DE LA RECHERCHE À L'INDUSTRIE

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R247 - Fission physics and observables: Prompt fission neutron emission

Ambassadeur room - Wednesday 14/06/2016

New Prompt Fission Neutron Spectra measurements in ^{238}U(n,f) reaction with a dedicated setup at LANSCE/WNR

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[2] *LPC Caen, ENSICAEN, Université de Caen, CNRS/IN2P3, Caen, France,*
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Motivations: Prompt fission neutron energy spectra (PFNS)

- Important role in many applications
  - understanding of the fission process
  - accuracy of nuclear criticality calculations (conventional and advanced reactors, non-proliferation applications)
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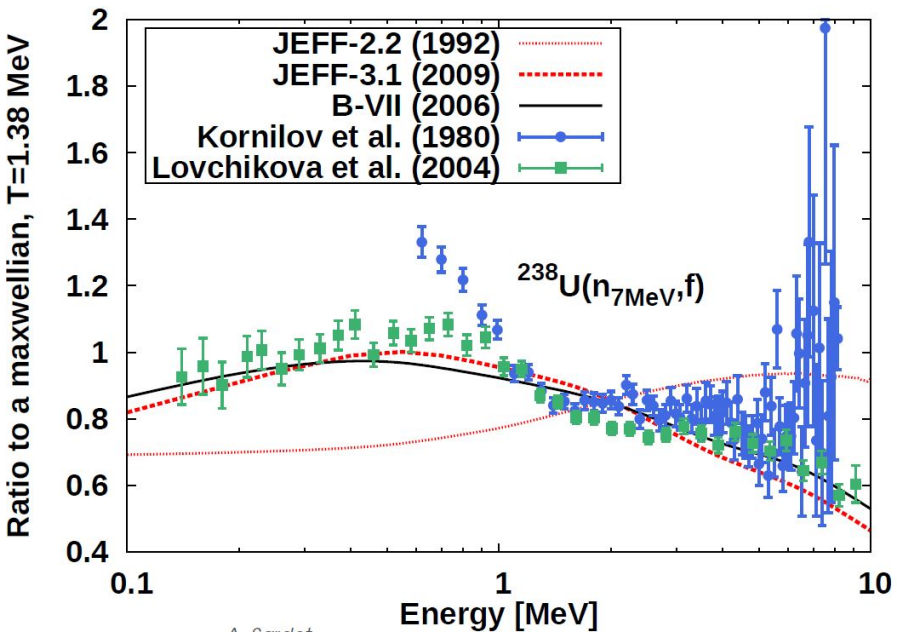

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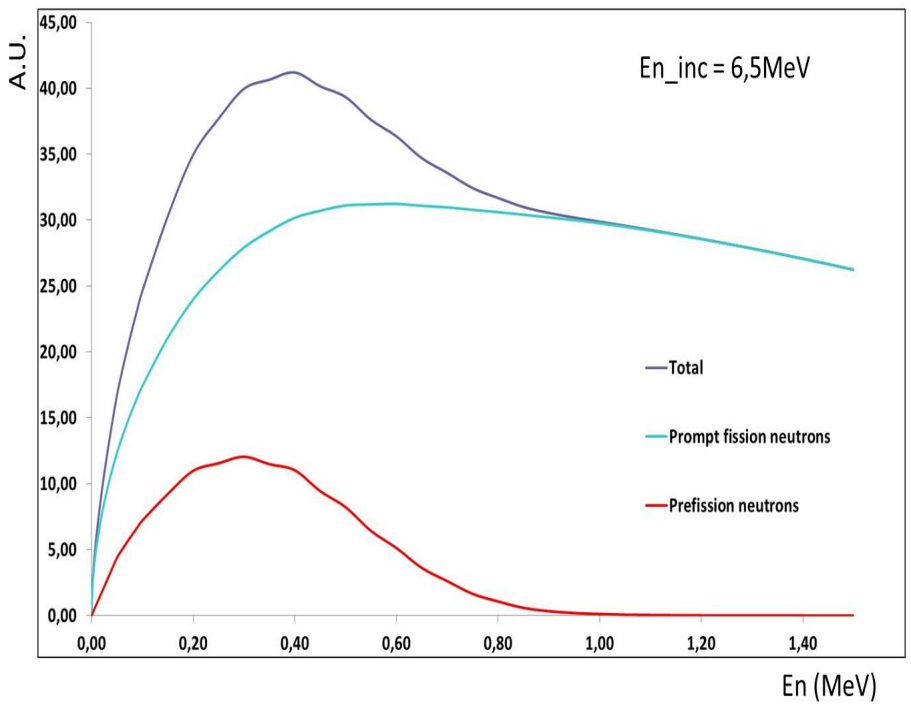
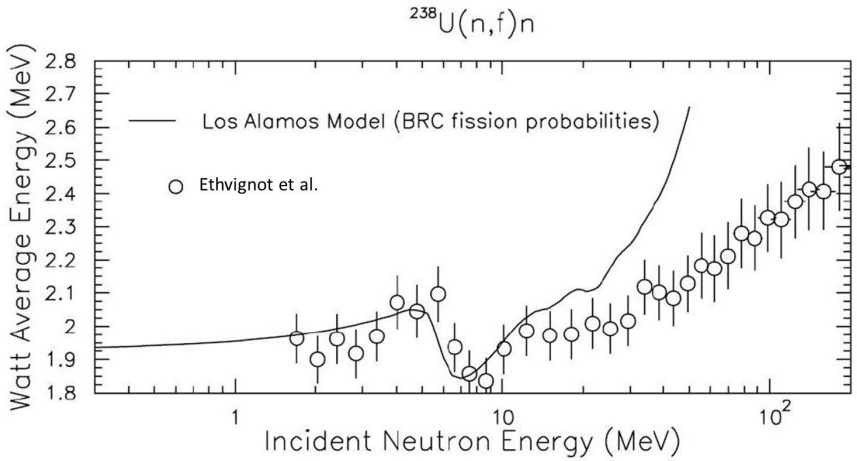
- Constraint on compound emission (pre-fission neutron) and partial fission probabilities





PFNS measurements at CEA, DAM, DIF

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- Forthcoming experiments already planned

Experimental principle

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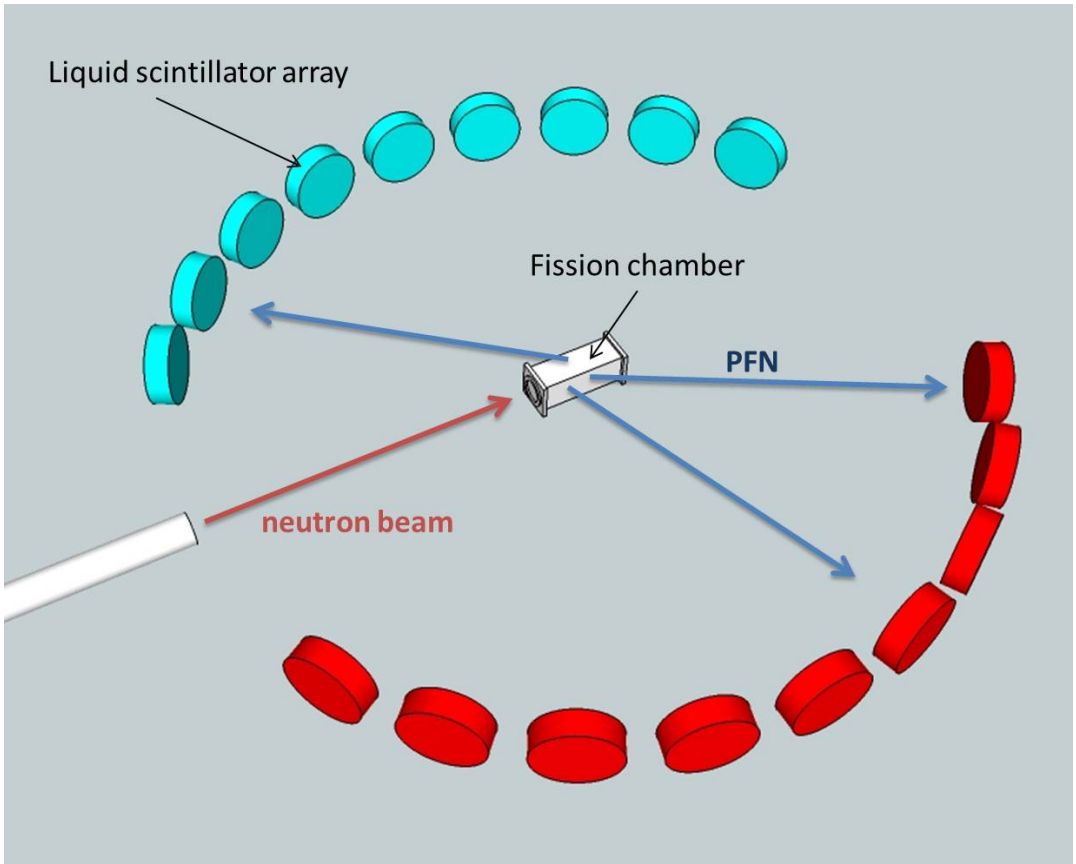

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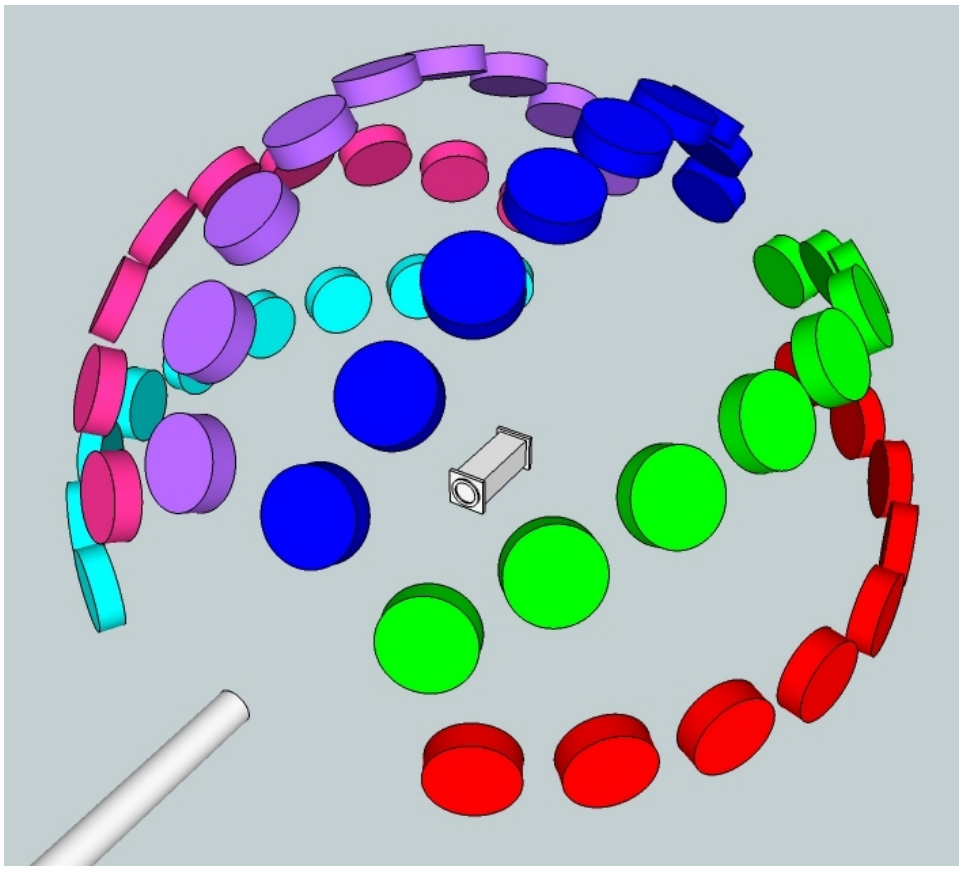

