Status of the n_TOF experiment

E.Chiaveri

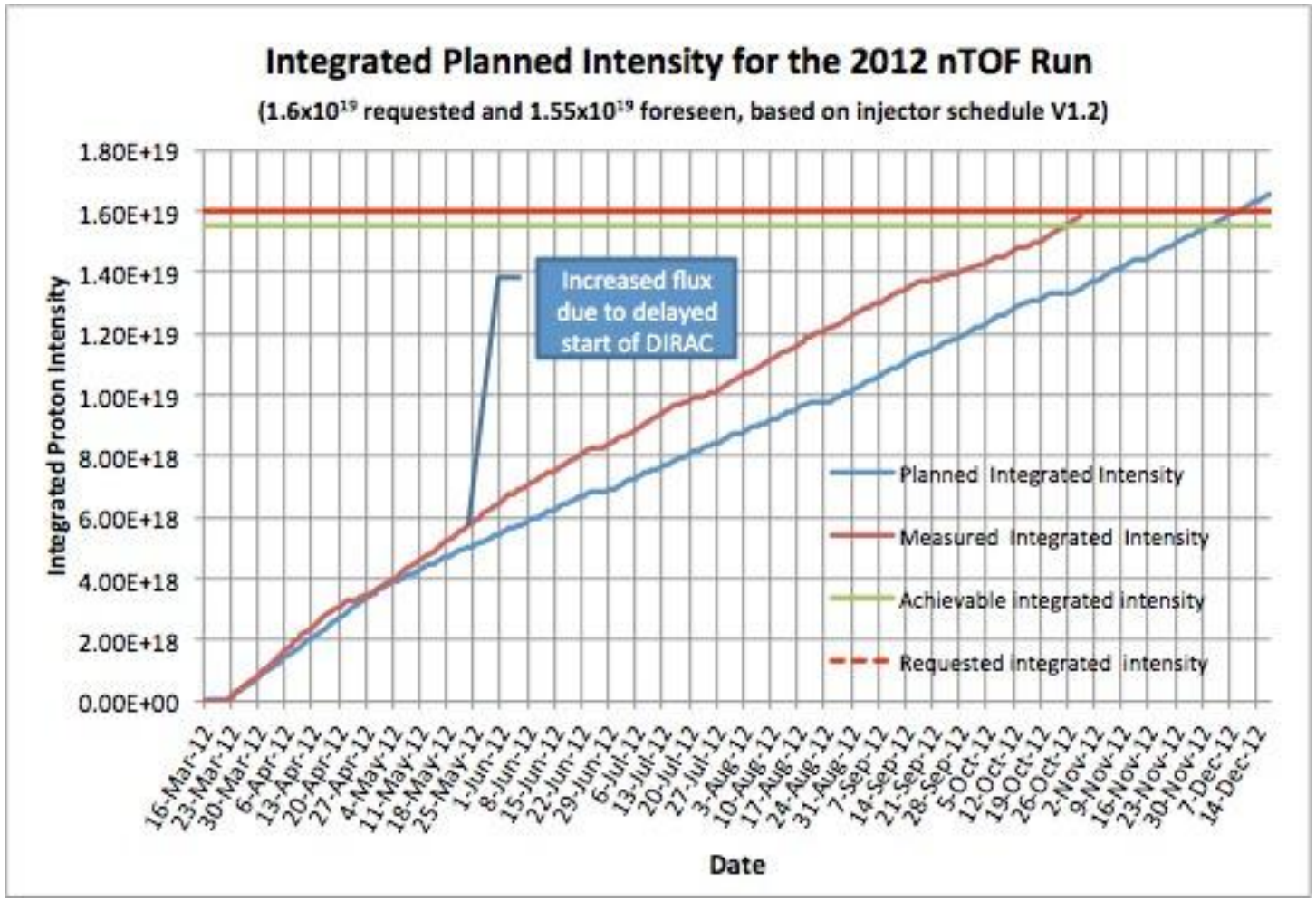
(EN-STI-EET)

On behalf of n_TOF collaboration

Outline

- ✓ Experimental campaign 2012
- ✓ EAR2 (experimental Area 2)
- ✓ Summary

Proton status



THANKS TO THE PS TEAM !

List of Experiments 2012

1. **Neutron capture cross section of 25Mg and its astrophysical implications**
   - CERN-INTC-2012-003 / INTC-P-320
2. **Micromegas detector for 33S(n,a) cross section measurement at n_TOF**
   - CERN-INTC-2012-006 / INTC-P-322
3. **The (n, a) reaction in the s-process branching point 59Ni**
   - CERN-INTC-2012-011 / INTC-P-327
4. **Fission Fragment Angular Distributions in the 234U(n,f) and 236U(n,f) reactions**
   - CERN-INTC-2012-016/ININTTCC-P-P-3-3030
5. **Measurements of neutron-induced capture and fission reactions on U-235: cross sections and alpha ratios, photon strength functions and prompt gamma-ray from fission**
   - CERN-INTC-2011-045 / INTC-P-309

List of Experiments 2012

6. **Neutron capture cross section of 93Zr**
   - CERN-INTC-2011-046 / INTC-P-310
7. **Measurement of the fission cross-section of ^{240}Pu and ^{242}Pu at CERN's nTOF Facility**
   - CERN-INTC-2010-042; INTC-P-280
8. **Spin assignments of nuclear levels above the neutron binding energy in 88Sr**
   - CERN-INTC-2011-030 / INTC-P-304

Spin assignments of ^{87}Sr + n resonances

Goal:

- Obtain spins of nuclear levels excited by ^{87}Sr + n for level density studies.
- Neutron resonances correspond to nuclear levels with energy, spin, parity.
- All current level density models are calibrated to neutron resonance data.

Experiment:

- Measurement: gamma-ray spectra and multiplicities of ^{87}Sr+n with BaF_2 TAC.
- Method: exploit gamma-ray multiplicity distributions for different spins.
- Sample: 287 mg enriched (87.7%) ^{87}Sr

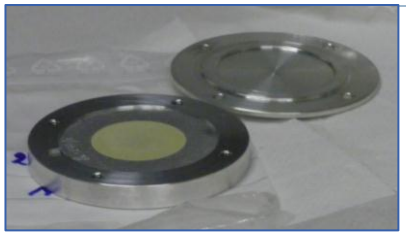
Status:

- Data have been taken in summer 2012
- New type of experiment at n_TOF, data handling procedures need optimization
- Analysis is ongoing

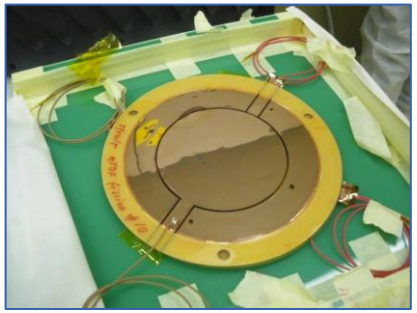
CERN-INTC-2011-030 / INTC-P-304

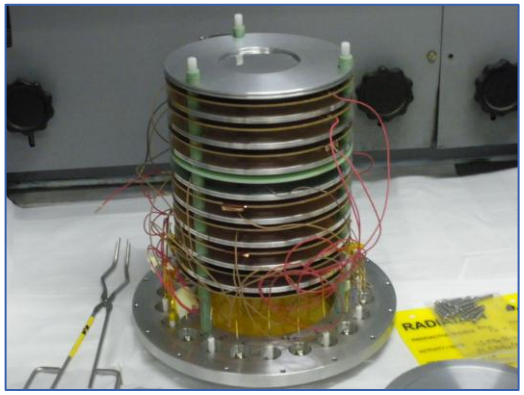
^{240,242}Pu(n,f) with Micromegas detectors

