



n_TOF Report

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CERN



OUTLINE



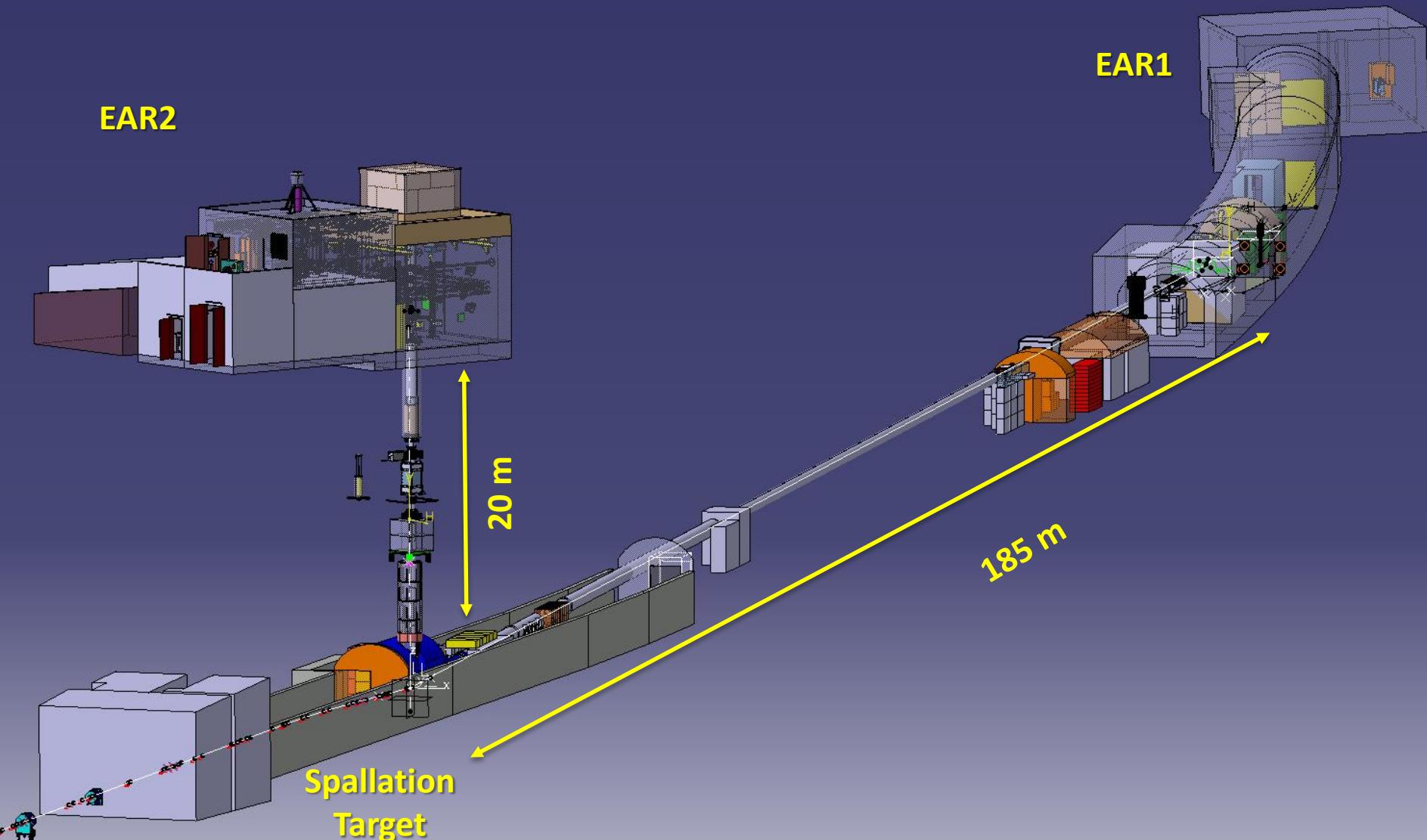
- n_TOF Facility (brief reminder)
- Last experiments in 2016
- Shutdown Activities
- Operation in 2017
- Draft planning 2017-2018
- n_TOF publications in 2016
- Conclusions



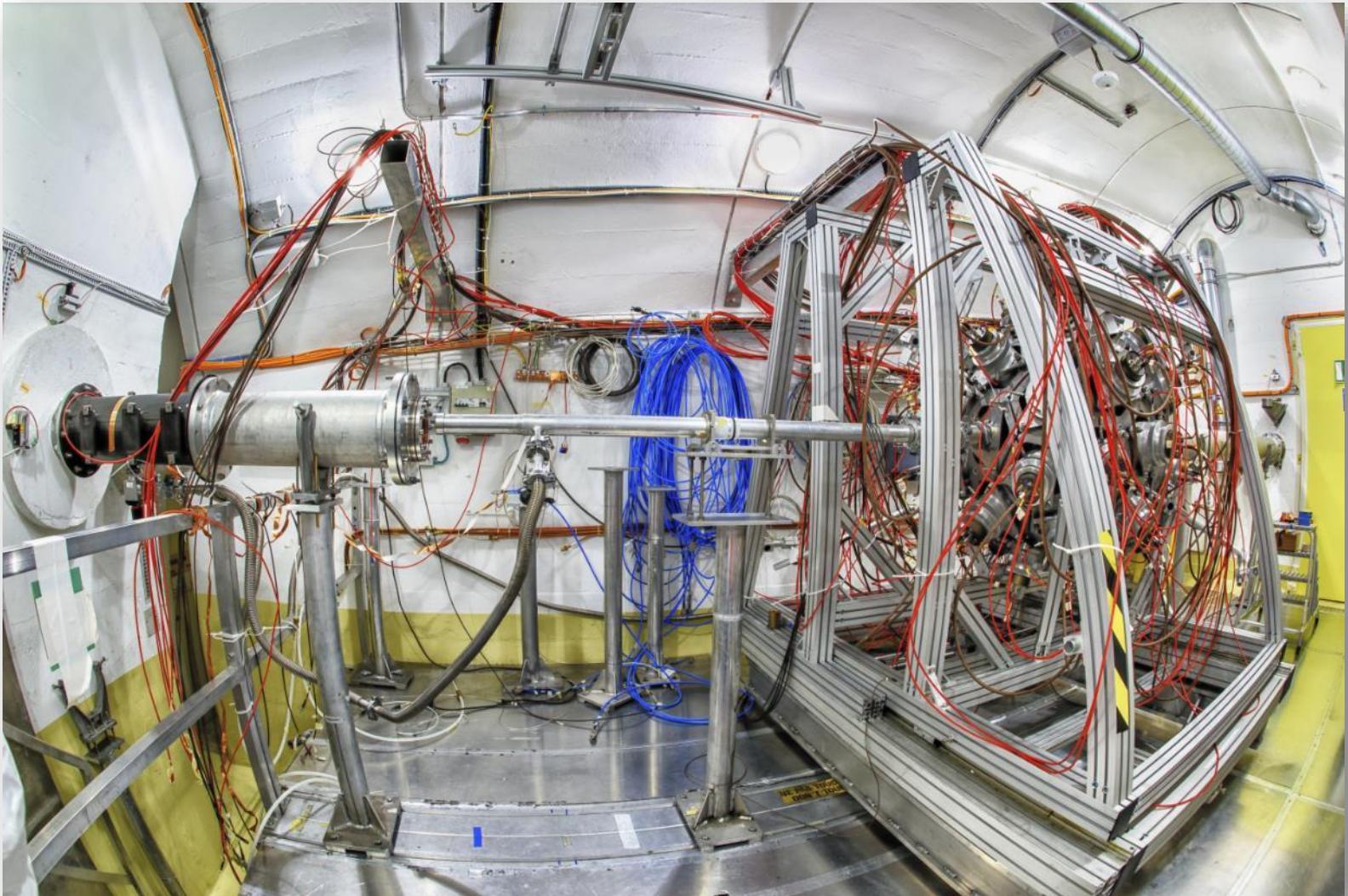
The neutron Time Of Flight Facility timeline