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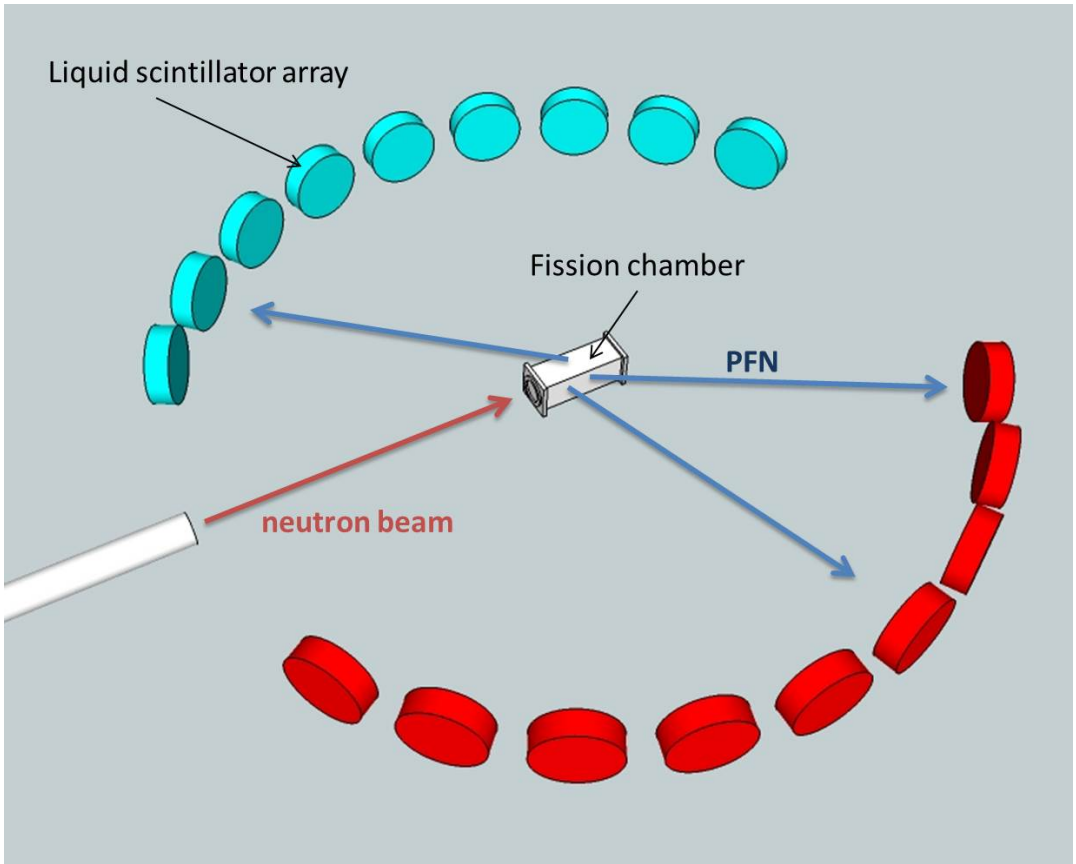

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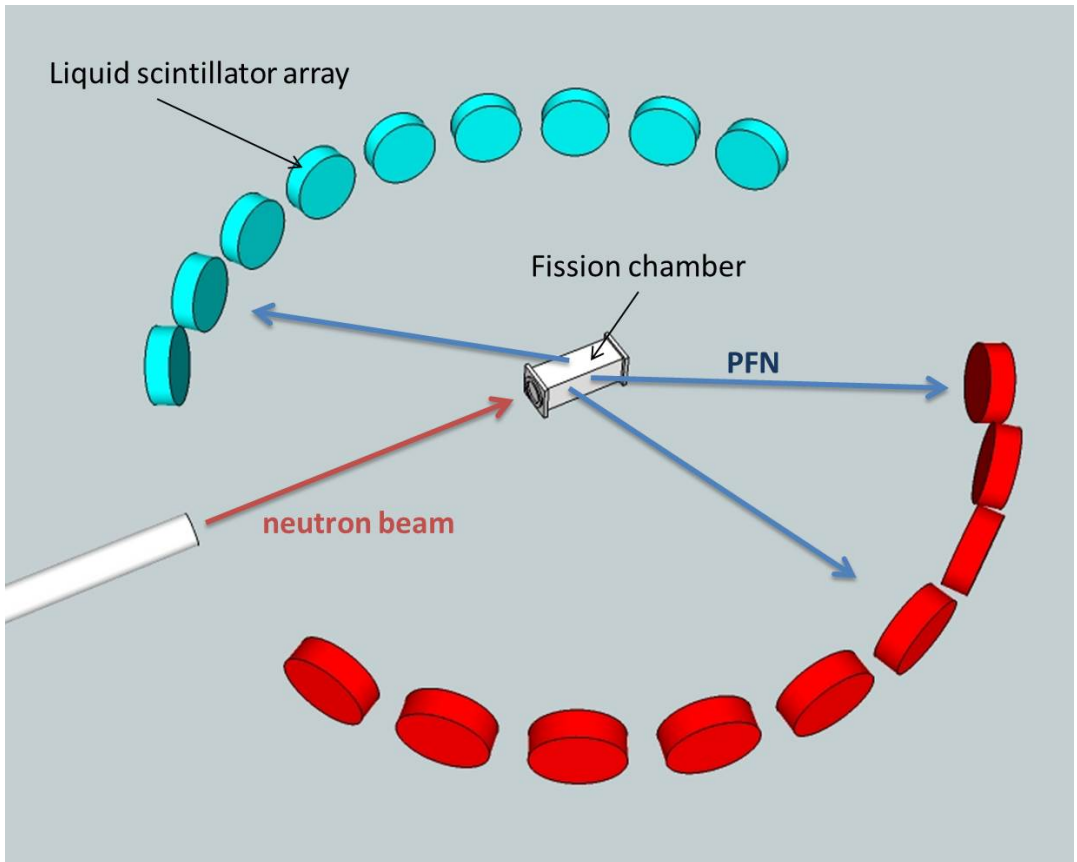
- Energy spectra calculated from time-of-flight measurements



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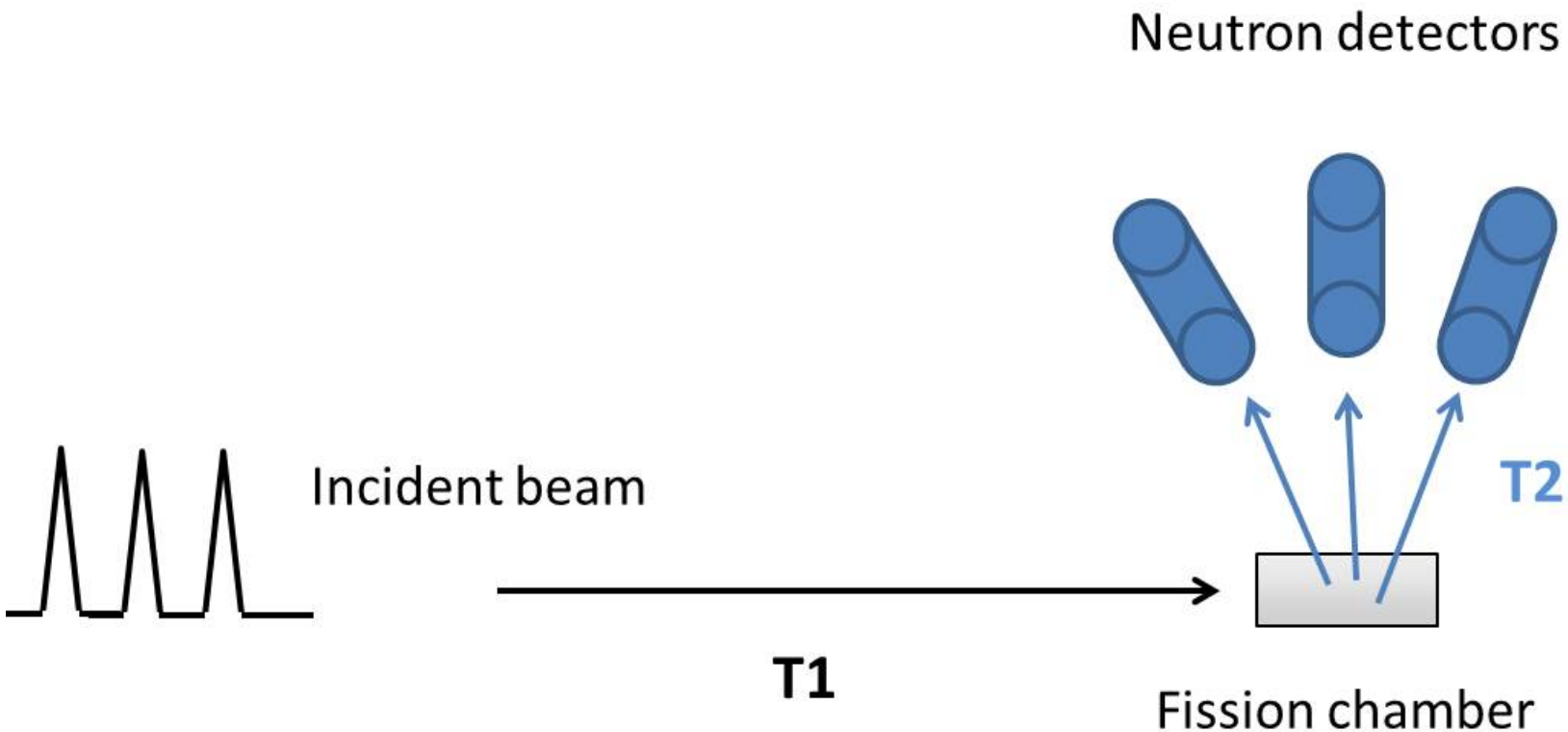

