Angular momentum and excitation energy sharing in neutronless fission

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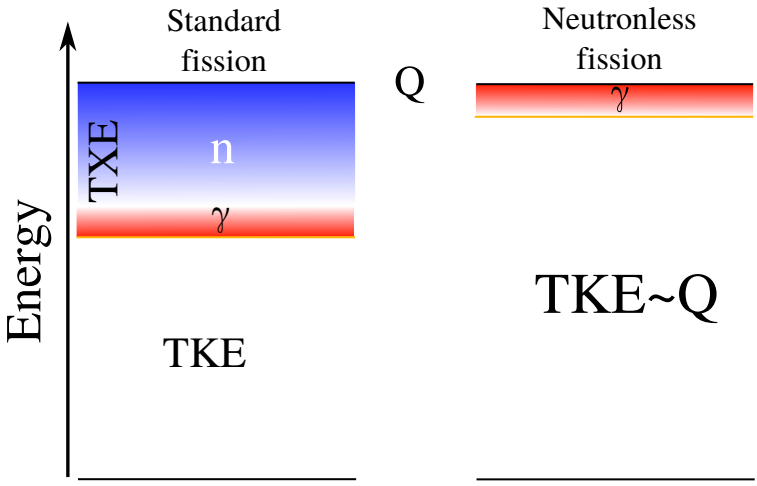
Neutronless fission as an access to the primary fragments



Neutronless fission as an access to the primary fragments

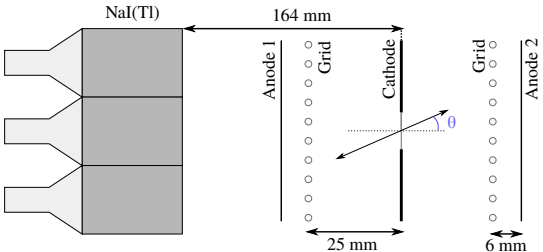
- Neutronless fission give access to the primary fragments.
- Excitation energy and angular momentum are both exhausted by the γ emission.
- Low probability and experimentally challenging [1,2], need for very efficient detection.

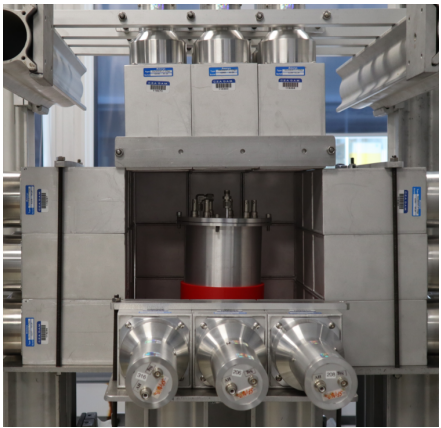
TKE~Q

[1] C. Signarbieux *et al*, J. Physique Lettres **42** (1981)
[2] H.-H. Knitter *et al*, Nucl. Phys. A **536** (1992)

Experimental Setup

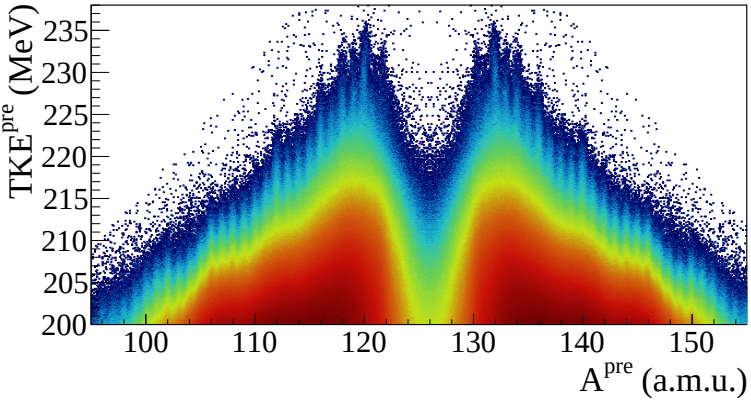
- 54 NaI: Prompt spectrum measurement and isomers identification.
- Twin Frisch-Gridded Ionization Chamber:
  - Fragments identification
    $\overrightarrow{p_L} = \overrightarrow{p_L} \Rightarrow A_L/A_H = E_H/E_L$,
  - excellent intrinsic resolution ($\sim$ 0.3 MeV).





