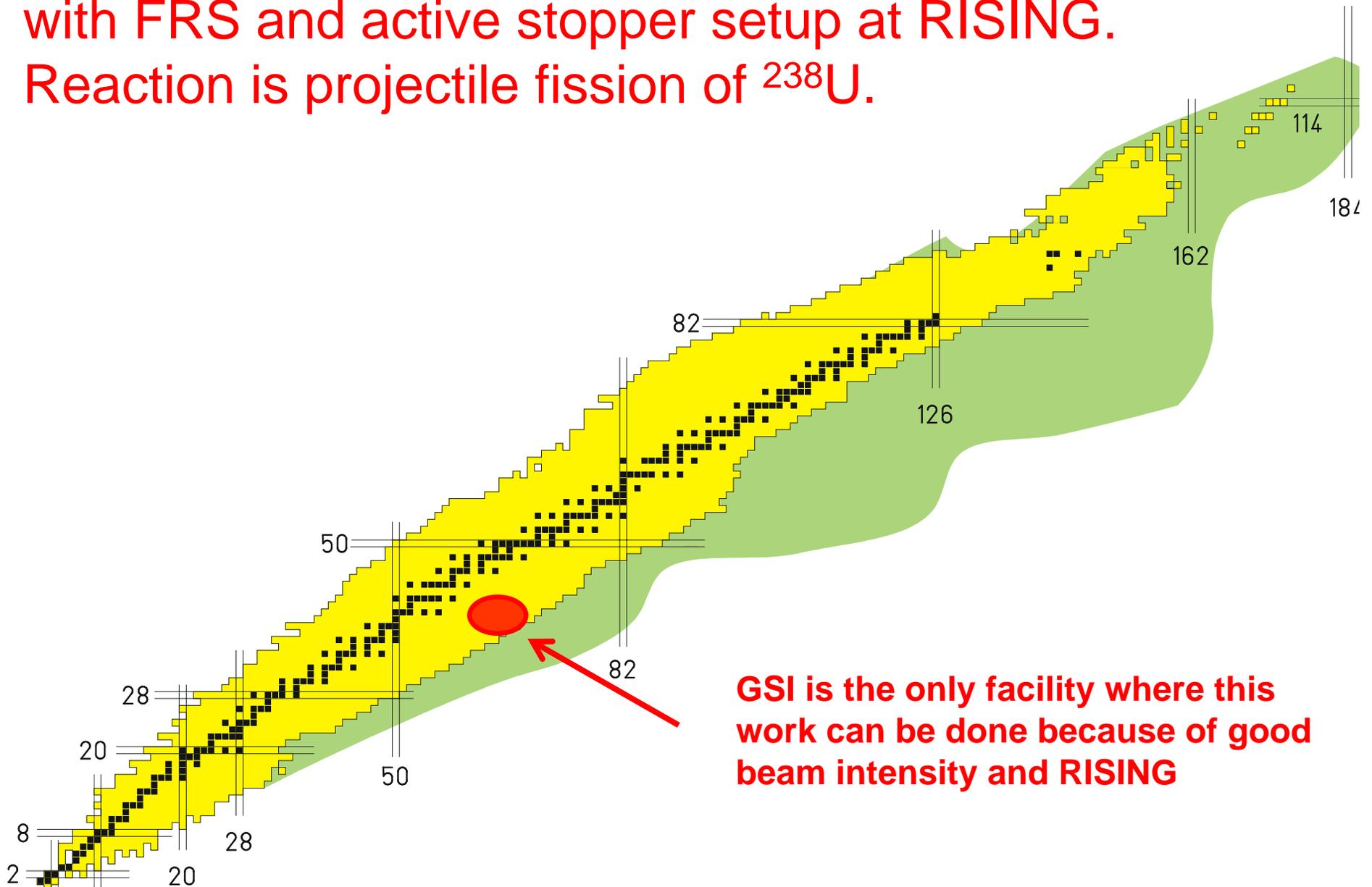


= 3.33 prolate sym. rotor

= 2.90 X(5)