Double ToF method

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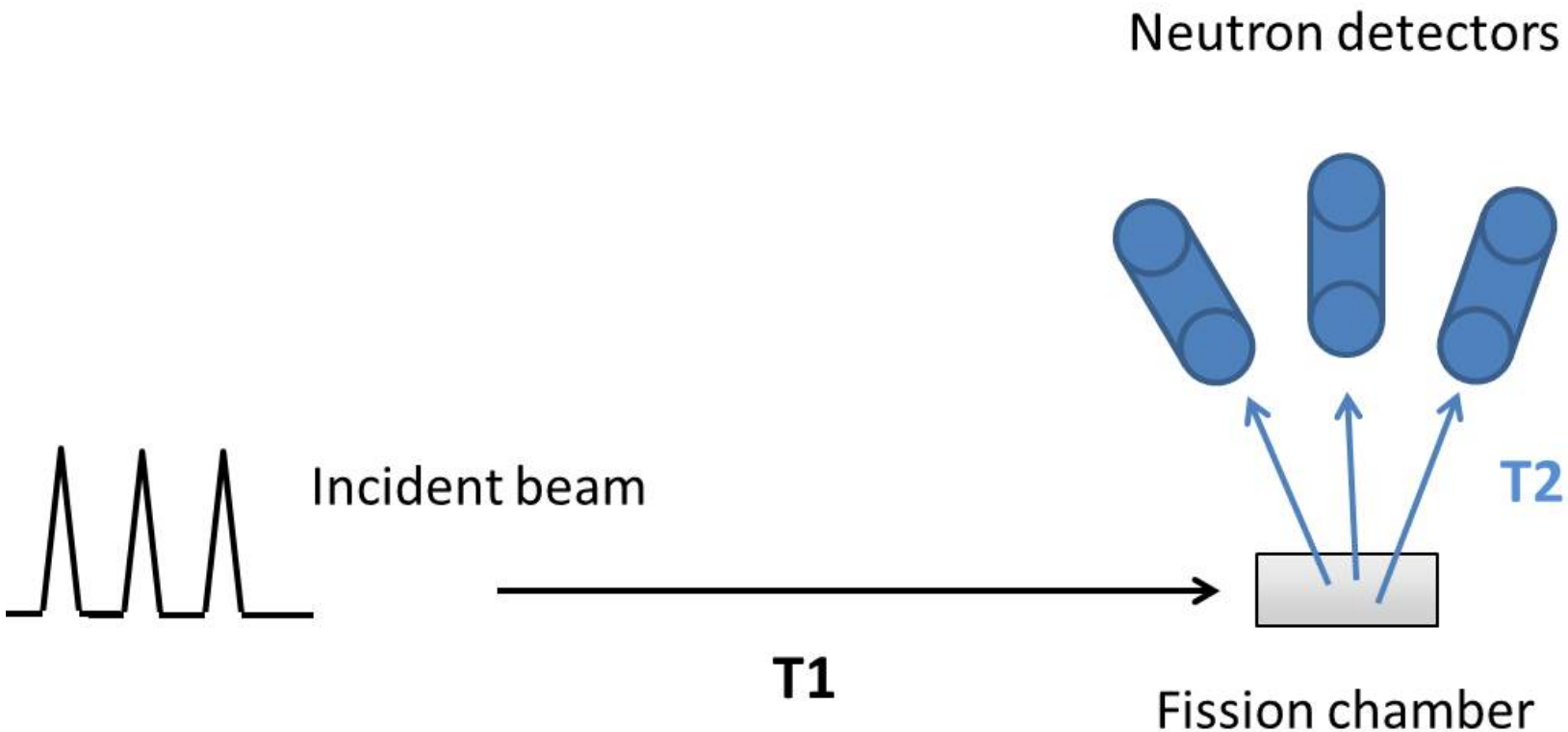
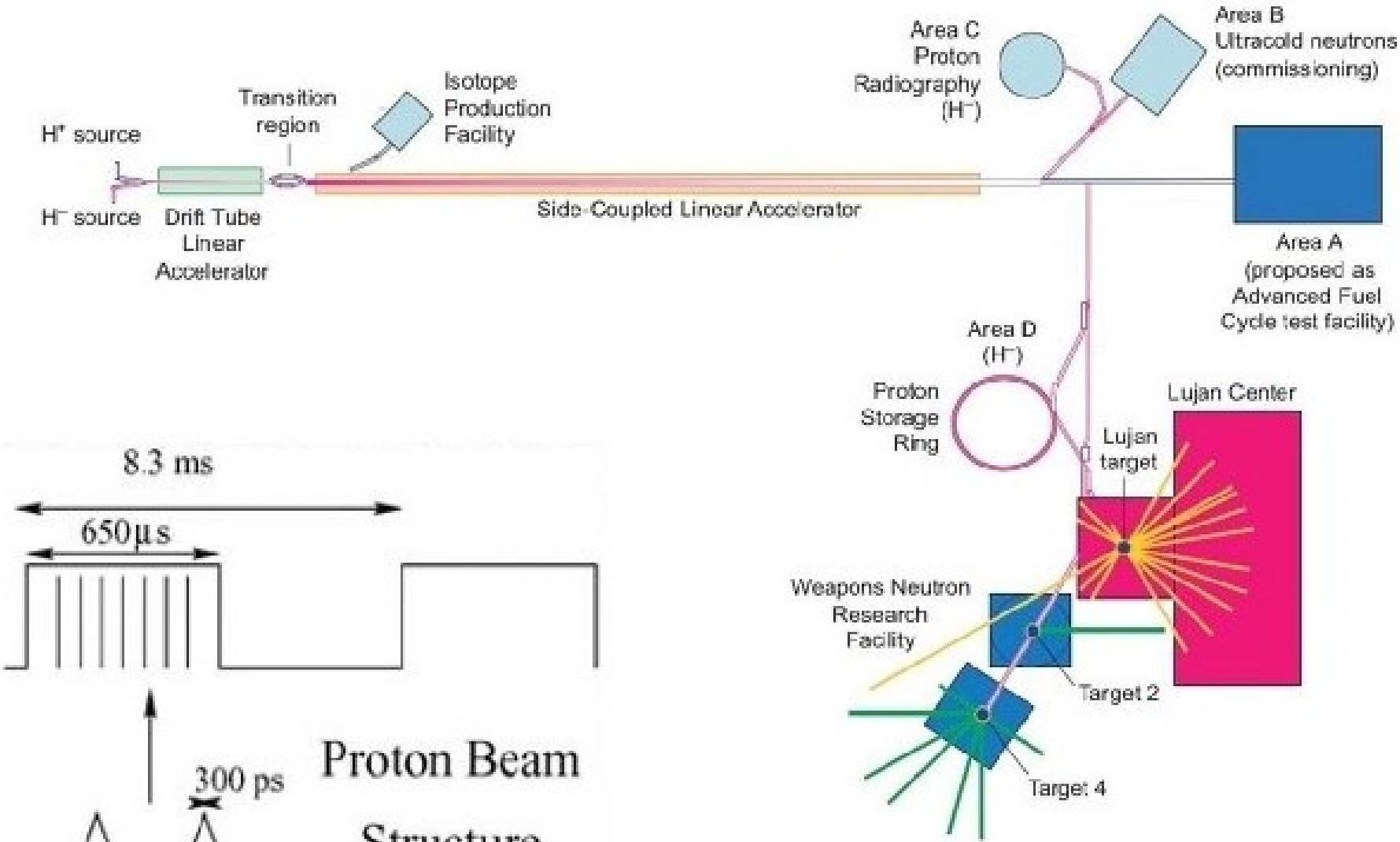
  - T2 : prompt neutron energy (fission event $\leftrightarrow$ n detector, flight path $\approx$ 1 m)



Facility: WNR@LANSCE and setup



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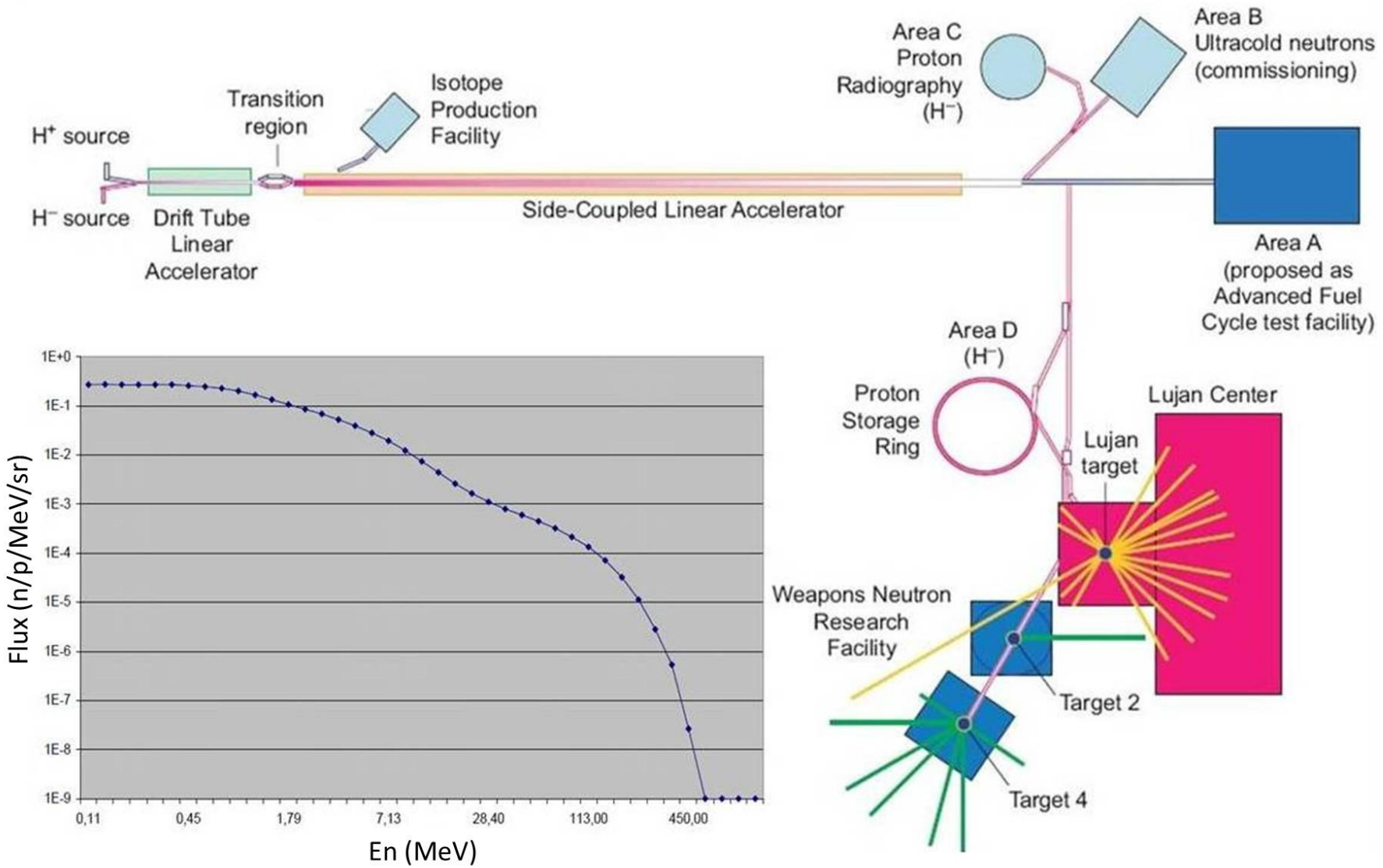

