Development of the Charge-Exchange Oslo Method and its First Application to Constrain (n,γ) Cross Sections

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Introduction

- The development of the Charge-Exchange Oslo (CE-Oslo) method is important for constraining multiple inputs for nucleosynthesis simultaneously;
  - Nuclear level density (NLD)
  - γ-ray strength function (γSF)
  - Gamow-Teller strengths
  - β-delayed neutron decay probabilities
- The long-term goal is to pursue (p,n+γ) experiments in inverse kinematics to extract such constraints for unstable nuclei.

Motivation

1. Charge-Exchange (CE) Reactions

- CE reactions are characterized by the exchange of a proton and a neutron between the target nucleus and the projectile nucleus.

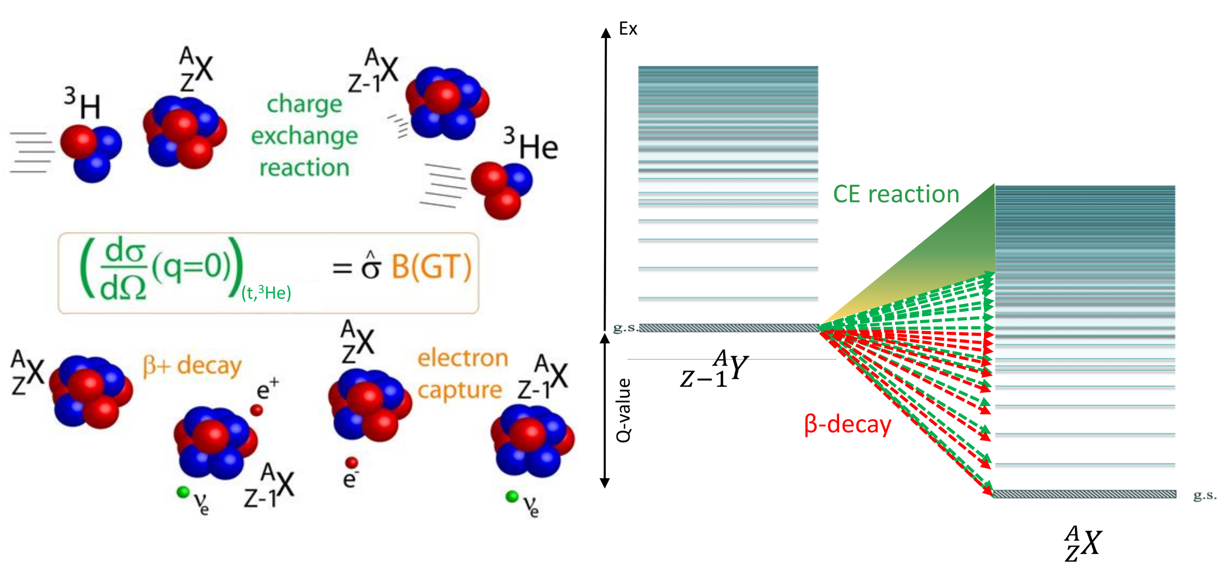

Fig. 1 Charge-Exchange reactions and comparison with EC and β-decay

2. CE-Oslo Method

- Similarly to Oslo Method and β-Oslo Method, we now develop the CE-Oslo Method for CE reactions.

Experimental Details

- To test the CE-Oslo method, data from a previous CE experiment ^{93}Nb(t,^{3}He+γ)^{93}Zr is taken, which has been run at 115 MeV/u in coincidence with S800 and GRETINA at NSCL.[3]
- Using the particle-γ coincidence data, the NLD of ^{93}Zr, γSF of ^{93}Zr, and (n,γ) cross sections of ^{92}Zr are extracted with the Oslo method package and the TALYS reaction code.[1,4,5,6,7]

