n_TOF Report

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on behalf of the n_TOF Collaboration (http://www.cern.ch/nTOF)

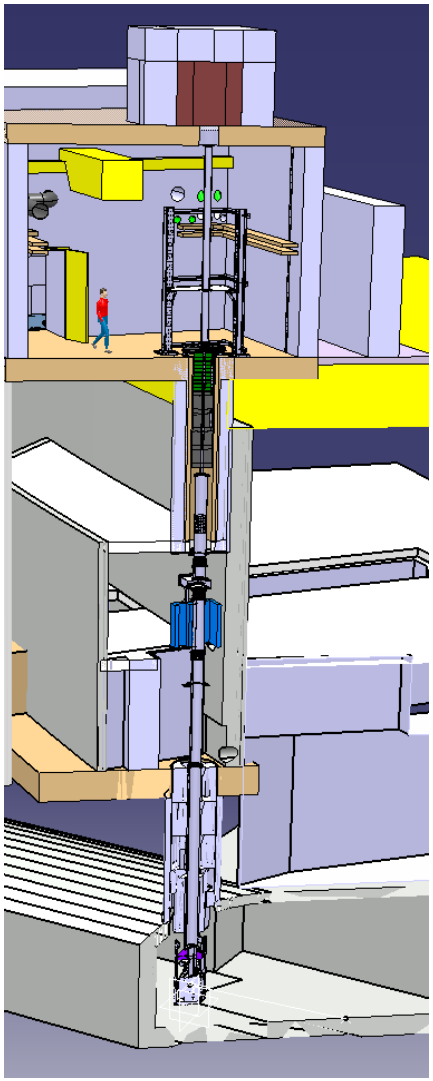
Outlook

- Introduction
- Protons delivered in 2014
- Experimental program at n_TOF in 2014
- Commissioning EAR1+2
- Measurements in 2014
  - EAR1
  - EAR2
- Outlook

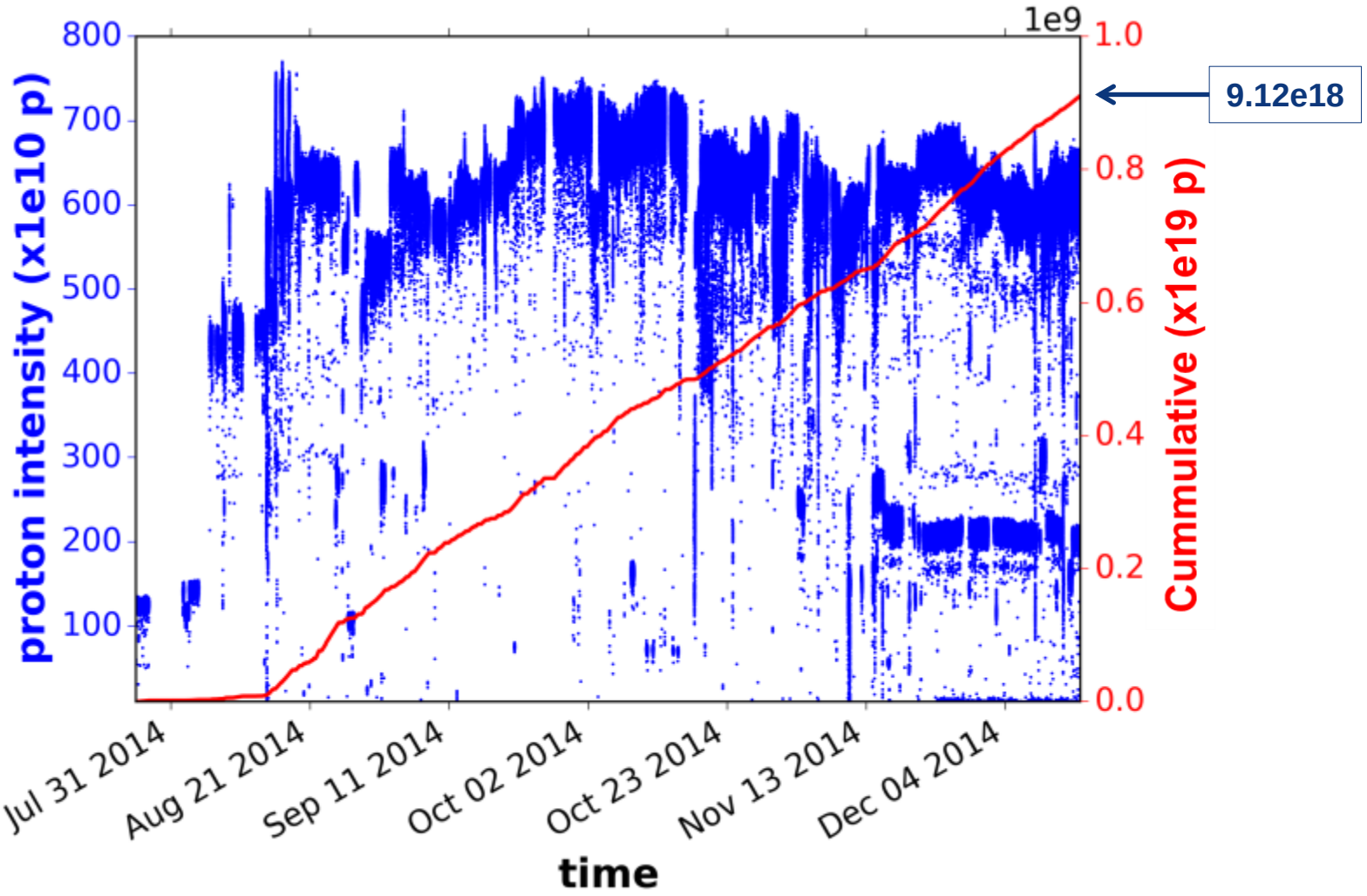
n_TOF in 2014

Main changes at n_TOF during LS1:

- New vertical flight path EAR2
- Beam line modifications for EAR1
- New DAQ system for n_TOF
- First beam on 25.07.2014



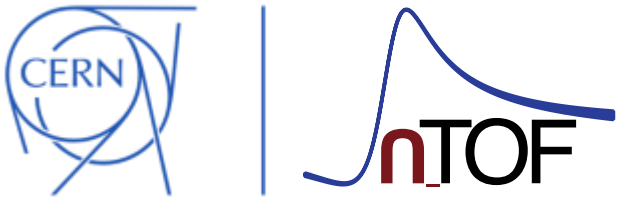
Protons received from PS in 2014



n_TOF Experimental Program 2014

EAR1 Dates	Campaign	**EAR2** Dates	Campaign
25.7. - 5.10.	**Re-commissioning**	25.7. – 12.11.	**Commissioning**
6.10. - 13.11	**73Ge(n,g)**	13.11. – 15.12.	**240Pu(n,f)**
14.11. - 15.12.	**171Tm(n,g)**	1.12. – 15.12.	**7Be(n,α) test**
9.12e18 protons on target in 2014			

Commissioning EAR1+2



Commissioning EAR1+2

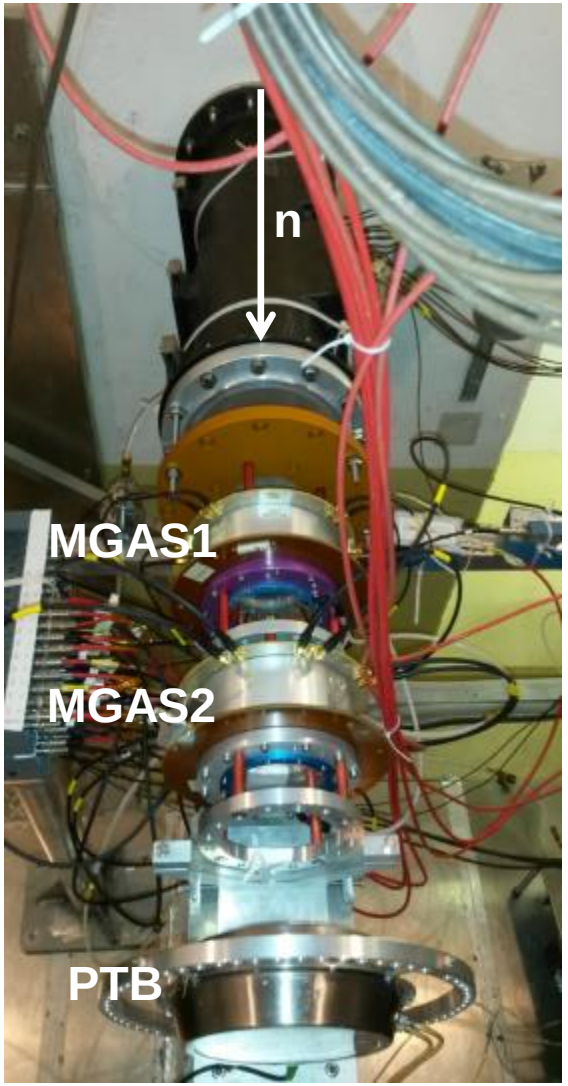
CERN-INTC-2014-008 / INTC-P-407 and CERN-INTC-2013-043 / INTC-P-399

- Measurements of:
  - Flux: PTB, MGAS, SILI ⟵
  - Profile: Si2D ⟵
  - Resolution: Fe(n,γ)
  - Backgrounds (^{3}He, Scintillators, MGAS, CR-39)
  - Detector tests (Ge, new scintillators, solid-state detectors)
- Commissioning of new DAQ
- Upgrade of timing system
- Alignment of laser system
- …