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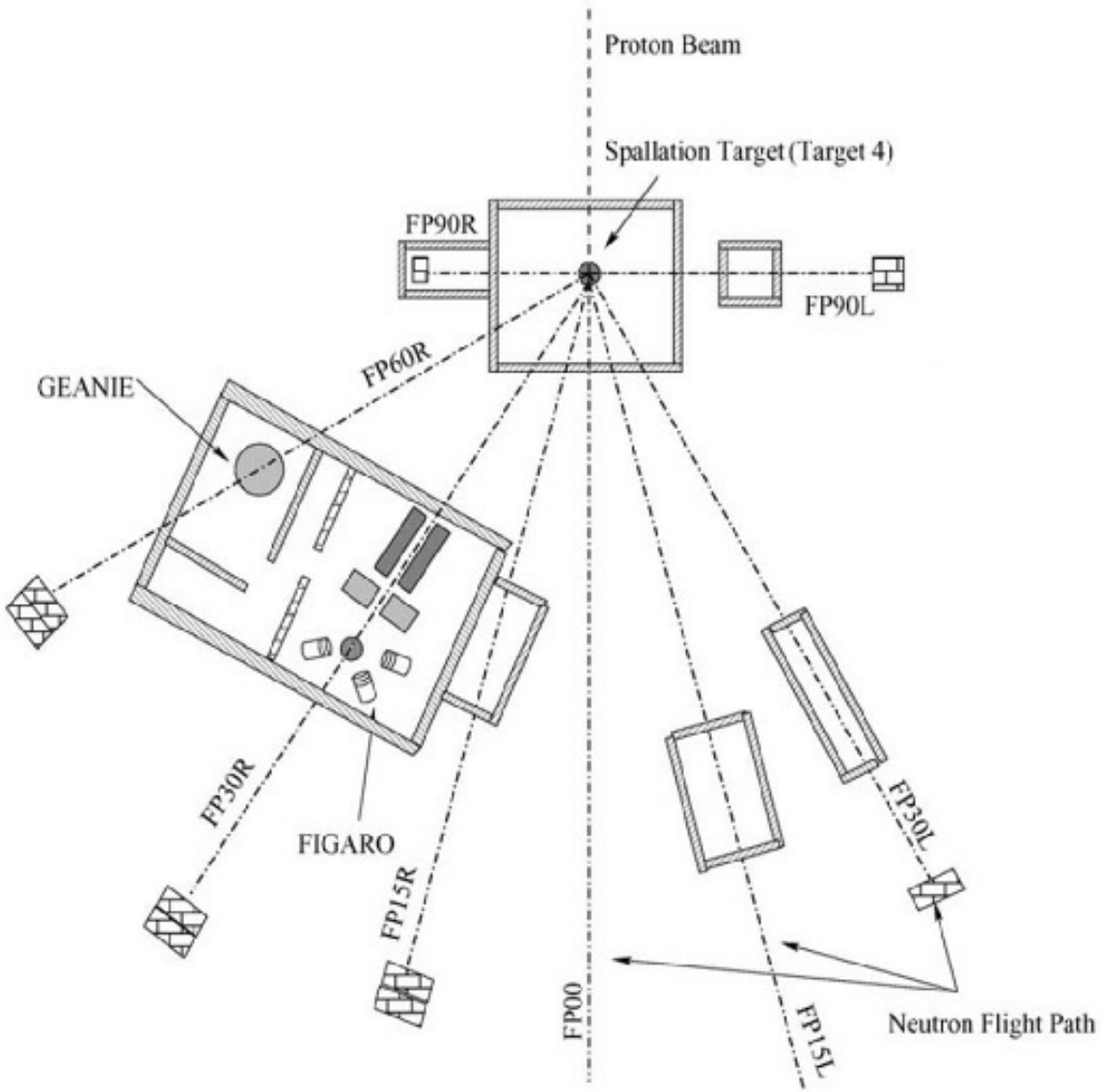

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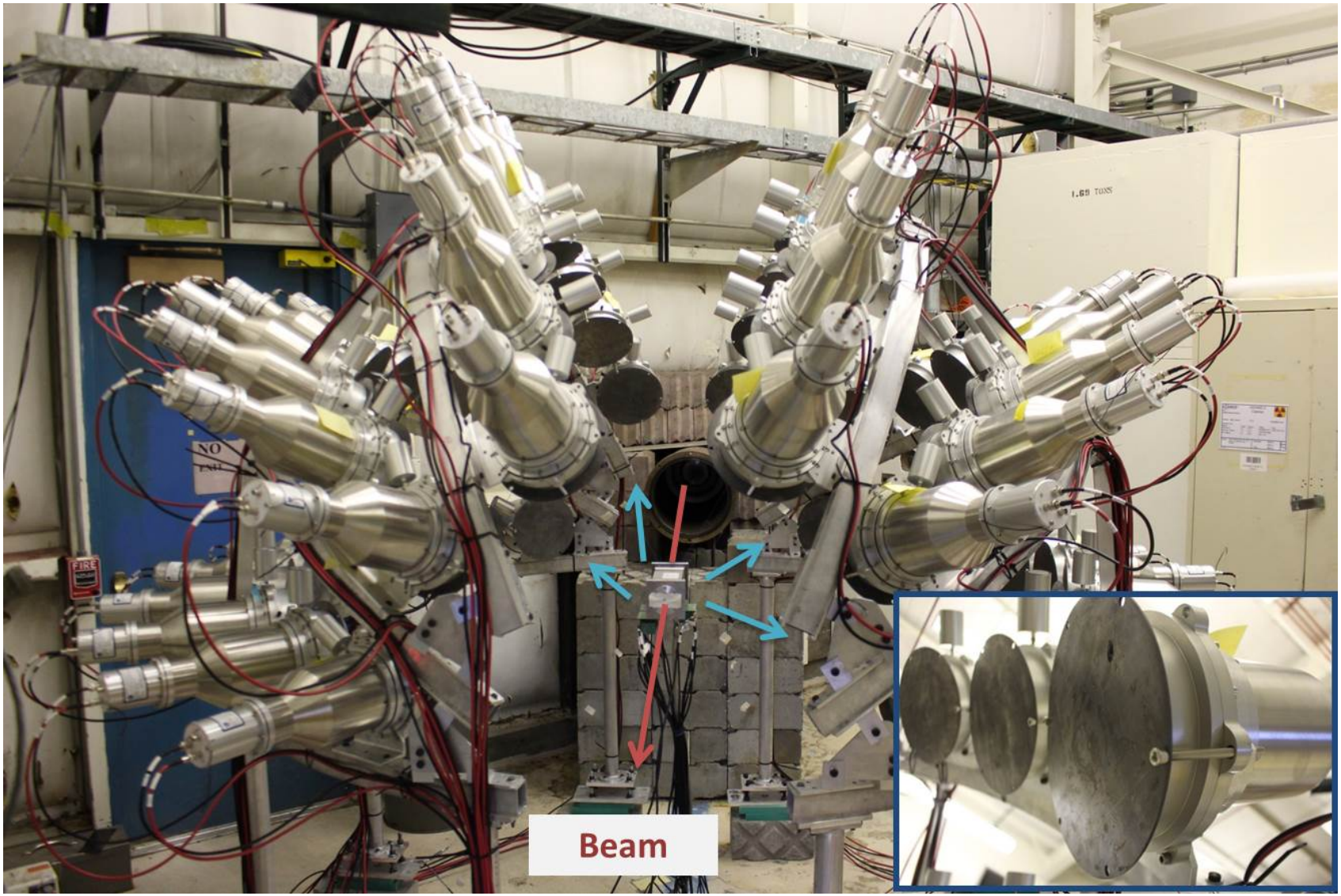
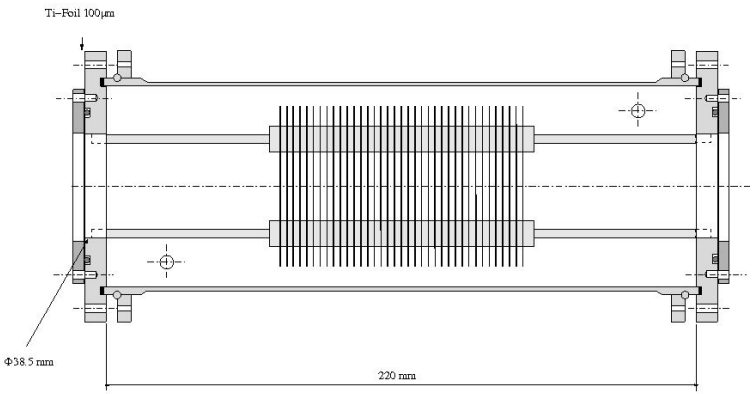


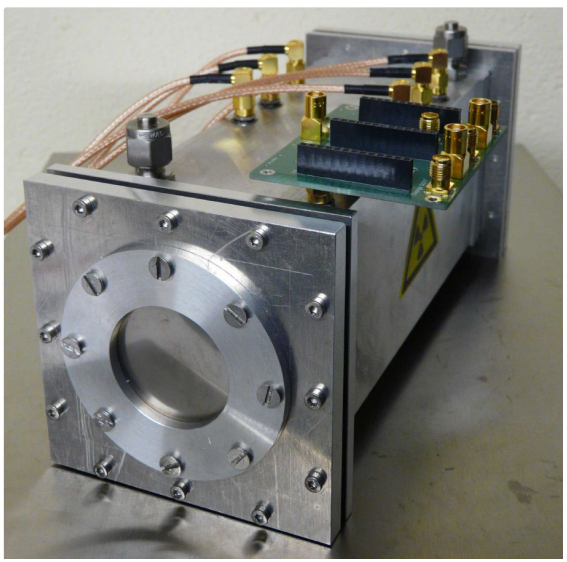
New experimental tools: Fission chambers

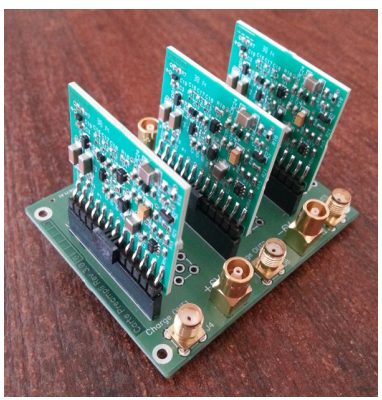
- Two identical multi-plates fission chambers ⋆ *J. Taieb et al., NIMA 833, 1 (2016)* ⋆
  - ^{238}U: 72 deposits on 37 anodes + cathodes (5 mg each, 360 mg total)
  - ^{252}Cf: 1 very thin deposit (65 kBq): neutron detection efficiency and scattering

