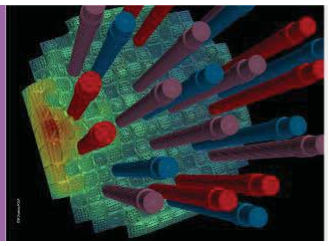

FISA 2022

30 May - 3 June 2022
Lyon, France

ARIEL & SANDA Nuclear Data Actitivies

C. Franzen[1], A.R. Junghans[1], E. Gonzalez[2], A.J.M. Plompen[3]

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2) Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT)
Avda. Complutense, 40, 28040 Madrid – Spain
3) European Commission Joint Research Centre – JRC Retieseweg 111, B-2440 Geel/Belgium

Accelerator and Research reactor Infrastructures for Education and Learning

ARIEL

SANDA

Supplying Accurate Nuclear Data for energy and non-energy Applications

HORIZON2020

ARIEL factsheet

Grant agreement ID: 847594

Funded under:
H2020-Euratom-1.8 (NFRP-2018-7)

EC budget contribution: 2 M€

Coordinated by: HZDR

Project type: Coordination & Support Action

Partners: 25 from 15 countries

Project duration: 54 months

Start /End date: September 1, 2019 – **February 29, 2024**

Management Board (MB):
A. Junghans (HZDR), A. Plompen (JRC), R. Nolte (PTB), C. Guerrero (USE), H. Penttilä (JYU)
Project Advisory Committee (PAC):
D. Cano-Ott (CIEMAT), R. Capote (IAEA), R. Jacqmin (CEA), M. Kerveno (CNRS), G. Van den Eynde (SCK*CEN)

Accelerator and Research reactor Infrastructures for Education and Learning — ARIEL

European Commission | Horizon 2020 European Union funding for Research & Innovation

www.ariel-h2020.eu

Accelerator and Research reactor Infrastructures for Education and Learning — ARIEL

10th European Commission Conference on EURATOM Research and Training in Safety of Reactor Systems
30 May - 3 June 2022 | Lyon, France

ARIEL Objectives

Provide young scientists, researchers and experts with access to high quality nuclear research and training facilities.
Experiments in international teams: Hands-on training for students in the graduate and postgraduate level - lead to PhD and master theses.

- Integration of the full nuclear data cycle by collaboration with JEFF (OECD/NEA), IAEA, and TSO's e.g. IRSN
- Collaboration with research reactor facilities MTK-EA, JGU, SCK*CEN, ILL, CVR
- Increase number of students in the nuclear data field; especially with the help of ENEN
- Increase support for early stage researchers
- Inclusion of technical staff (engineers, operators) in ARIEL activities