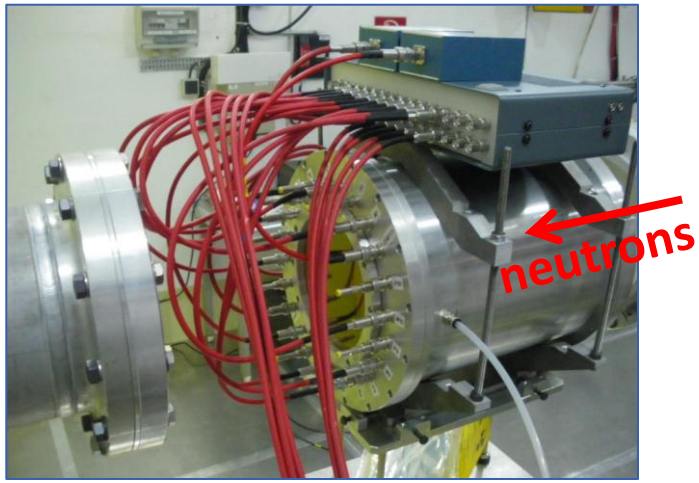
CERN-INTC-2012-016/ININTTCC-P-P-3-3030



- Eight (8) samples (4 x ^{240}Pu, 4 x ^{242}Pu) received from IRMM (Geel)
  - 3 cm diameter PuO_2 deposit
  - 0.25 mm aluminium backing (5cm diameter)
- U-235 reference sample also included
- Measurement carried out with Micromegas detectors mounted in custom-made chamber
- Micromegas chamber placed downstream from the TAC (@188.7m flight-path)





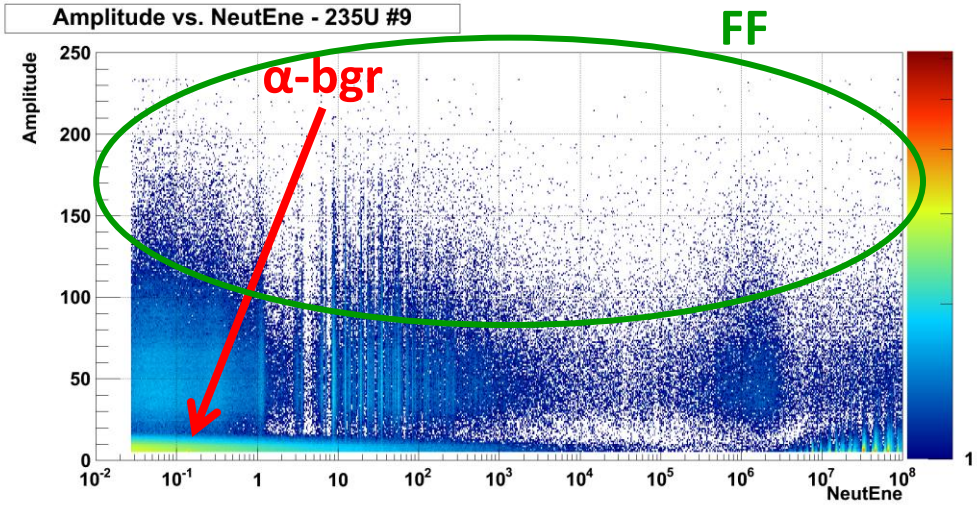


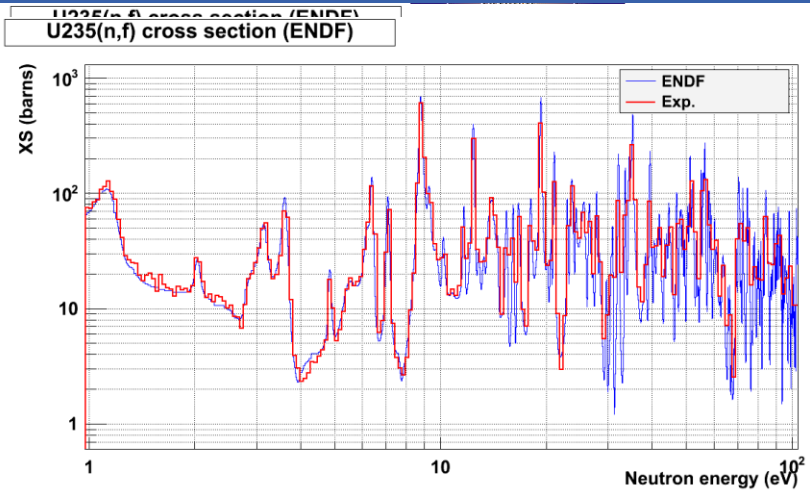
- Data-taking has been completed!
- Run summary:
  - 5.59 x 10^{18} (2011) + 7.89 x 10^{18} (2012) → 1.35 x 10^{19} protons
  - Original proposal (CERN-INTC-2010-042 / INTC-P-280) called for 8.0 x 10^{18} protons
    - The proposal was based on higher sample mass and assuming the fission collimator setup
    - Nevertheless, the measurement has been fully carried out in parallel mode → No impact on proton budget

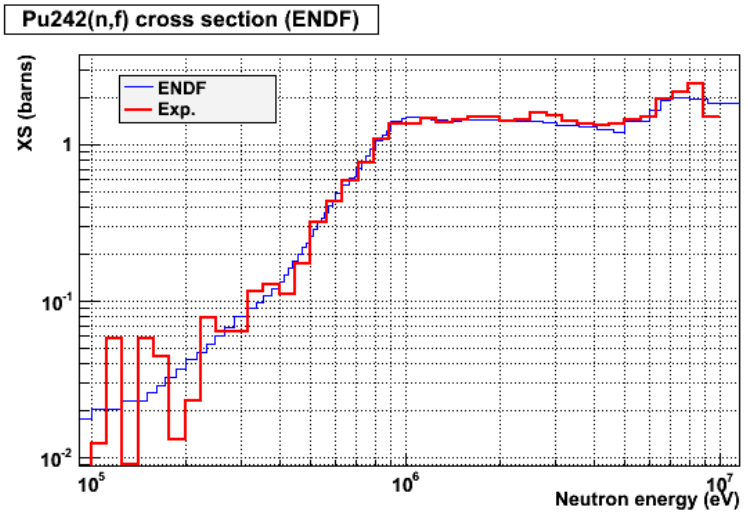
^{240,242}Pu(n,f) with Micromegas detectors

CERN-INTC-2012-016/ININTTCC-P-P-3-3030

- Data analysis is ongoing: raw data analysis routine has been written, analysis software has been written (v.1)
- Analysis of Pu-240 is challenging due to high α-activity (>6MBq per sample)
- Background studied using beam-off runs







(Preliminary plots for ~3% of total statistics)

