The Shape Method

Mathis Wiedeking

NRF - iThemba LABS, Cape Town
University of the Witwatersrand, Johannesburg

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Shape Method

- D_0 is not known.
- No standard approach in absence of D_0 .
- Unambiguous identification of origin and destination of primaries.
- Functional form is retained between primaries from same excitation energy bin.
- Concepts from Average Resonance Capture, Ratio, and χ^2 methods.

PHYSICAL REVIEW C **104**, 014311 (2021)

Independent normalization for γ-ray strength functions: The shape method

M. Wiedeking,[1,2,*] M. Guttormsen,[3] A. C. Larsen,[3] F. Zeiser,[3] A. Görgen,[3] S. N. Liddick,[4,5] D. Mücher,[6,7] S. Siem,[3] and A. Spyrou[4,8]

PHYSICAL REVIEW C **107**, L011602 (2023)

Letter

Extracting model-independent nuclear level densities away from stability

D. Mücher,[1,2,3,*] A. Spyrou,[4,5,6,†] M. Wiedeking,[7,8] M. Guttormsen,[9] A. C. Larsen,[9] F. Zeiser,[9] C. Harris,[10,5] A. L. Richard,[10,6] M. K. Smith,[10] A. Görgen,[9] S. N. Liddick,[10,11] S. Siem,[9] H. C. Berg,[10,5] J. A. Clark,[12] P. A. DeYoung,[13] A. C. Dombos,[14] B. Greaves,[1] L. Hicks,[10,5] R. Kelmar,[14] S. Lyons,[15] J. Owens-Fryar,[10,5] A. Palmisano,[10,5] D. Santiago-Gonzalez,[12] G. Savard,[12] and W. W. von Seeger[13]

Shape Method Concepts

Identification of origin and destination of primaries.

Functional form is retained between primary transitions from a specific excitation energy.

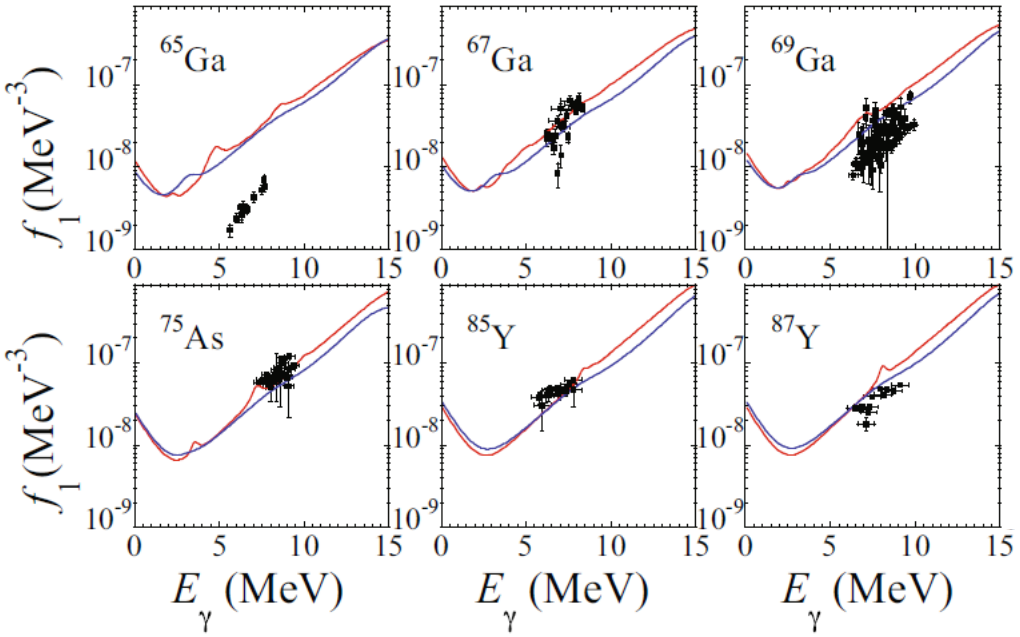
Concepts from Average Resonance Capture, Ratio, and χ^2 methods

Shape Method Concepts

Identification of origin and destination of primaries.

Functional form is retained between primary transitions from a specific excitation energy.