- Good timing resolution: ≈ 700 ps
  - CF_4 gas in circulation (fast gas)
  - Dedicated PA

- Distortion and scattering minimization
  - 1.5 mm aluminium housing
  - 100 µm Ti windows and 50 µm Ti backing

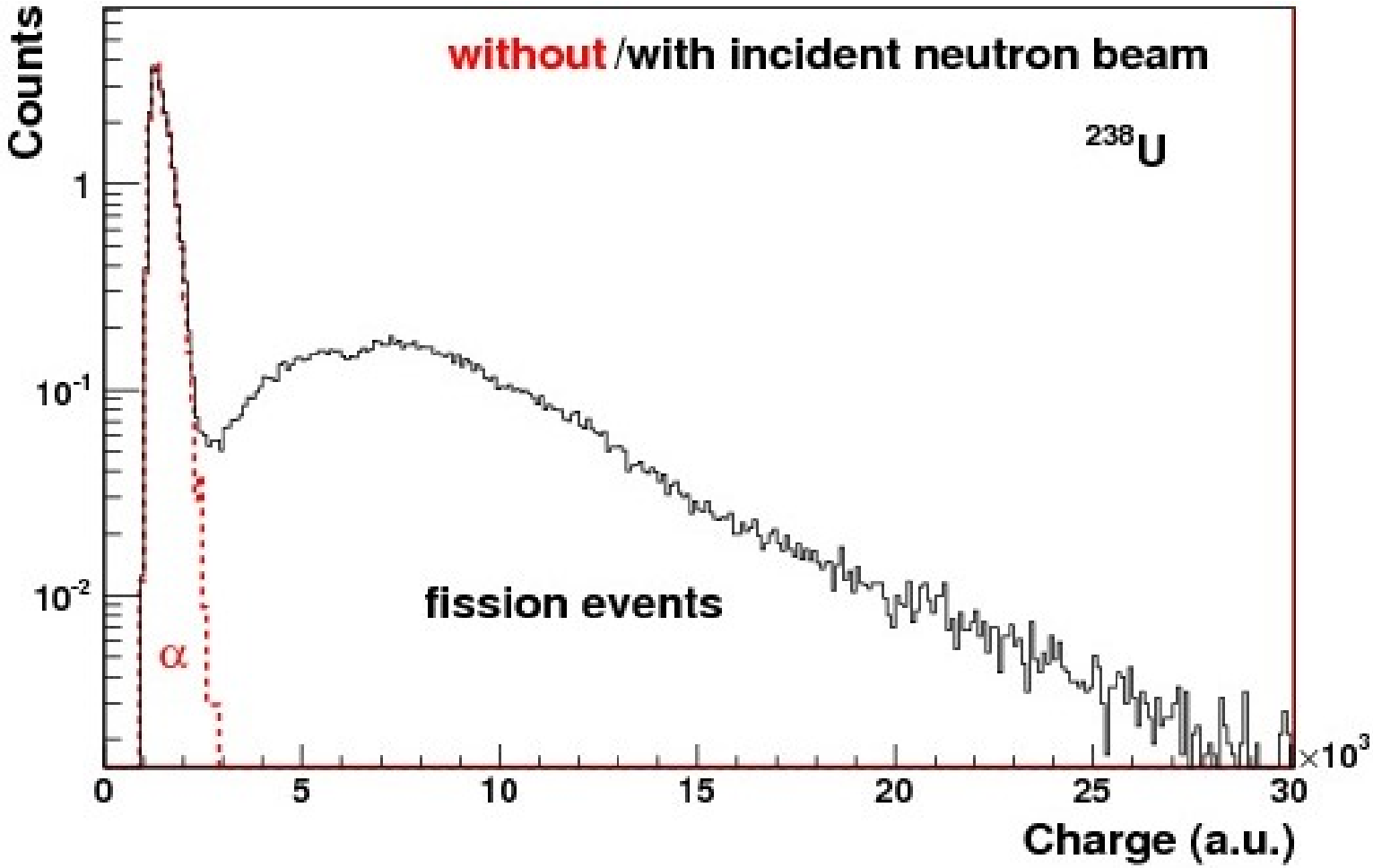






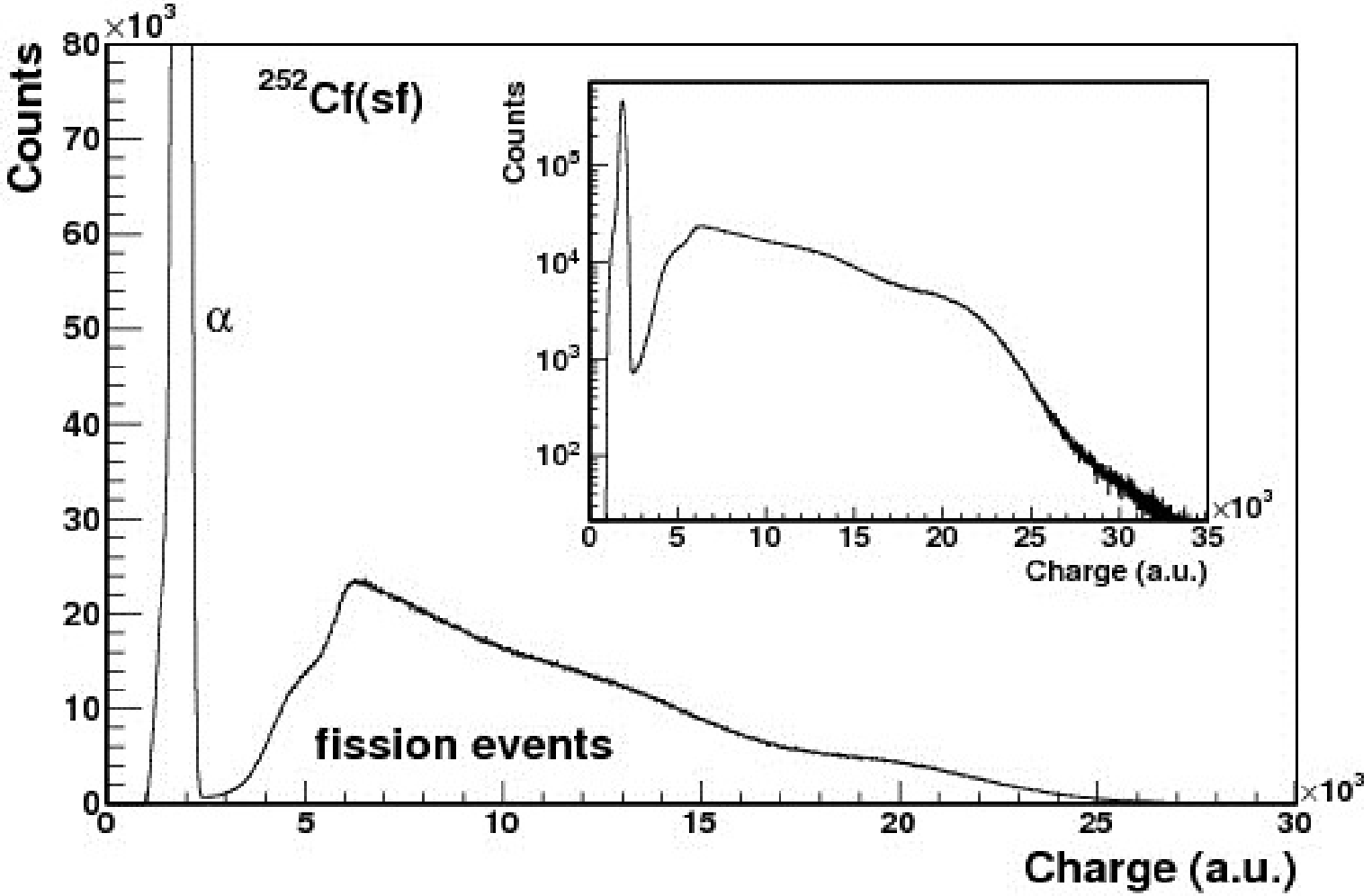
Alpha-fission discrimination: ^{238}U

- $>$100 f/s, overlap represents $\approx$ 3% of fission events



Alpha-fission discrimination: ^{252}Cf

- 65 kBq ^{252}Cf(sf), good calibration statistics in 24h



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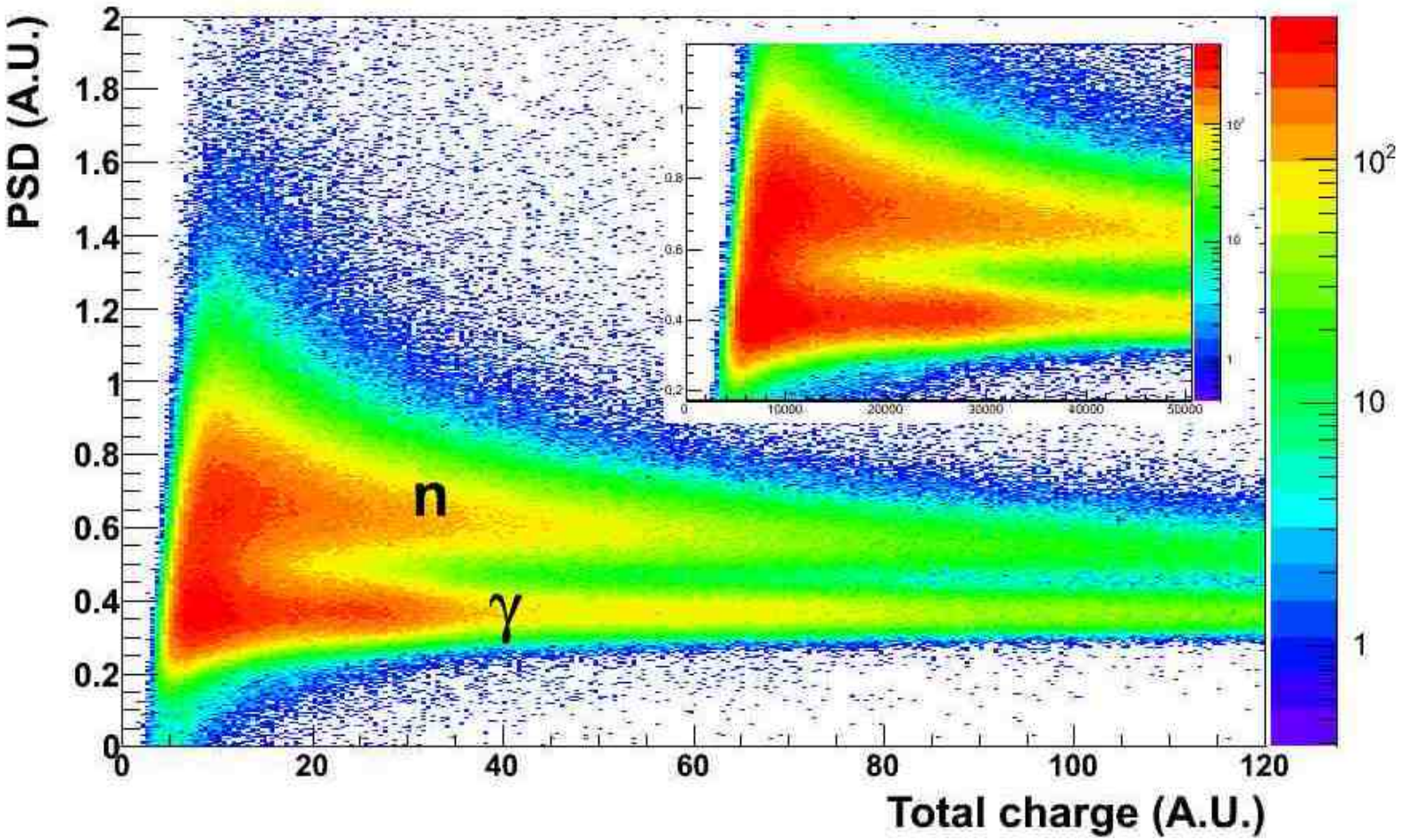