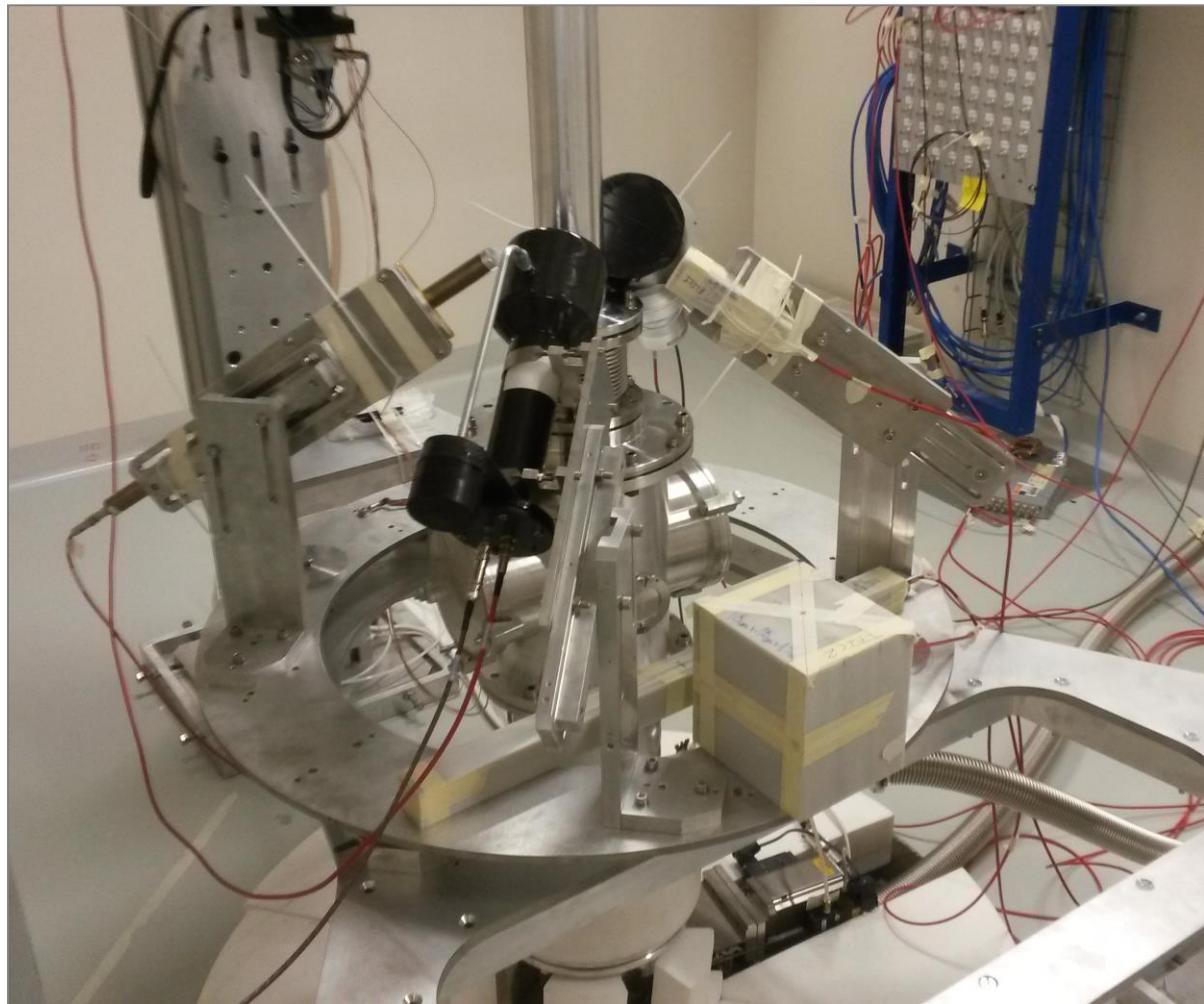
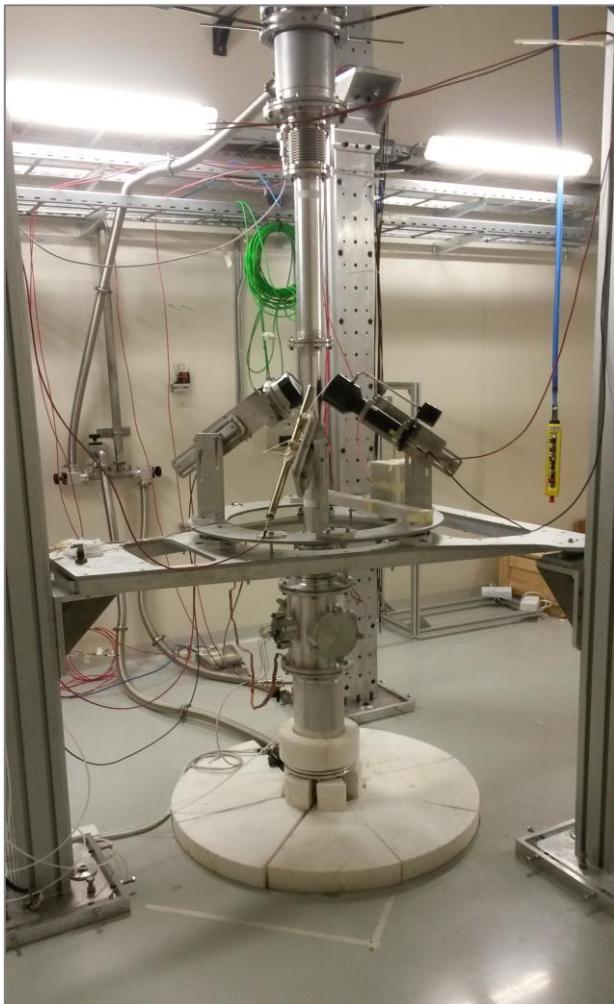
The neutron Time Of Flight Facility

