DSA lifetime measurements of chiral 124Cs @HIL

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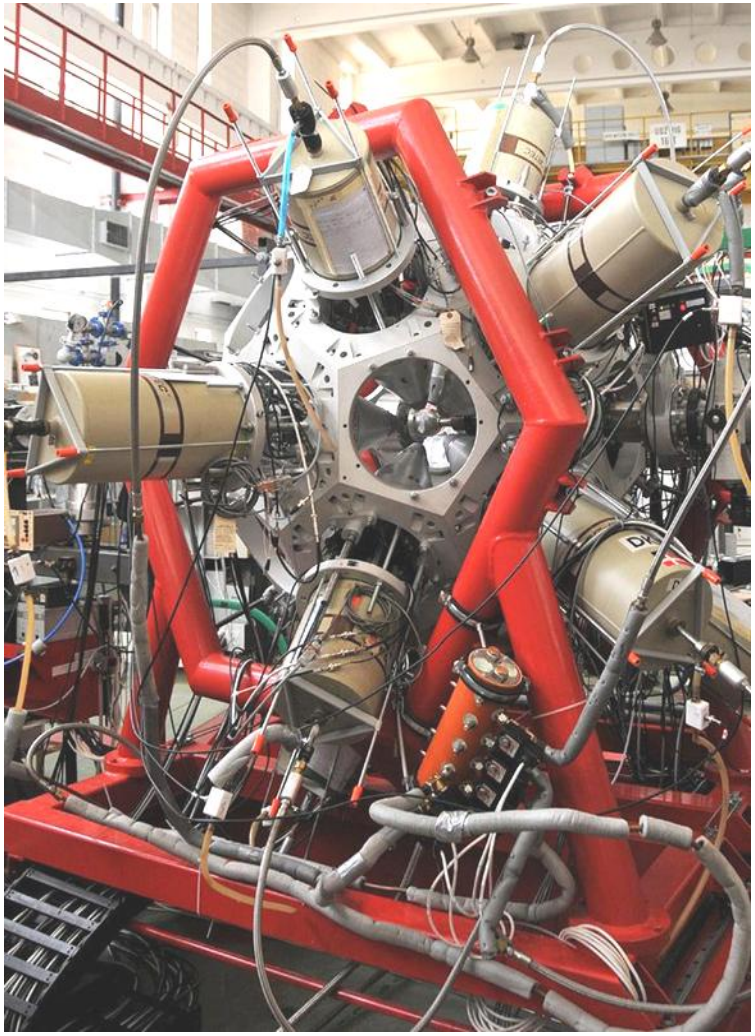
Experiment



Fusion - evaporation reaction
14N(114Cd,4n)124Cs

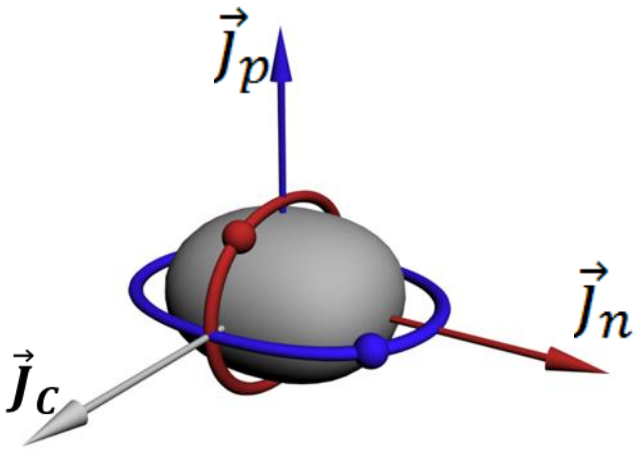
Target density: 34 mg/cm^2
(thick target used as a stopper)

Beam energy: 73 MeV

DSA measurement with
γ-γ coincidences

EAGLE array equiped with 15 HPGe obtained from GAMMAPOOL

Why 124Cs?

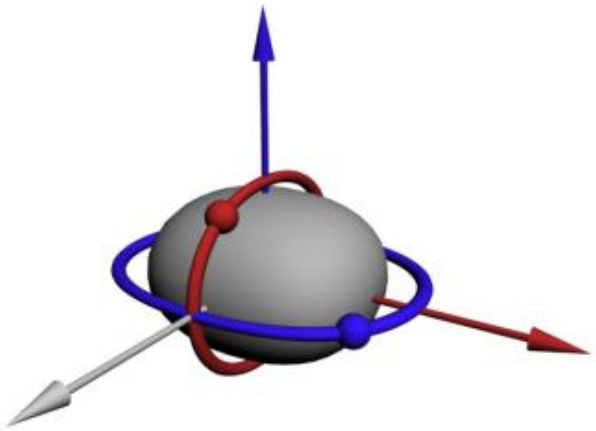


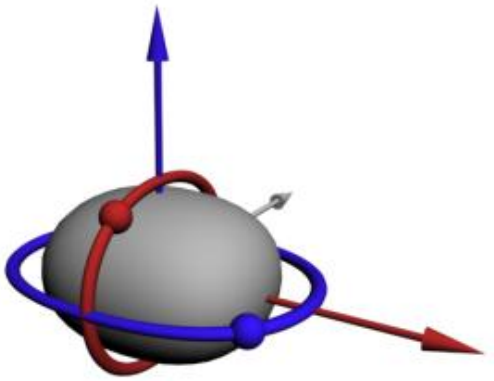
3 components:
- **Even-even core**
- **Odd proton**
- **Odd neutron**

We need these angular momentums to be perpendicular (chance to see spontaneous time-reversal symmetry breaking)

Effect expected in odd-odd nuclei within A ~ 130 region

Where is time-reversal?



