
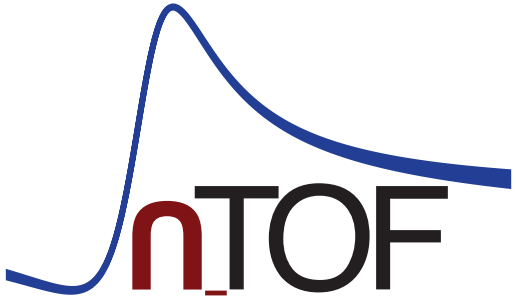

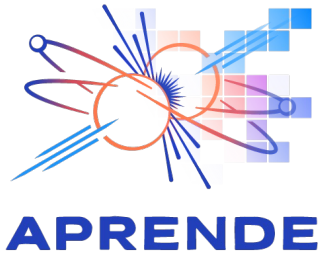

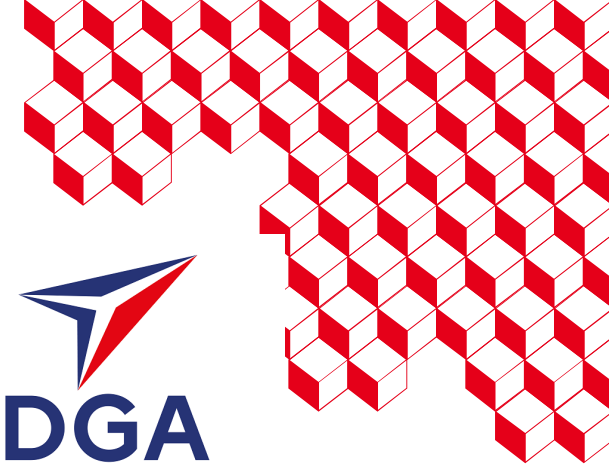

Measurement of the ^{241}Pu capture and fission cross sections (WP1.4)

CEA – E. Berthoumieux, A. Cahuzac, E. Dupont, F. Gunsing, M. Spelta (DRF),
D. Bernard, G. Noguère, O. Serot (DES), J. Aupiais, G. Bélier, J. Taïeb (DAM)

JRC-Geel – G. Alaerts, Y. Aregbe, E. Dhaene, J. Heyse, C. Paradela,
A. Plompen, P. Schillebeeckx, G. Sibbens, D. Vanleeuw, R. Wynants,

and the n_TOF Collaboration

Motivations and challenges

- Why ^{241}Pu cross sections
  - Fissile isotope produced in nuclear reactors
  - Impact on the loss of reactivity with burnup
  - Only one available capture xs measurement (Weston and Todd, NSE 65, 454-463, 1978)
  - Priority requests to improve both ^{241}Pu capture and fission xs (HPRL)
- Challenges
  1. Production & characterization of ^{241}Pu samples (β-decay to ^{241}Am, $T_{1/2}$ ~14 years)
  2. Development of compact fission tagging detectors for high counting rates
  3. Double-check measurements at n_TOF@CERN (EAR1, EAR2) and GELINA@JRC-Geel (within a few months, i.e., before ^{241}Am buildup becomes an issue)

Scientific objectives

- New accurate data to improve the evaluation of ^{241}Pu
  - Capture-to-fission cross section (α-ratio) up to 100-200 eV
  - Fission cross section from thermal up to ~1 MeV
  - Spectra and multiplicity of prompt gamma from fission and capture reactions
- Support to evaluators for using the new data in their evaluation work
- Outcome
  - Publications
  - Data in EXFOR (part of PEPR SCIAM deliverable “WP1 2029”)
  - Evaluation updates

  + PhD training

Collaborations and resources

- The n_TOF Collaboration for beam time and access to CERN resources
- EURO-LABS for Trans-National Access to CERN
- CEA-JRC Collaboration agreement (2023-2026) for high-level support
- EUFRAT (2025-2026) for samples, beam time and support from JRC-Geel
- NEEDS/NACRE (2020-2024, 30k€) for the development of fission chambers at CEA (DRF, DAM)
- DGA for funding the PhD of A. Cahuzac (2023-2027)
- APRENDE (2024-2028, 70k€), Université Paris-Saclay (2026, 30k€) and DES SINET (2027, 30k€) for co-funding the post-doc of M. Spelta (2026-2028)
- PEPR Science amont pour le nucléaire de fission (2026-2030, 45k€) for M&O, missions, samples…