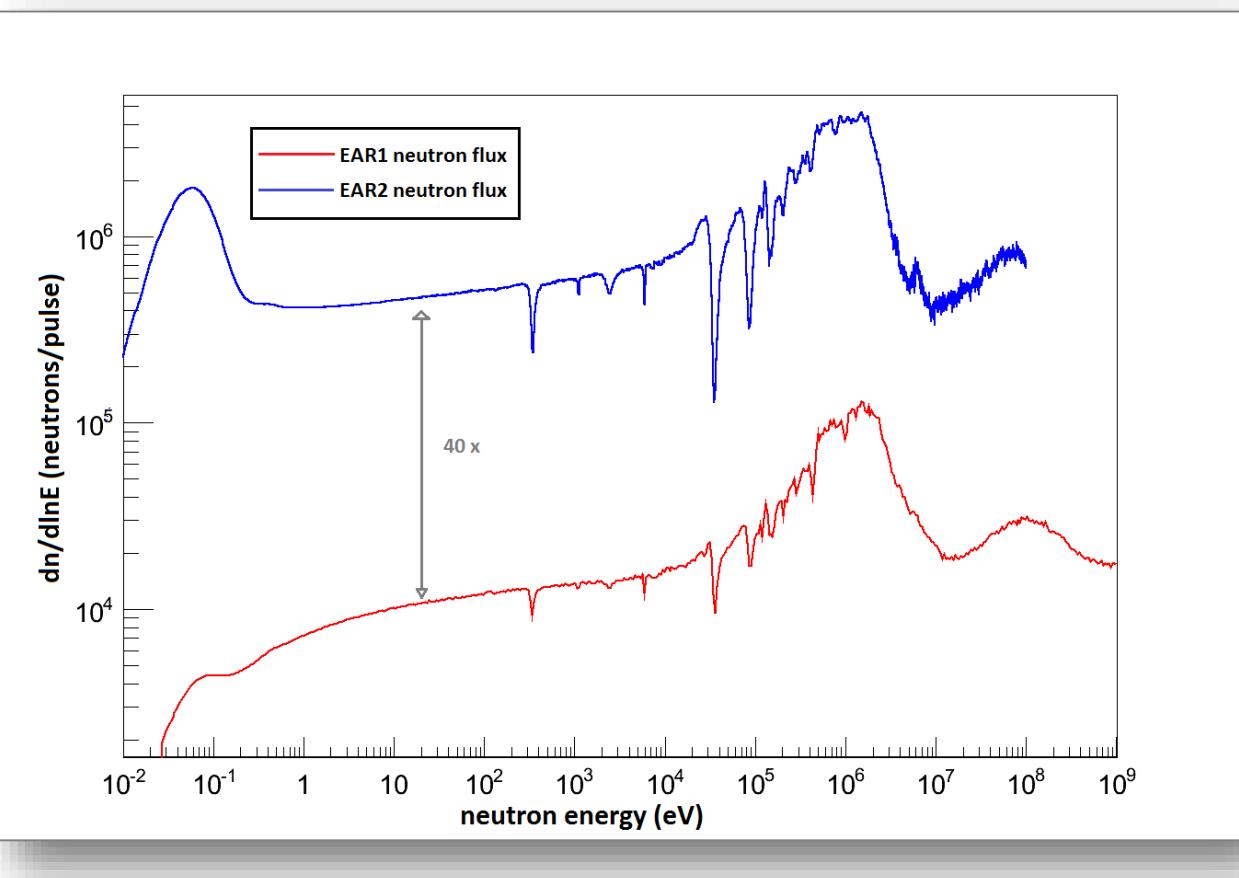


The neutron Time Of Flight Facility: EAR1



The neutron Time Of Flight Facility: EAR2



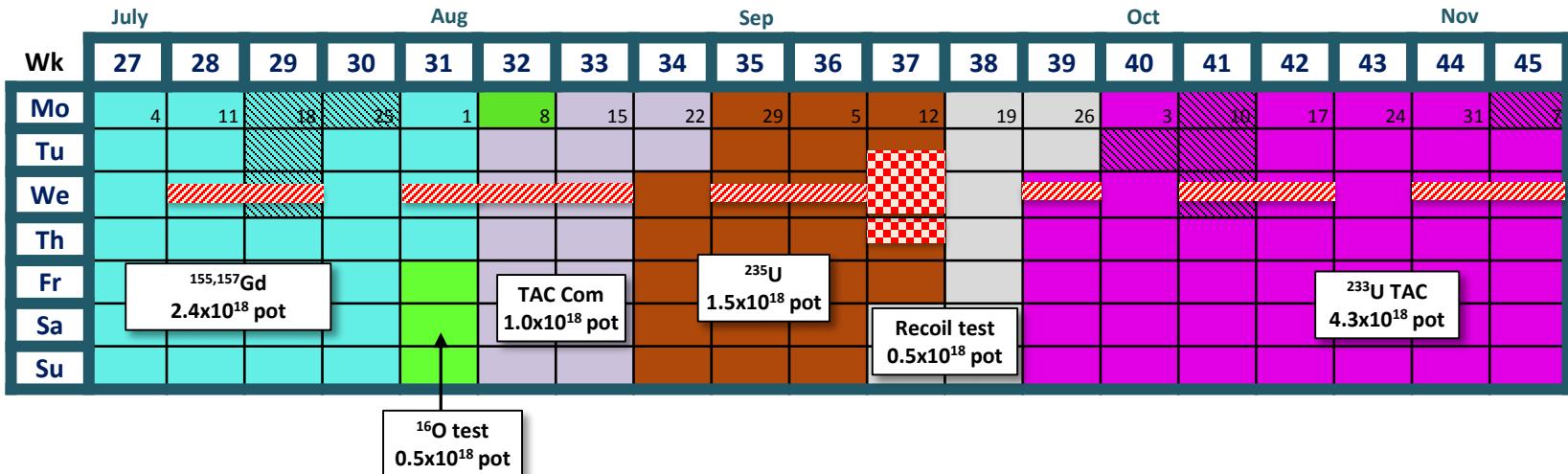


Wide neutron energy range

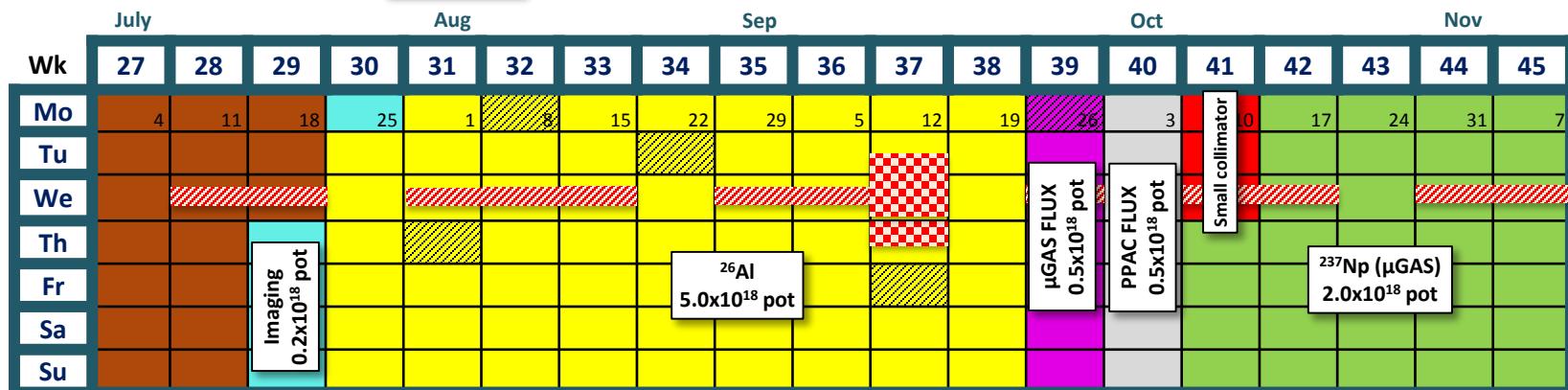
**Very high instantaneous
neutron flux**

Measurements last part 2016

EAR1



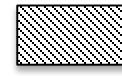
