The (n,α) Reaction Cross-Section for light Isotopes

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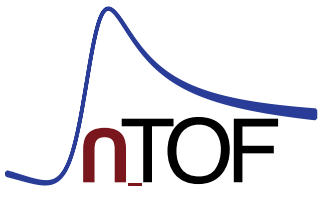
A. Goverdovski[1], V. Khryachkov[1], I. Bondarenko[1], T. Khromyleva[1], V. Ketlerov[1], V. Poryvaev[1], P. Prusachenko[1], J. Andrzejewski[2], C. Weiss[3]

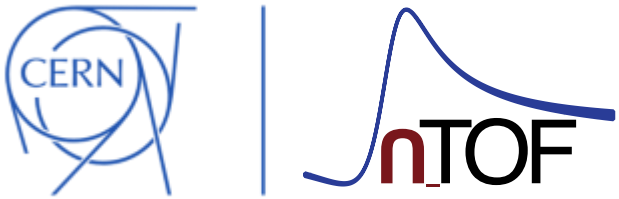
[1] Institute for Physics and Power Engineering, Obninsk, Russia
[2] University of Lodz, Poland
[3] CERN, Geneva, Switzerland



Outlook

- Introduction and Motivation
- The Case $^{16}O(n,\alpha)^{13}C$
- Experimental Setup and Data Processing
- Summary

Introduction and Motivation



Introduction

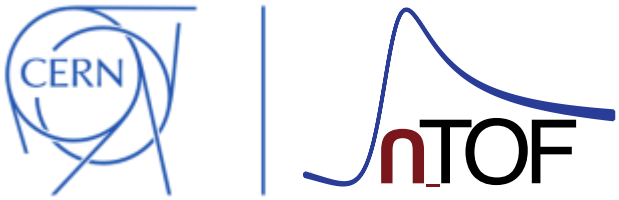
- Proposal of a first measurement in a series of five.
- We intend to measure the (n,α) reaction cross-section for the following light isotopes: ^{16}O, ^{10}B, ^{12}C, ^{14}N, ^{19}F,
- Using gaseous targets: possibility to have up to 1 g target mass with zero thickness.

This proposal concerns the measurement of ^{16}O(n,α)^{13}C!