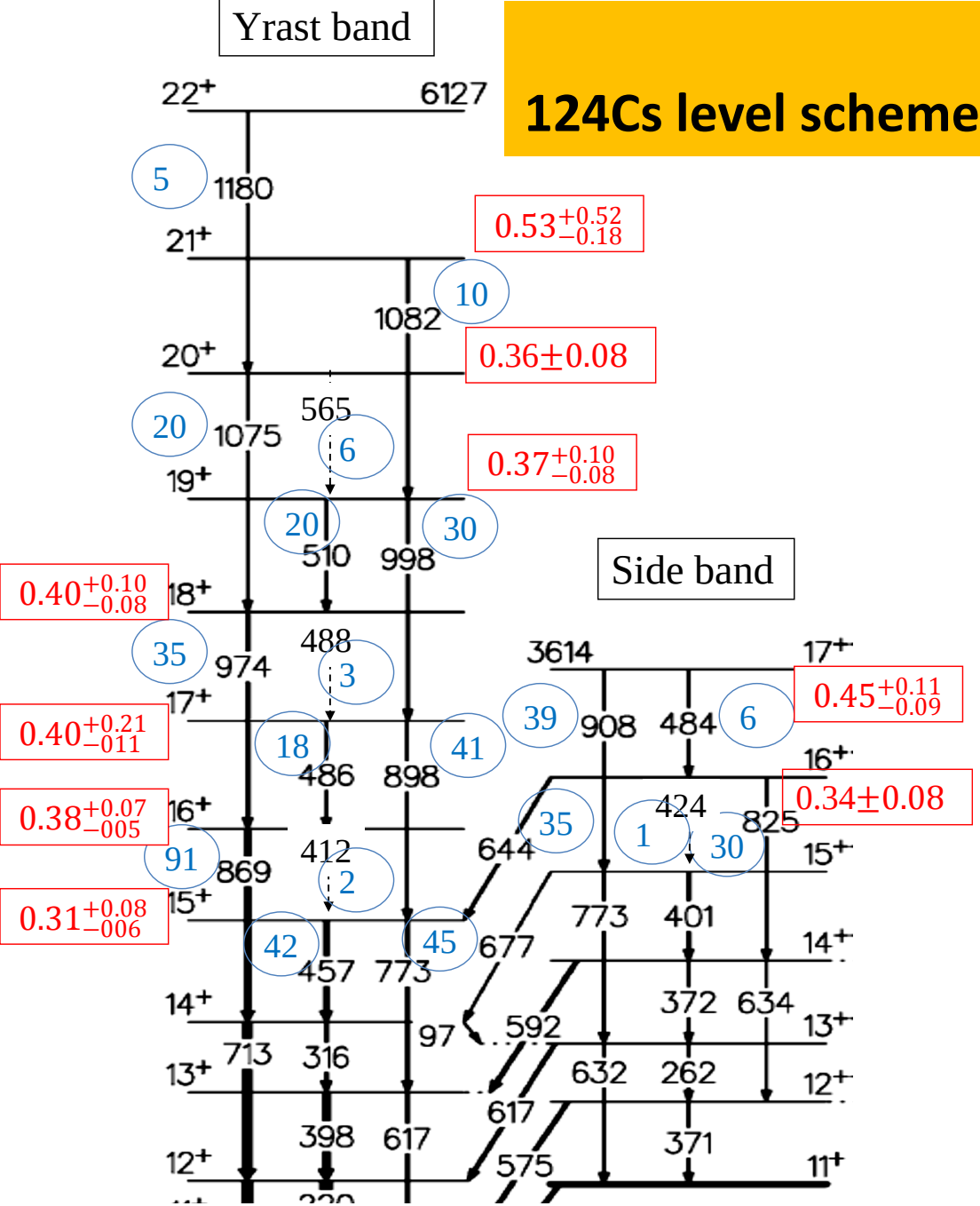


$|\mathrm{L}>$

$|\mathrm{R}>$

$$R_y T|\mathrm{L}> = |\mathrm{R}>$$
$$R_y T|\mathrm{R}> = |\mathrm{L}>$$

(there will be no more equations)



Lab system

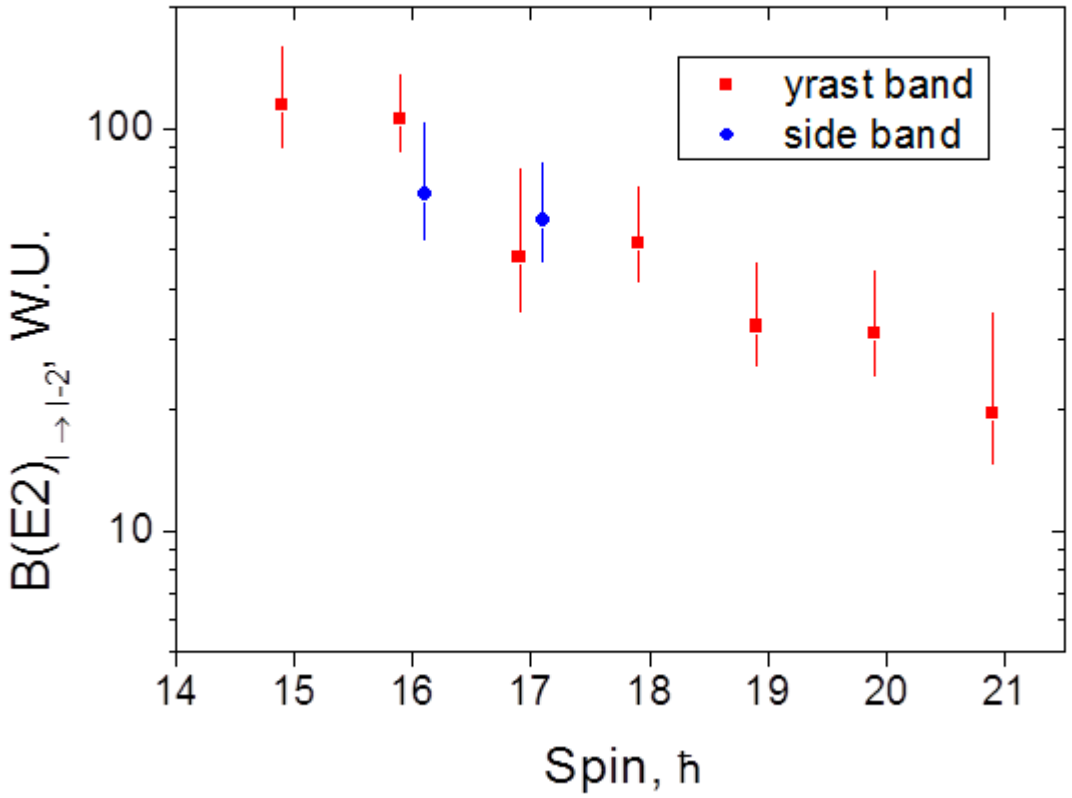
Visible partner bands with similar properties:

- **Level energies**
- **Transition probabilities**

Lifetimes given in ps

Relative transition probabilities presented in circles

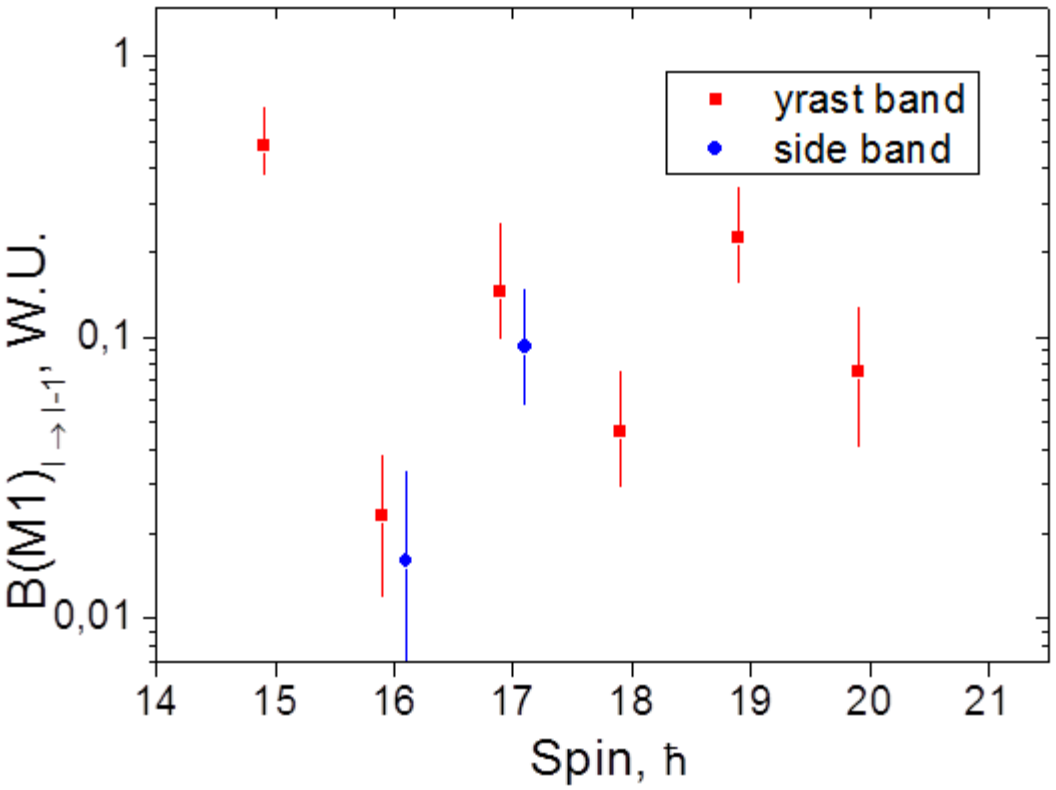
E2 transitions



Reduced E2 transition probabilities are the same in partner bands

No gamma selection rules predicted for E2

Final test

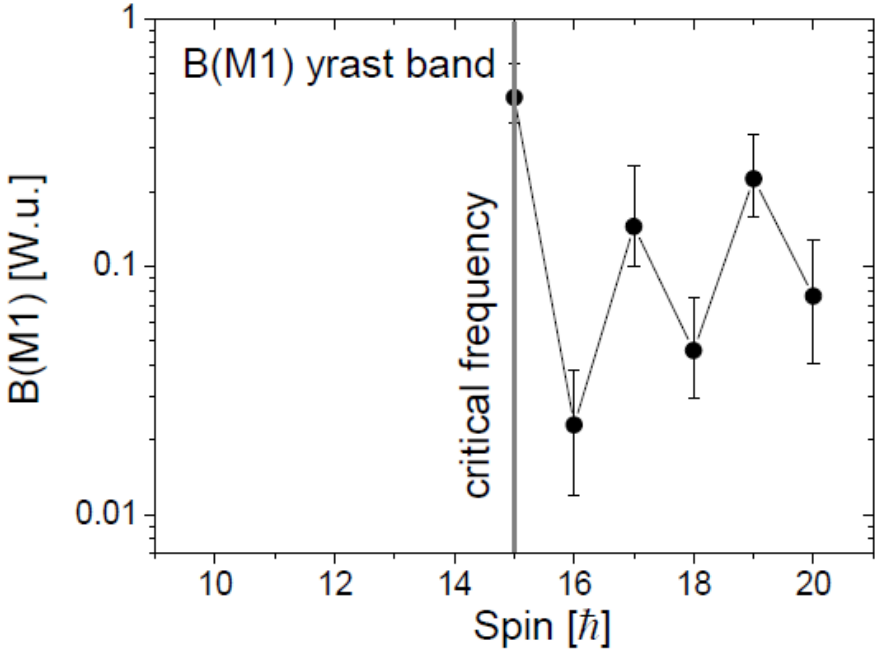


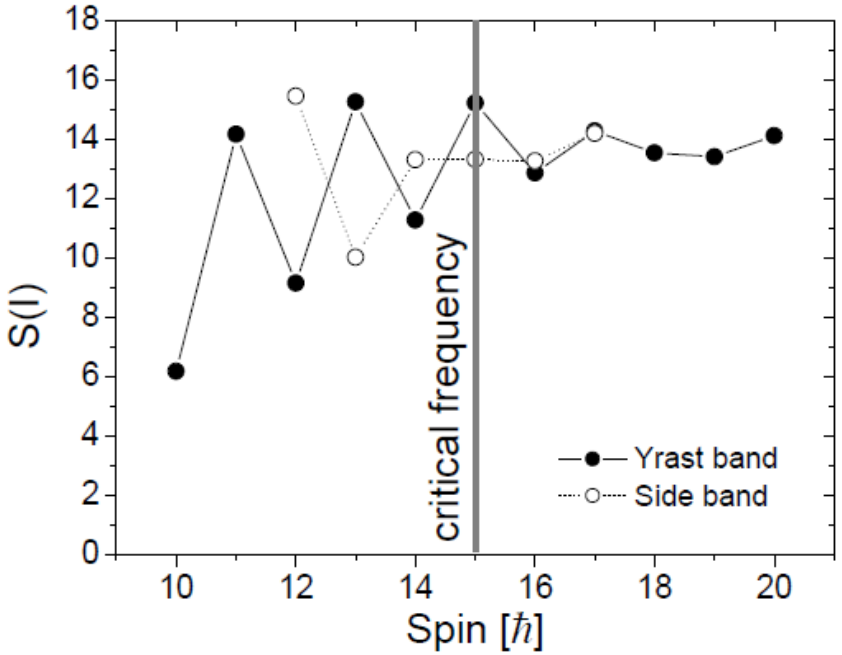
DCO analysis result: pure M1 transitions