=> Many… but important for (inter)national visibility, coordination, networking, support, co-funding…

Status

- ^{241}Pu samples
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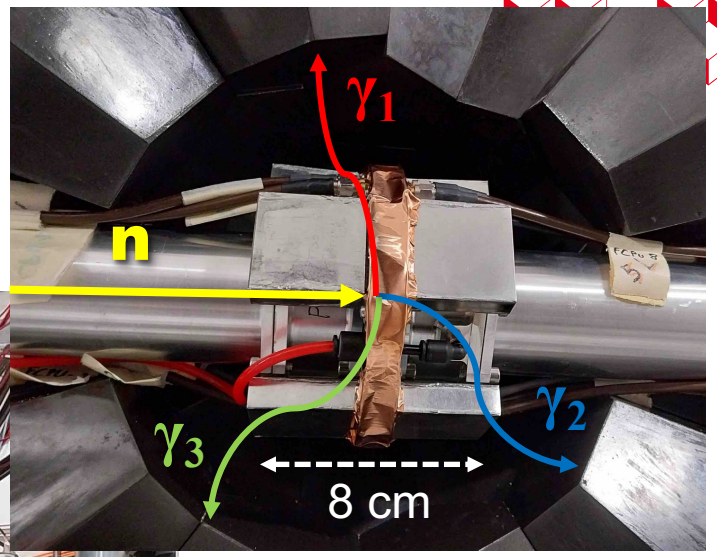
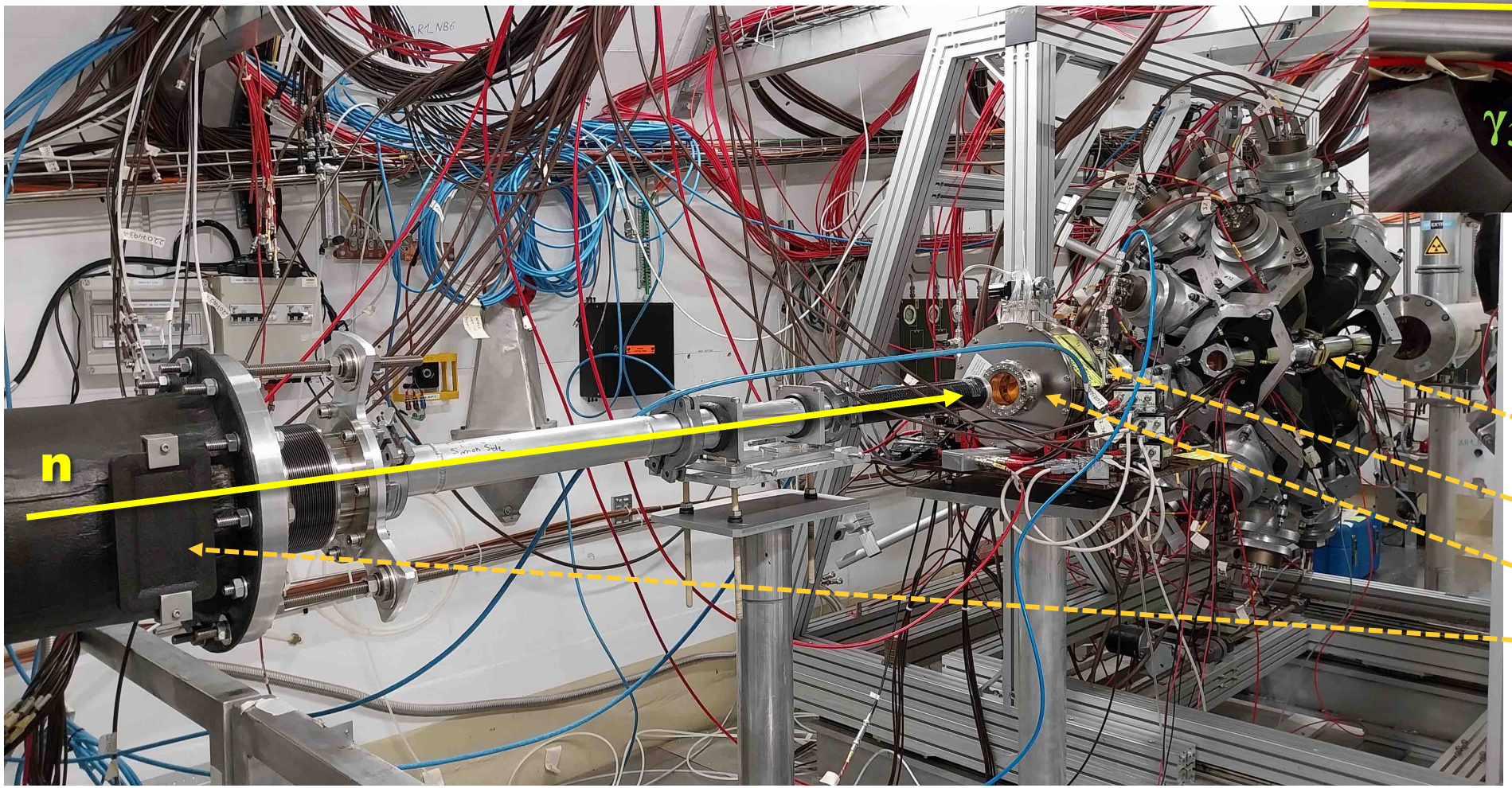
n_TOF EAR1 measurement
with the Total Absorption Calorimeter (TAC)
Data taking: 7 weeks in July-August 2025