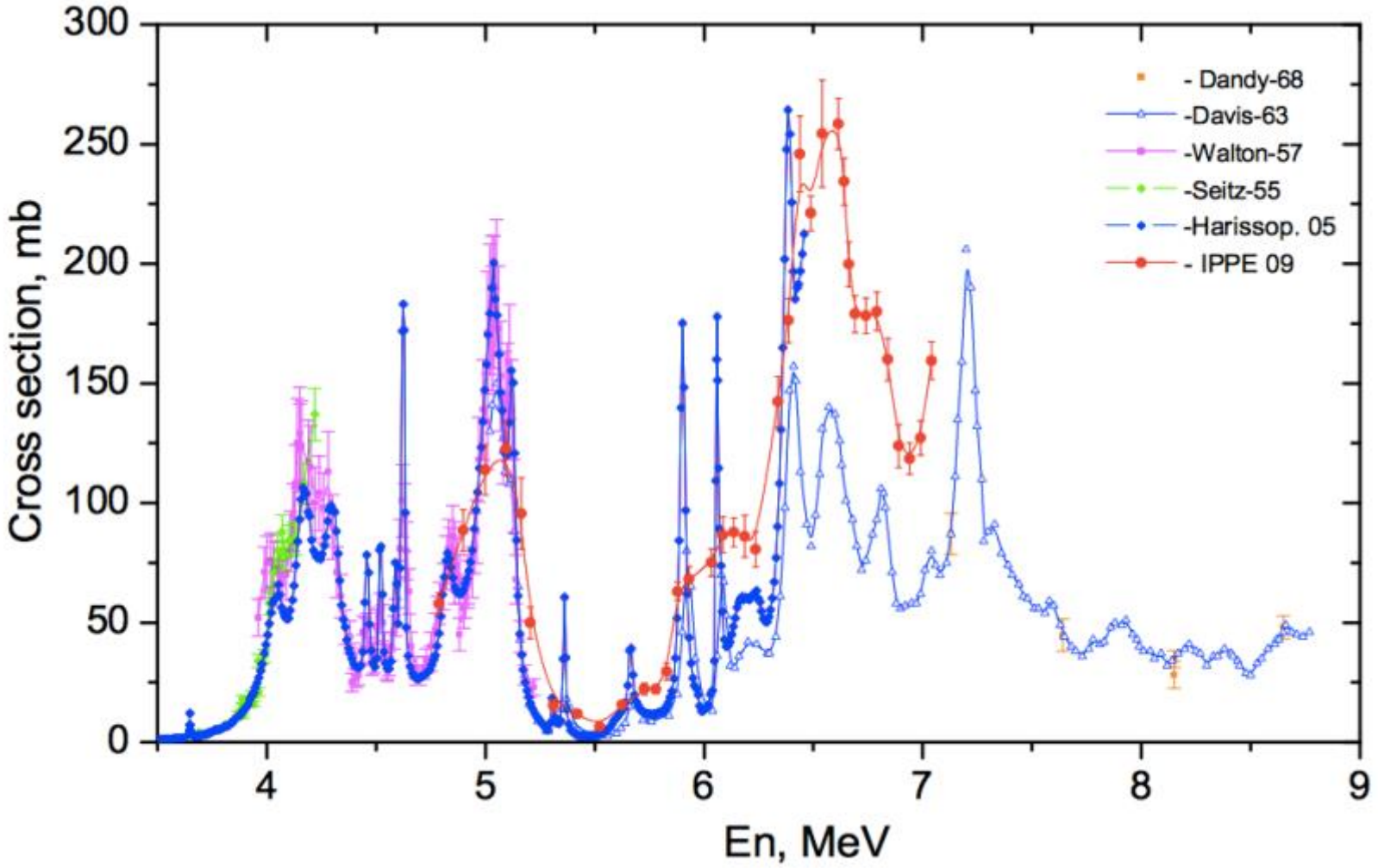
Motivation

- Nuclear Technology:
  - These elements are contained in reactor cores in large amounts.
  - (n,α) reactions affect reactivity of the reactor.
  - (n,α) reactions yield He gas which alters the properties of structural materials and fuel rods.
  - **Need of additional measurements of ^{16}O(n,α)^{13}C** was pointed out on the latest international project meeting on nuclear data. (http://www.oecd-nea.org/science/wpec/sg40-cielo/).
- Medical physics:
  - Significant contribution to absorbed dose through these reactions (O, N, C).
- Neutron detection:
  - Influence on response function for fast neutron detectors (C, F).
- Nuclear standards:
  - Discrepancies in ^{10}B(n,α) cross-section.
- Nuclear data libraries:
  - Large discrepancies with experimental data for E_n > 5MeV for all isotopes.