Commissioning EAR1+2: Neutron Flux

CERN-INTC-2014-008 / INTC-P-407 and CERN-INTC-2013-043 / INTC-P-399

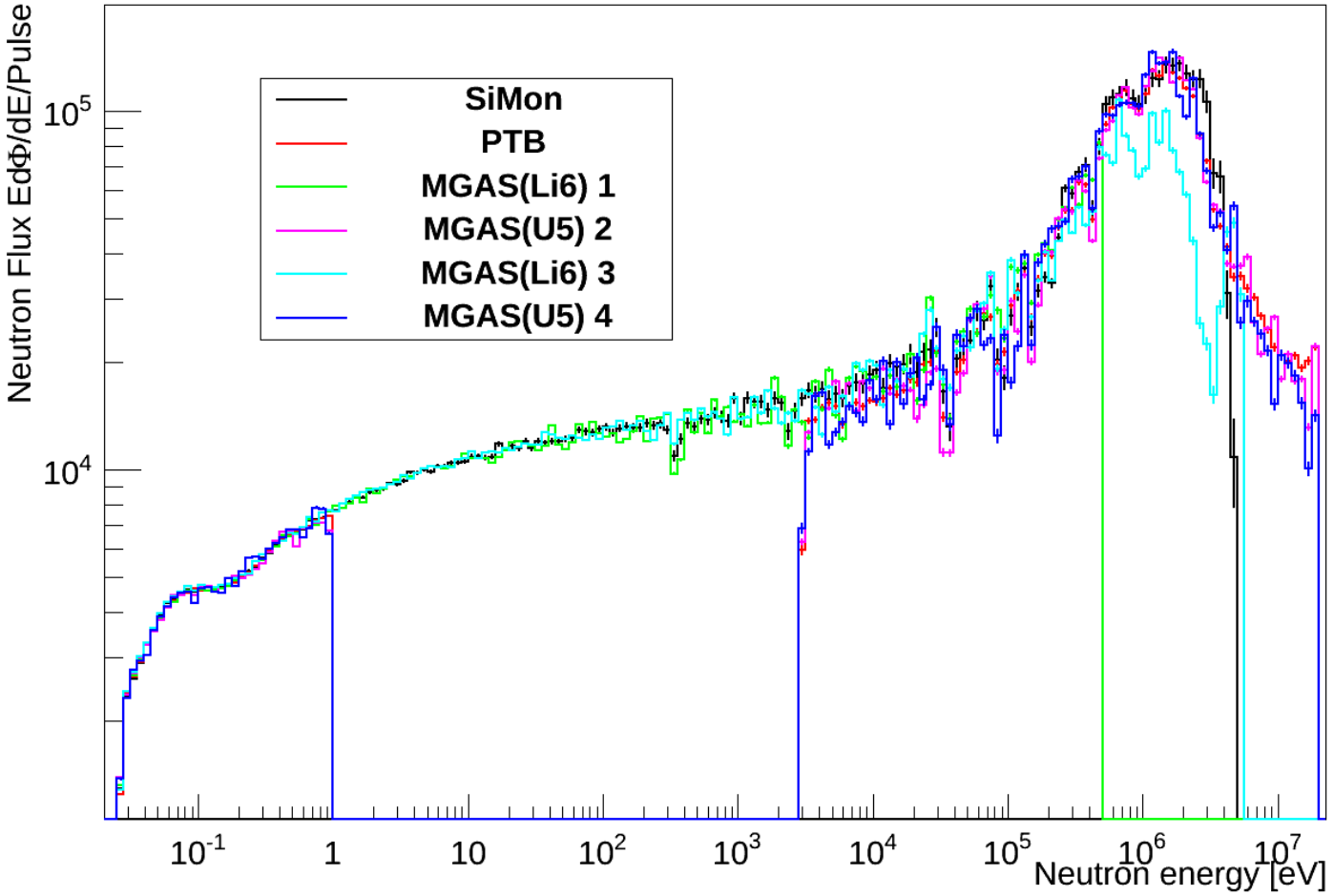
1. Calibration of flux detectors with PTB chamber in EAR1.
2. Flux measurements:
   - EAR1: PTB, MGAS, SiMon1
   - EAR2: MGAS, SiMon2
3. Data analysis ongoing – results preliminary!



Commissioning EAR1+2: Neutron Flux

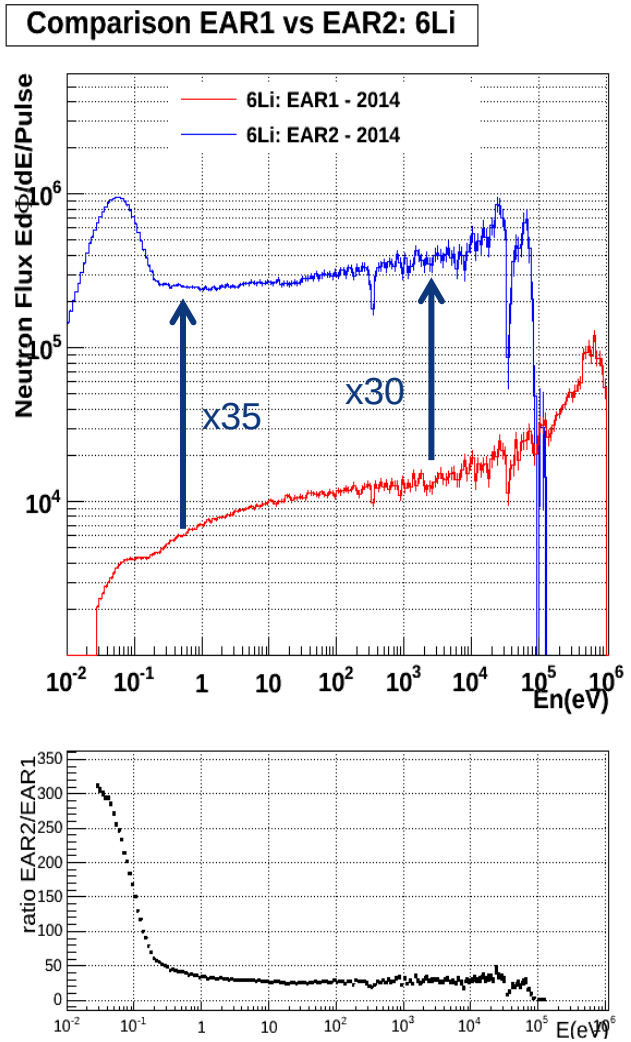
CERN-INTC-2014-008 / INTC-P-407 and CERN-INTC-2013-043 / INTC-P-399