Concepts from Average Resonance Capture, Ratio, and X^2 methods



S. Goriely *et al.*, Eur. Phys. J. A 55, 172 (2019)

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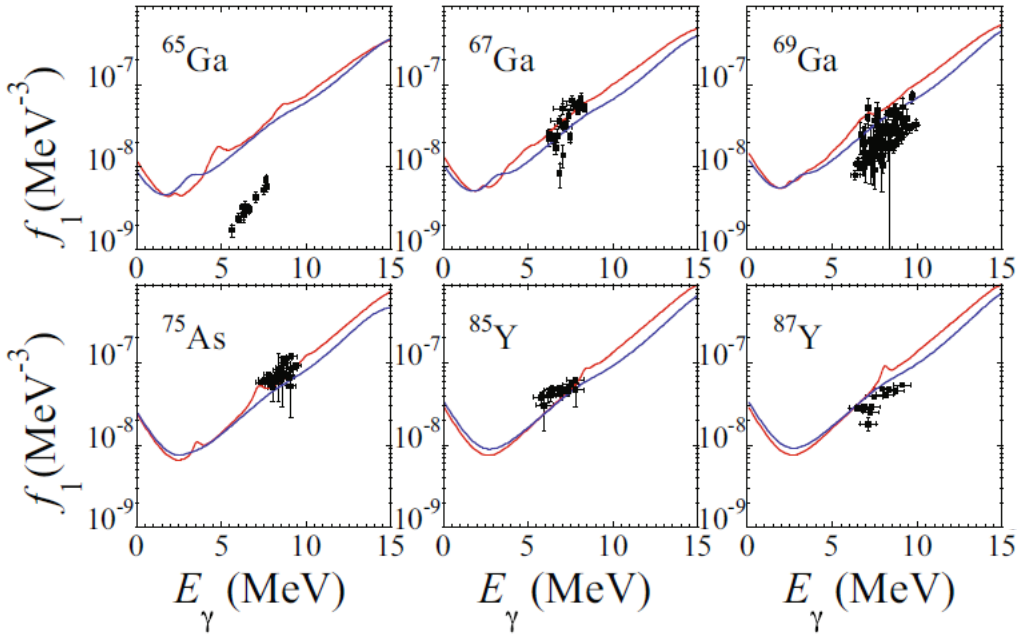
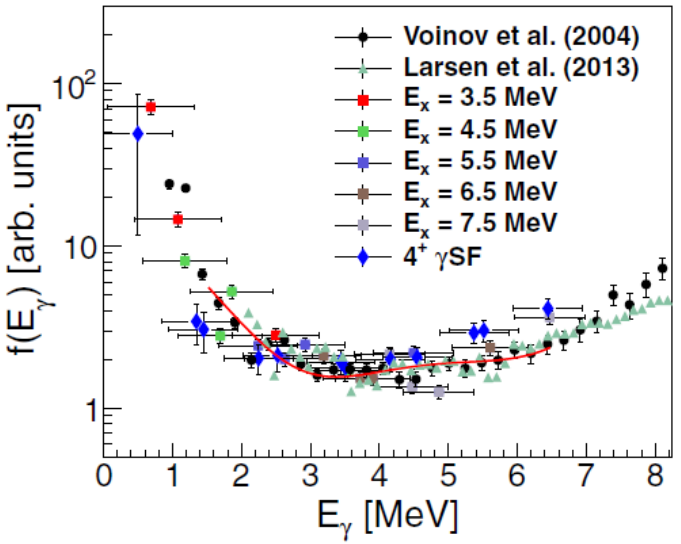
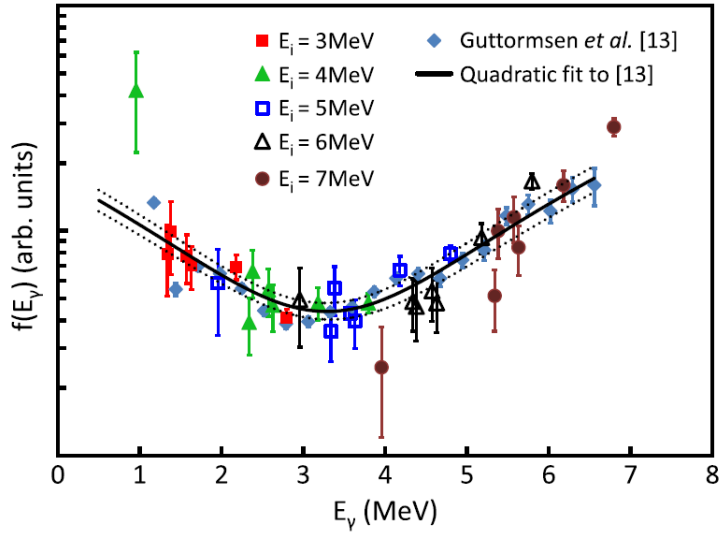
Concepts from Average Resonance Capture, Ratio, and X^2 methods