= 2 spherical vibrator

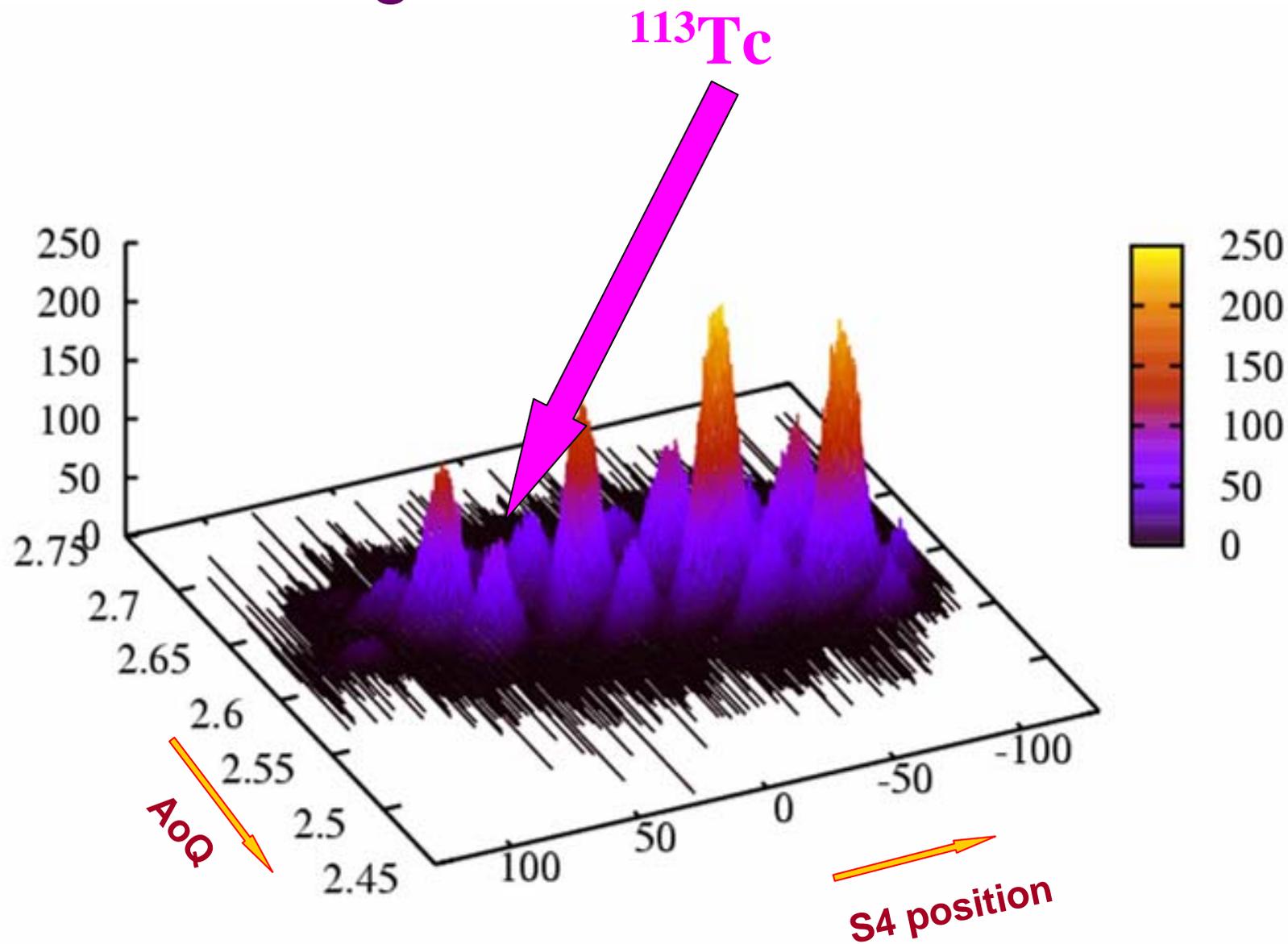
Study $^{104,106}\text{Zr}$ and neighbouring region
with FRS and active stopper setup at RISING.
Reaction is projectile fission of ^{238}U .