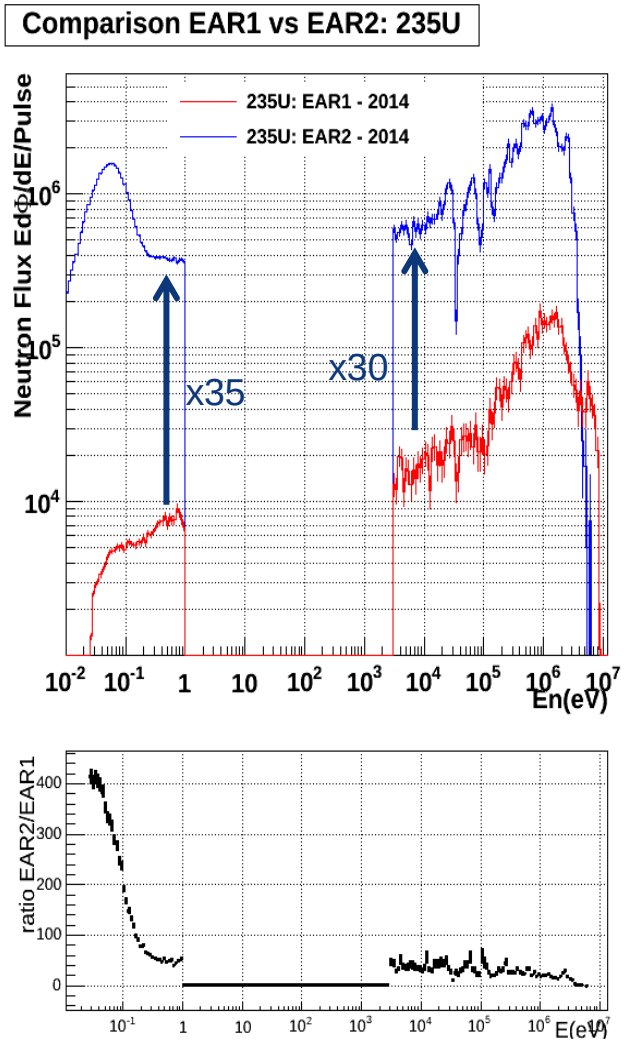
Normalized to PTB @ thermal



Commissioning EAR1+2: Neutron Flux

CERN-INTC-2014-008 / INTC-P-407 and CERN-INTC-2013-043 / INTC-P-399





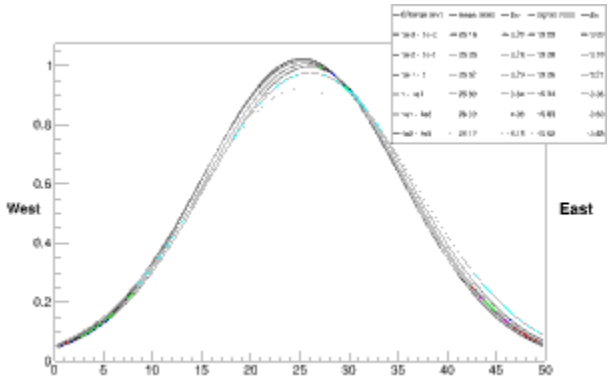
Commissioning EAR1+2: Beam Profile

CERN-INTC-2014-008 / INTC-P-407 and CERN-INTC-2013-043 / INTC-P-399

- Beam Profile measurements:

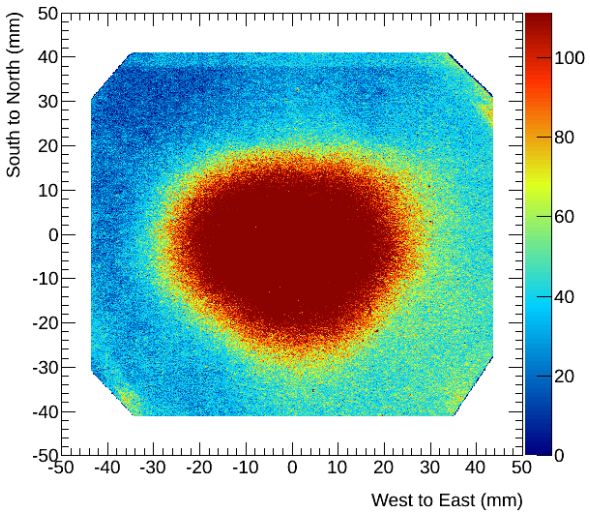
1. Low energy neutron beam:
   - Si2D detector with ^{6}Li-converter

   Gaussian beam in EAR1+2.

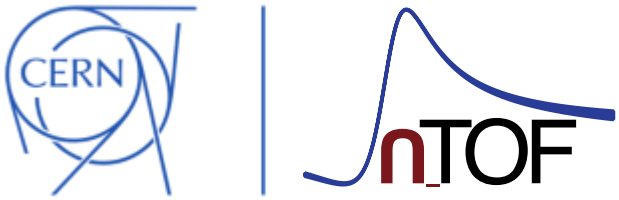


2. High energy neutron beam + photons:
   - Medipix detector
   - CR-39 detectors (passive)
   - Gafchromic foils (passive)

   Bottom part of beam line visible in EAR2, for E_n > MeV.

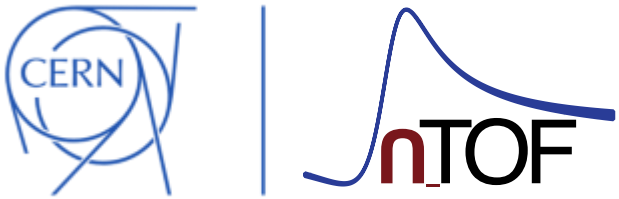


Measurements EAR1



EAR1

^{73}Ge(n,γ)



^{73}Ge(n,γ) Measurement

CERN-INTC-2013-021 / INTC-P-381

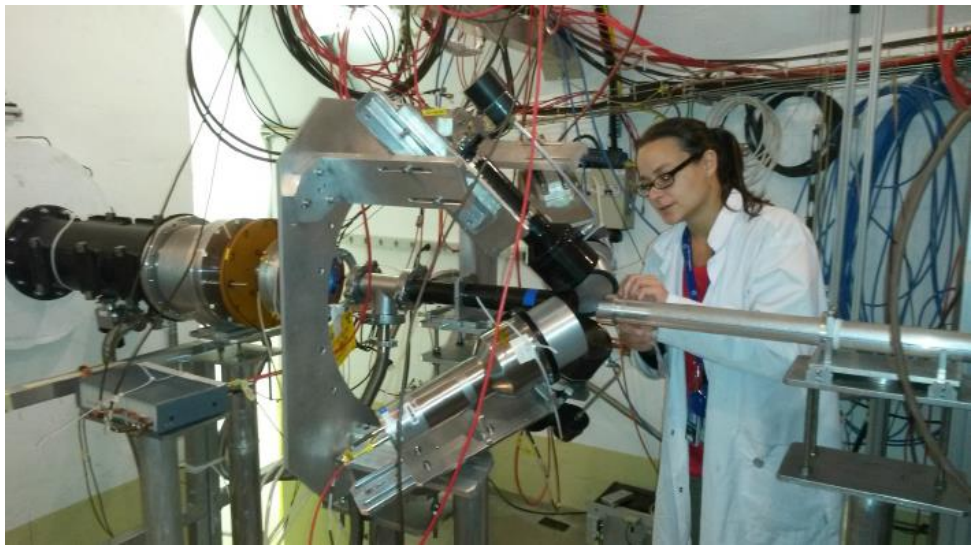
- Sample: GeO_2 enriched in 73Ge (2000 g elemental weight):