The (n, a) reaction in the s-process branching point 59Ni

CERN-INTC-2012-011 / INTC-P-327

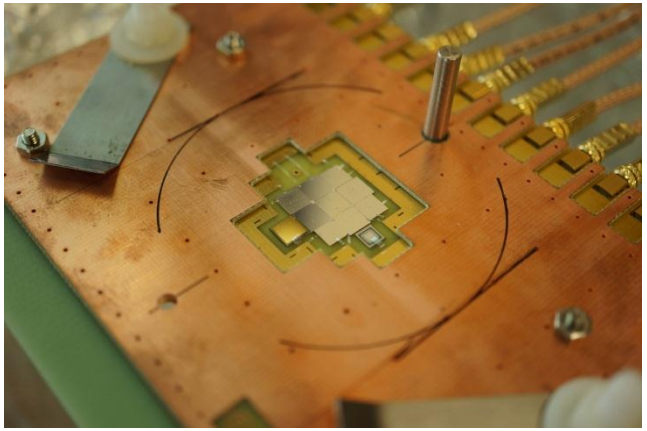
CERN-INTC-2012-011(INTC-P-327)

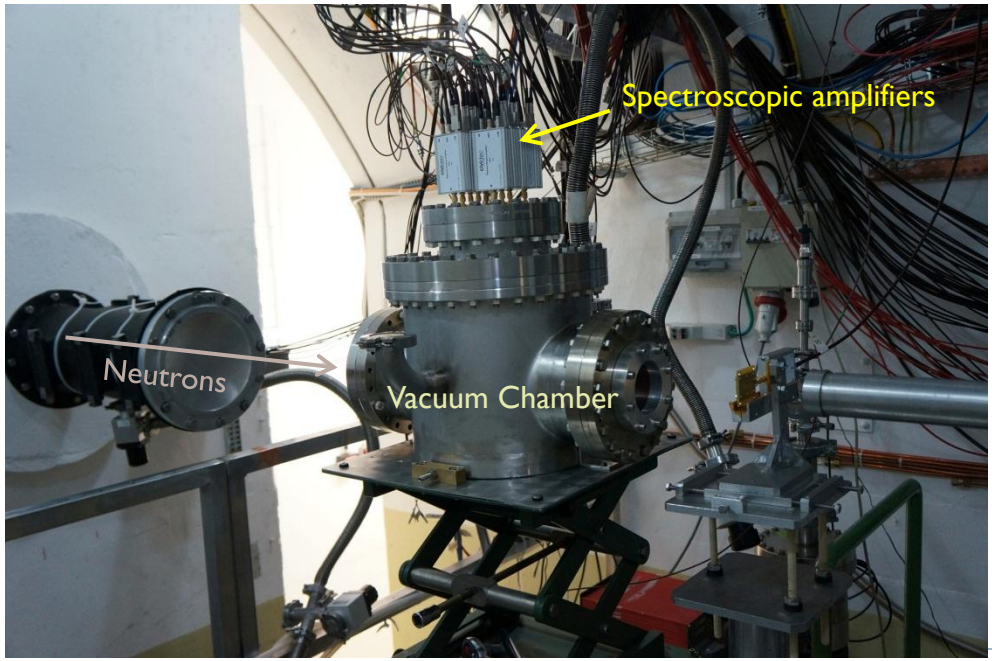
The (n, α) reaction in the s-process branching point ^{59}Ni

Measurement on-going, started on 15.10.2012:

- Diamond mosaic – detector:
  9 sCVD diamonds of 150 μm thickness [1)]
- Dedicated electronics [1)]
- Measurement under vacuum

=> High resolution spectroscopic measurement





- Sample:
  - 180 μg metallic Ni (95% ^{59}Ni)
  - 205 μg LiF (95% ^{6}Li)
  electro-plated on Pt foil

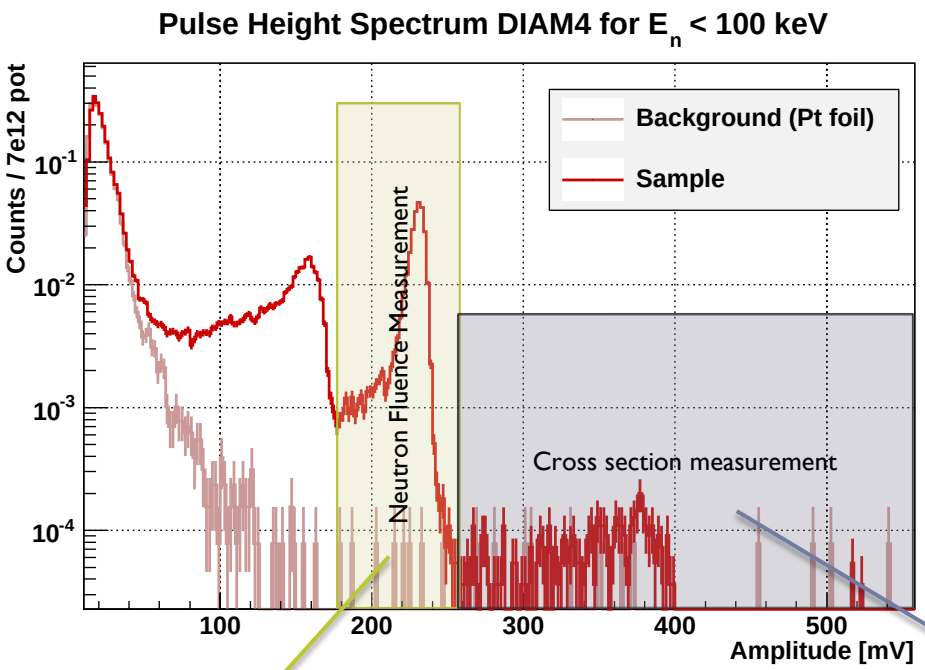
⇒ Neutron fluence and

⇒ Cross-section measurement in parallel

[1)] Sponsored by CIVIDEC Instrumentation GmbH

CERN-INTC-2012-011(INTC-P-327)

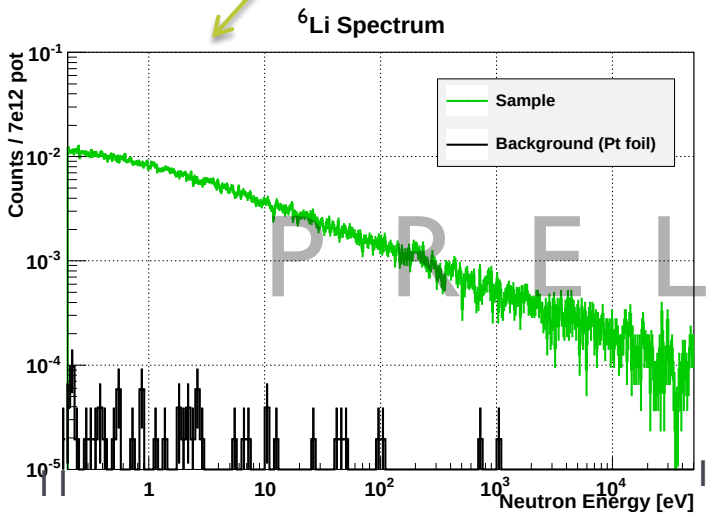
The (n, α) reaction in the s-process branching point ^{59}Ni