Zoom on FICH-Pu241 inside the TAC (open)

FICH-Pu241

FICH-U235 (reference)

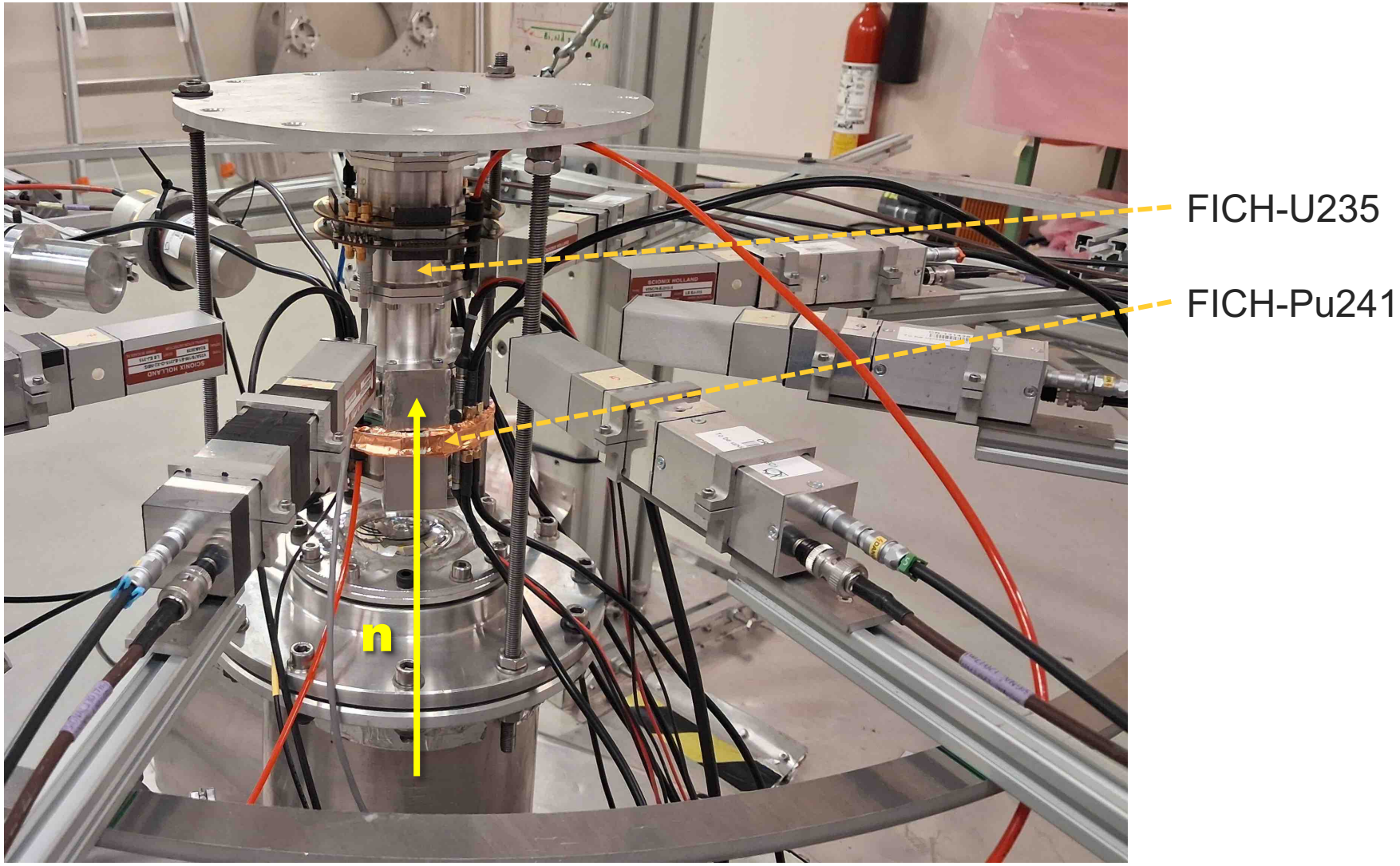
^{235}U PTB LMFC (ref.)