Isotopic Distribution

ISOTOPE	Ge-70	Ge-72	Ge-73	Ge-74	Ge-76
CONTENT (%)	0.04	2.84	96.07	1.03	0.02

- Powder sample was prepared as stable 2 cm diameter cylinder at PSI (S. Heinitz)

- Measurement with 4 C6D6 detectors (2xB6D6, 2xL6D6)

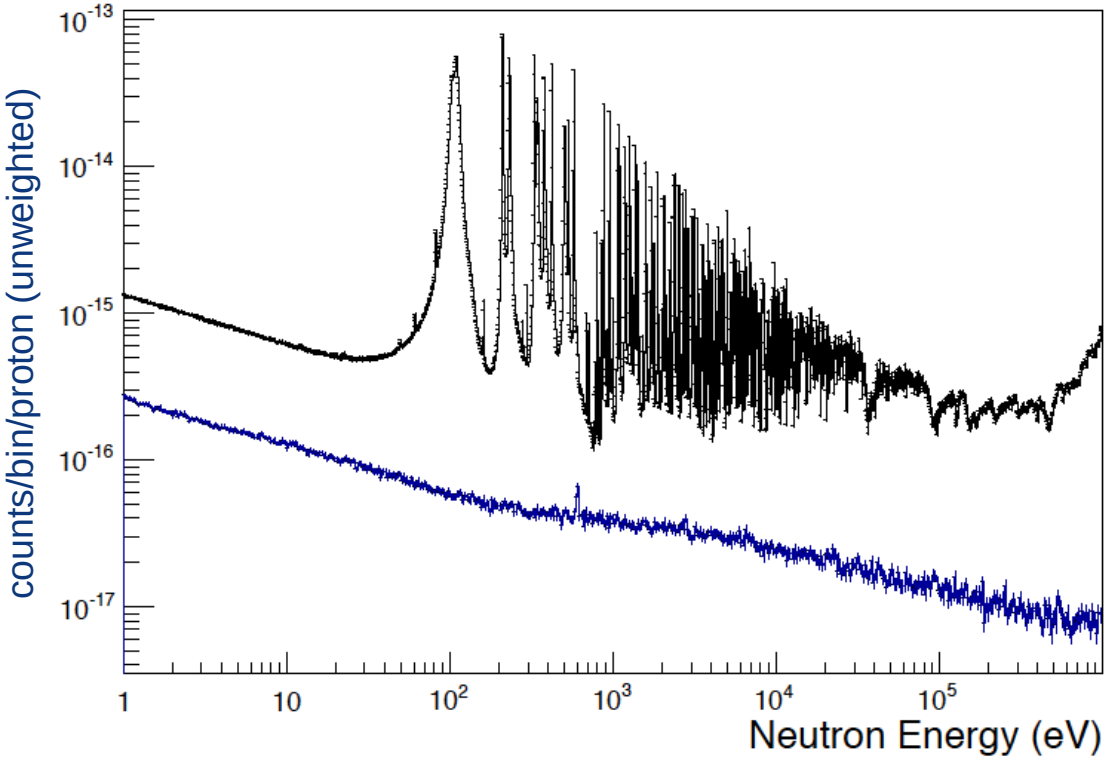


^{73}Ge(n,γ) Measurement

CERN-INTC-2013-021 / INTC-P-381

- Good signal to background ratio for this measurement.
- Unknown resonances already observed in the data, in comparison with ENDF/B-VII.

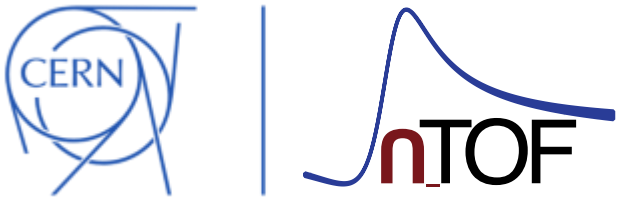
✓First ^{73}Ge(n,γ) measurement over full neutron energy range!



- L6D6 detectors showed non-linearity in calibrations
  => to be investigated during this winter shutdown.

EAR1

^{171}Tm(n,γ)



^{171}Tm(n,γ) Measurement

CERN-INTC-2014-003 / INTC-P-404

^{171}Tm sample (300 mSv/h at 40cm):

- Isotope production @ILL:

  ^{171}Tm: ^{170}Er(n,γ)^{171}Er (β^-, 7.5h)^{171}Tm (enrichment 1.8%)

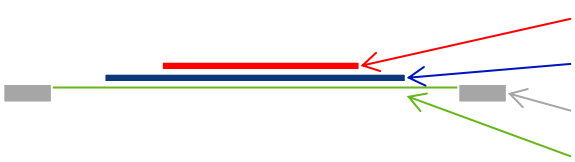
  → 3.6 mg of ^{171}Tm (1.9 y) [1.3x10^{19} atoms]

- Chemical separation @PSI:

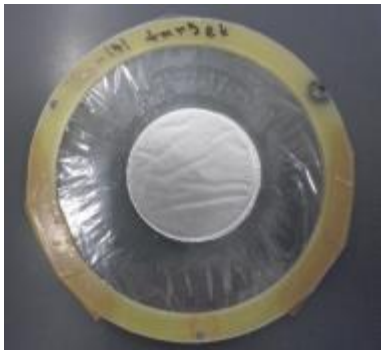
  Final comp.: ^{171}Tm (97.9%) + ^{169}Tm (2.1%) + ^{170}Tm(0.07%)