Accelerator and Research reactor Infrastructures for Education and Learning

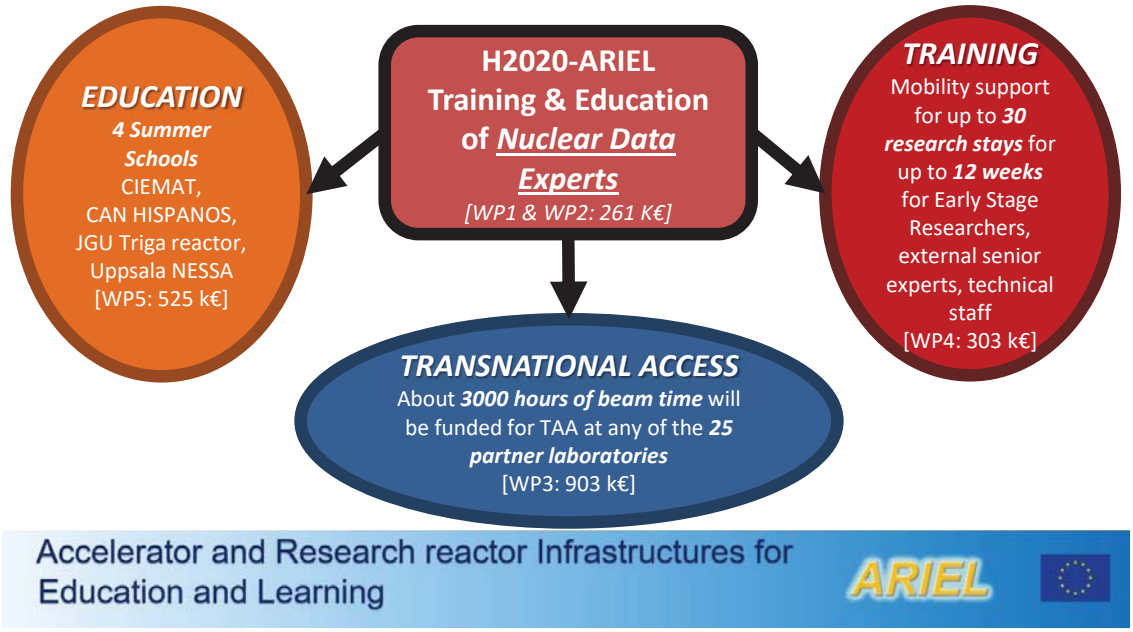
ARIEL

SUMMARY OF H2020-ARIEL FACILITIES AVAILABLE FOR TAA

		ACCELERATORS																			RESEARCH REACTORS				
		e^- BEAMS		ION BEAMS																					
		nELBE@HZDR	GELINA@JRC	MONNET@JRC	n_TOF@CERN	AIFIRA@CNRS	ALTO@CNRS	GENESIS@CNRS	NFS@GANIL	CEA-DAM	FNG@ENEA	PTB	FNG@NPI	HISPANOS@CNA	NESSA@UU	U. Oslo	NPL	IFIN-HH	JYU	AMANDE@IRSN	BRR@MTA-EK	BR1@SCK·CEN	TRIGA@JGU	LR-0/LVR-15@CVR	RHF@ILL
Neutrons	Cold (<25 meV)																				■		■		■
	Thermal ($\langle E_n \rangle$=25 meV)		■	■										■			■			■	■	■	■	■	■
	Epithermal (25 meV – 100 keV)		■	■	■	■				■		■		■			■			■	■	■	■	■	■
	Fast (0.1-20 MeV)	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■			■	■	■	■	■	■
	Very fast (>20 MeV)				■				■				■												
	Pulsed beam	■	■	■	■		■		■	■		■	■	■	■					■			■		
	Time-of-flight	■	■	■	■		■		■	■		■	■	■						■					
Charged particles						■	■									■		■							
Radioactive beam							■												■						■

Accelerator and Research reactor Infrastructures for Education and Learning

ARIEL



Status

- Education and Training: 195 weeks endorsed in 25 proposals
  8 visits (78 weeks) completed
  45 weeks available
- Transnational access to neutron beam facilities:
  1433 beam time hours endorsed after PAC 5 for 17 experiments
  596 hours delivered (7 experiments)
- COVID has restricted the transnational access and Education and training activities. The visits of early stage researchers were resumed. The experiments still have to catch up.

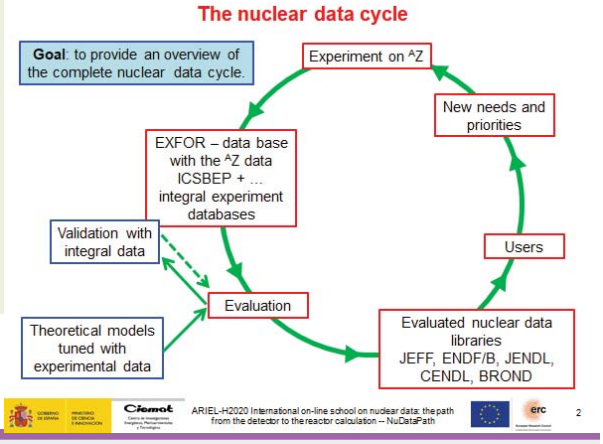
ARIEL schools

2/2022 @CIEMAT, Madrid, Spain
Nuclear data: the path from the detector to the reactor calculation
(24 participants) https://agenda.ciemat.es/event/3201/