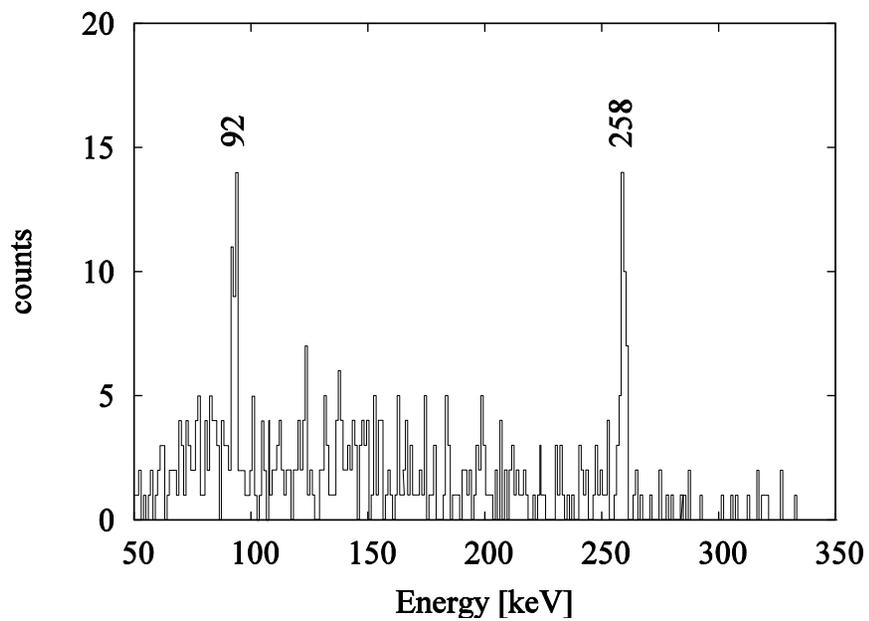


**GSI is the only facility where this
work can be done because of good
beam intensity and RISING**

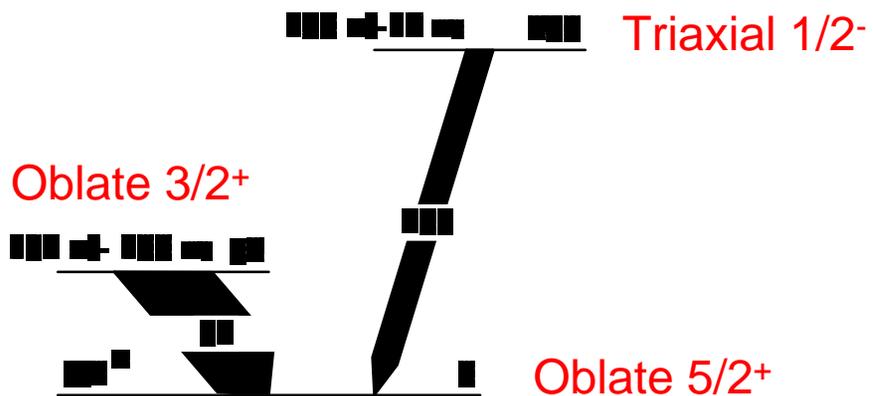
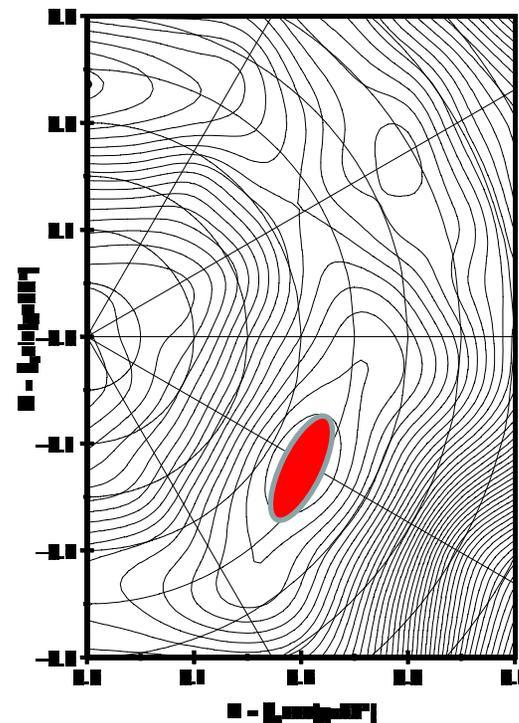
Previous experiment S300
sensitive to isomeric decays
only

110Nb settings:





TRS calculations for lowest energy positive parity state



Setup

- FRS focal planes equipment : the active stopper will be used
- Is the setup ready? :
yes, tested in beam last year, ready for action
- Is there any new or non-standard equipment required? No
- Is there a modification or a new DAQ required? No
- What is the requested primary beam and intensity?
 ^{238}U from MEVVA source, 5×10^9 per spill, extraction 4s.
- How many shifts are requested for 2009? 15 + 5 parasitic
- Need to run before the setup is changed, (planned for September 2009)