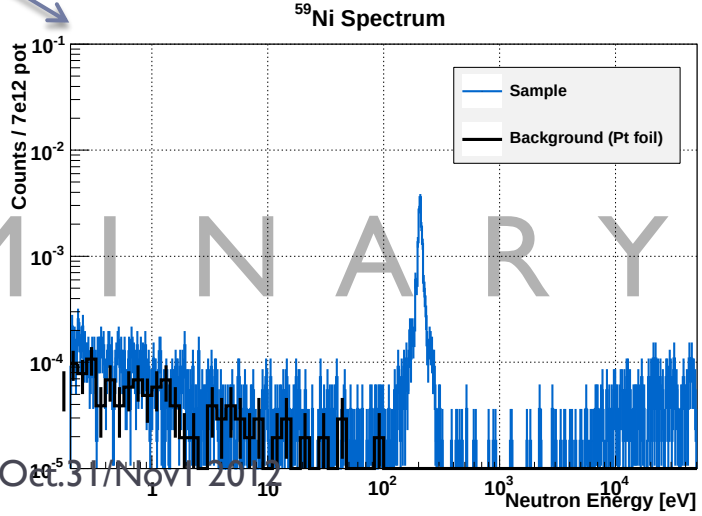


Spectroscopic measurement:
Charged particles can be distinguished in pulse height spectra

⇒ Amplitude cuts for

1. Tritons from ^{6}Li(n, α)t
2. Alphas from ^{59}Ni(n, α)^{56}Fe





CERN-INTC-2011-045 / INTC-P-309
06/10/2011

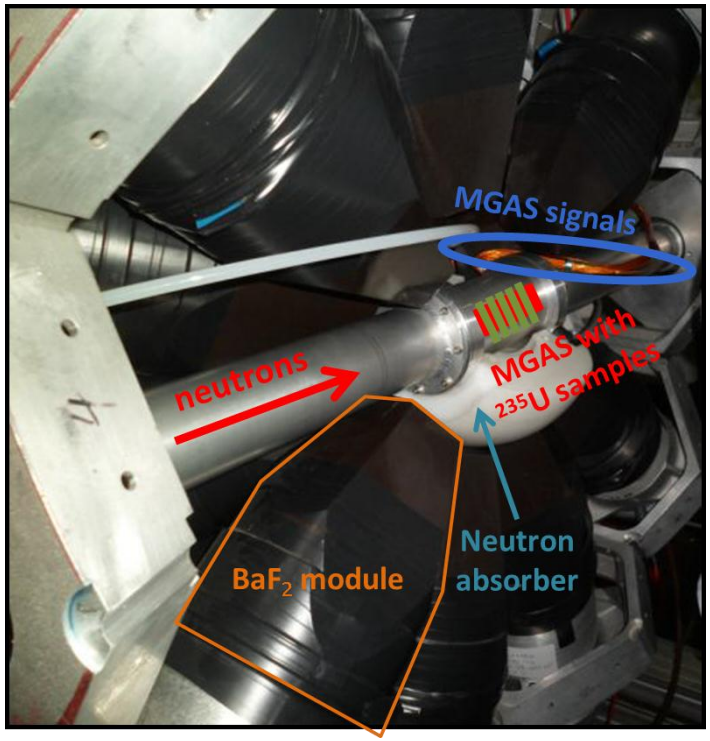
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

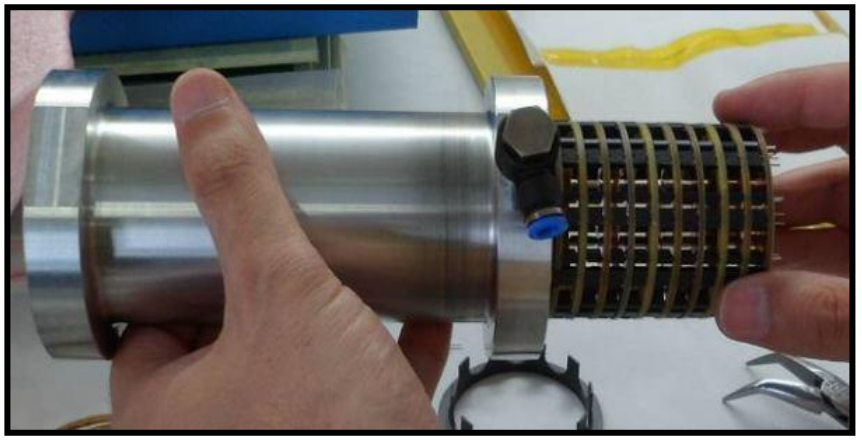
Proposal to the ISOLDE and Neutron Time-of-Flight Committee

Measurements of neutron-induced capture and fission reactions on ^{235}U: cross sections and α ratios, photon strength functions and prompt γ-ray from fission

October, 5 2011

C. Guerrero1, E. Berthoumieux2, D. Cano-Ott3 and the n_TOF Collaboration4





Follow up of the test measurement:
C. Guerrero et al., "*Simultaneous measurement of neutron capture and fission reactions at CERN*", Eur. Phys. J. A (2012) 48:29

- ✓ Front cover of the Eur. Phys. J (March 2012)
- ✓ Selected as Highlight in EuroPhysics News

CERN-INTC-2011-045 / INTC-P-309
06/10/2011

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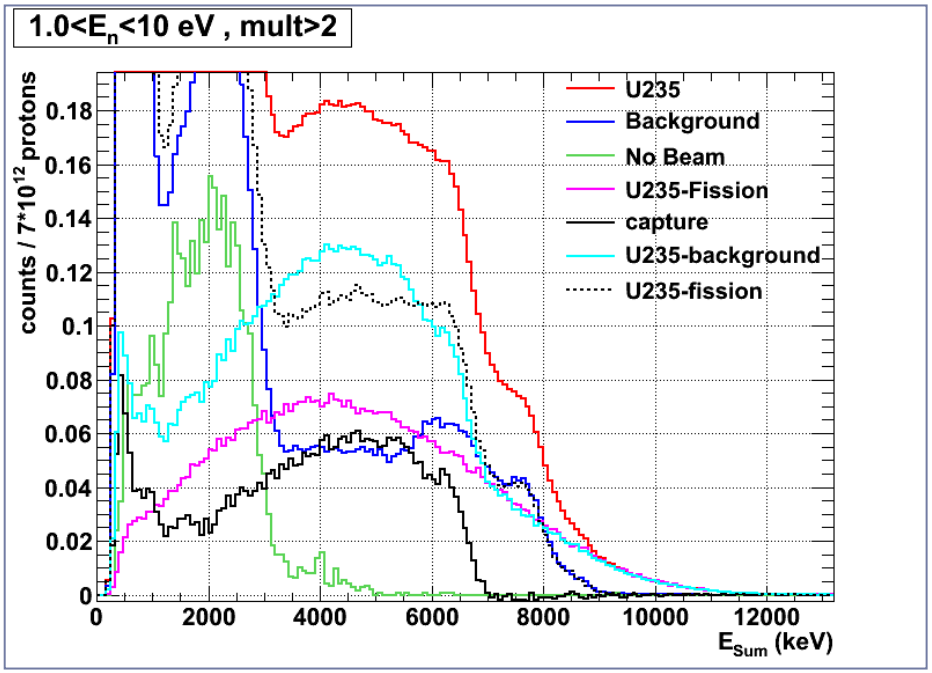
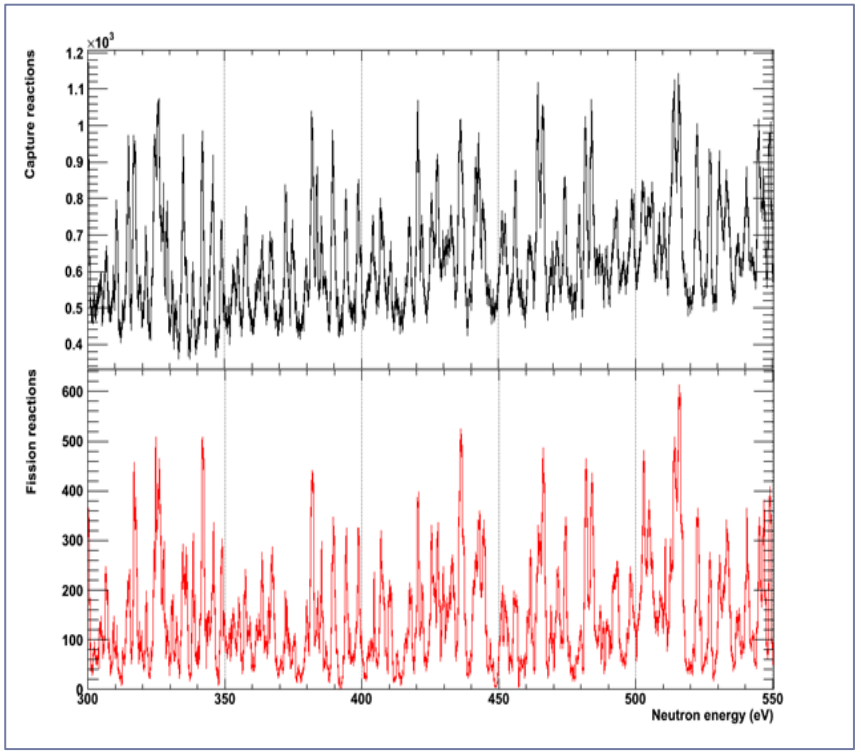
Measurement carried out successfully between July and October 2012.