SiMon (reference)

n_TOF EAR2 measurement (thermal fission)

Data taking:

1 week in Sept. 2025

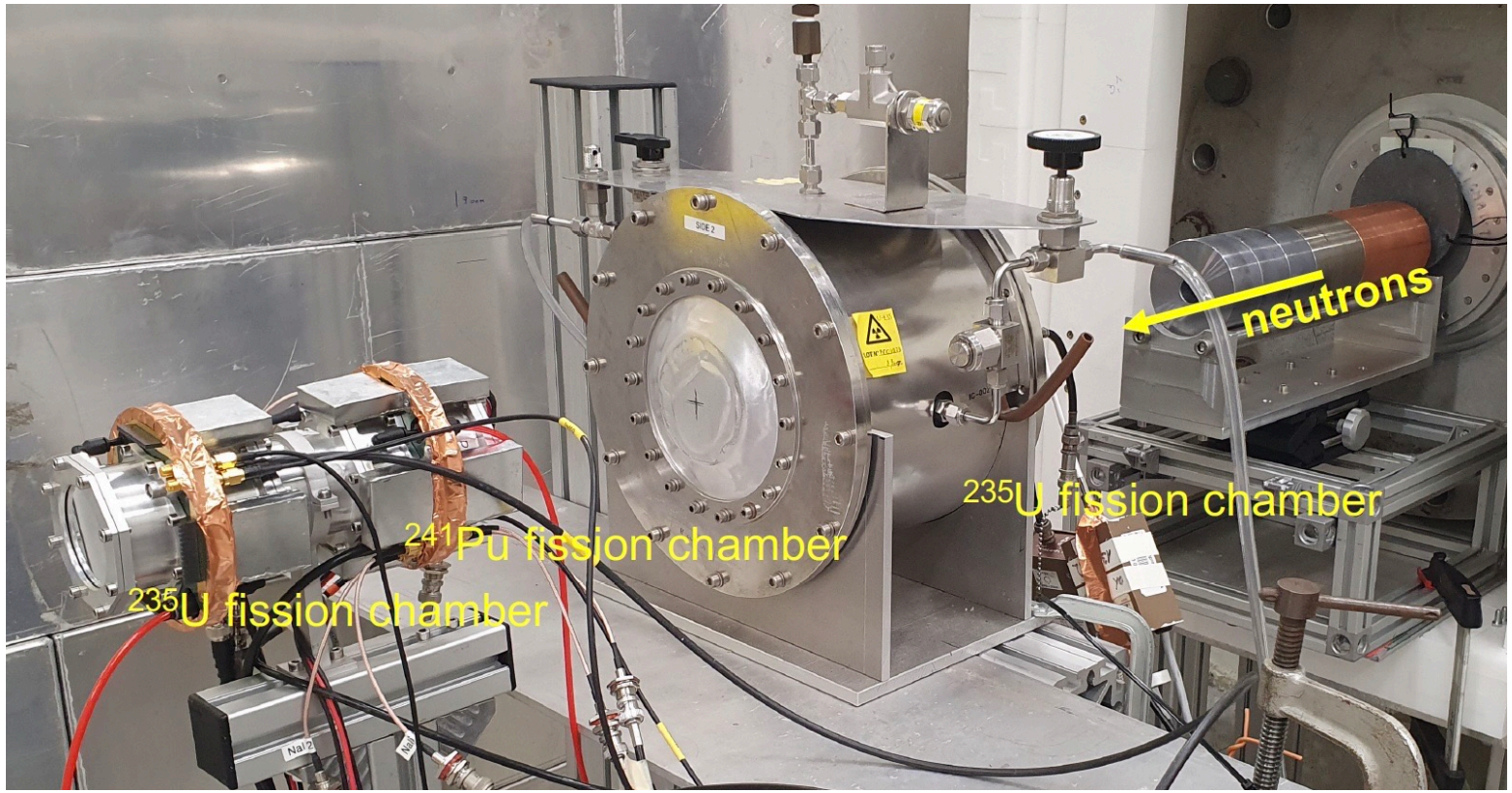


GELINA measurement (fission resonances)