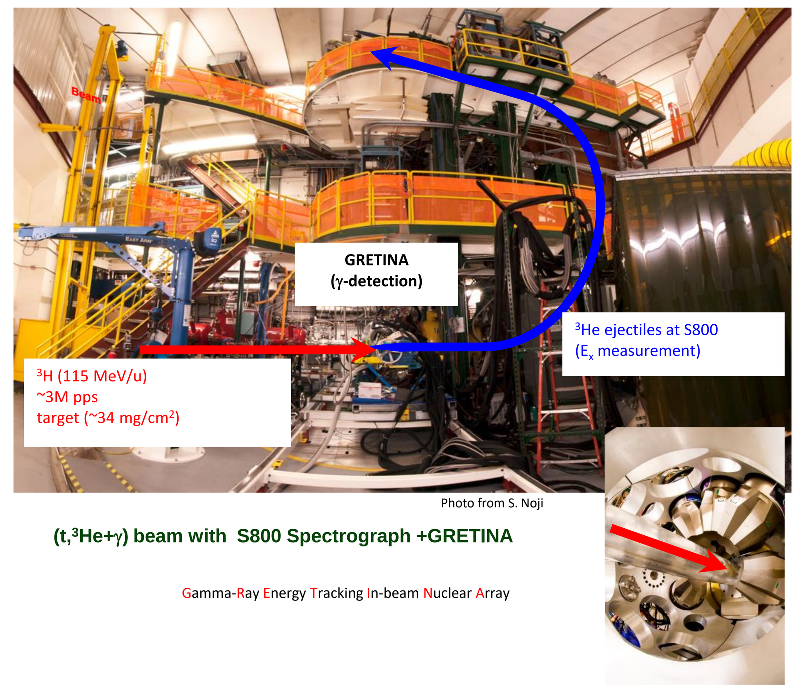

Fig. 2 ^{93}Nb(t,^{3}He+γ)^{93}Zr experimental setup

Results for ^{93}Nb(t,^{3}He+γ)^{93}Zr

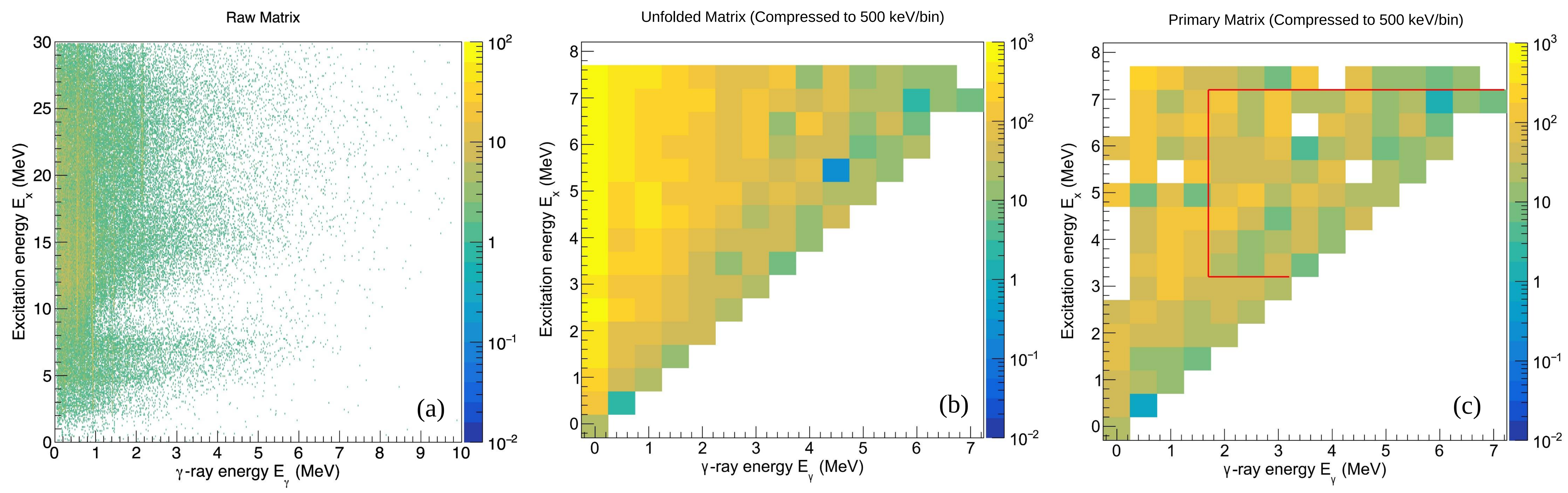

Fig. 3 The (a) raw matrix (b) unfolded matrix and, (c) primary matrix

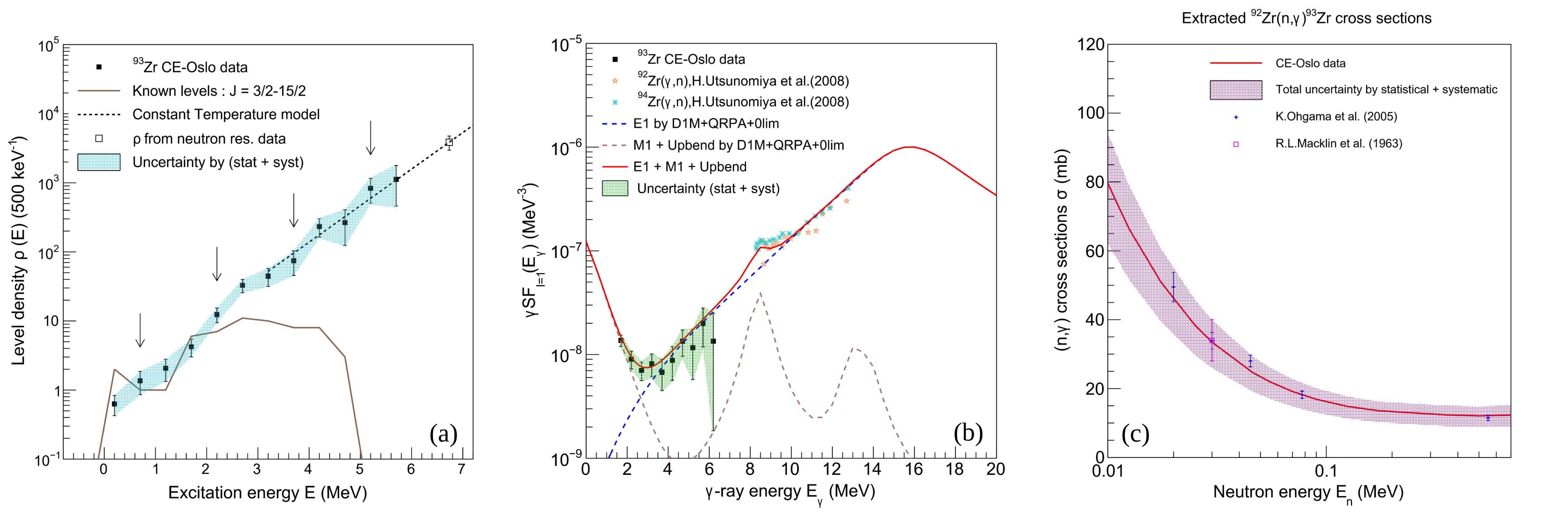

Fig. 4 The (a) NLD of ^{93}Zr (b) γSF of ^{93}Zr and, (c) ^{92}Zr(n, γ) ^{93}Zr cross sections

Conclusion

- This is the first time that:
  - ^{92}Zr(n,γ)^{93}Zr cross sections are measured using the Oslo Method.
  - The CE-Oslo method is applied to constrain the (n,γ) cross sections.
  - The Oslo method is applied to constrain (n,γ) cross sections using the GRETINA γ-coincidence data with S800.

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