→ 10 samples of highly enriched ^{235}U (4.1 mg each)





Detector tests at n_TOF

1. **Test of HPGe detectors for (n,n') and (n,2n) measurements in EAR1 and EAR2**
   [NTUA (Greece), CERN]

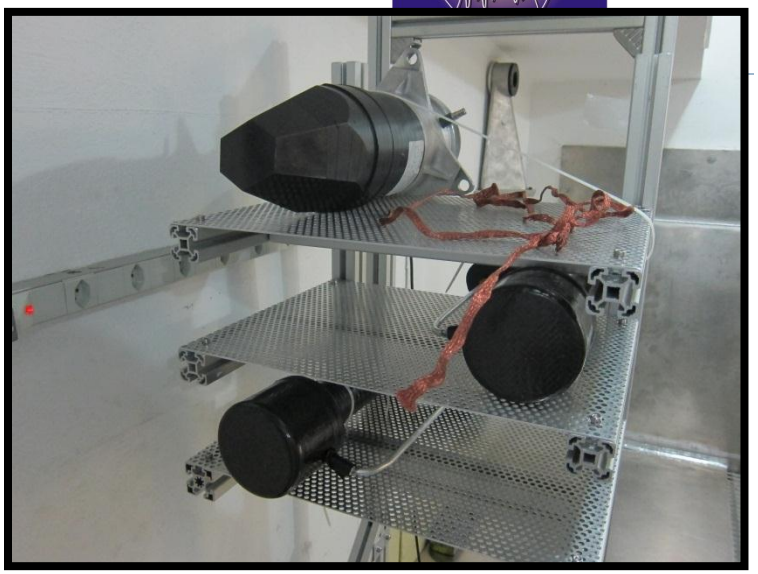
2. **Test of $LaCl_3$ and $LaBr_3$ for (n,n') and (n,2n) measurements in EAR1 and EAR2**
   [CERN, CIEMAT (Spain), IFIC (Spain)]

3. **High energy resolution measurement of the backgrounds in EAR1**
   [CERN, CIEMAT (Spain), IFIC (Spain)]

4. **Test of the very new $CeBr_3$ scintillators for g-rays and charged particles**
   [USC (Spain)]

5. **Viability of high energy (n,chp) reactions measurements with (plastics+PbWO) crystals**
   [U. Kyushu (Japan), JINR (Russia)]

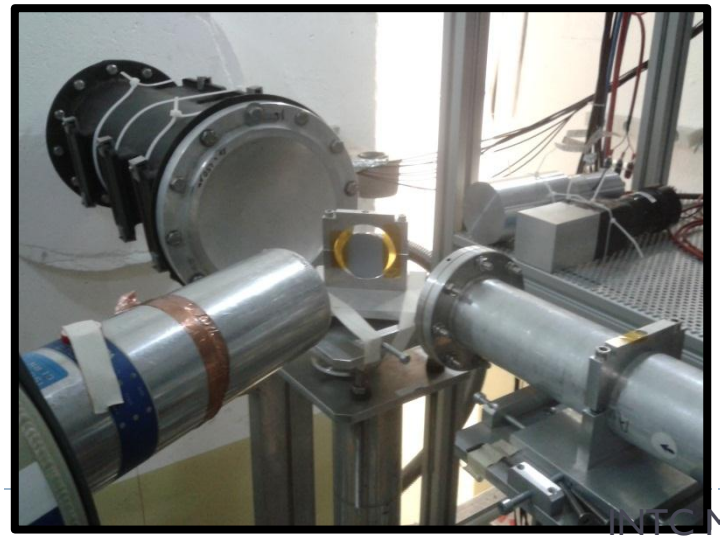
Detector tests at n_TOF

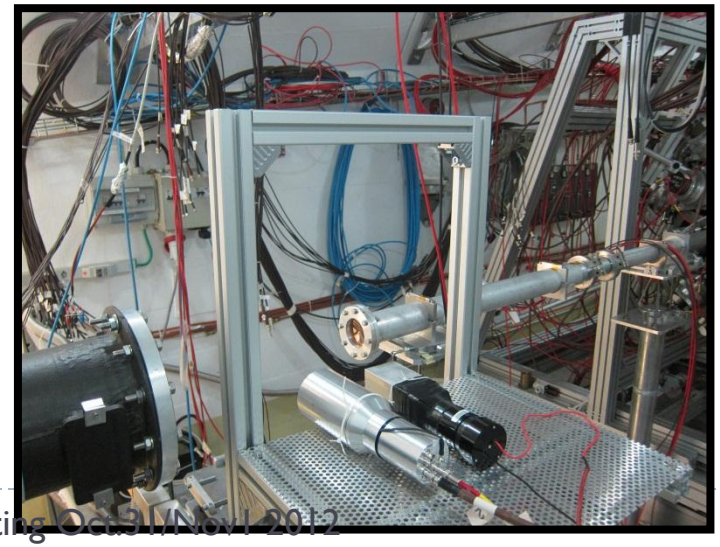


The response to the g-flash has been tested for:

Liquid scintillators
Scintillator crystals: BaF_2, $LaBr_3$, $LaCl_3$, CsI
HPGe
A telescope with Plastic scintillators