EAR2



Injector MD



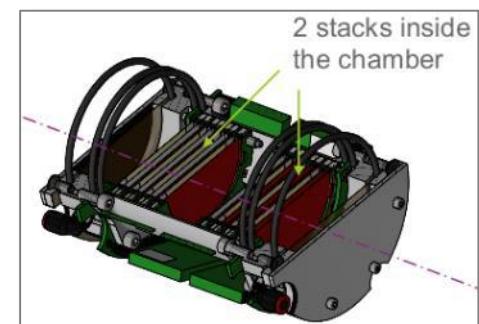
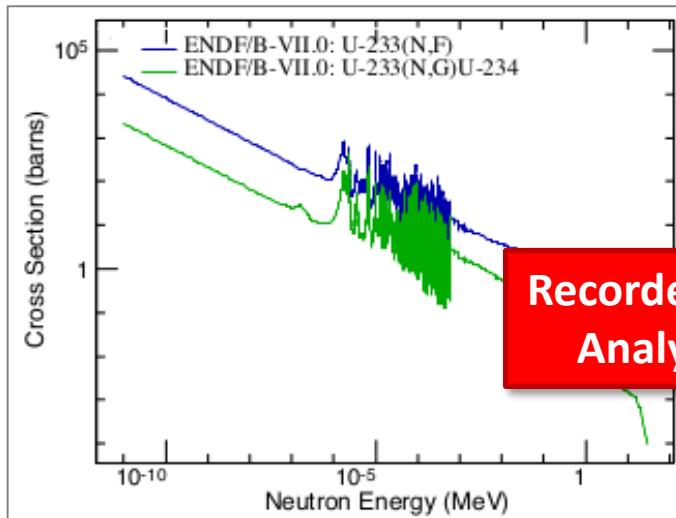
PS Technical Stop 36 hrs



No full time beam due to
activities in the other area

^{233}U (n,γ) & (n,f) in EAR1 (fission tagging)

Essential role in Th-U fuel cycle / Gen-IV systems
Challenge: XS ratio $(n,f)/(n,g) \sim 10$