S. Goriely *et al.*, Eur. Phys. J. A 55, 172 (2019)

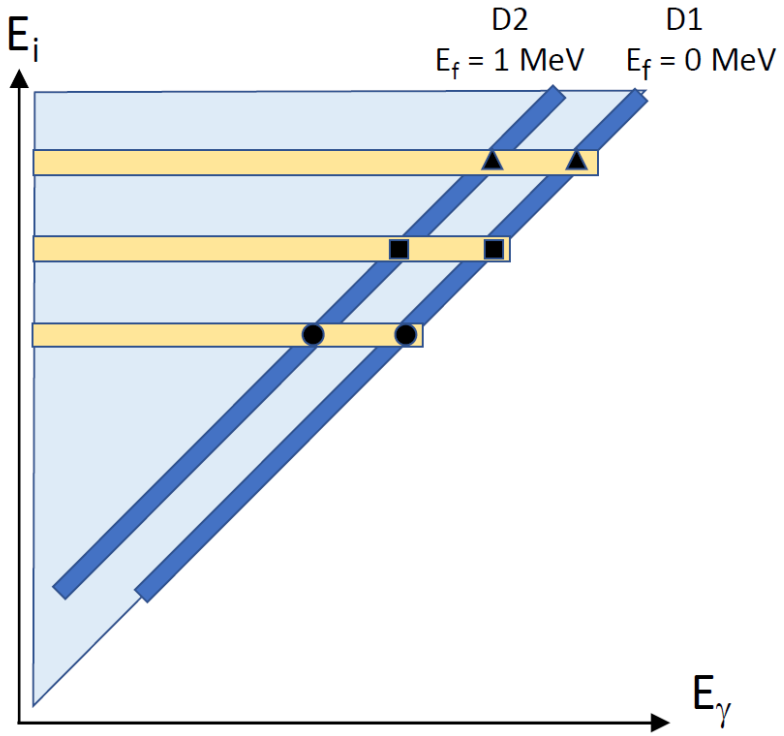


MD Jones *et al.*, PRC 97, 024327 (2018)



MW *et al.*, PRL 108, 0162503(2012).

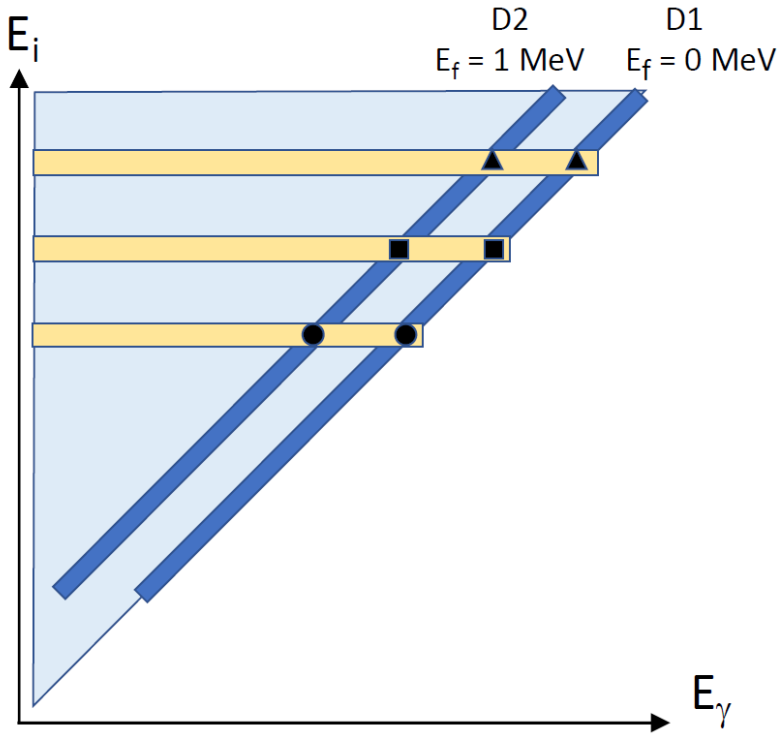
Shape and Sewing Method



- Primary gamma-rays from intercepts of diagonals with E_x gate.

MW, Guttormsen, Larsen *et al.*, Phys Rev C 104, 014311 (2021).