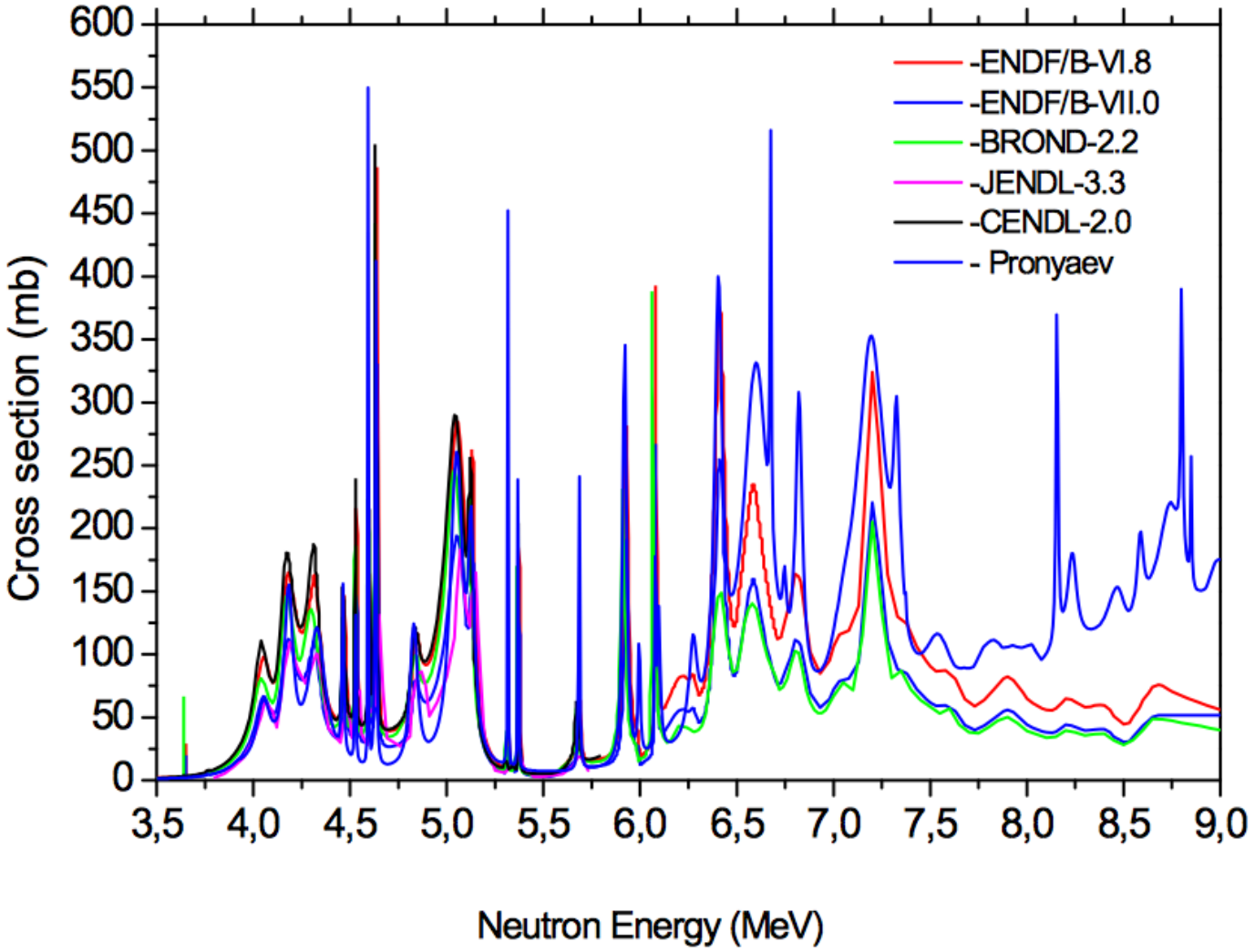
The Case $^{16}O(n,\alpha)^{13}C$



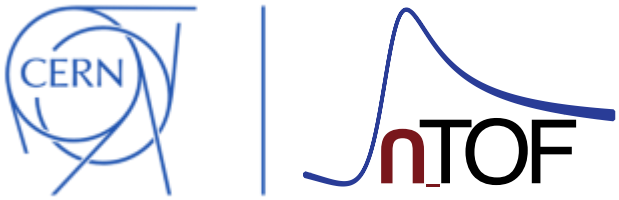
$^{16}O(n,\alpha)^{13}C$ available experimental Data