Test of HPGe/ $LaCl_3$/$LaBr_3$ detectors for (n,n') and (n,2n) measurements





Detector tests at n_TOF

a) 2D-GEM detectors with neutron converter to as beam profiler

(CERN/DGS/RP and U. Milano)

b) Medipix with polyethylene converter to get neutron beam profile

(CERN/DGS/RP)

c) Diamonds for neutron detection in a fusion facility

(U. Milano, Italy)

d) Fiber optics: wavelength shifts for neutron dose estimations

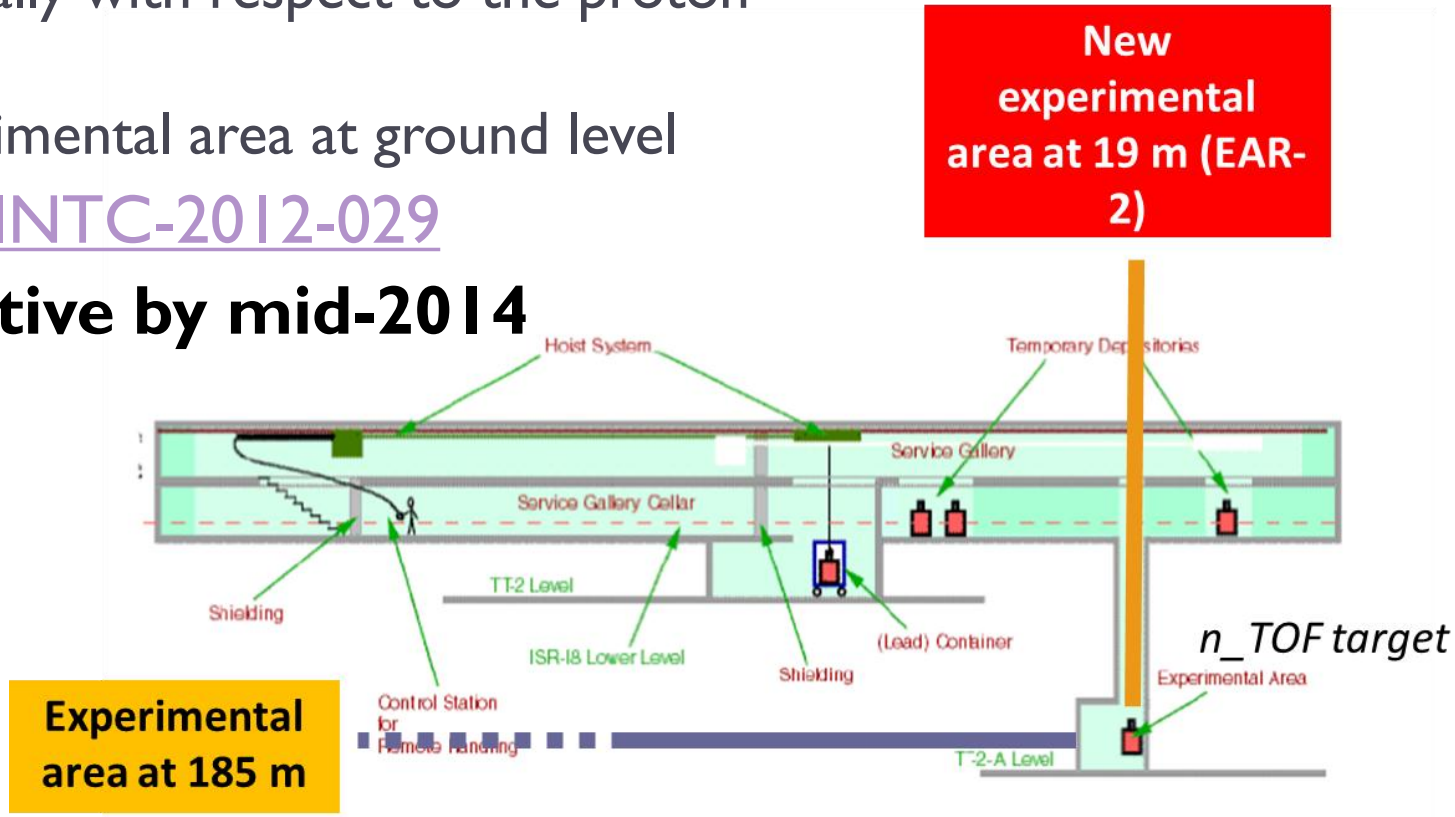
(U. Sevilla and IFCA, Spain)

e) Innovative 3D silicon devices under neutron irradiation

(U. Sevilla and IFCA, Spain)

Experimental Area 2 Project

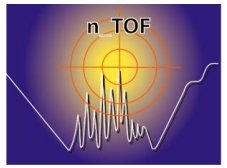
- 2nd Experimental Area:
  - Flight path located at ~19 m at 90° vertically with respect to the proton beam
  - Experimental area at ground level
- CERN-INTC-2012-029
- **Operative by mid-2014**



Experimental Area 2 Project

- Civil Engineering ✔
- Radiation Protection ✔
- Cooling & Ventilation ✔
- Electrical Infrastructure ✔
- Permanent Magnet ✔
- General Infrastructure in progress
- Safety file ready in 2012