Shape and Sewing Method



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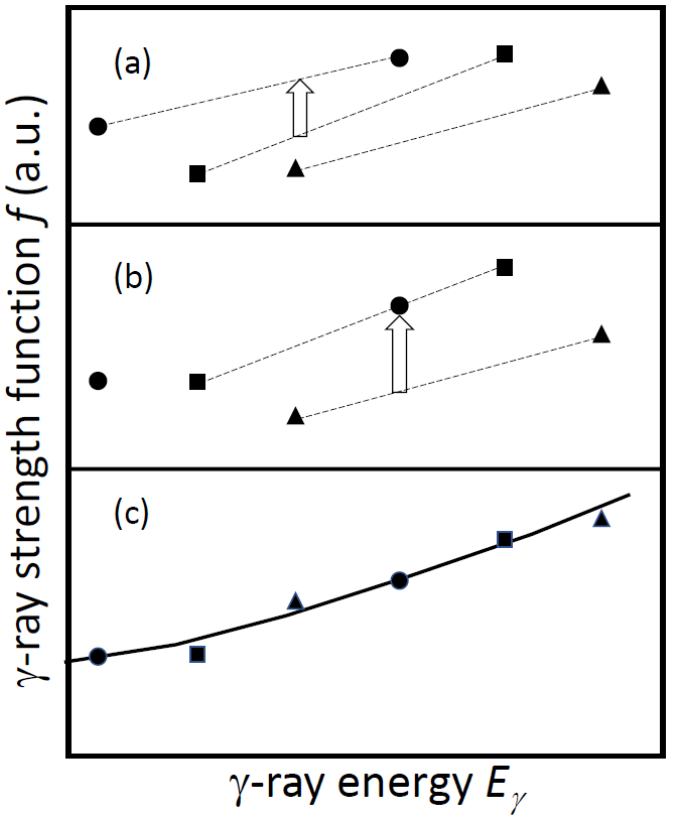
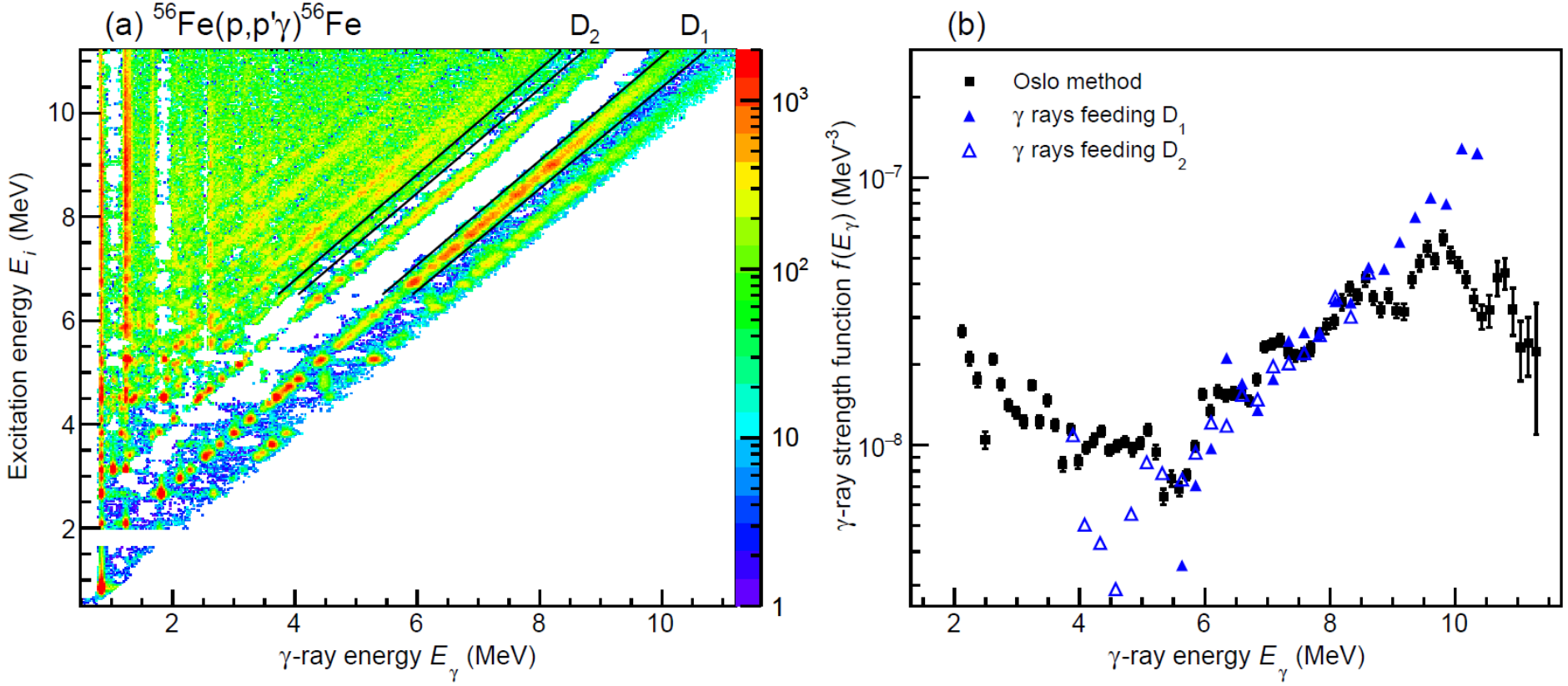


- Pair of data points internally normalized and proportional to PSF.
- Average γ energy of the extremes of 2 neighboring pairs.
- 2nd pair scaled by a factor to match 1st pair.
- Logarithmic interpolation.
- Results in functional form of PSF.