9/2022 @CNA, Seville, Spain
Hands-on school on the production, detection and use of neutron beams
(18-24 participants)

10/2023 @JGU, Mainz, Germany
Lab course in Reactor Operation and Nuclear Chemistry
(10 participants)

6/2023 @University of Uppsala (Sweden)
EXTEND'2023 summer school
(25 participants)



SANDA

SUPPLYING ACCURATE NUCLEAR DATA FOR ENERGY AND NON-ENERGY APPLICATIONS

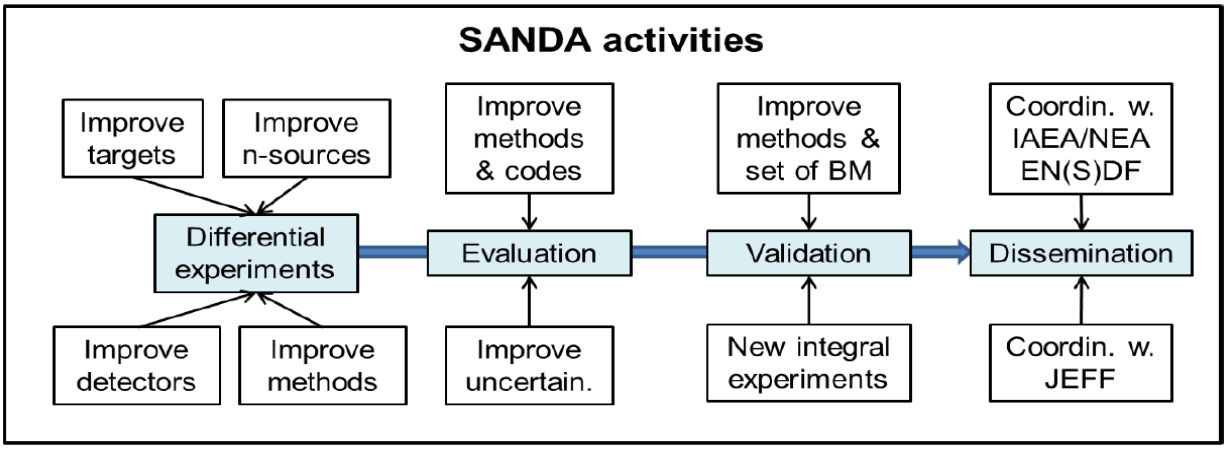
H2020 Grant Agreement number: 847552
A project for the EURATOM WP2018 for NFRP-2018-4

Project Start date: 01/09/2019
Duration: 48 months
Requested contributions: 3.5 MEuros

35 Partners: *CIEMAT*, Atomki, CEA, CERN, CNRS, CSIC, CVREZ, ENEA, HZDR, IFIN-HH, IRSN, IST-ID, JRC, JSI, JYU, KIT, NPI, NPL, NRG, NTUA, PSI, PTB, SCK-CEN, Sofia, TUW, UB, ULODZ, UMAINZ, UMANCH, UOI, UPC, UPM, USC, USE, UU.
from 18 countries (Au, Be, Bu, Cz, Fi, Fr, Ge, Gr, Hu, It, Ne, Pol, Por, Ro, Sln, Sp, Sw, UK)