- Sample preparation @PSI:

Sketch



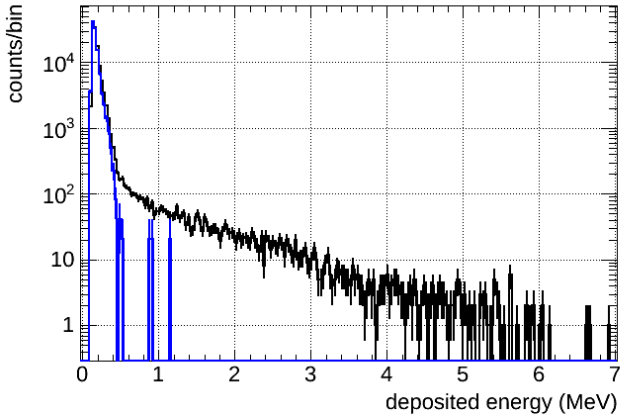
Assembly mounted

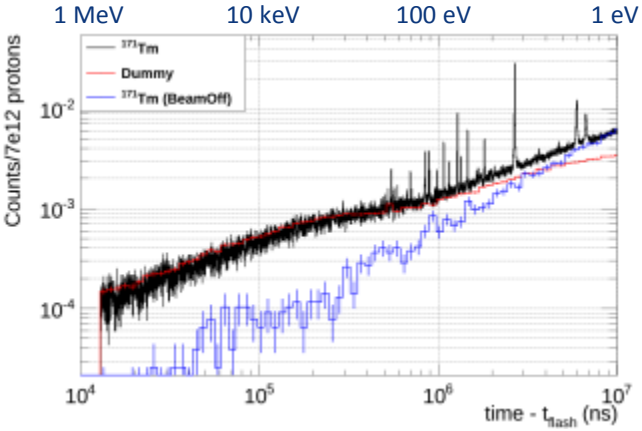


^{171}Tm(n,γ) Measurement

CERN-INTC-2014-003 / INTC-P-404

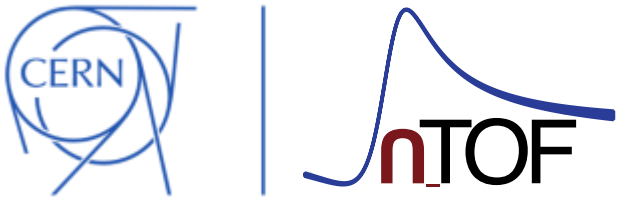
- Measurement with 4 B6D6 detectors.
- Sample activity dominates below 500 keV deposited energy.
- Gain-drift of the detectors due to the activity of the sample observed – regular calibrations were performed during the campaign.
- Resonances were observed up to 800 eV (limited statistics).
- Above 1 keV background dominating -> no resonances observed.





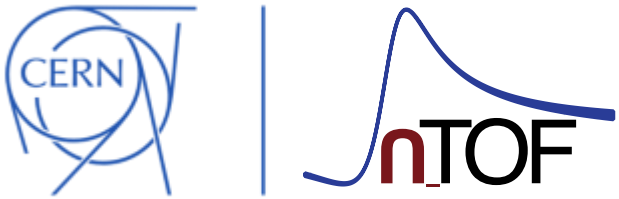
✓**First ever ^{171}Tm(n,γ) measurement successful!**

Measurements EAR2



EAR2

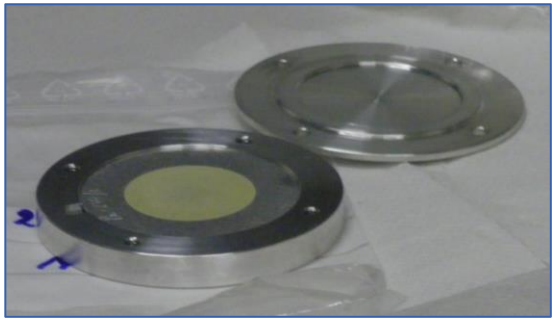
^{240}Pu(n,f)



^{240}Pu(n,f) Measurement

CERN-INTC-2014-051 / INTC-P-418

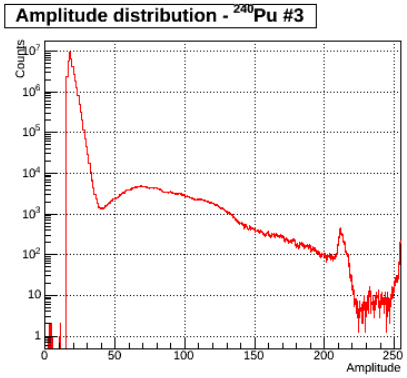
- Measurement during Phase 2 in EAR1 not successful:
  1. Detector deterioration over time (2 years!).
  2. Spontaneous fission rate – dominant in sub-threshold region.
- New measurement in EAR2:
  - ⇒ Higher flux = shorter measurement time.
  - ⇒ Shorter time window per pulse = signals dominate over spontaneous fission.
- Samples from IRMM:
  Three $^{240}PuO_2$ (99.89%) deposits of 3 cm diameter on 0.25 mm Al backing: 25.7 MBq
- Reference samples:
  - ^{235}U (~90μg/cm^2)
  - ^{238}U (~110μg/cm^2)