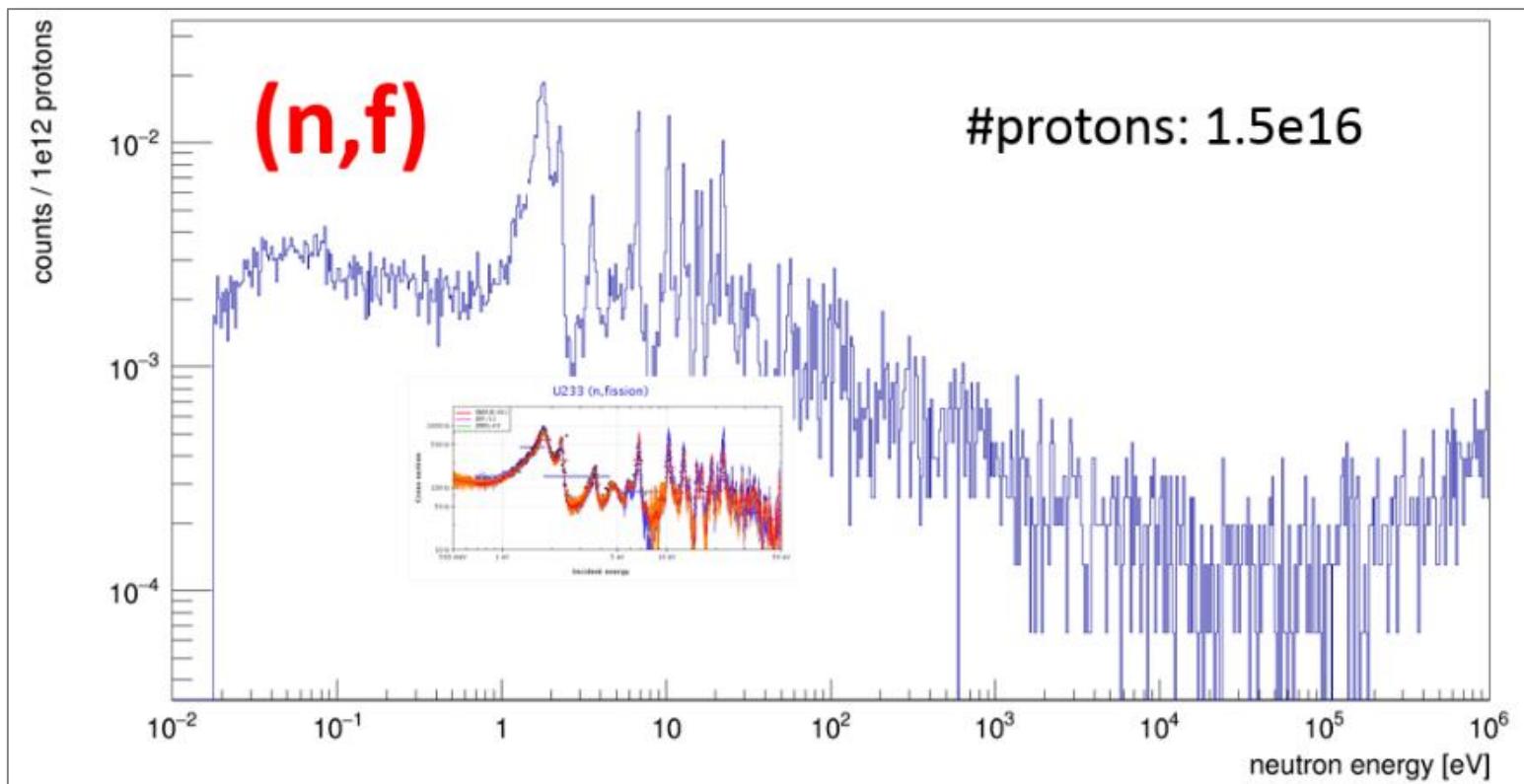


Detector setup

(n,g) with Total Absorption Calorimeter TAC
(n,f) with novel compact fission chamber