M1 transition probabilities in partner bands are the same = we have spontaneous time-reversal symmetry breaking!

we can see staggering

Phase transition – first observation





Left panel: Reduced M1 transition probabilities in the yrast band.
Right panel: Energy levels staggering in the chiral partner bands.
S(I) = E(I) – E(I-1)/2I

P. Olbratowski et al., Phys. Rev. Lett 93, 052501 (2004)

Thank you for your attention

E. Grodner, R. Szenborn, J. Srebrny,
J. Samorajczyk, A.A. Pasternak, M. Kowalczyk,
J. Mierzejewski, M. Kisieliński, P. Decowski,
Ch. Droste, J. Perkowski, T. Abraham,
J. Andrzejewski, K. Hadyńska-Klęk,
Ł. Janiak, A Kasparek, P. Napiorkowski

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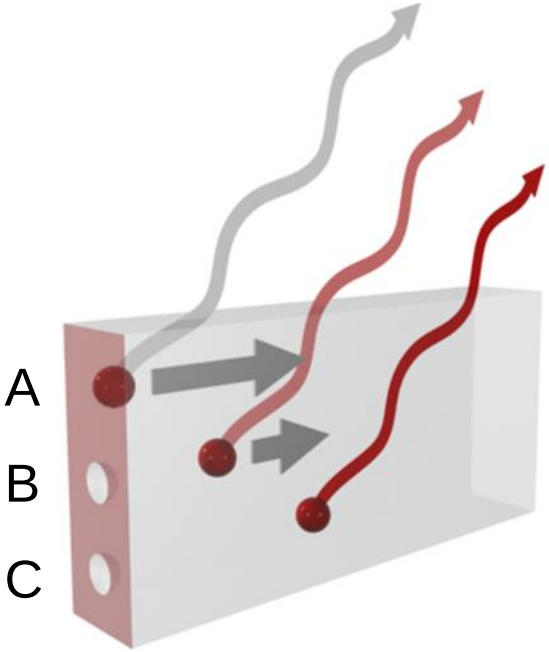
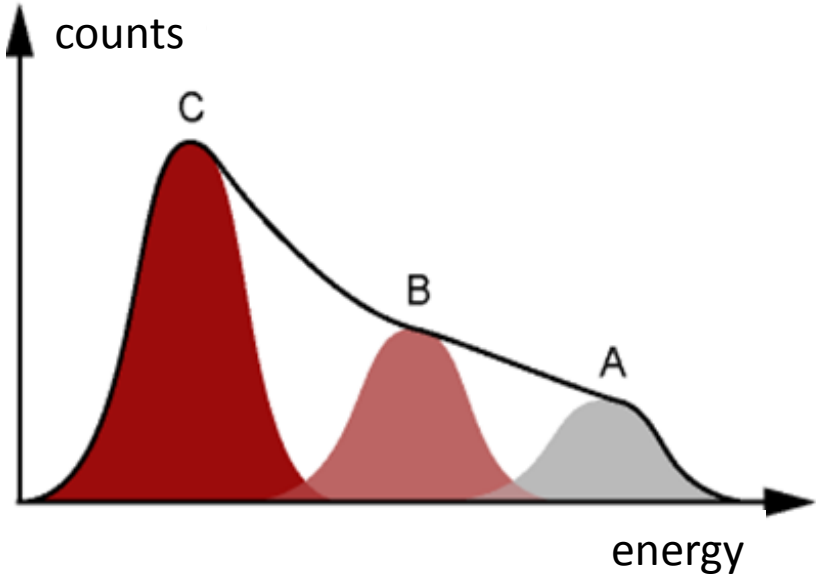
Additional informations