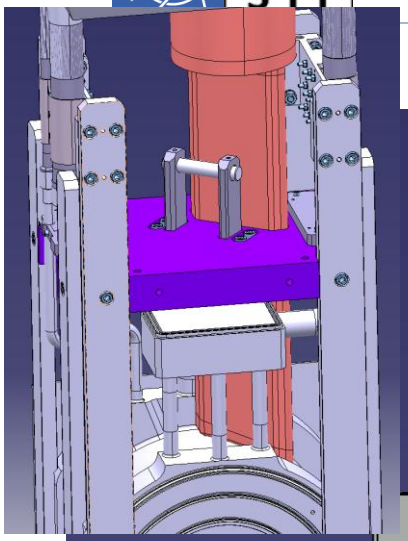
Experimental Area 2 Project planning

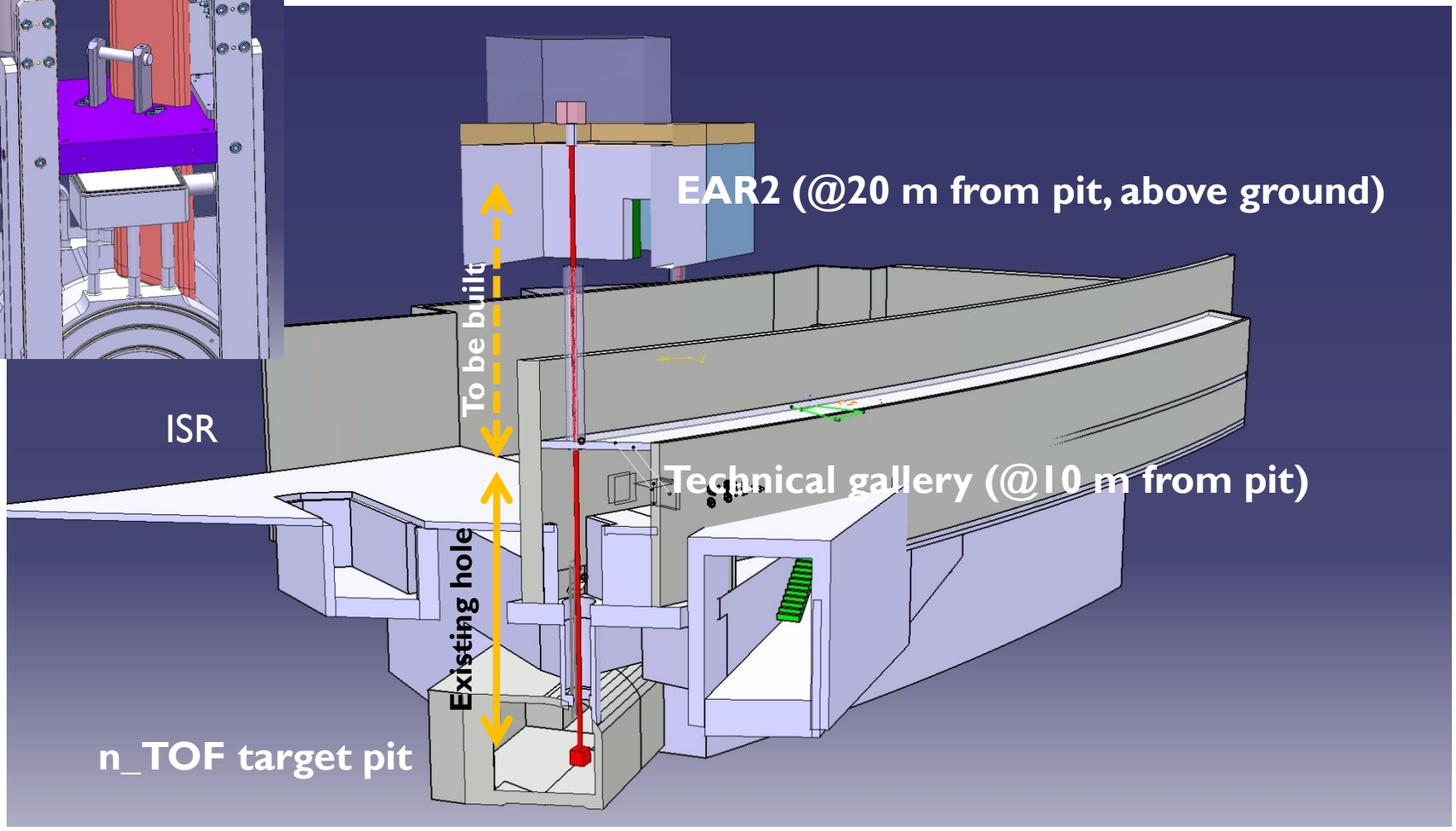


n_TOF EAR2 general Planning

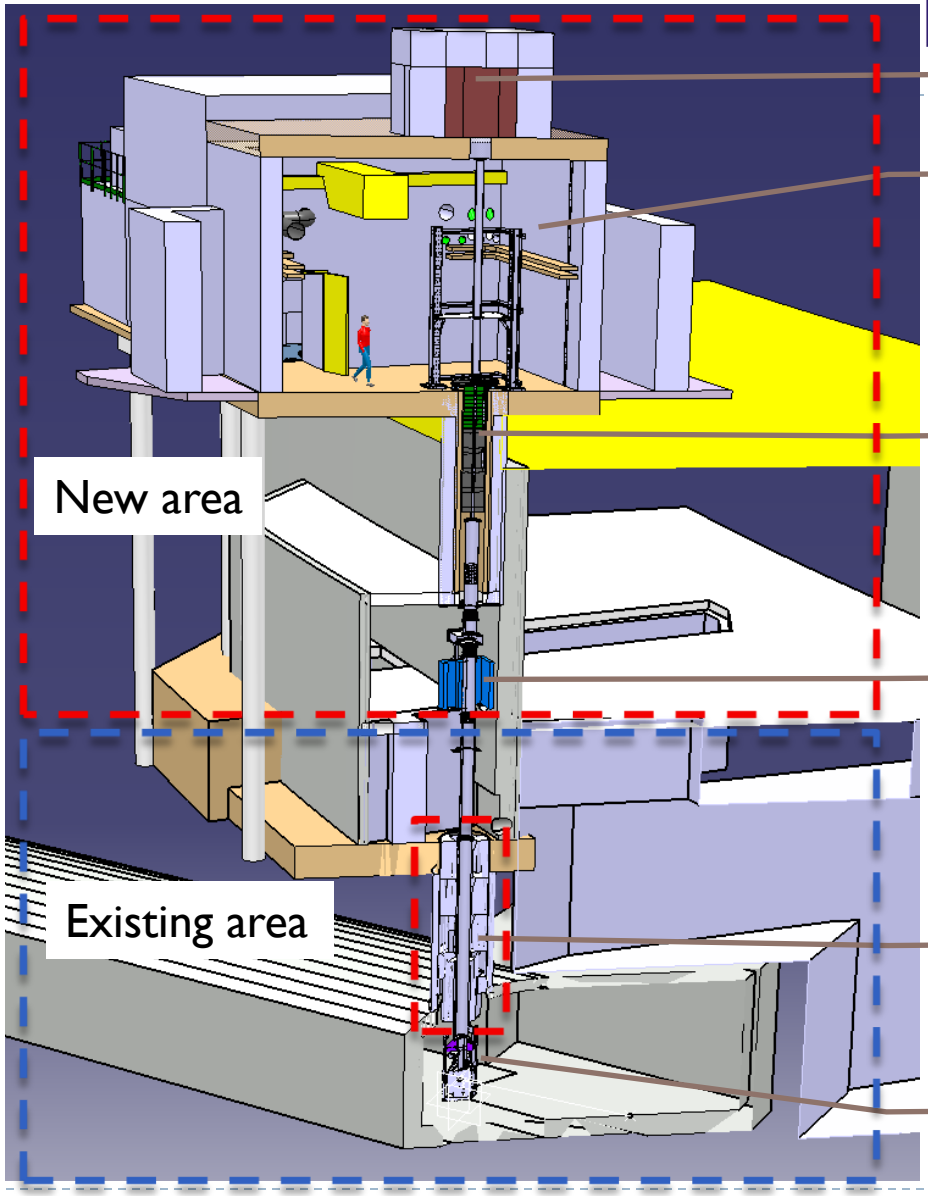
	2012												2013												2014											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
EAR2 Approval																																				
Detailed Studies																																				
Request for Quotes																		Injectors Long Shut-Down 1																		
Dismatling Building 559																																				
Civil Engineering																																				
Services Installation																																				
Beam Line Installation																																				
Commissioning																																				
EAR2 ready for Physics																																				