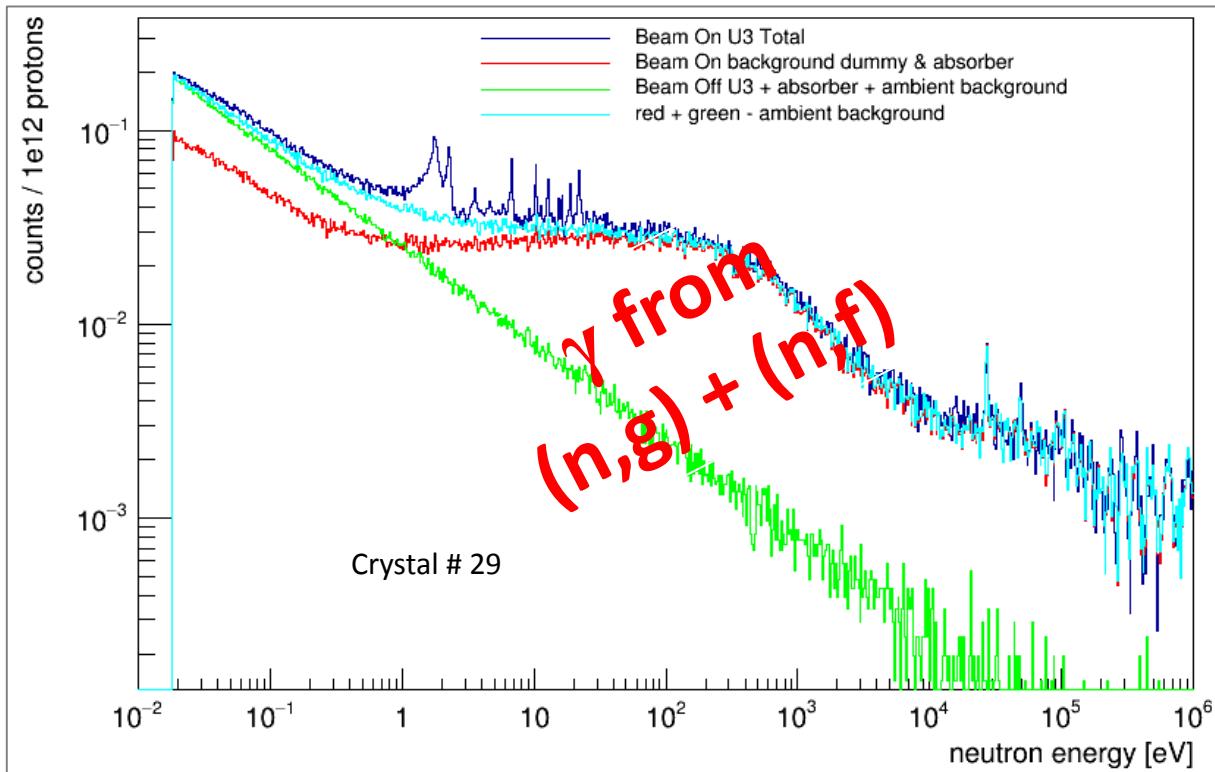
Courtesy M. Bacak

DRAFT Very limited statistics
Fission chamber response



Courtesy M. Bacak

DRAFT Very limited statistics
 Response of 1 BaF₂ crystal



Courtesy M. Bacak

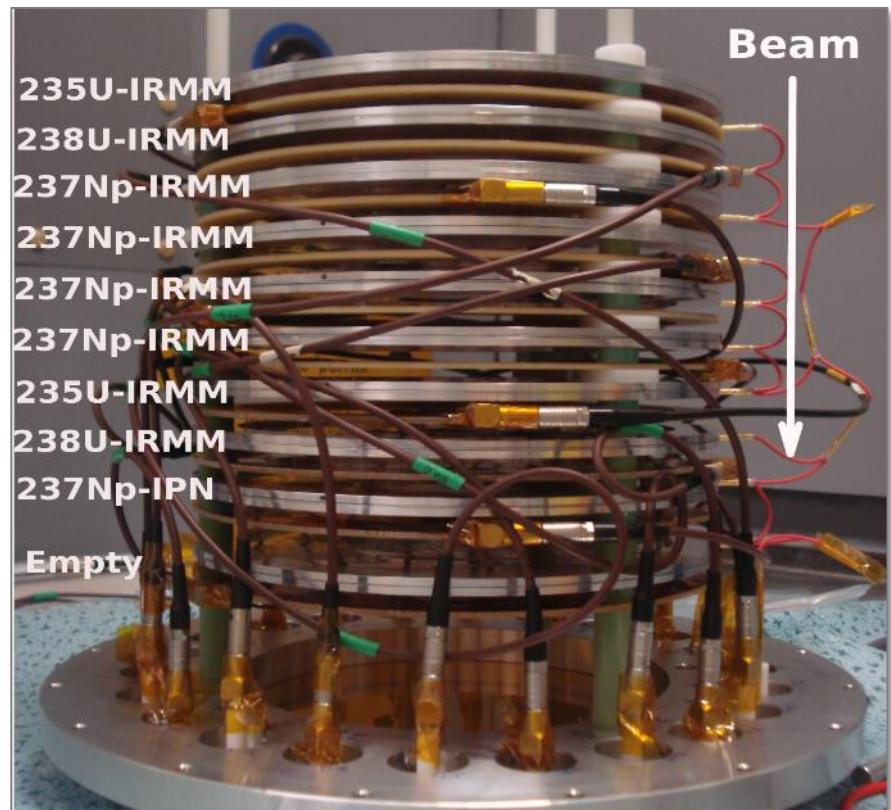
^{237}Np potential target of incineration in fast neutron reactors

Discrepancies of $\sim 6\%$ in the fission $\sigma \rightarrow$

- Measure ^{237}Np (n,f) in EAR1 with PPAC
- Measure ^{237}Np (n,f) in EAR2 with μMGAS

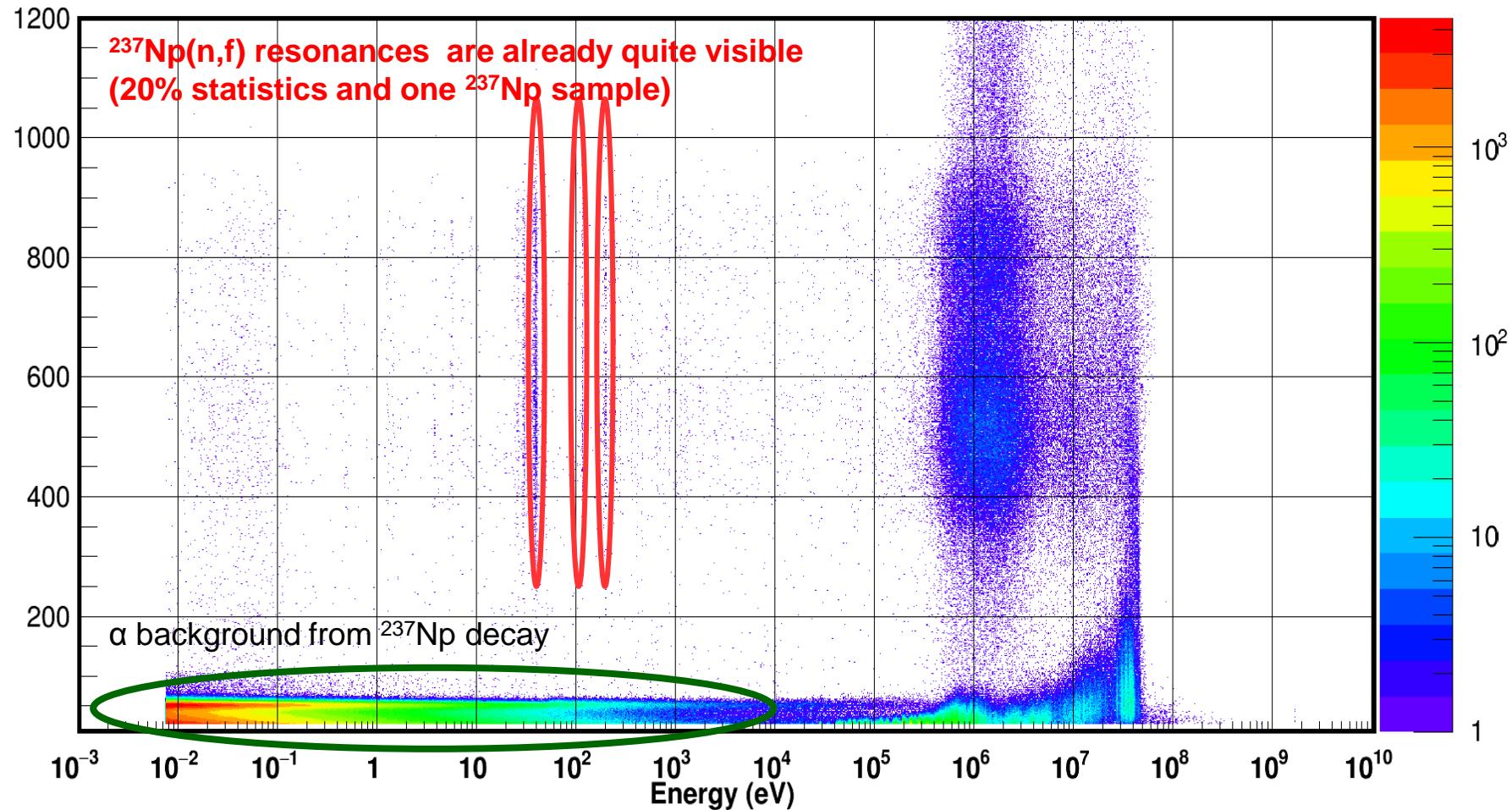
Detector SetUp

- ^{235}U & ^{238}U to use for reference
- One ^{237}Np sample prepared at IPN-Orsay from the same batch as in the PPAC measurement, in order to cross out discrepancies coming from the sample