Data taking at FP2/10m

Started in Nov. 2025

Completed in Feb-Mar. 2026



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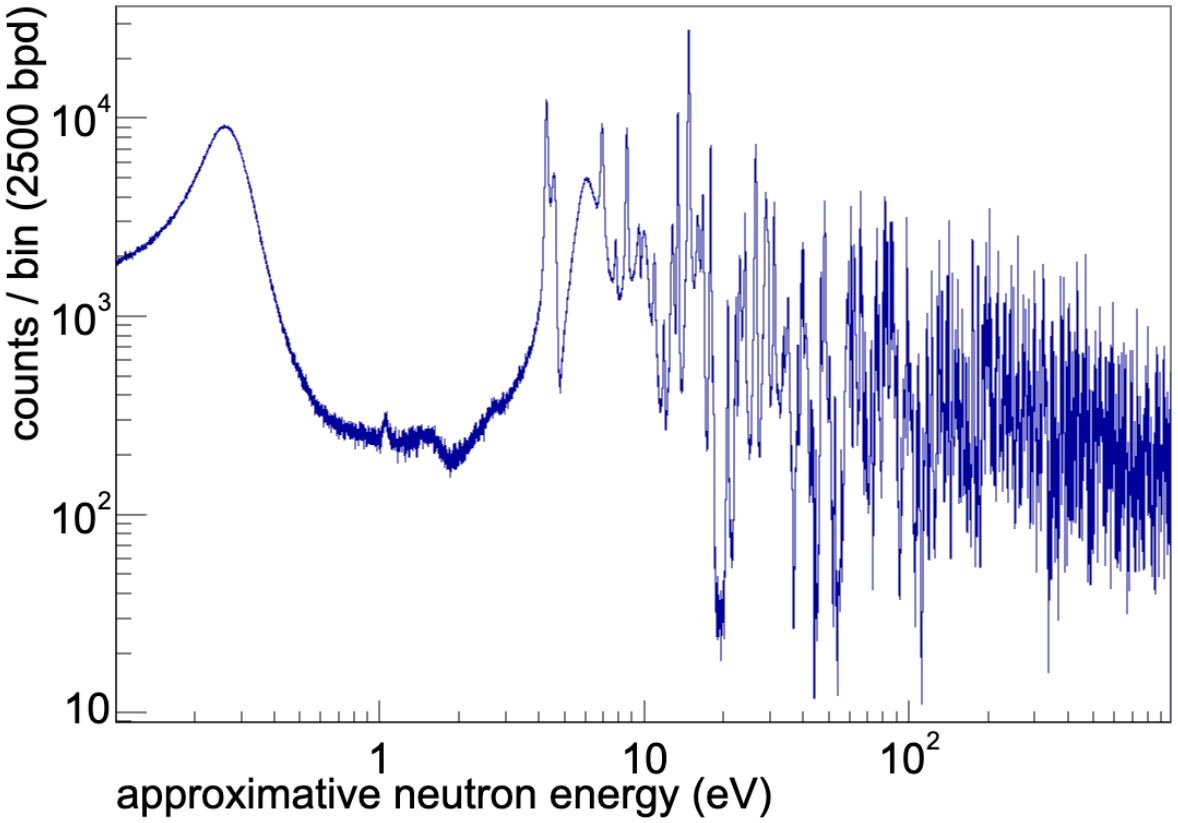
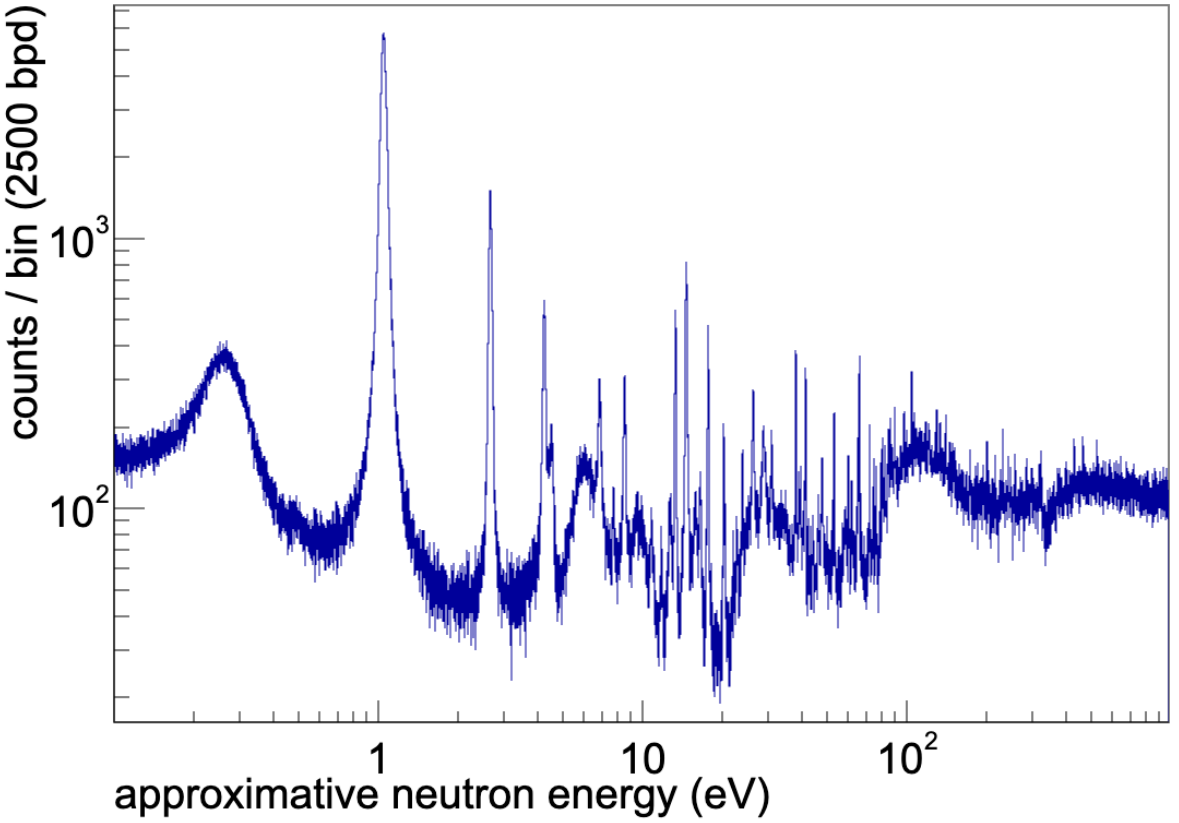
n_TOF raw data (PhD A. Cahuzac)