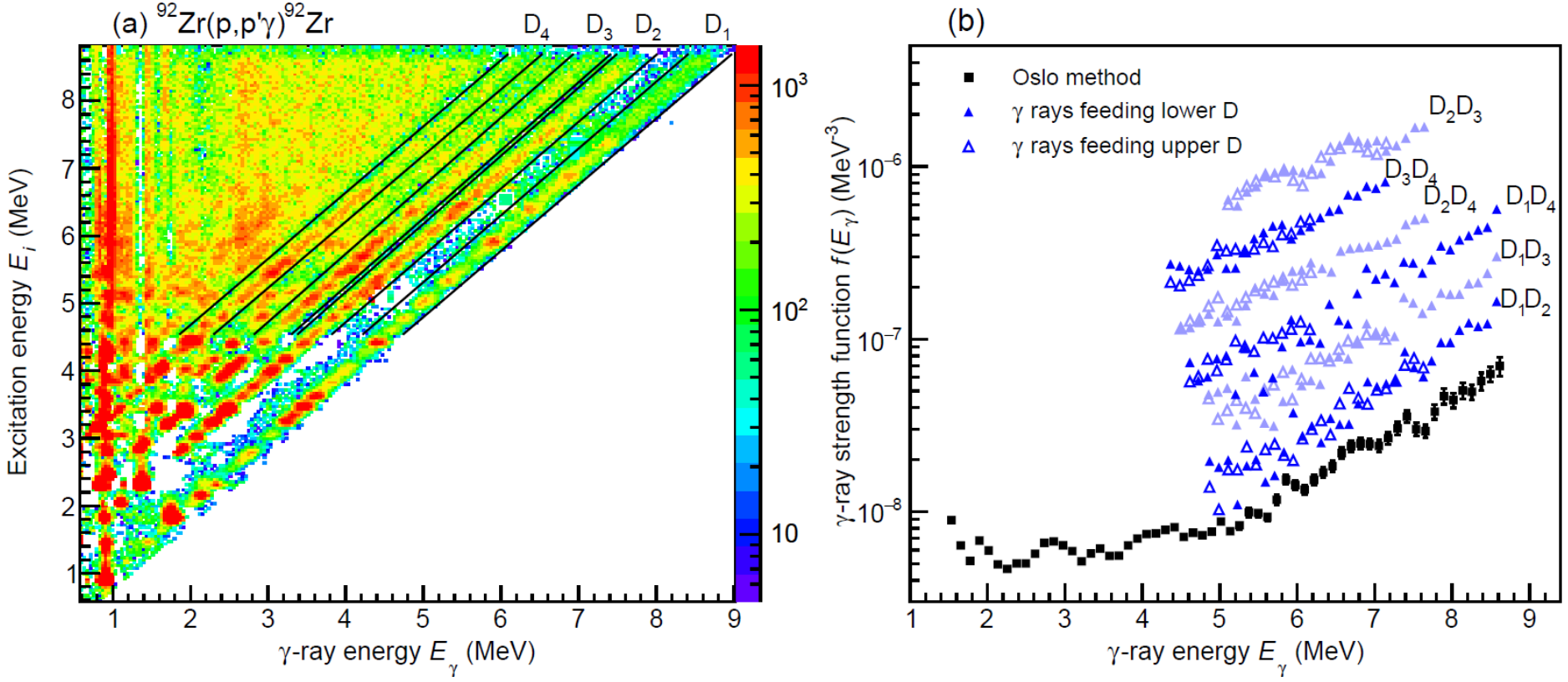
Shape Method in practice: ^{56}Fe



$D_1 = 2^+$ 847 keV

$D_2 = 2^+$ 2658 keV

Shape Method in practice: ^{92}Zr



$D_1 = 0^+$ 0 keV

$D_2 = 2^+$ 934 keV

$D_3 = 0^+$ 1383 & 4^+ 1495 keV

$D_4 = 3^-$ 2340 & 4^+ 2398 & 5^- 2486 keV

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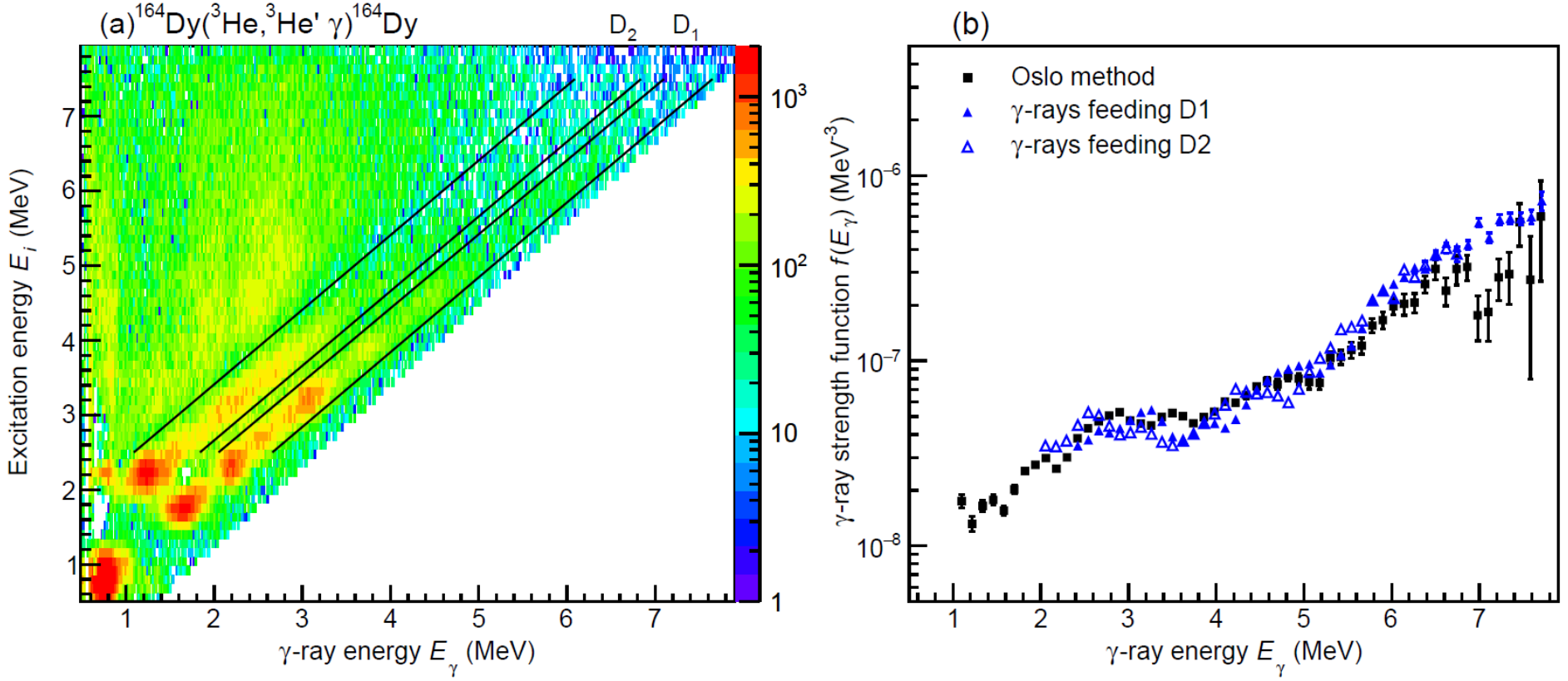
MW, Guttormsen, Larsen *et al.*, Phys Rev C 104, 014311 (2021).