Coordinator: CIEMAT

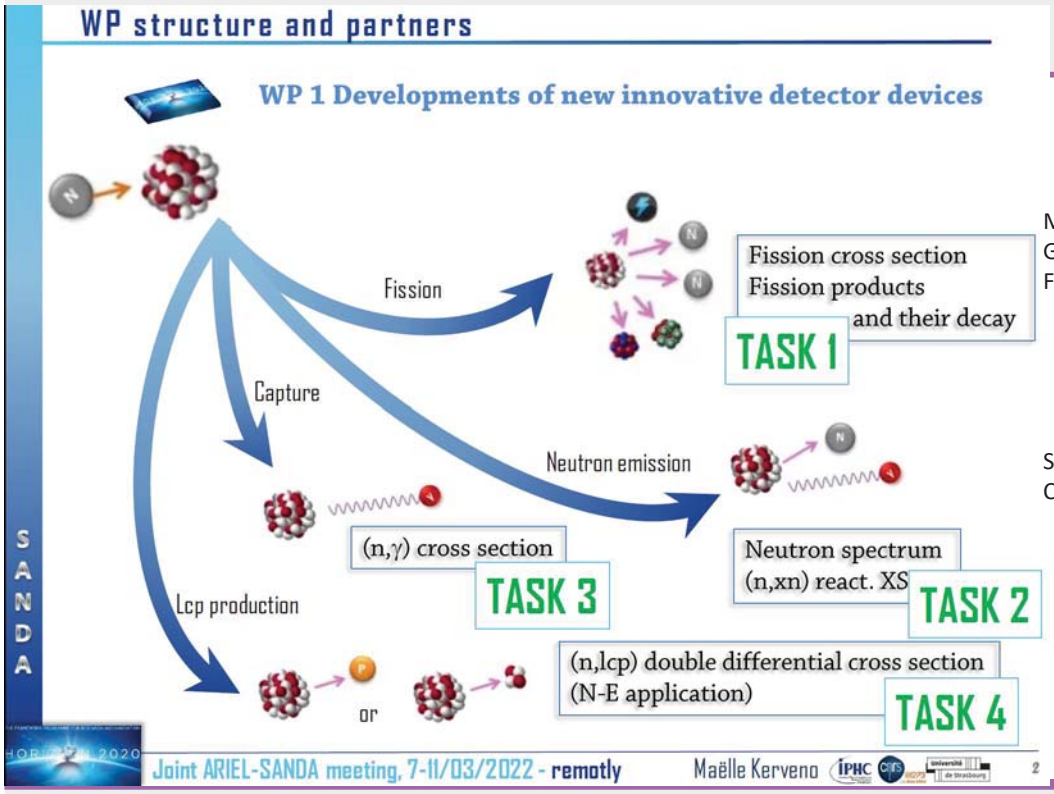
SANDA activities



- Relevant experiments for microscopic nuclear data improvement of nuclear safety
- Full nuclear data cycle: Nuclear data evaluation and validation
- NEA/OECD and IAEA high priority lists

Nuclear data measurements

- average **neutron multiplicity** of ^{235}U(n,f) and the **fission cross sections** of the ^{230}Th(n,f), ^{241}Am(n,f) and ^{239}Pu(n,f) reactions;
- **neutron capture cross sections** of the ^{239}Pu(n,γ) and ^{92,94,95}Mo(n,γ) reactions;
- neutron **elastic and inelastic scattering** and **neutron multiplication** cross sections for the nuclides ^{14}N,^{35,37}Cl, ^{209}Bi, ^{233}U, ^{238}U and ^{239}Pu;
- **decay data** of ^{95}Rb, ^{100gs}Nb, ^{102m}Nb, ^{103}Tc, ^{140}Cs with Total Absorption Gamma-ray spectrometry and of ^{106}Ru, ^{153}Sm, ^{166}Ho, ^{186}Re, ^{212}Pb, ^{225}Ac and ^{223}Ra half-lives and branching ratios for reactor and medical applications;
- **fission yields** and related distributions from neutron induced fission of ^{235}U at LOHENGRIN (ILL) and PI-ICR at IGISOL and (p,2p) inverse kinematics fission reactions for ^{238}U and ^{237}Pa;
- **spectrum-averaged cross sections** for the ^{117}Sn(n,inl)^{117m}Sn and ^{60}Ni(n,p) reactions in a ^{252}Cf spectrum for **dosimetry**, ^{12}C double differential cross sections relevant for hadron therapy and the production cross sections of β+ emitters ^{11}C, ^{13}N, ^{15}O, ^{30}P for proton-induced reactions up to 250 MeV energy (non-energy applications);