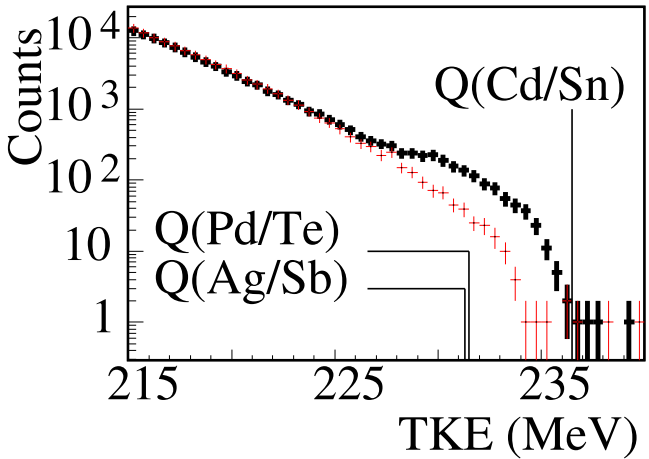
Neutronless fission

- ultra-thin backing (5 $\mu g.cm^{-2}$) allows to see neutronless fission
- Resolved masses (0.7 a.m.u.) for high TKE events: without neutron emission, $\sigma(A) = \sigma(E)$



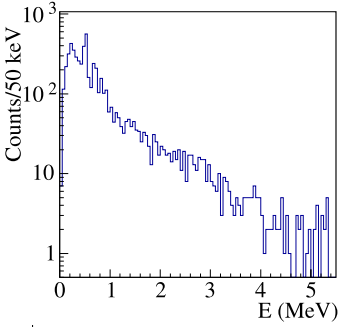
The ^{120}Cd/^{132}Sn fragmentation

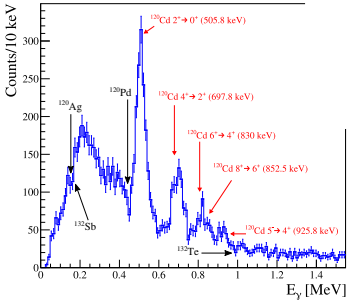
- ^{120}Cd/^{132}Sn fragmentation extracted by TKE selection,



The ^{120}Cd/^{132}Sn fragmentation

- ^{120}Cd/^{132}Sn fragmentation extracted by TKE selection,
- ^{132}Sn observed in its ground state in at least 98% of the Cd/Sn events.





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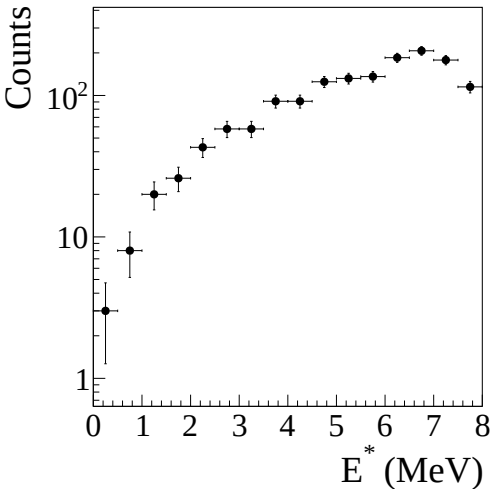
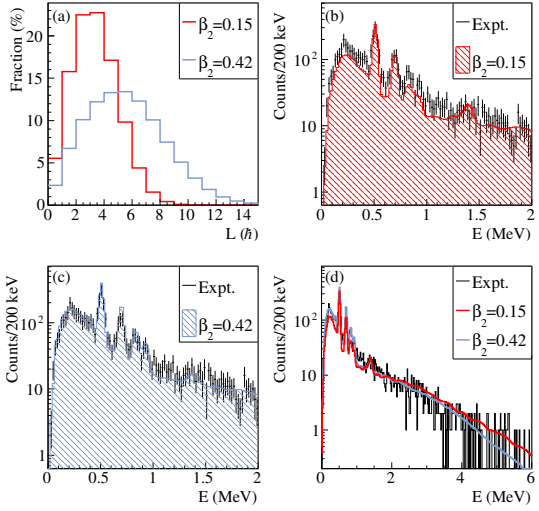
- ^{132}Sn observed in its ground state in at least 98% of the Cd/Sn events.
- **Measurement of ^{120}Cd excitation energy distribution.**



Angular momentum of ^{120}Cd

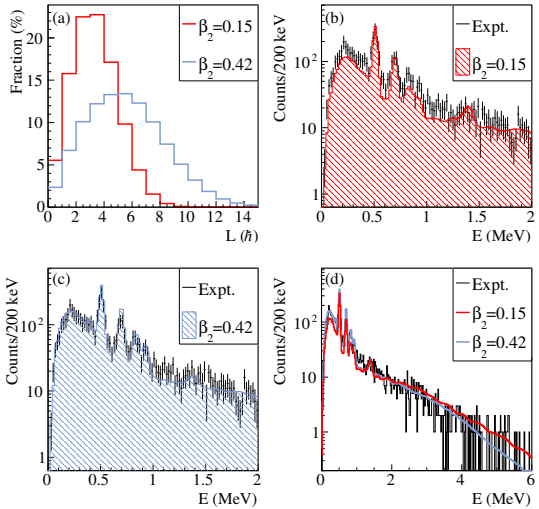
- Angular momentum is the most constraining observable to reproduce the experimental spectrum:
  - AM generated from collective quantum DoF and its dynamics [3] (**cf J. Randrup talk**),