WITS UNIVERSITY

NRF National Research Foundation

iThemba LABS Laboratory for Accelerator Based Sciences

Shape Method in practice: ^{164}Dy

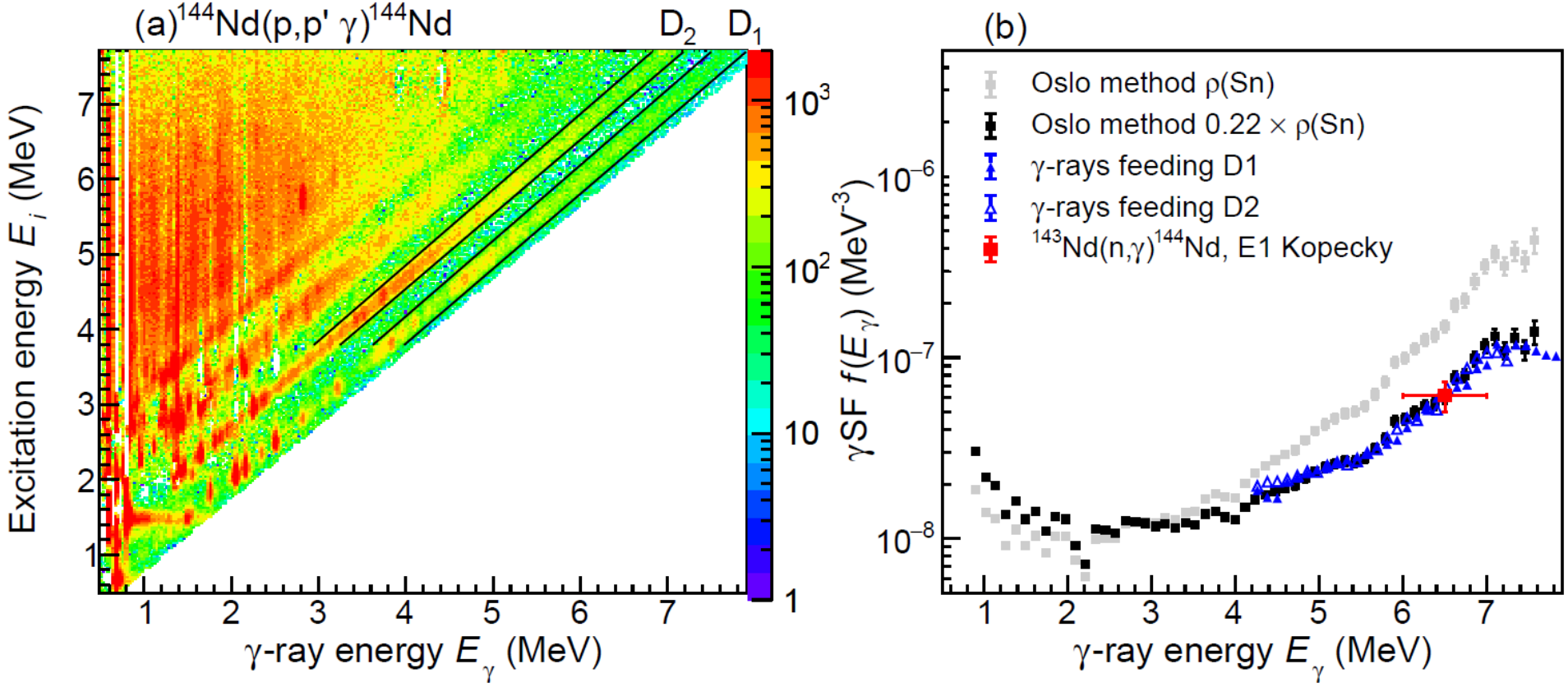


$D_1 = 0^+, 2^+, 4^+, 6^+, 0 – 0.5$ MeV

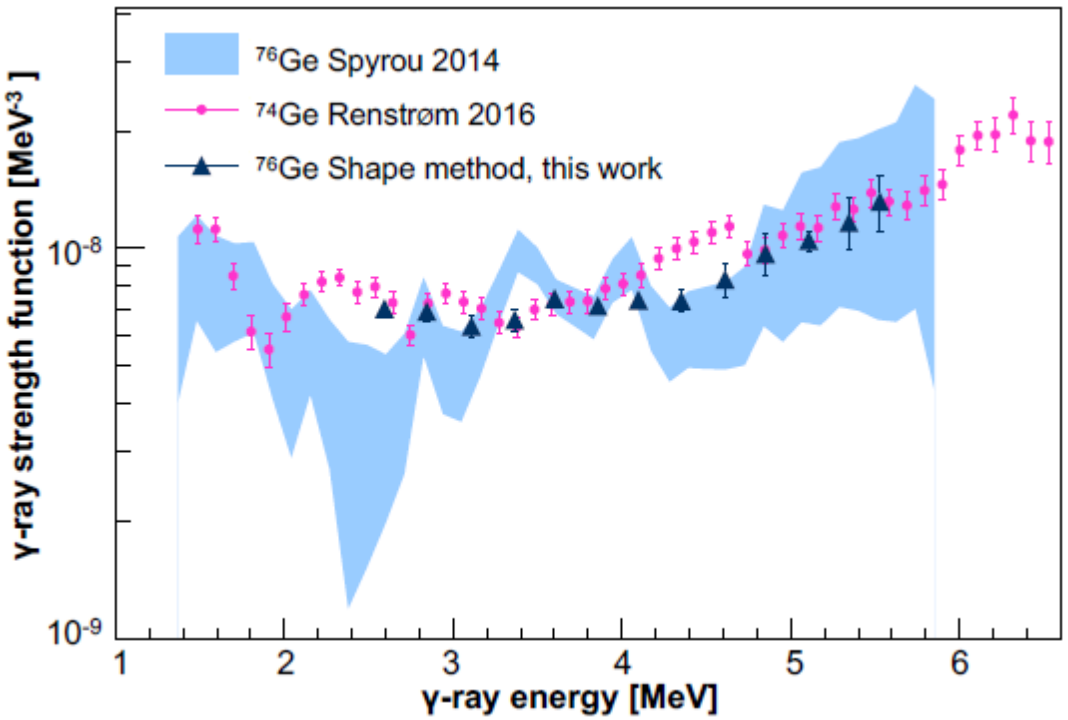