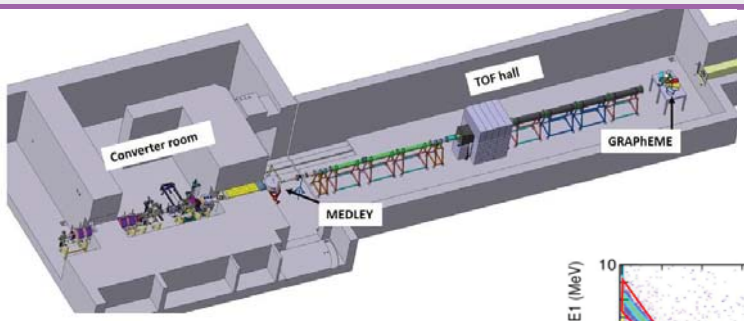
Micromegas TPC (CEA)
Gaseous proton recoil telescopes (CNRS)
Falstaff fission yield studies (CEA)

SCONE detectorTPC (CEA)
Compact fast neutron spectrometer (CEA)

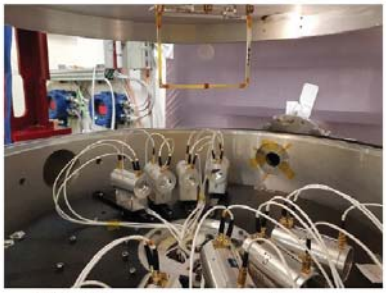
CLYC (CERN)
I-TED (CERN)

Si- proton recoil telescopes (PTB,HZDR)

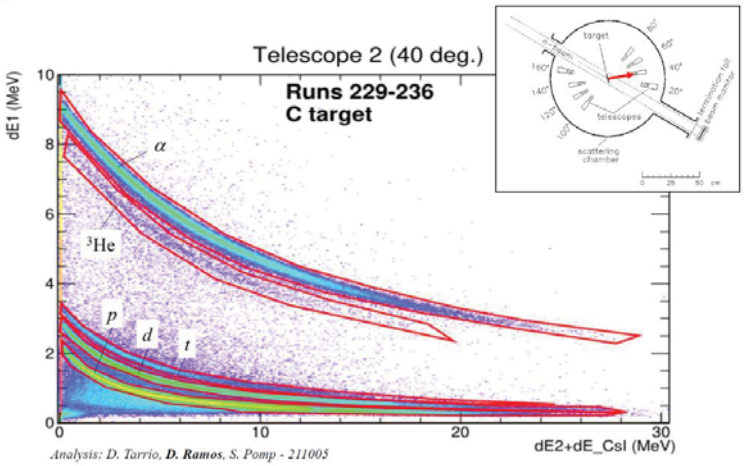
First Experiments at Neutrons for Science at GANIL



Light charged particle detection $^{12}C(n,x)$ at NFS
(A. Prokofiev et al, Uppsala University)