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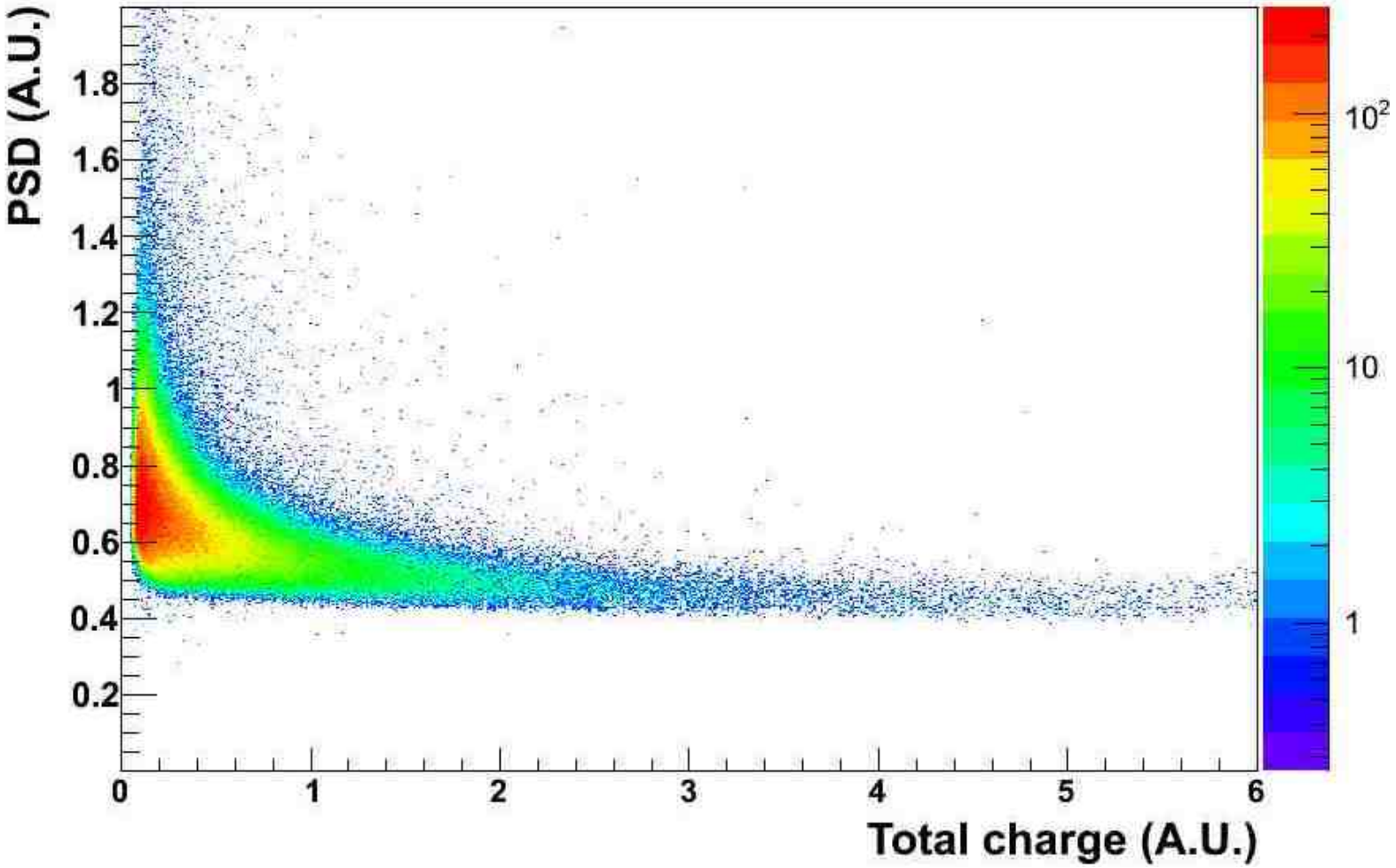
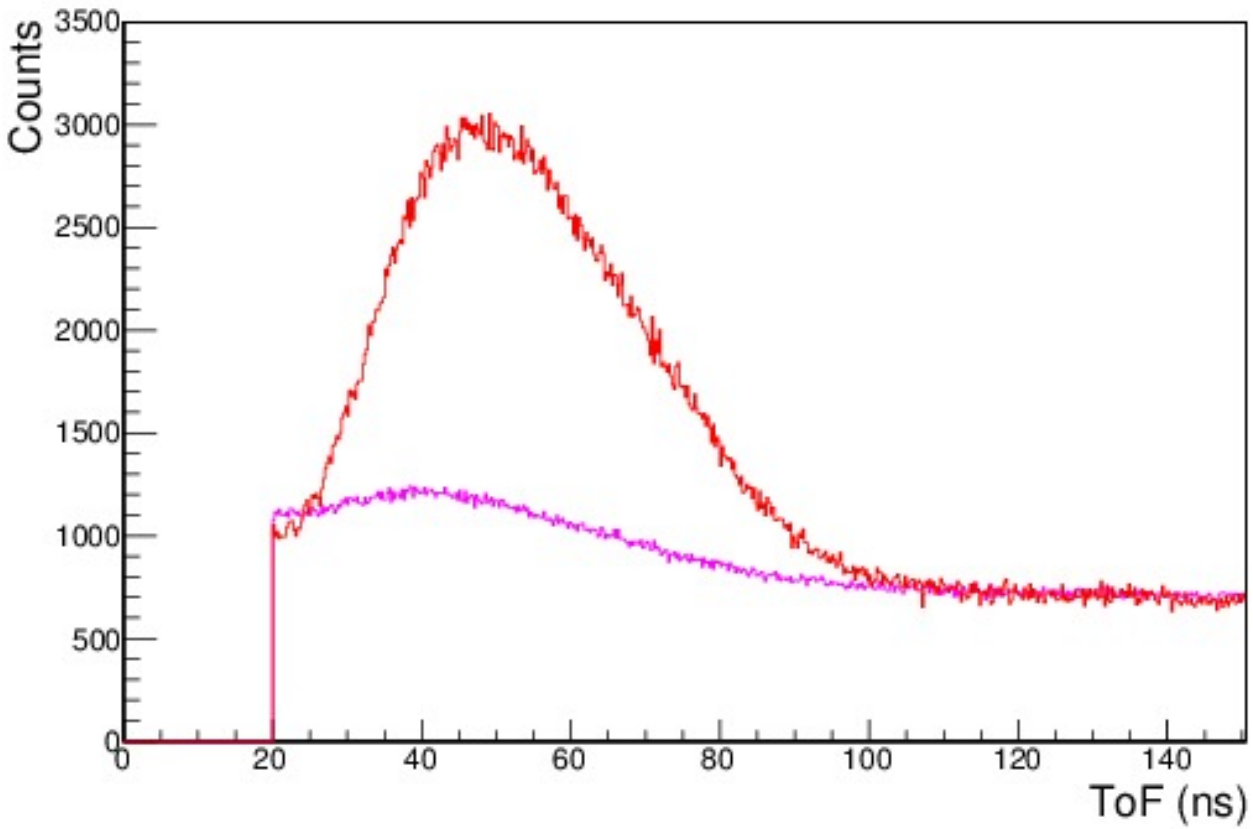


Data analysis

- Fission-neutron ToF
- Background subtraction: beam scattering and PFN scattering



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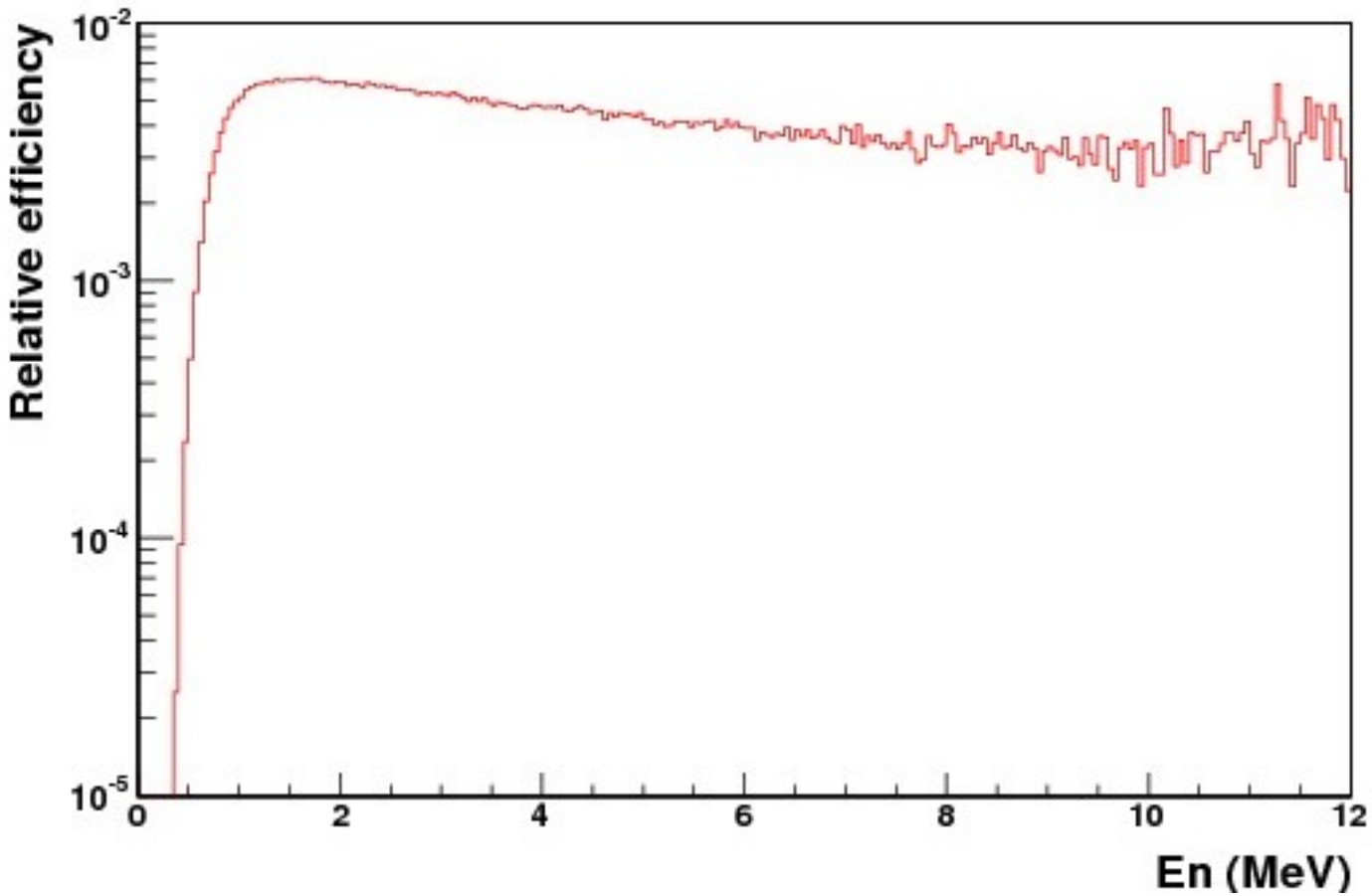
- Efficiency corrections from ^{252}Cf(sf) measurement in the same conditions