Courtesy A. Stamatopoulos

DRAFT
Analysis on going



Courtesy A. Stamatopoulos



Activities during the EYETS 2016-2017



- Bought additional SP Device digitisers to permanently equip both areas for the most demanding experiments (64 channels per area). New digitisers already at CERN and presently under test
- Refurbishing the rack area in EAR1
- Installation of the new cooling system in EAR2 to keep a constant temperature in the bunker (and rack area) at 20 °C
- Preparation of the SIR course to enter the n_TOF Experimental Areas



n_TOF Operation in 2017

Apr										June			
Wk	14	15	16	17	18	19	20	21	22	23	24	25	26
Mo	3	↓	10	Easter Mon	17	24	May Day	1	8	15	22	29	5
Tu			Recommissioning with beam			NA setup							
We													
Th			ISOLDE, nTOF, EA, AD										
Fr					SPS commissioning with beam inc. new TIDVG								
Sa													
Su			G. Friday										

Key events in April:

- Beam to PSB
- Start ISOLDE physics
- Start LHC commissioning
- Start EA, nTOF, AD I physics
- Beam to SPS
- Start NA, AWAKE physics
- Start LEIR
- Ions to PS
- Ions to SPS

Oct										Dec			
Wk	40	41	42	43	44	45	46	47	48	49	50	51	52
Mo	2	9	16	23	30	6	13	20	27	4	11	18	Xmas 25
Tu		UA9 [24 h]			COLDEX 24 hrs								
We		Injector MD 10 hrs 8 to 18	Injector MD 10 hrs 8 to 18	Injector MD 10 hrs 8 to 18		Injector MD 10 hrs 8 to 18	UA9 [24 h]	Injector MD 10 hrs 8 to 18	Injector MD 10 hrs 8 to 18				
Th													
Fr													
Sa						North Area xenon physics (8 weeks (inc. 2 weeks set-up))							
Su													

Key events in October and November:

- End NA proton physics
- W44 LHC TS
- W43 LHC MD
- End HI proton physics (ISOLDE, nTOF, EA)
- North Area xenon physics (8 weeks (inc. 2 weeks set-up))
- End of run (06:00) (LHC, AD, AWAKE, NA)

29 weeks operation → ~ 1.84×10^{19} P.O.T.



Draft Planning 2017-18



Area	Proposal	INTC	Comment	Status
EAR1	$^{69,71}\text{Ga}$ (n,γ)	P-466	Astrophysics	✓
EAR1	^{88}Sr (n,γ) and ^{89}Y (n,γ)	P-453	Astrophysics & nuclear technologies	✓
EAR1	$^{154,\text{nat}}\text{Gd}$ (n,γ)	P-437	Astrophysics	✓
EAR1	^{16}O (n,α)	P-430	Basic nuclear physics & nuclear technologies	✓
EAR1	Recoil test (2 nd part)	I-165	Detector development for nuclear physics measurements	✓
EAR2	$^{244,246}\text{Cm}$	P-469	Nuclear technologies	✓
EAR1	^{12}C (n,p)	P-488	Basic nuclear physics	Submitted for recommendation
EAR2	^{241}Am (n,γ)	P-491	Nuclear technologies	Submitted for recommendation
EAR2	^{241}Am (n,f)	P-492	Nuclear technologies	Submitted for recommendation
EAR2	Imaging	P-497	Nuclear applications	Submitted for recommendation
EAR1 & EAR2	^{230}Th (n,f)	P-493	Basic nuclear physics & nuclear technologies	Submitted for recommendation
EAR2	^{235}U (n,f)	I-174	Nuclear technologies	Submitted for recommendation



n_TOF Publications in 2016

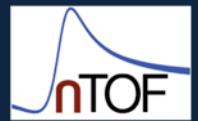


Peer Reviewed Publications 2016

- [130] M. Barbagallo, A. Musumarra, L. Cosentino, and the n_TOF Collaboration,
The $^7\text{Be}(n, \alpha)^4\text{He}$ reaction and the Cosmological Lithium Problem: measurement of
Phys. Rev. Lett., 117:152701 (2016),
- [129] F. Gunsing and E. Chiaveri on behalf of the n_TOF Collaboration,
Neutrons in full flight at CERN's n_TOF facility,
CERN Courier, article 64364 (2016).
- [128] F. Gunsing, O. Aberle, and the n_TOF Collaboration,
Nuclear data activities at the n_TOF facility at CERN,
Eur. Phys. J. Plus, 131:371 (2016),
- [127] L. Cosentino, A. Musamarra, M. Barbagallo, and the n_TOF Collaboration,
Experimental setup and procedure for the measurement of the $^7\text{Be}(n, \alpha)$ reaction at n_TOF,
Nucl. Instr. Meth. A, 830:197 (2016),
- [126] J. Lerendegui-Marco, S. Lo Meo, C. Guerrero, and The n_TOF Collaboration,
Geant4 simulation of the n_TOF-EAR2 neutron beam: characteristics and prospects,
Eur. Phys. J. A, 52:100 (2016),
- [125] D.L. Pérez Magán, L. Caballero-Ontanaya, C. Domingo-Pardo, and The n_TOF Collaboration,
First tests of the applicability of g-ray imaging for background discrimination in time-of-flight
neutron capture measurements,
Nucl. Instr. Meth. A, 823:107 (2015),
- [124] P. Žugec, D. Bosnar, N. Colonna, F. Gunsing, and The n_TOF Collaboration,
A novel method for estimating the neutron background in measurements of neutron capture
reactions,
Nucl. Instr. Meth. A, 826:80 (2016),



n_TOF Publications in 2016



Peer Reviewed Publications 2016

- [123] P. Žugec, C. Weiß, C. Guerrero, F. Gunsing, V. Vlachoudis, M. Sabate-Gilarte, A. Stamatopoulos, T. Wright, J. Lerendegui-Marco, F. Migrone, A. Tsinganis, M. Barbagallo, on behalf of The n_TOF Collaboration,
Pulse processing routines for neutron time-of-flight data,
Nucl. Instr. Meth. A, 812:134 (2016),
- [122] M. Diakaki, D. Karadimos, R. Vlastou, M. Kokkoris, P. Demetriou, E. Skordis, A. Tsinganis, and The n_TOF Collaboration,
Neutron induced fission cross section of ^{237}Np in the keV-MeV range at the CERN n_TOF facility,
Phys. Rev. C, 93:034614 (2016),
- [121] P. Žugec, N. Colonna, D. Bosnar, A. Ventura, A. Mengoni, and The n_TOF Collaboration,
Measurement of the $^{12}\text{C}(n, p)^{12}\text{B}$ integral cross section up to 10 GeV,
Eur. Phys. J. A, 52:101 (2016),