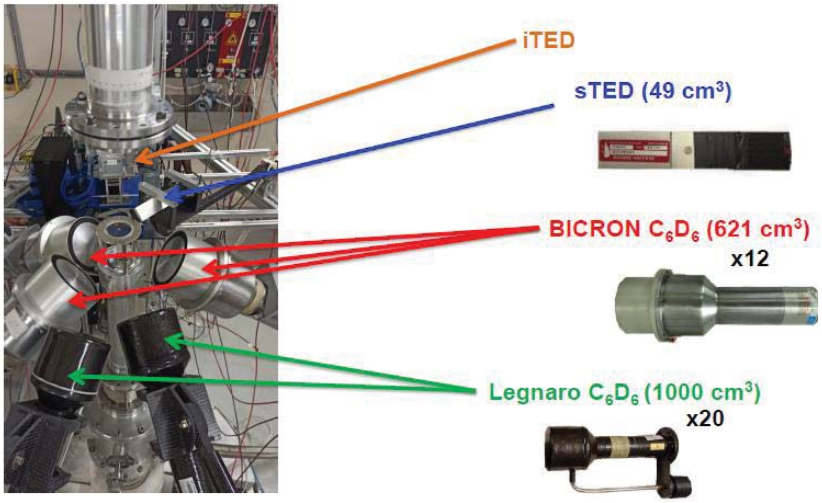
Medley vacuum chamber

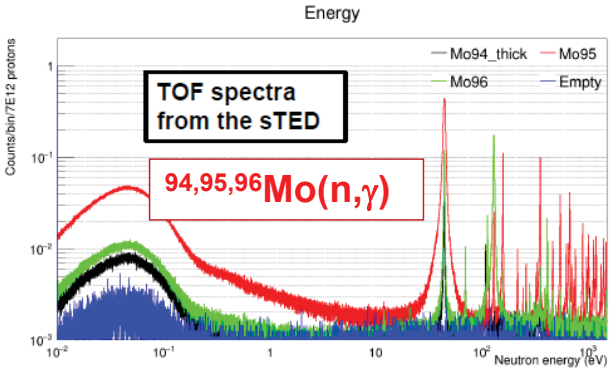


SANDA

WP1-TASK3

Test of different capture detectors for the n_TOF EAR2 (@CERN)





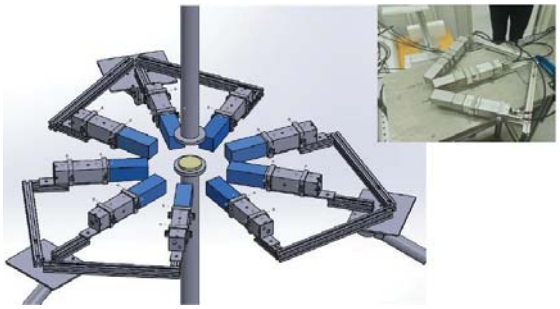
Measurements of ^{94,95,96}Mo(n,γ) at n_TOF (EAR1) using sTED innovative detectors

SANDA

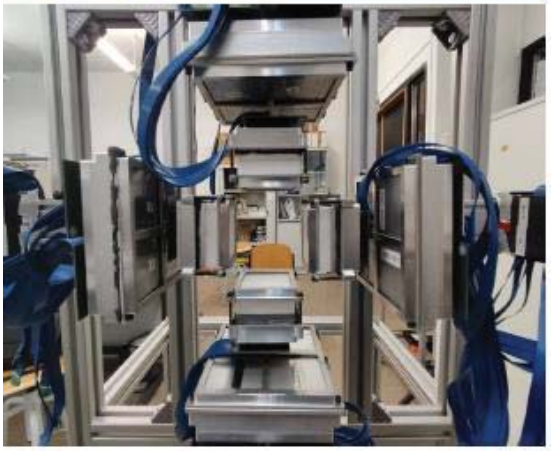
WP1-TASK3

Development of advanced capture detectors

sTED



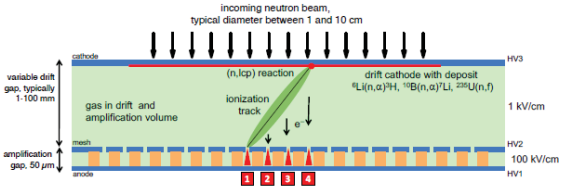
Full i-TED detector completely assembled, commissioned and prepared for first (n,g) experiments in 2022