[3] G. Scamps *et al*, Phys. Rev. C **108**, 034616 (2023)

Angular momentum of ^{120}Cd

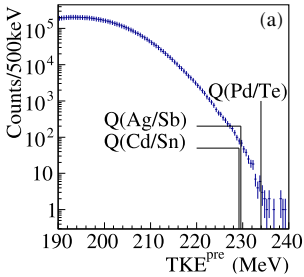
- Angular momentum is the most constraining observable to reproduce the experimental spectrum:
  - AM generated from collective quantum DoF and its dynamics [3] (**cf J. Randrup talk**),
  - Constrains the scission deformation of ^{120}Cd ($\beta_2 \sim 0.4$) [4].

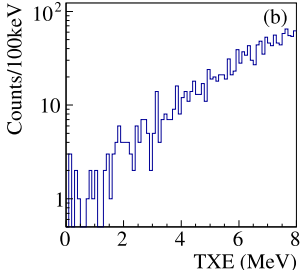


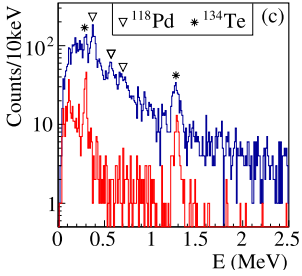
[3] G. Scamps *et al*, Phys. Rev. C **108**, 034616 (2023)
[4] A. Francheteau *et al*, Phys. Rev. Letters **132**, 142501 (2024)

^{118}Pd/^{134}Te fragmentation

- Pd/Te identified in the same way,
- **Both** fragments seen in their excited states,
- delayed cascade of the 6^+ isomer of ^{134}Te is observed.
- Sharing of the TXE based on a genetic algorithm.





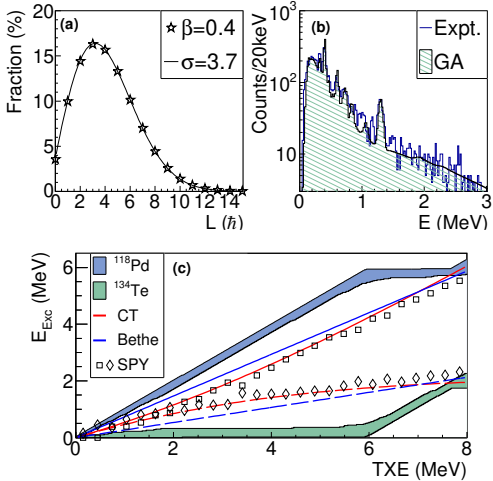


^{118}Pd/^{134}Te neutronless fragmentation

Excitatio0n energy repartition

- AM constrained by G. Scamps calculations.
- Compared with sharing with different models of nuclear level densities,
- The present work validates the current understanding of the EE sharing.

(Submitted to Phys. Rev. Letters.)



Summary

- First study of the γ-spectra in cold fission.
- $^{120}\mathrm{Cd}/^{132}\mathrm{Sn}$ (published in PRL):
  - $^{132}\mathrm{Sn}$ measured in its ground state,
  - Determination of its angular momentum distribution using the orientation-pumping mechanism,
  - Constrain the scission deformation of $^{120}\mathrm{Cd}$, different from its ground state.
- $^{118}\mathrm{Pd}/^{134}\mathrm{Te}$ (submitted to PRL):
  - First determination of the energy repartition with a genetic algorithm,
  - All approaches reproduce the global trend, regardless of the hypothesis.

Collaborators

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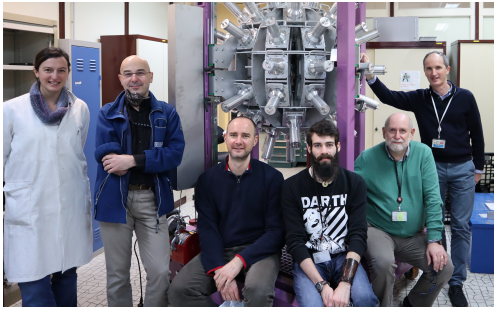

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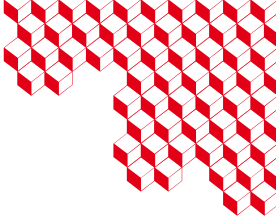
Guillaume Scamps



Thank you for your attention

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