DSA Method

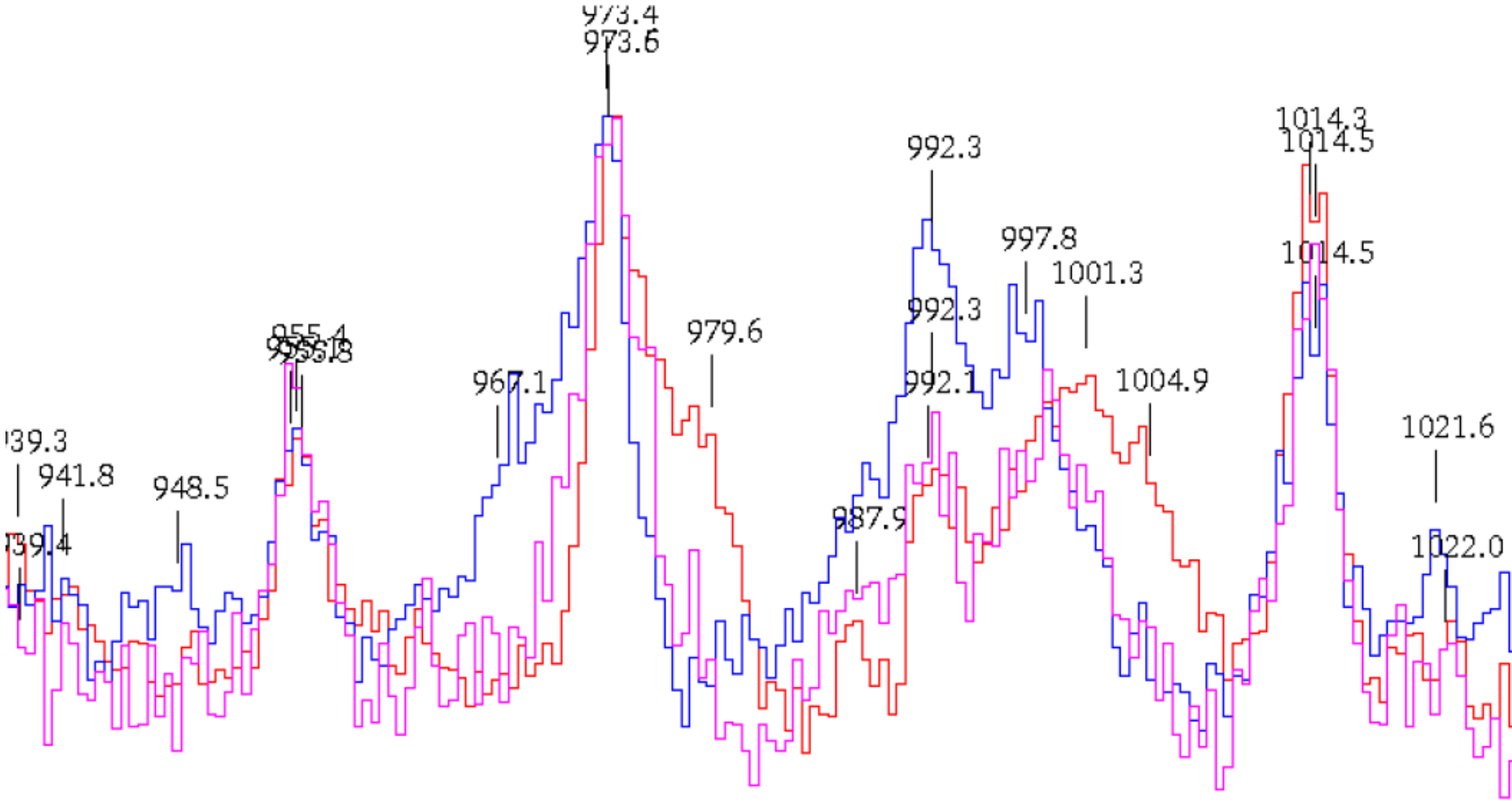




$E=E_0(1+\beta\cos\theta)$

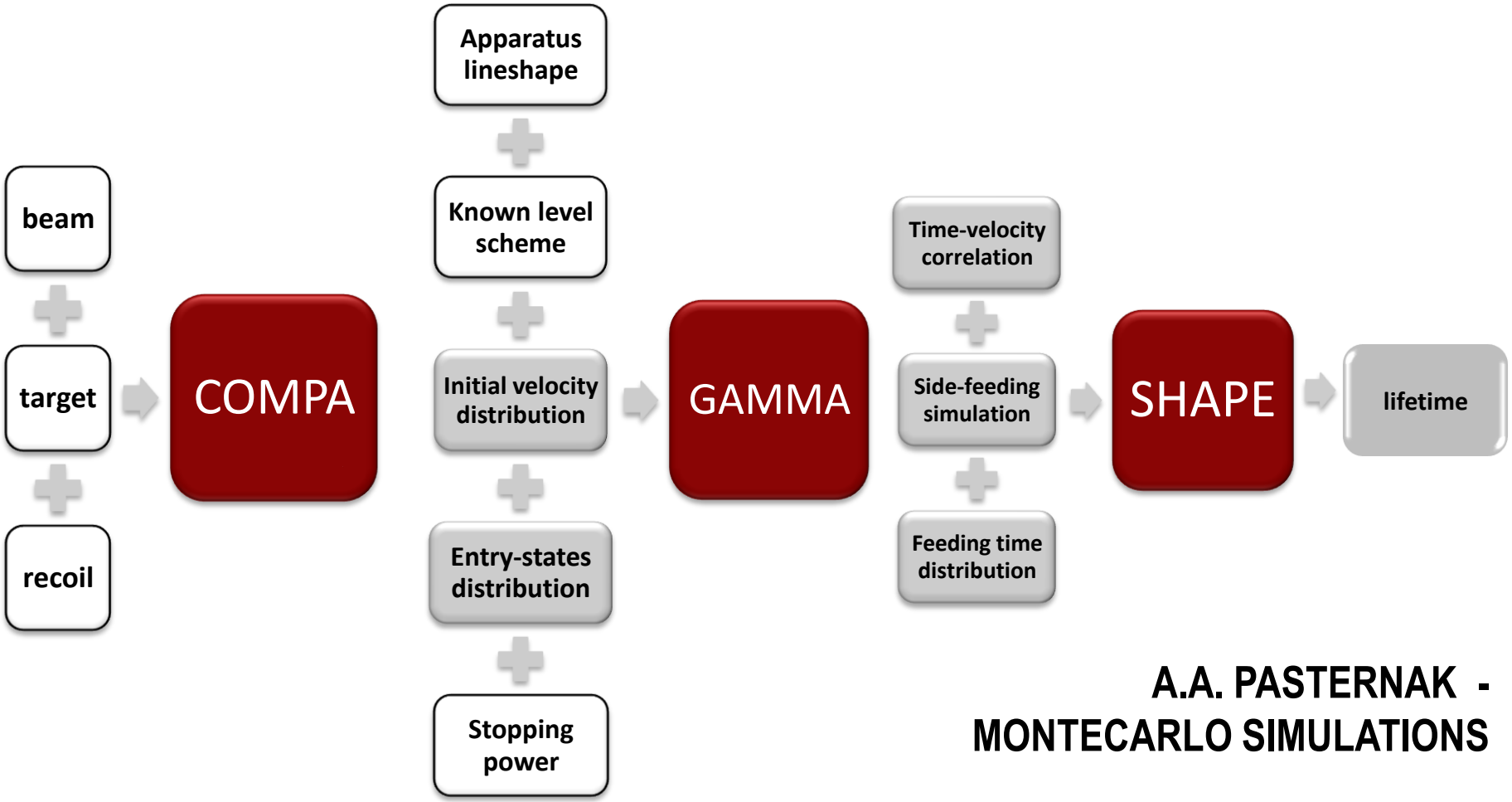
$v \approx 0{,}01c$

974 keV transition (how our data looks like)