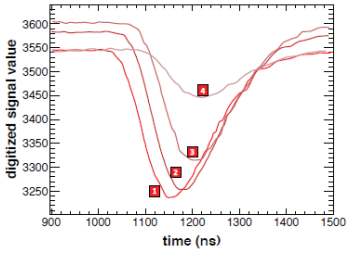


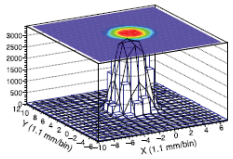
10th European Commission Conference on EURATOM Research and Training in Safety of Reactor Systems
30 May - 3 June 2022 | Lyon, France

SANDA WP1-TASK 1 & 4

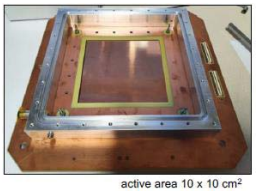
XY-Micromegas and LCP measurements



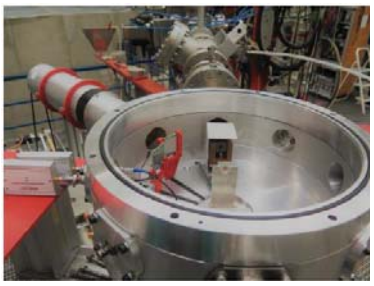


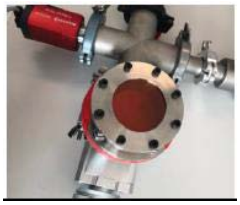


M. Diakaki et al. NIMA 903 (2018) 4



XY-Micromegas

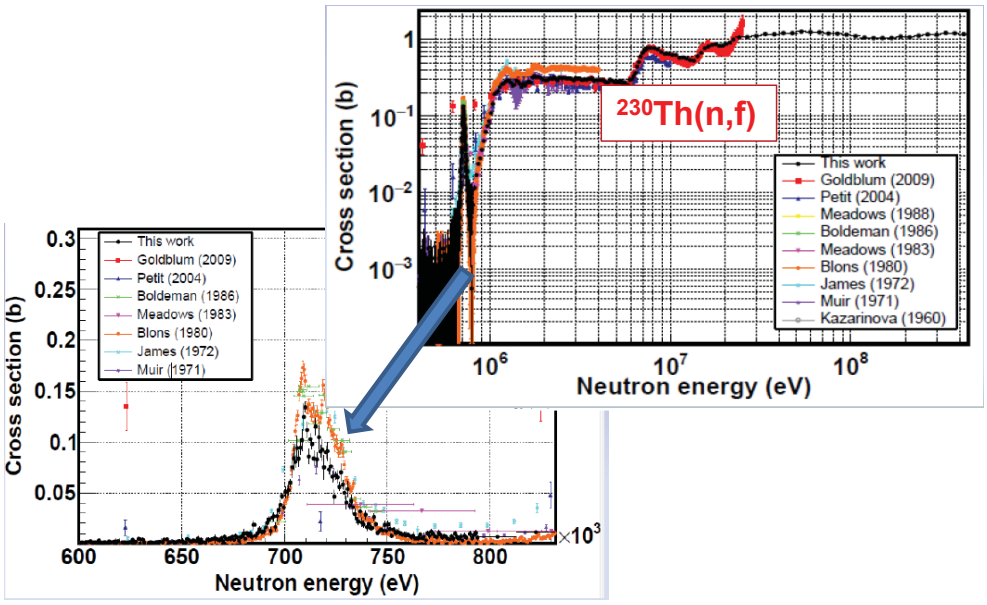




Scattering chamber from PIAF to n_TOF

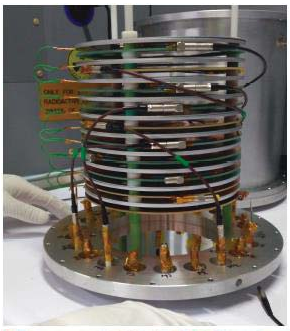
SANDA WP2

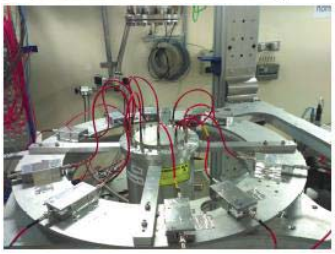
^{230}Th(n,f) cross-section measurements