$^{16}O(n,\alpha)^{13}C$ Status of Evaluations

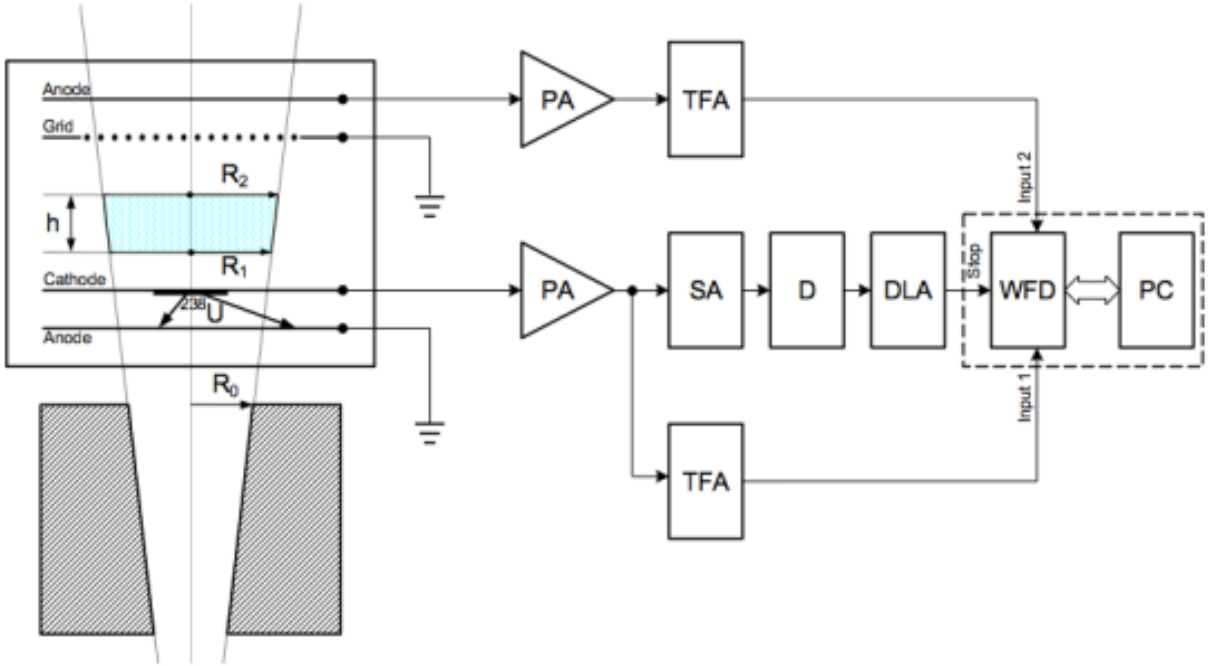


Experimental Setup and Data Processing



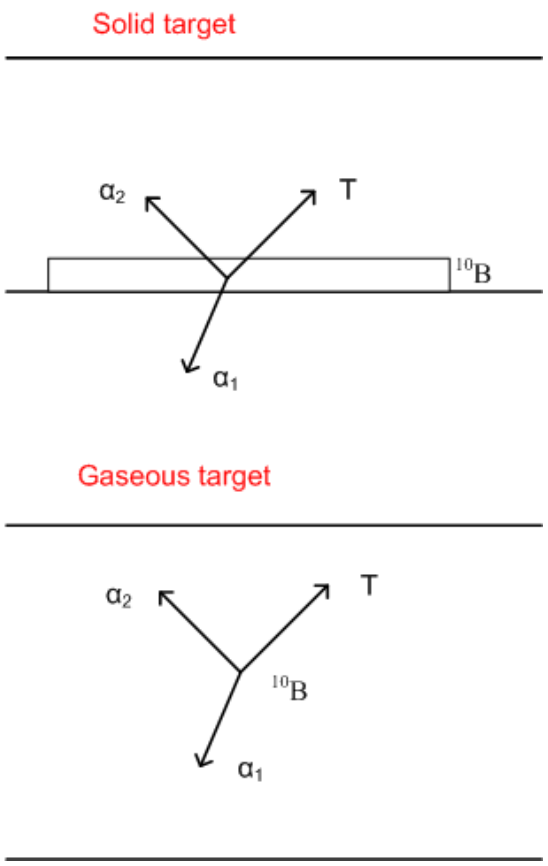
Experimental Setup

- Method developed and tested at IPPE and IRMM.
- Double ionization chamber with common cathode.
- Gaseous target: 95% Kr + 5% CO_2 at 6 atm.
- ^{238}U solid target for neutron flux monitoring.

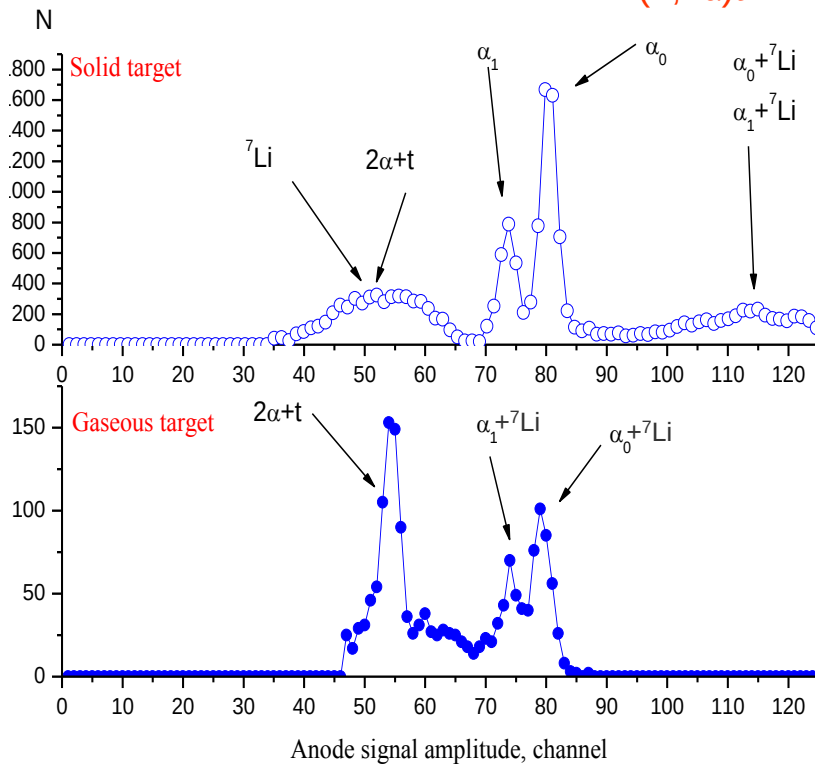


Advantage of gaseous Targets

- No energy loss of reaction products in a gaseous target!