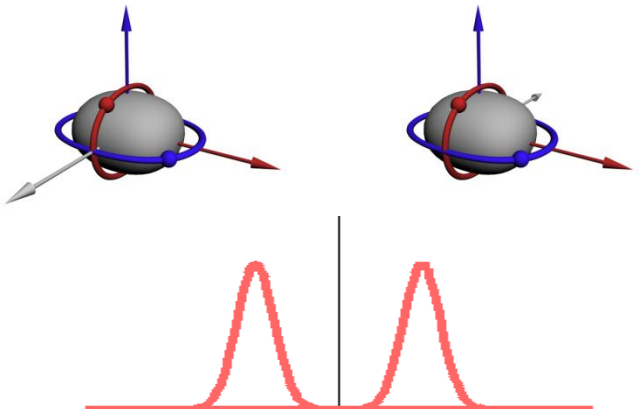


Additional informations

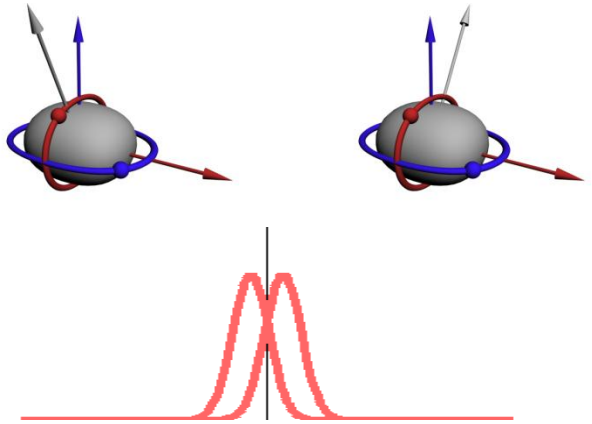
DSA Method – data analysis



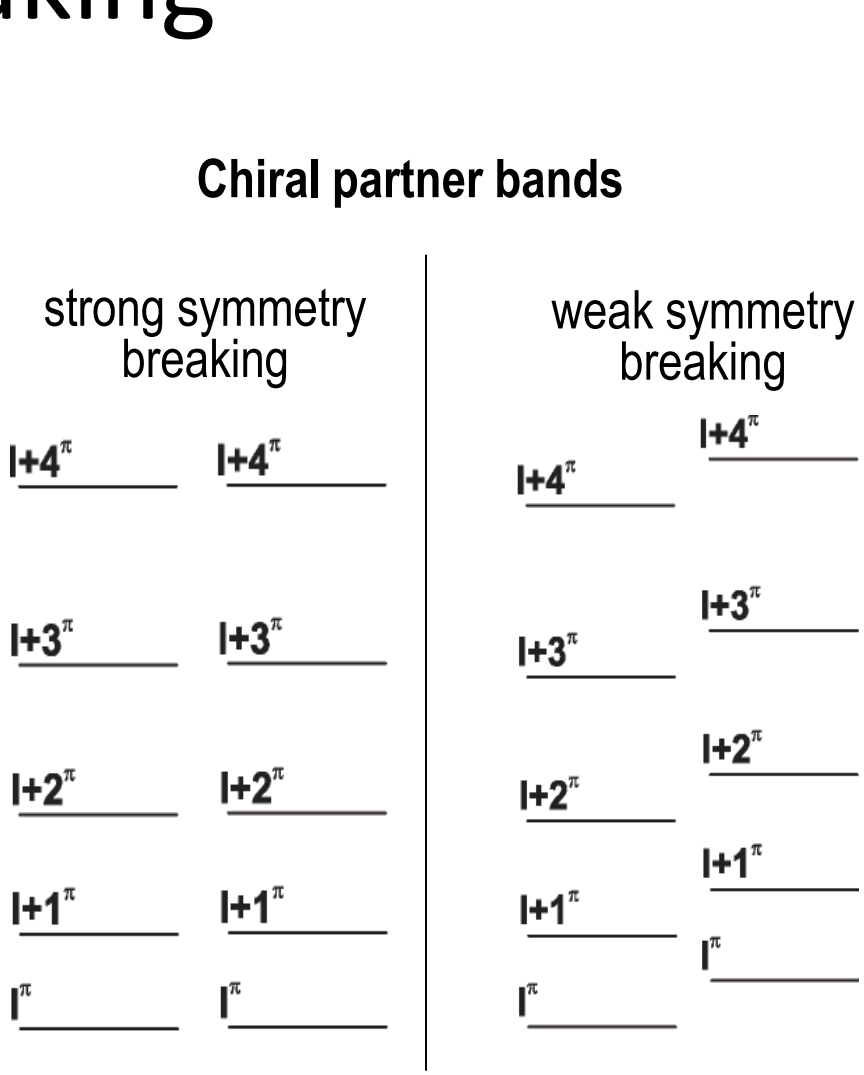
Weak time-reversal symmetry breaking



Strong chiral symmetry breaking



Weak chiral symmetry breaking



S-symmetry

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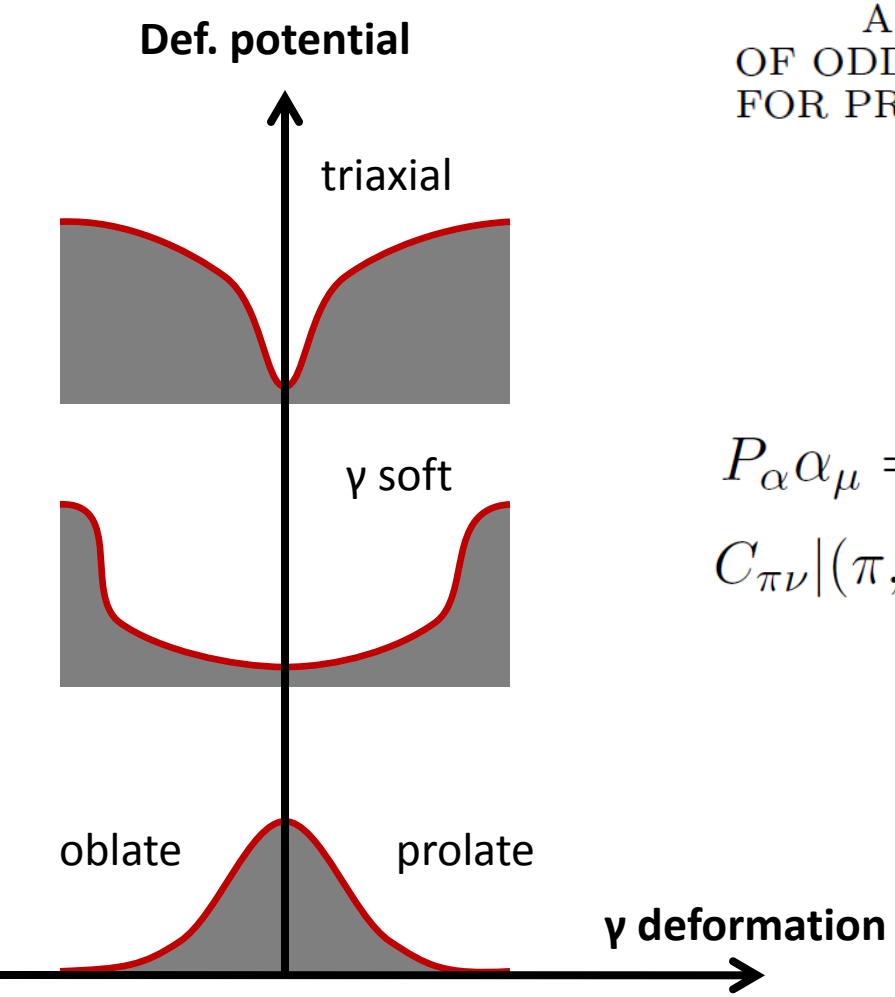
A SYMMETRY OF THE CPHC MODEL OF ODD–ODD NUCLEI AND ITS CONSEQUENCES FOR PROPERTIES OF $M1$ AND $E2$ TRANSITIONS*