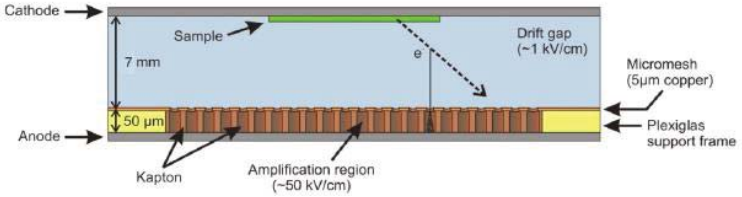


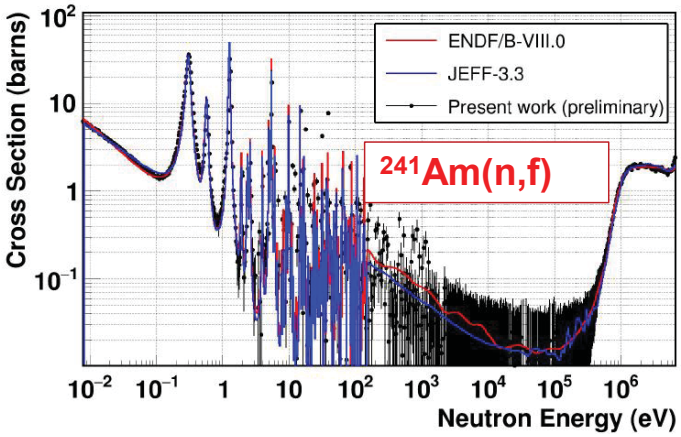
SANDA WP2

^{241}Am(n,f) cross-section measurements at n_TOF EAR2@CERN

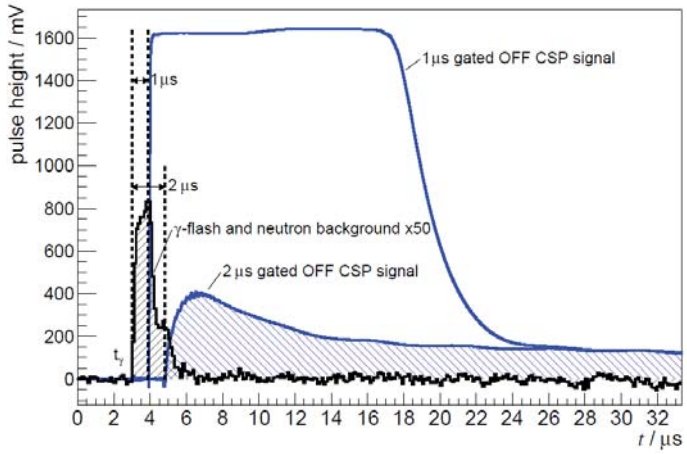








Nanosecond-gating at pulsed radiation sources



Switching detector output to ground to avoid Instantaneous radiation (gamma-flash) at pulsed Radiation sources.

➔ Sensitivity greatly increased for later neutron-induced signals for time-of-flight measurements

--- directly measured current (no preamplifier)
--- Charge sensitive preamplifier output. Input grounded for 1 or 2 microseconds.

Sebastian Urlass et al., *Nuclear Instruments and Methods in Physics Research A 1002,* p. 165297, 2021

Conclusions

- ARIEL and SANDA support the measurement, evaluation and validation of nuclear data that will improve the safety of present reactors and improve the precision and efficiency of the new advanced reactor and fuel cycles designs and of the applications of nuclear technologies.
- Response to the high priority request list of nuclear data (HPRL) collected by the international organizations IAEA and NEA/OECD from inputs and discussions with nuclear data users and producers.
- About 6 to 12 months delays accumulated due to COVID still both projects have already achieved significant results to develop and improve detectors, commission new neutron sources, perform some new measurements, and to improve the tools and environment for evaluation and validation.