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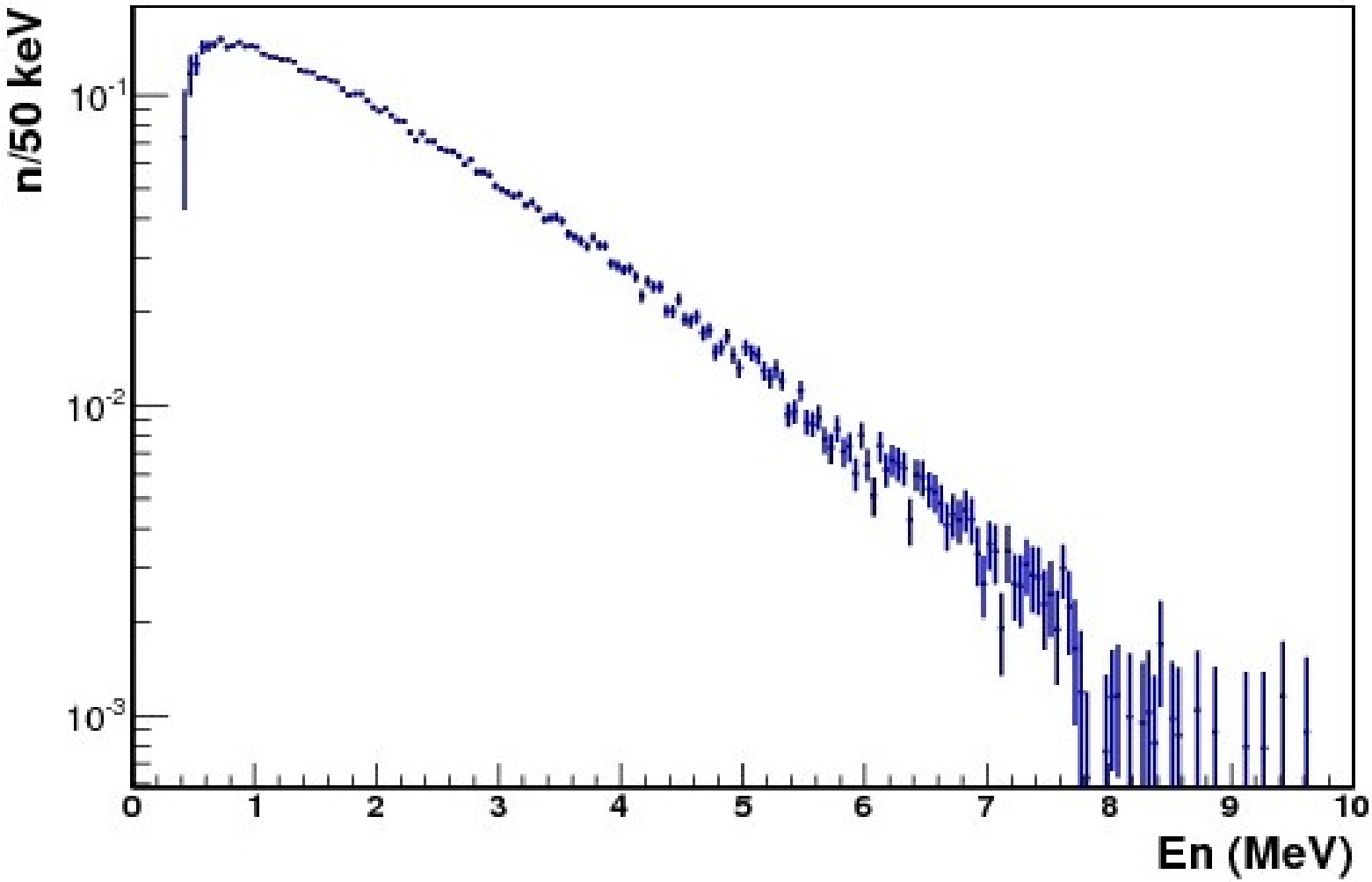

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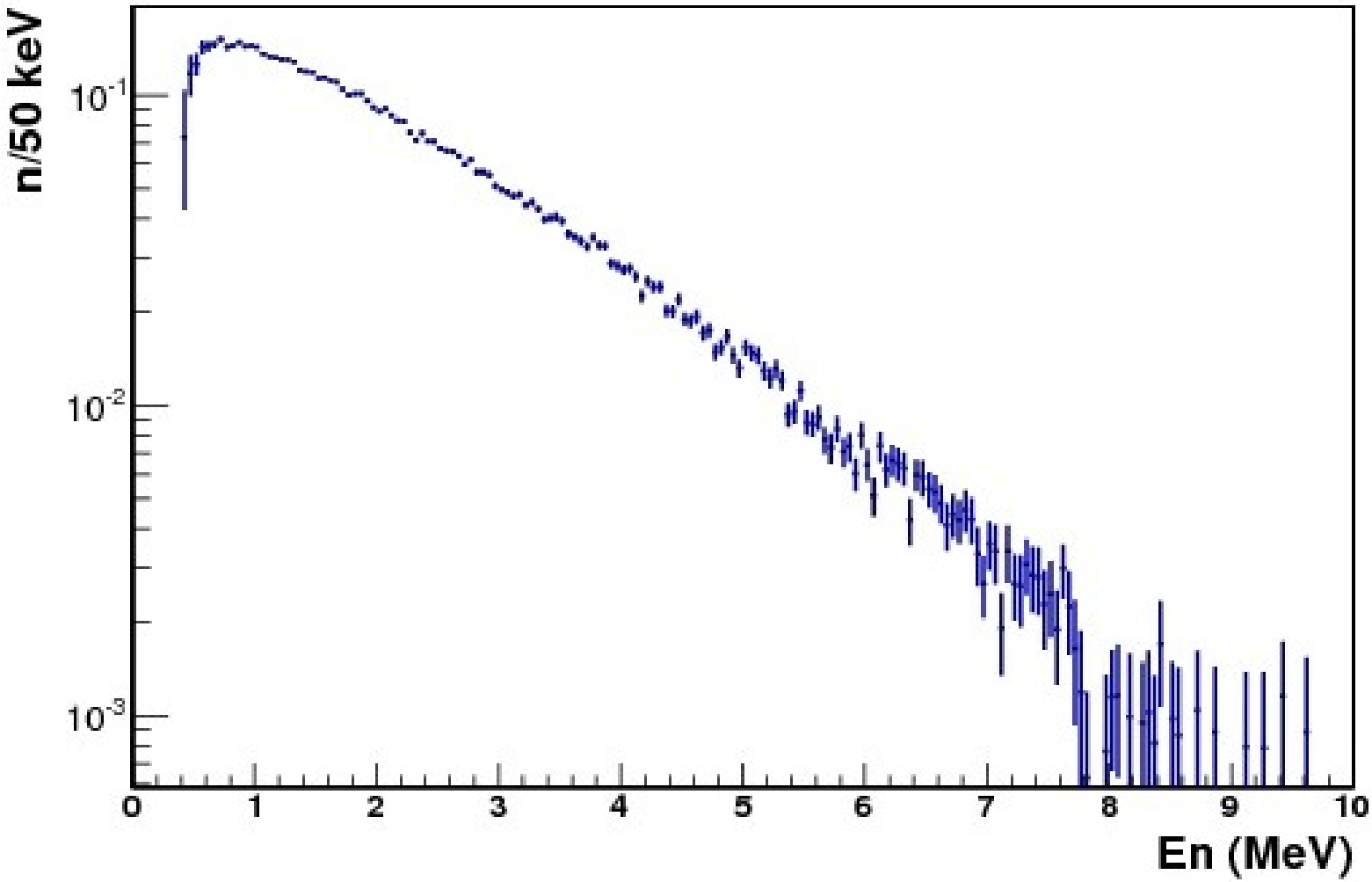

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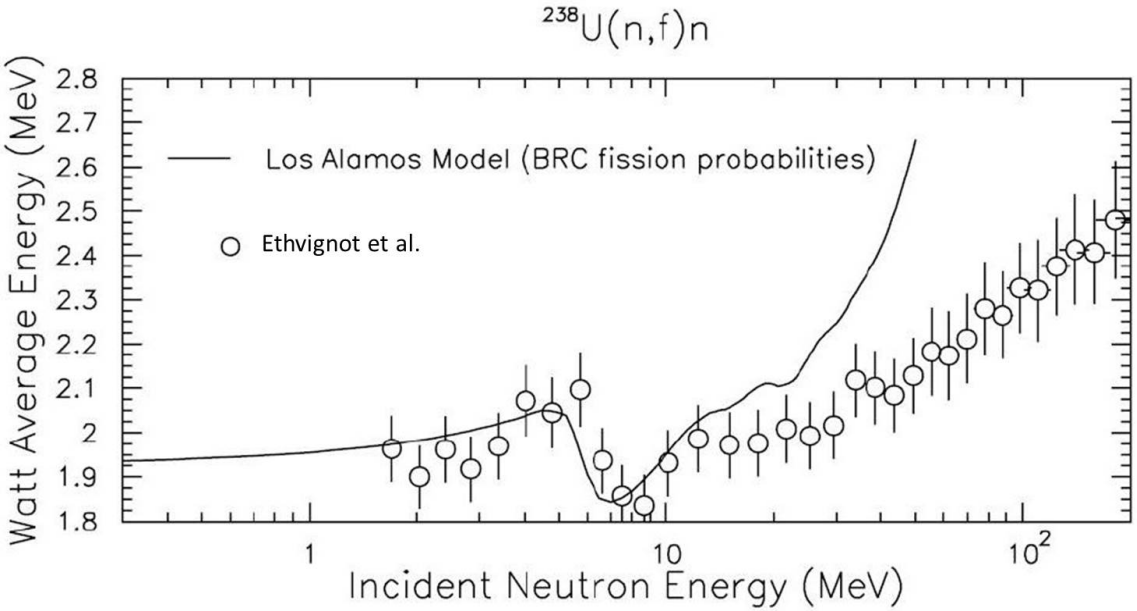