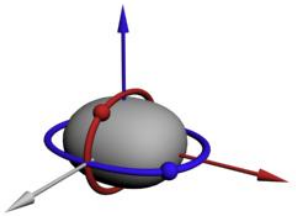
L. PRÓCHNIAK



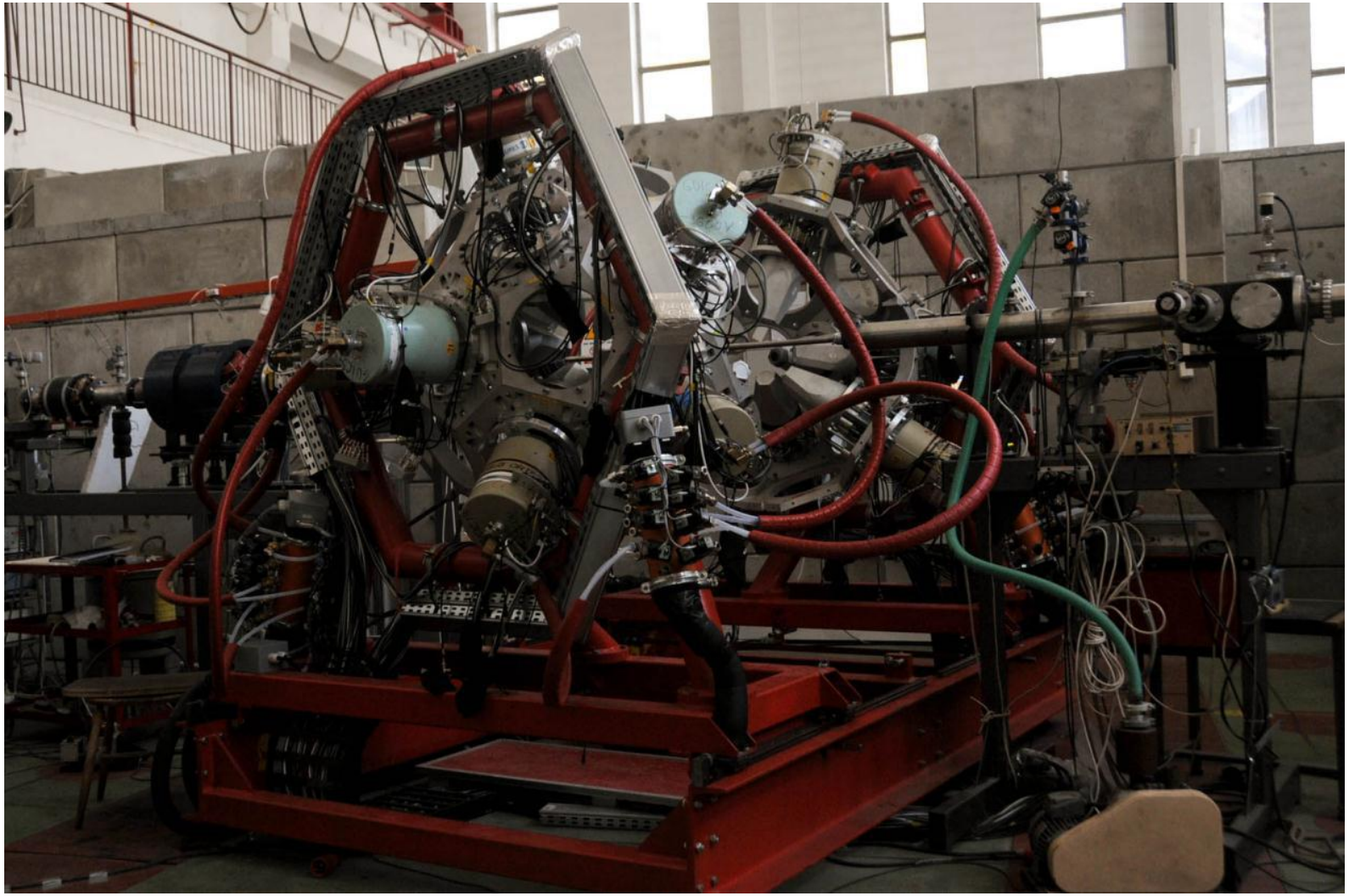
$$S = P_\alpha C_{\pi\nu}$$

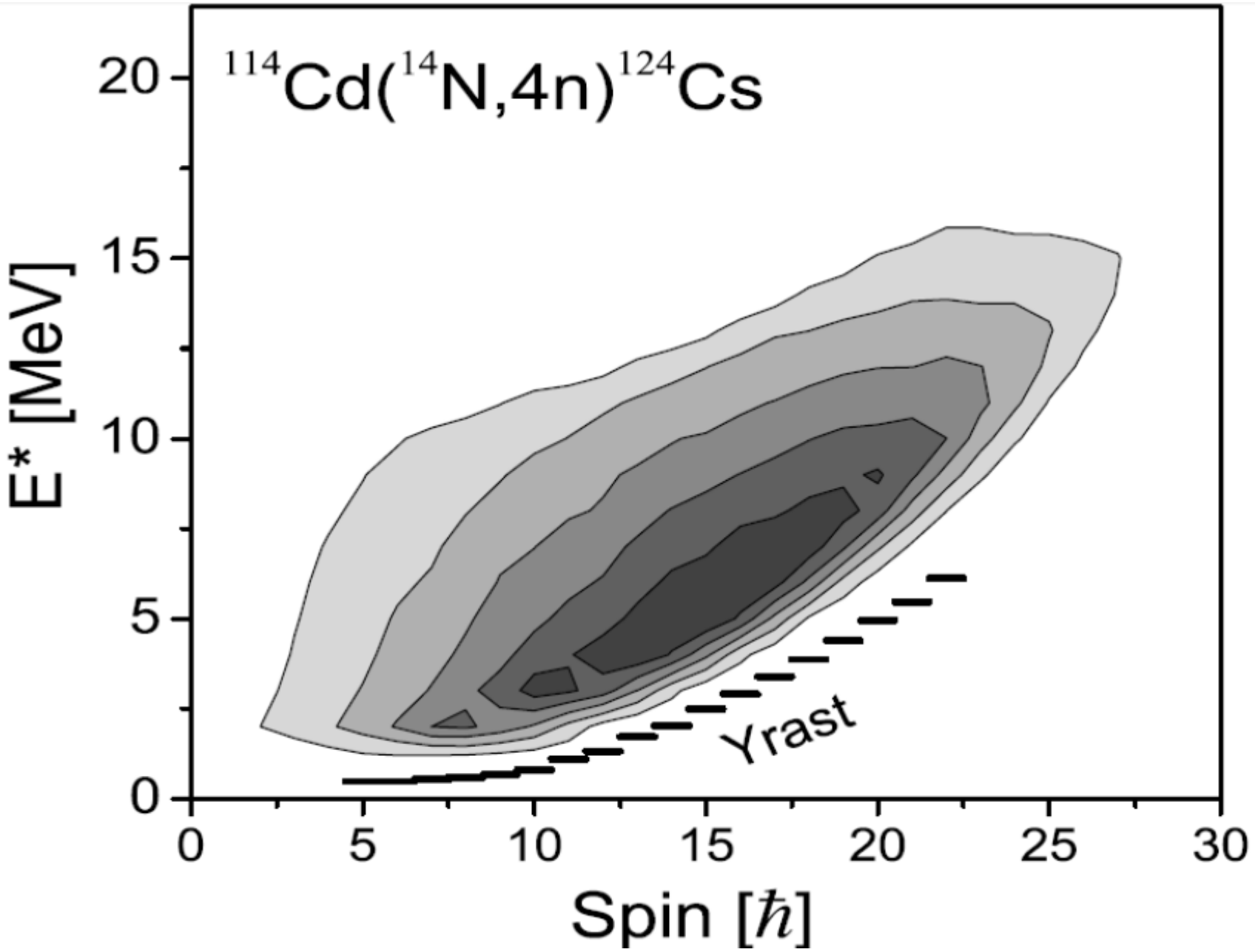
$$P_\alpha \alpha_\mu = -\alpha_\mu\,, \qquad \mu = -2, \ldots, 2$$