$D_2 = 14$ levels $0.76 – 1.39$ MeV

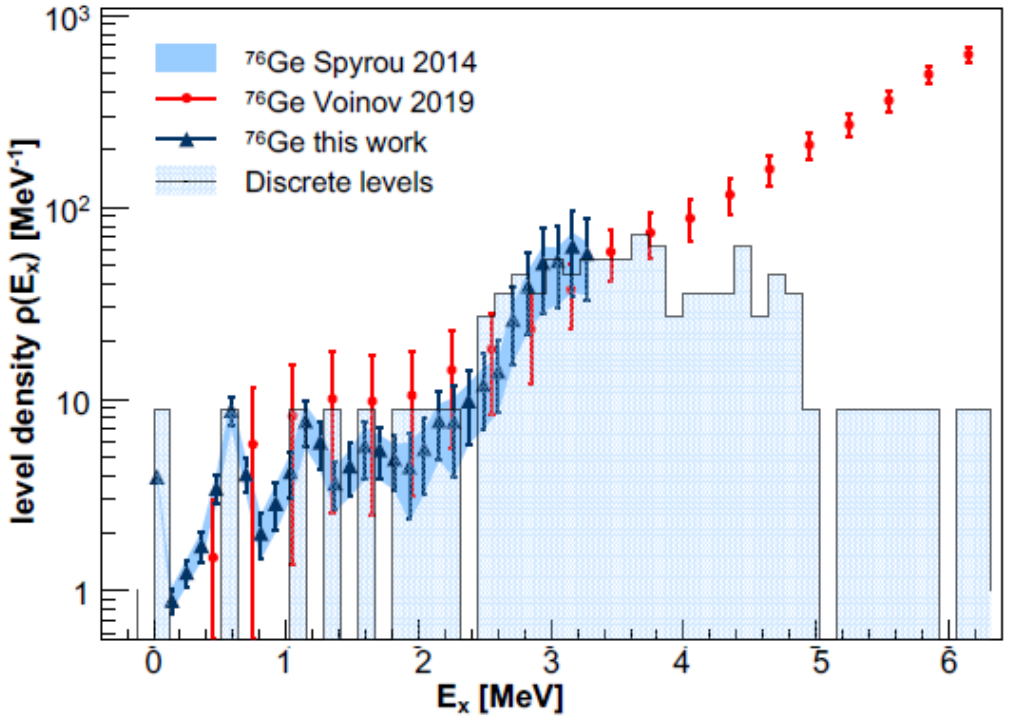
Shape Method in practice: ^{144}Nd

Guttormsen, Ay, Ozgur et al., Phys. Rev. C 106, 034314 (2022).
Comprehensive study on PSF evolution for 9 Nd isotopes.