General view around the n_TOF target area





Layout of EAR-2



Beam Dump

EAR-2 Exp. Hall

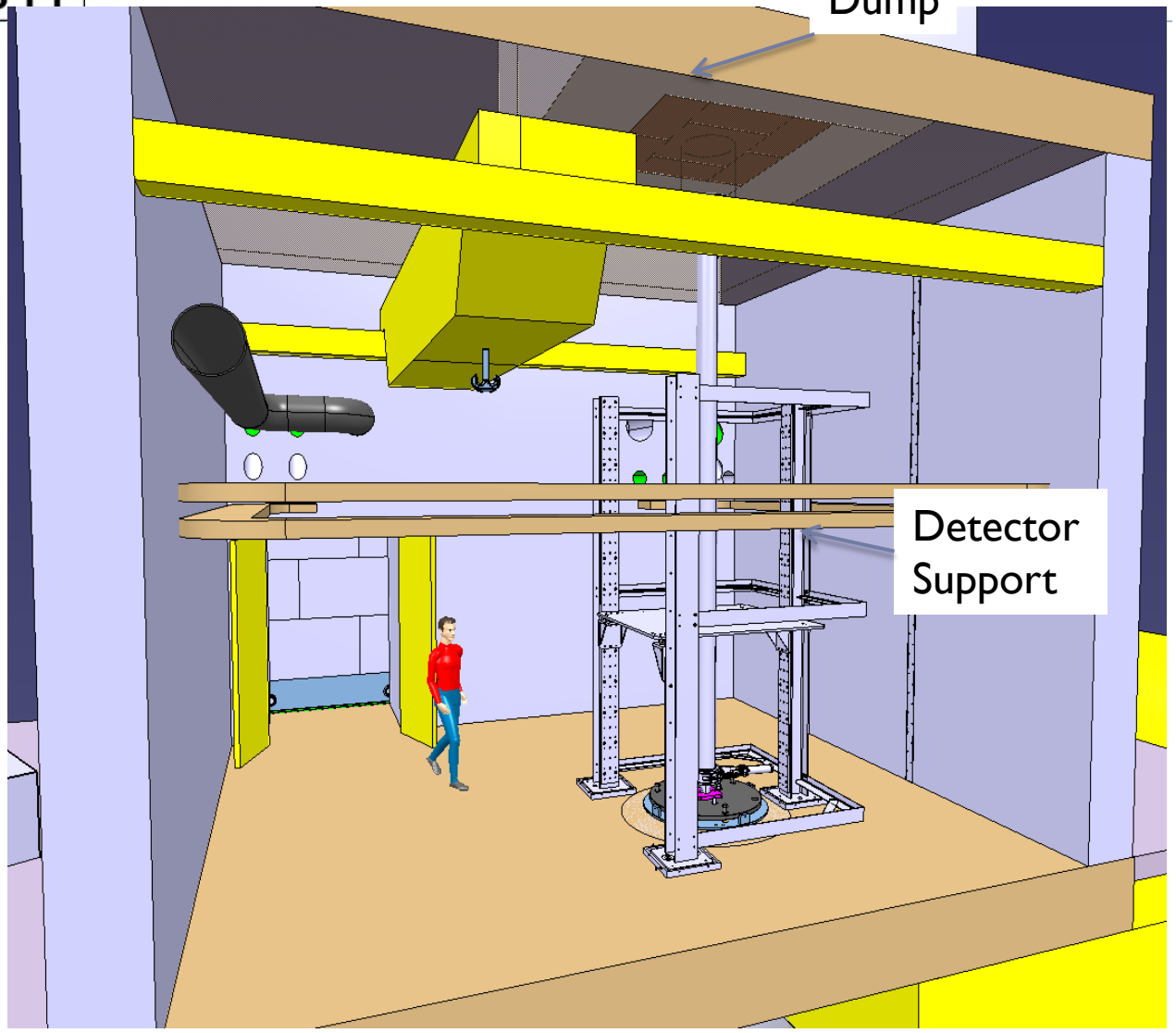
Collimator

Magnet

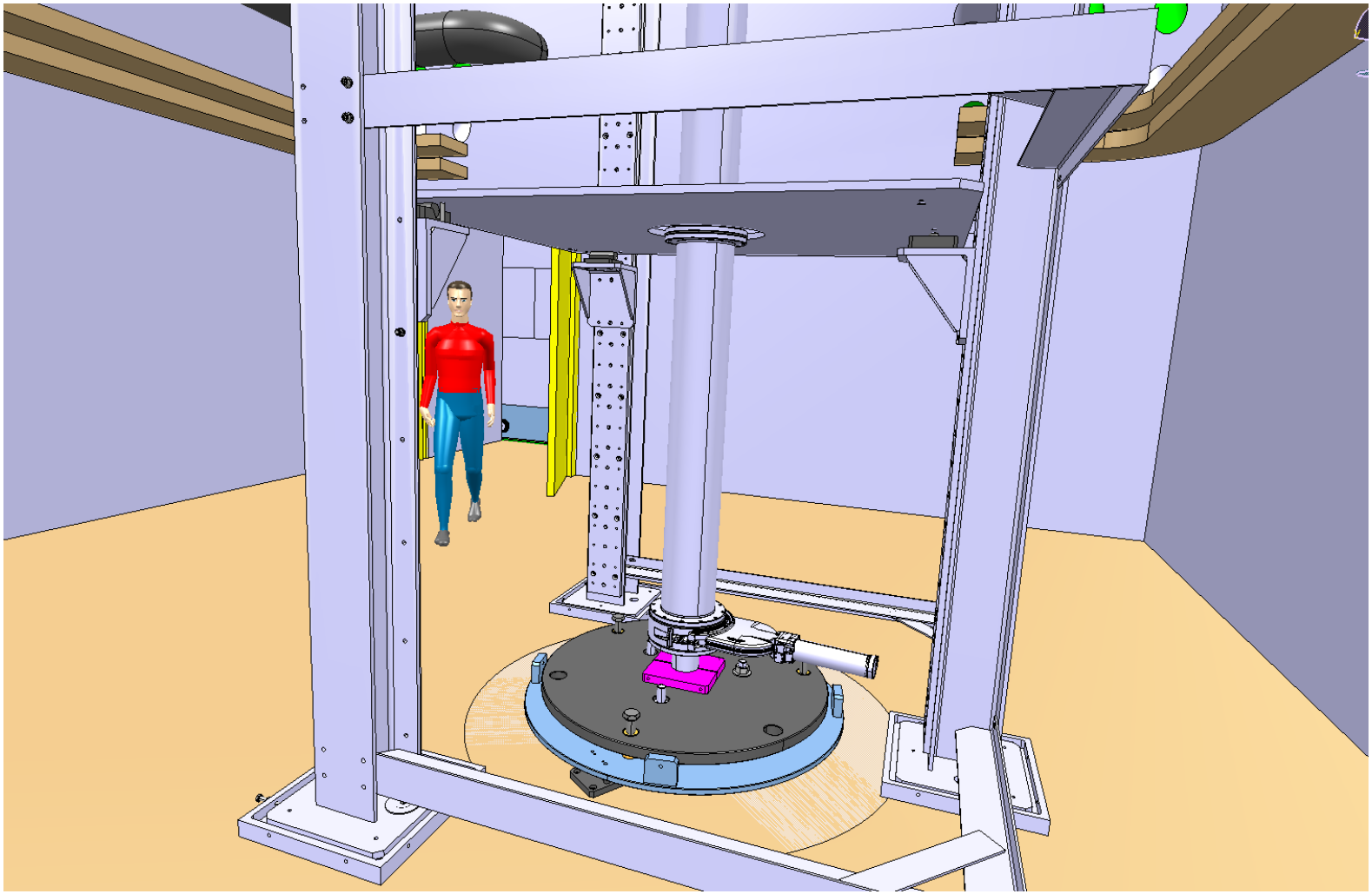
Pit shielding

Target

EAR2 experimental hall



EAR2 experimental hall



Summary

- ✓ 2012 experimental campaign
  - According to scheduled program
  - Detector's test done successfully

- ✓ EAR-2 (Experimental Area 2)
  - Design Study completed
  - Start of the construction April 2013
  - Completed May 2014

- ✓ Scientific program for 2014 onward
  - CHANDA European program FP7-2013
  - n_TOF Collaboration Nov. 2012 preparation for INTC proposals on 2013