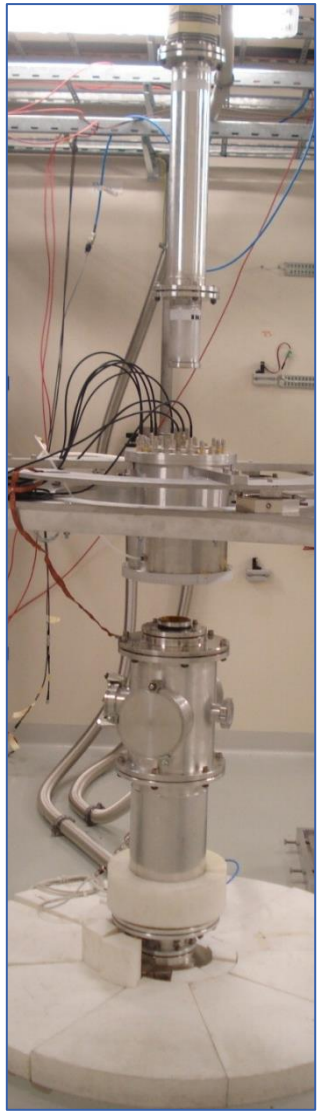


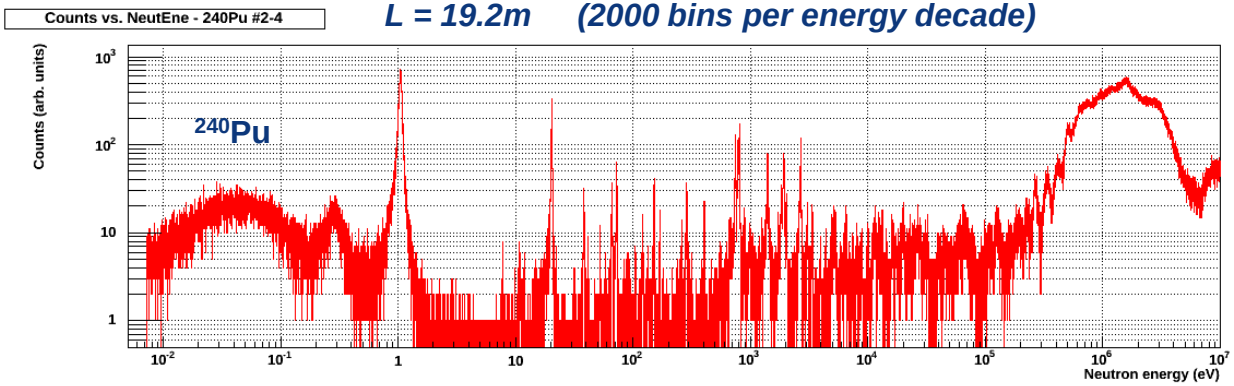
^{240}Pu(n,f) Measurement

CERN-INTC-2014-051 / INTC-P-418

- Measurement with MGAS detectors.
- Good α-FF separation.
- Small, manageable gain loss observed (8 days).
- Many resonances visible in sub-threshold region.



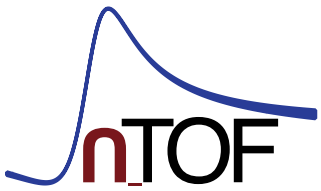




✓ ^{240}Pu(n,f) measurement successful in EAR2!