Example:
$^{10}B(n,2\alpha)t$



Background Suppression

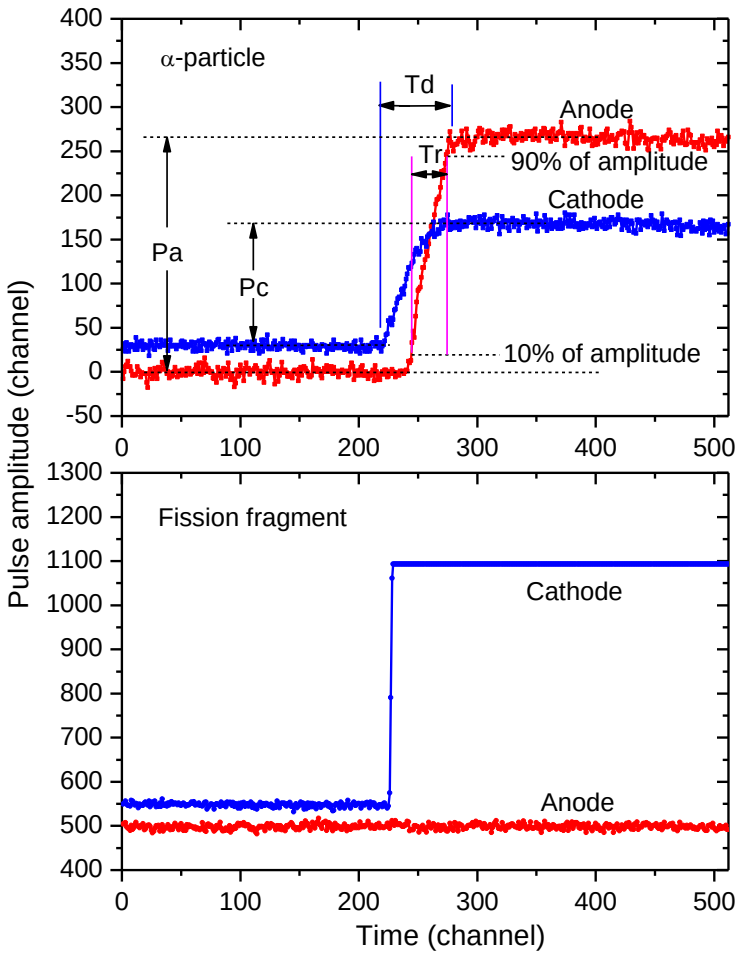
- Digital signal processing for:
  - Location of the particle.
  - Distinguishing reaction products by type.

➢ Reduction of parasitic background reactions.

➢ Separation of events occurring in the structural elements of the detector.

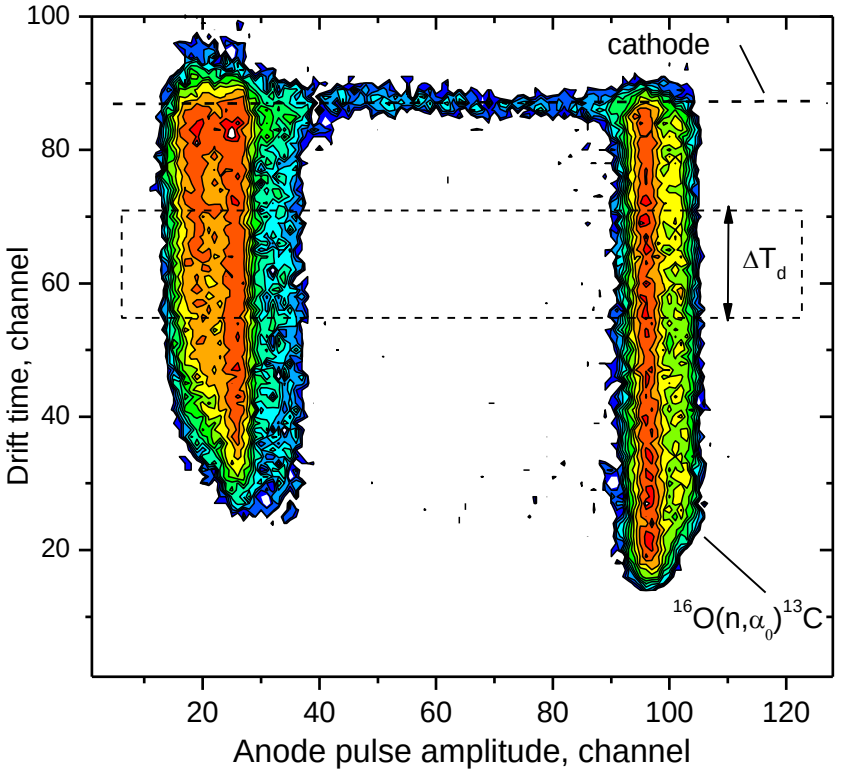
➢ Suppression of the wall effect.