10 publications in 2016

130 since 2002



n_TOF Conference contributions in 2016



6th International Conference on Fission and Properties of Neutron-Rich Nuclei, November 6 - 12, 2016, Sanibel Island, Florida/USA

- M. Diakaki, L. Audouin, E. Berthoumieux, M. Calviani, Y. Chen, N. Colonna, E. Dupont, I. Duran, C. Guerrero, F. Gunsing, E. Leal-Cidoncha, L.-S. Leong, M. Mastromarco, C. Paradela, A. Stamatopoulos, D. Tarrio, L. Tassan-Got, A. Tsinganis, R. Vlastou and The n_TOF Collaboration,
Fission activities at the CERN n_TOF facility.

Int. Symposium Nuclei in the Cosmos XIV, June 19-24, 2016, Niigata/Japan

- C. Guerrero, C. Domingo-Pardo, J. Lerendegui-Marco, A. Casanovas, M.A. Cortes-Giraldo, R. Dressler, S. Halfon, S. Heinitz, N. Kivel, U. Köster, M. Paul, J. M. Quesada-Molina, D. Schumann, A. Tarifeño, M. Tessler, L. Weissman and The n_TOF and SARAF-LiLiT Collaborations,
Neutron capture cross sections of the s-process branching points ^{147}Pm , ^{171}Tm , and ^{204}Tl ;
- A. Musumarra and M. Barbagallo for The n_TOF Collaboration,
The cosmological lithium problem and the measurement of the $^7\text{Be}(n, \alpha)$ reaction at n_TOF-CERN;
- G. Tagliente and The n_TOF Collaboration,
Recent results in Nuclear Astrophysics at n_TOF/CERN.

Int. Conference on Nuclear Data for Science and Technology, Sept 11-16, 2016, Brugge/Belgium

- J. Balibrea, E. Mendoza, D. Cano Ott, E. Berthoumieux, C. Guerrero, and The n_TOF Collaboration,
Measurement of the neutron capture cross section of the fissile isotope ^{235}U with the CERN n_TOF total absorption calorimeter and fission tagging based on micromegas detectors;
- D. Cano-Ott, E. Berthoumieux, C. Guerrero, E. Mendoza, and The n_TOF Collaboration,
Measurement of the neutron capture cross section of the fissile isotope ^{235}U with the CERN n_TOF Total Absorption Calorimeter and a fission tagging based on micromegas detectors;
- E. Chiaveri on behalf of The n_TOF Collaboration
The n_TOF facility: neutron beams for challenging future measurements at CERN;
- M.A. Cortés-Giraldo, J. Lerendegui-Marco, C. Guerrero, J.-M. Quesada, S. Lo Meo, C. Massimi, Cristian, M. Barbagallo, N. Colonna, D. Mancusi, F. Mingrone, M. Sabaté-Gilarte, G. Vannini, V. Vlachoudis, and The n_TOF Collaboration,
Monte Carlo simulations of the n_TOF lead spallation target with the GEANT4 toolkit: A benchmark study;
- L. Cosentino and The n_TOF Collaboration,
Study of a proton recoil telescope for the measurement of the $^{235}\text{U}(n, f)$ fission cross section relative to n-p scattering at n_TOF;



n_TOF Conference contributions in 2016



- E. Dupont, N. Otsuka, O. Cabellos, and The n_TOF Collaboration,
Dissemination of data measured at the CERN n_TOF facility;
- C. Guerrero, C. Domingo-Pardo, M.-A. Cortes-Giraldo, S. Heinitz, U. Koester, J. Lerendegui,
M. Paul, J.-M. Quesada, D. Schumann, and The n_TOF Collaboration,
Time-of-flight and activation experiments on ^{147}Pm and ^{171}Tm for astrophysics;
- F. Gunsing for The n_TOF Collaboration,
The measurement programme at the neutron time-of-flight facility n_TOF at CERN;
- E. Leal-Cidoncha, C. Paradela, I. Duran, L.Tassan-Got, L.Audouin, M. Caamaño, L. C. Leal,
C. Le Naour, G. Noguerre, D. Tarrío, and the n_TOF Collaboration,
High accuracy $^{234}\text{U}(n, f)$ cross section in the resonance energy region;
- J. Lerendegui-Marco, C. Guerrero, D. Cano-Ott, M.-A. Cortés-Giraldo, K. Eberhardt, A. Junghans,
E. Mendoza, J.-M. Quesada, and The n_TOF Collaboration,
New measurement of the $^{242}\text{Pu}(n, \gamma)$ cross section at n_TOF-EAR1 for MOX fuels;

- C.

20 contributions to 3 conferences in 2016

- M

- E

- F

- M

180 since 2001

- The $^{33}\text{S}(n,\alpha)^{30}\text{Si}$ cross section measured at n_TOF EAR2 (CERN): from thermal to the resonance energy region;
- A. Stamatopoulos, A. Tsinganis, N. Colonna, R. Vlastou, P. Schillebeeckx, A. Plompen, J. Heyse,
M. Kokkoris, M. Barbagallo, M. Calviani, E. Berthoumieux, E. Chiaveri, and The n_TOF Collaboration,
Measurement of the $^{240}\text{Pu}(n,f)$ cross-section at the CERN n_TOF facility: first results from Experimental Area II (EAR-2).



Summary and conclusions



- Data analysis going on full steam on the experiments performed in 2016
- Shutdown activities: well on track to be ready for the 2017 start-up
- A lot of very interesting experiments to be planned and performed before the LS2