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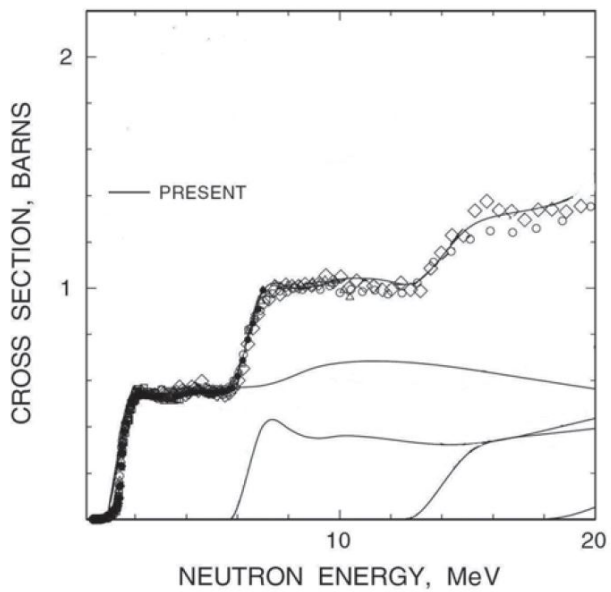
  - scan the opening of the chance of fission

    ⇒ accepted experiment at the new Spiral2/NFS facility: En_{inc}=6.5 MeV



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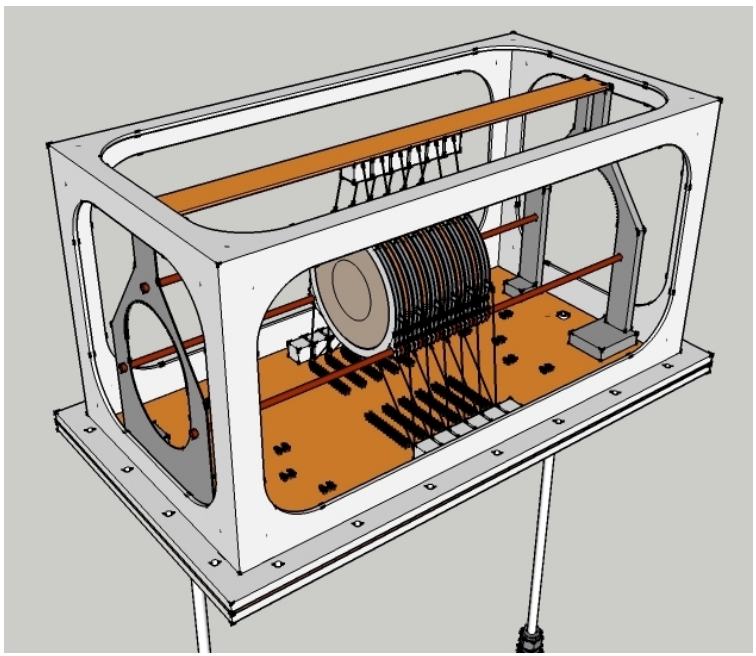

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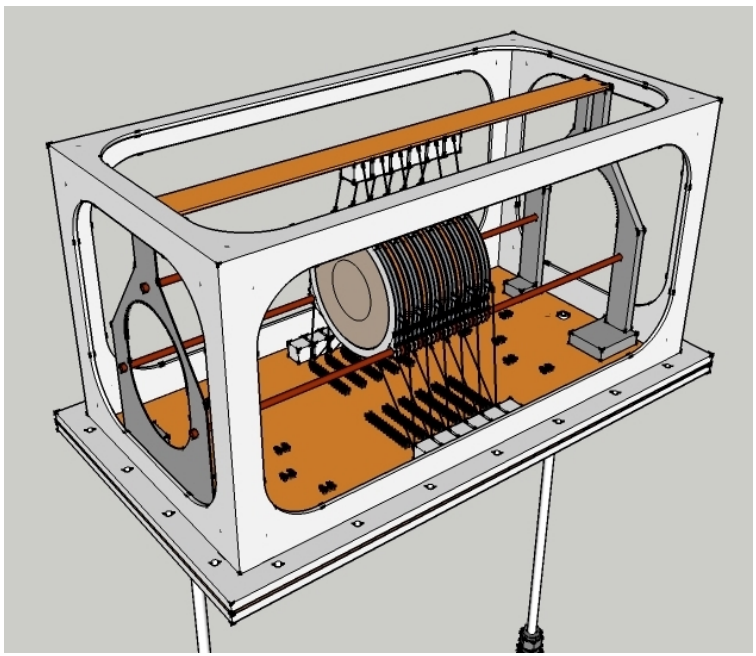

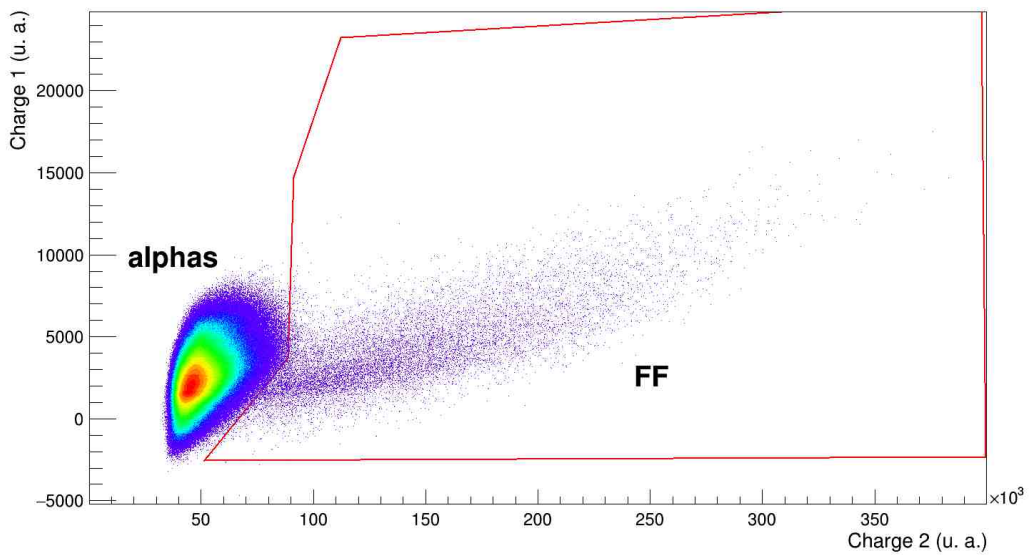

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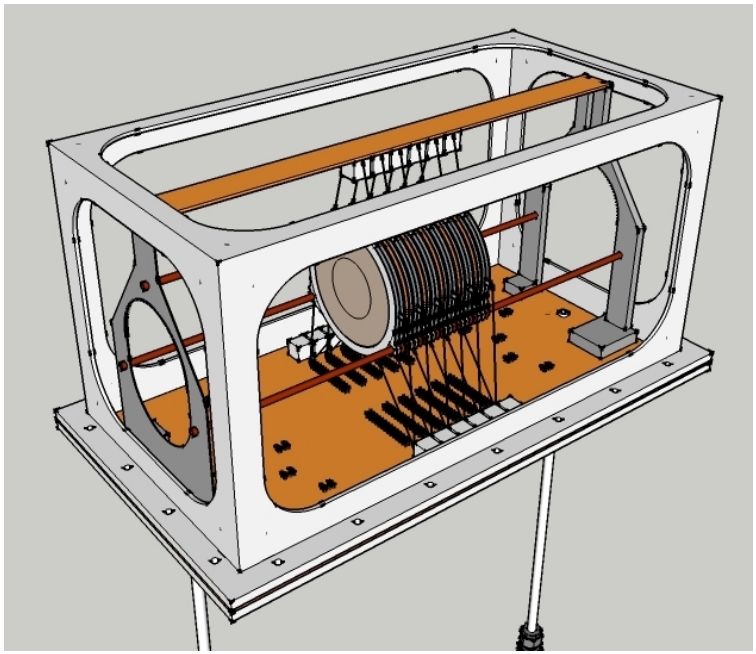

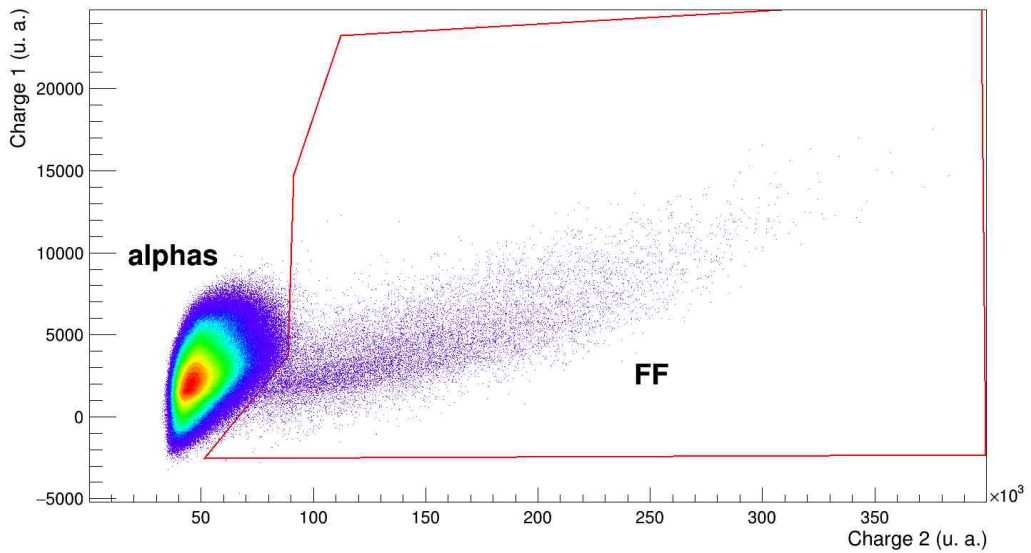

Thank you !

⋆ *benoit.laurent@cea.fr* ⋆