Fission fragments detected in FICH-Pu241



Fission and capture gamma detected in the TAC



Conclusion and outlook

Experimental work (2022-2026) => ND2025 proceedings (publication expected in 2026)

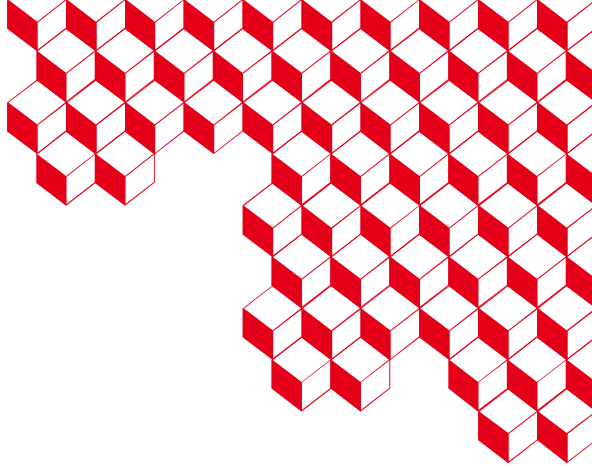
- Samples production and characterization
- Detector development and tests
- Experimental campaigns and raw data

Data reduction/analysis (2025-2028+) => TAC analysis in the WONDER 2026 proceedings

- Verification of the sample homogeneity (scheduled in autumn 2026)
- Capture-to-fission ratio in the TAC by Aline Cahuzac (PhD 2023-2027)
- Fission cross section by Michele Spelta (postdoc 2026/06-2028)
- Discussion of preliminary results with evaluators (2026 WONDER and APRENDE WS)

Preparation of the next measurements at n_TOF (2028-2033, no beam in 2027)

- Fission product capture, ^{238}Pu fission… (under discussion)



Thank you for your attention