$$C_{\pi\nu}|(\pi, j_\pi m_\pi)(\nu, j_\nu m_\nu)\rangle = |(\pi, j_\nu m_\nu)(\nu, j_\pi m_\pi)\rangle$$

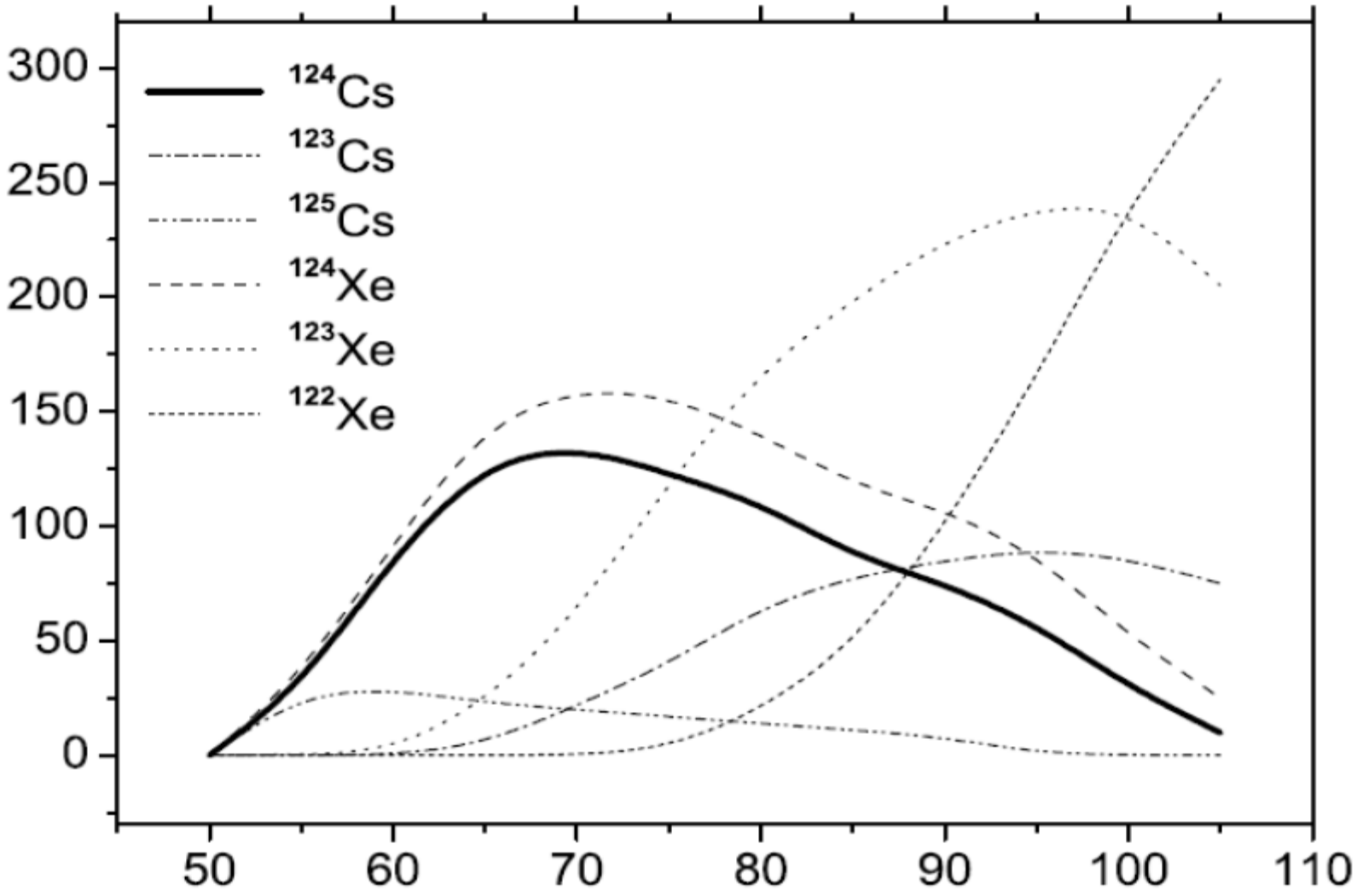


EAGLE




^{114}Cd(^{14}N,4n)^{124}Cs
E* [MeV]
Spin [ħ]
Yrast
0
5
10
15
20
25
30

x-sections


300
250
200
150
100
50
0
50
60
70
80
90
100
110
^{124}Cs
^{123}Cs
^{125}Cs
^{124}Xe
^{123}Xe
^{122}Xe