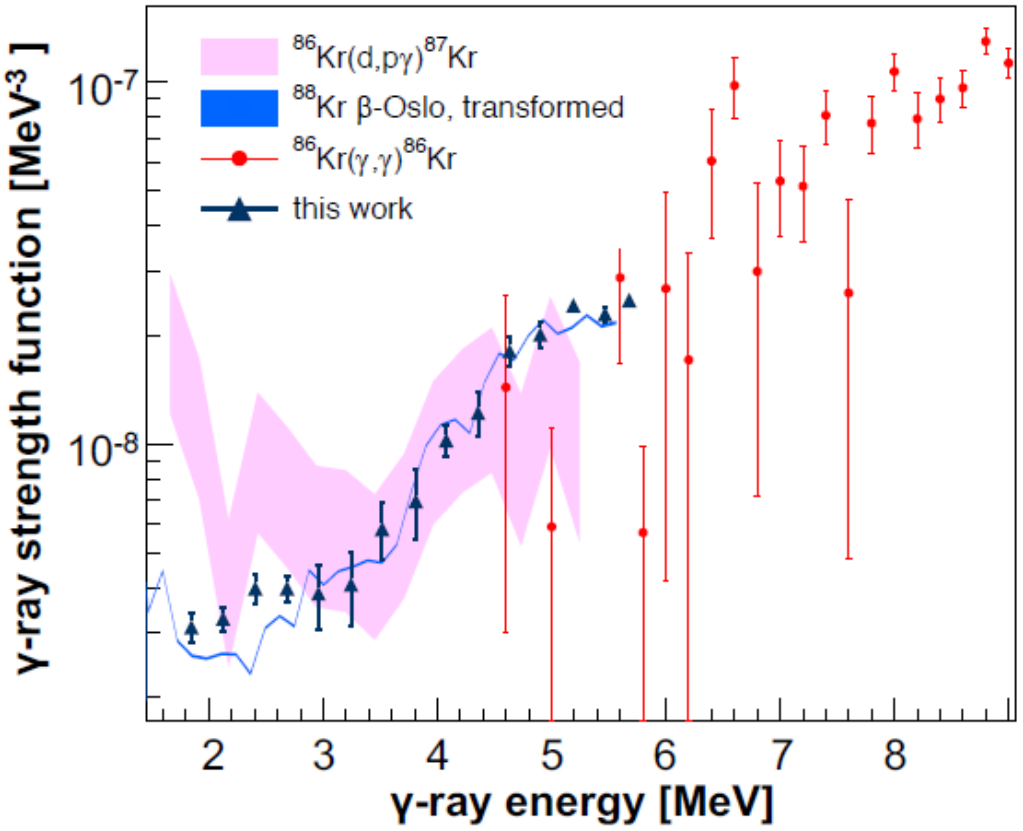
Shape Method and NLD on stable isotope

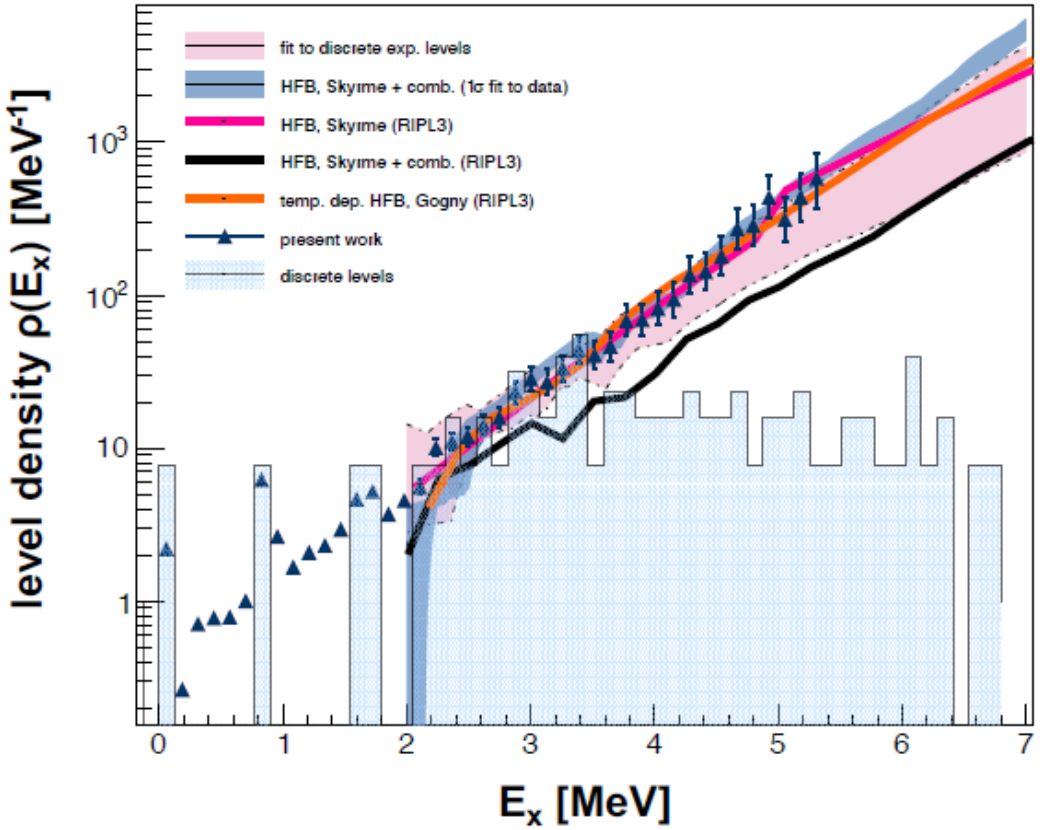




Mücher, Spyrou, MW et al., Phys. Rev. C 107, L011602 (2023).

Shape Method and NLD on radioactive isotope





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