EAR2

^{7}Be(n,α) Test Measurement

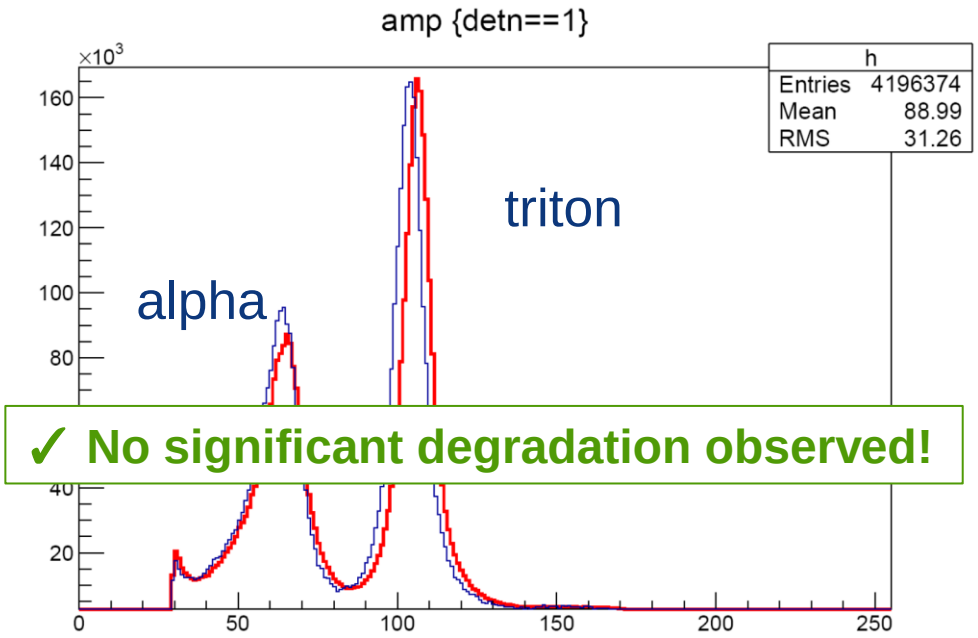


^{7}Be(n,α) Test Measurement

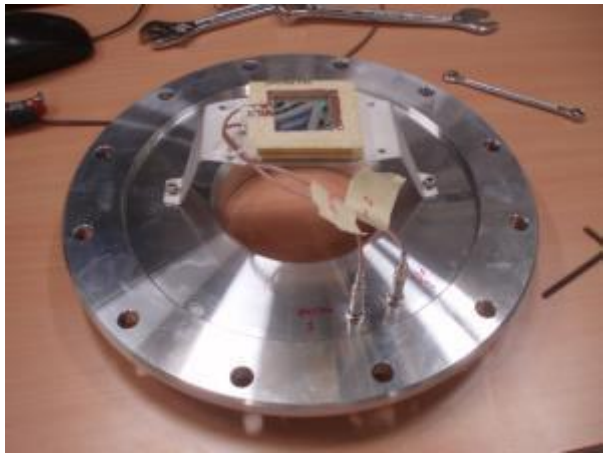
CERN-INTC-2014-049 / INTC-P-417

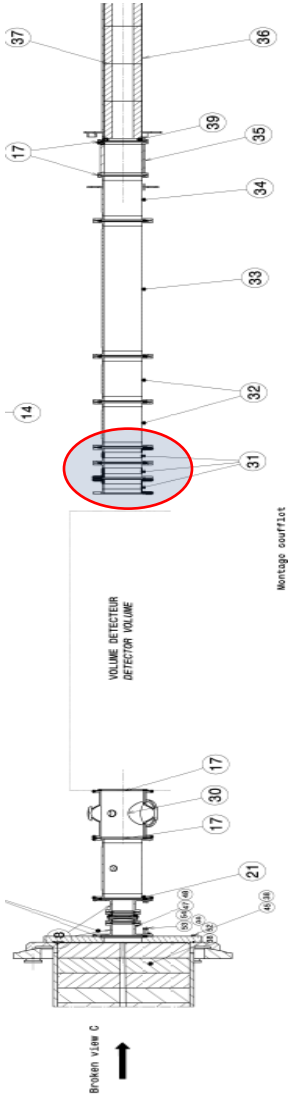
EAR2

- Study of (possible) degradation of the detector performance.
- Sandwich of Silicon detectors (140 mm, 3x3 cm^2).
- LiF converter (105 mg/cm^2) on mylar foil.
- Installed at the lower part of the beam dump in EAR2.

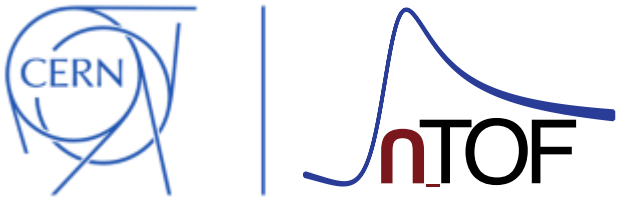


✓ **No significant degradation observed!**





Outlook



Proposals EAR1

n_TOF EAR1 Proposal Document #	Field of interest	Protons
Neutron capture at the s-process branching points 171Tm and 204Tl CERN-INTC-2014-003 / INTC-P-404	Astrophysics	7.5E+18
Neutron capture cross sections of 70;72;73;74;76Ge at n TOF EAR-1 CERN-INTC-2013-021 / INTC-P-381	Astrophysics	1.2E+19
Radiative capture on 242Pu for MOX fuel reactors CERN-INTC-2013-027 / INTC-P-387	Nuclear Tech.	3.5E+18
Measurements of neutron induced capture and fission reactions on 233U CERN-INTC-2013-041 / INTC-P-397	Nuclear Tech.	4.3E+18
SiMon and Micromegas tests for (n,p) measurements at n_TOF: 35Cl(n,p)35S and 14N(n,p)14C Cross Sections. CERN-INTC-2014-007 / INTC-I-156	Medical App.	2.0E+17 (parallel)
High accuracy measurement of the 235U(n,f) reaction cross-section in the 10-30 keV neutron energy range CERN-INTC-2014-048 / INTC-P-416	Nuclear Tech.	1.5E+18
The (n,α) reaction cross-section measurement for light isotopes *CERN-INTC-2015-001 / INTC-P-430*	*Basic Physics*	1E+18
Neutron-induced fission cross-section of 237Np obtained with two different detection systems *CERN-INTC-2015-007 / INTC-P-431*	*Nuclear Tech.*	2E+18 in EAR1

Proposals EAR2

n_TOF EAR2 Proposal Document #	Field of interest	Protons
Commissioning of n_TOF EAR2 CERN-INTC-2013-043 / INTC-P-399	Commissioning	9.8E+18
γ-ray Energy Spectra and Multiplicities from the Fission of 235U using STEFF CERN-INTC-2014-004 / INTC-P-405	Nuclear Tech.	3.0E+18
Measurement of the neutron capture cross-sections of 53Mn at EAR-2 CERN-INTC-2014-012 / INTC-P-408	Astrophysics	3.5E+18
Destruction of the cosmic γ-ray emitter 26Al by neutron induced reactions CERN-INTC-2014-006 / INTC-P-406	Astrophysics	5.0E+18 (parallel)
Tackling the s-process stellar neutron density via the 147Pm(n,γ) reaction CERN-INTC-2014-047 / INTC-P-415	Astrophysics	2.0E+18
Neutron-induced fission cross-section of 237Np obtained with two different detection systems *CERN-INTC-2015-007 / INTC-P-431*	*Nuclear Tech.*	2E+18 in EAR2
Letter of Intent for a neutron imaging station at n_TOF EAR2 *CERN-INTC-2014-070 / INTC-I-160*	*Radiography*	6E+17

Outlook

- This INTC meeting:

  2 Proposals + 1 Letter of Intent from n_TOF.

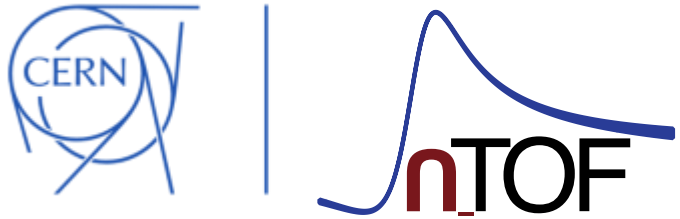
- Measurement program for 2015 to be discussed at the next n_TOF collaboration meeting.

  Most likely, we will start with:

  - EAR1: capture measurement.
  - EAR2: finalizing the commissioning.

We look forward to the beam time in 2015:

7. April – 16. November 2015



Thank you for your attention.