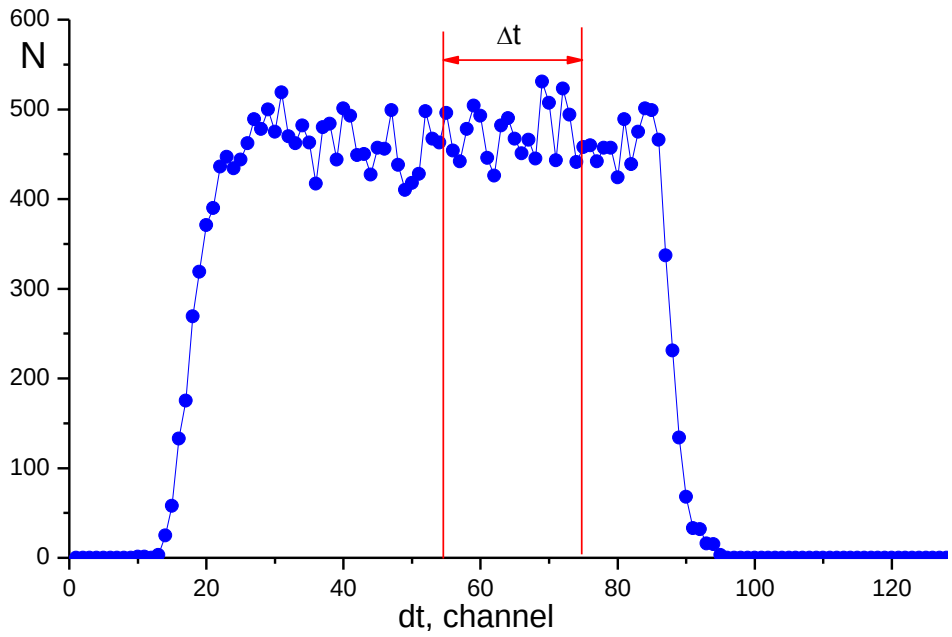
➢ Defining target volume.



Determination of vertical Position - Track

- Restricting the drift time defines the length of the target cell.

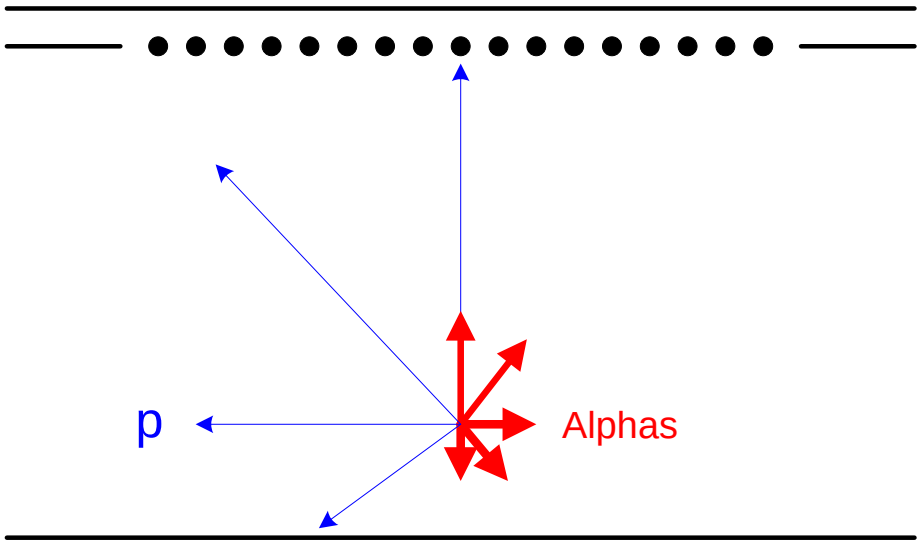


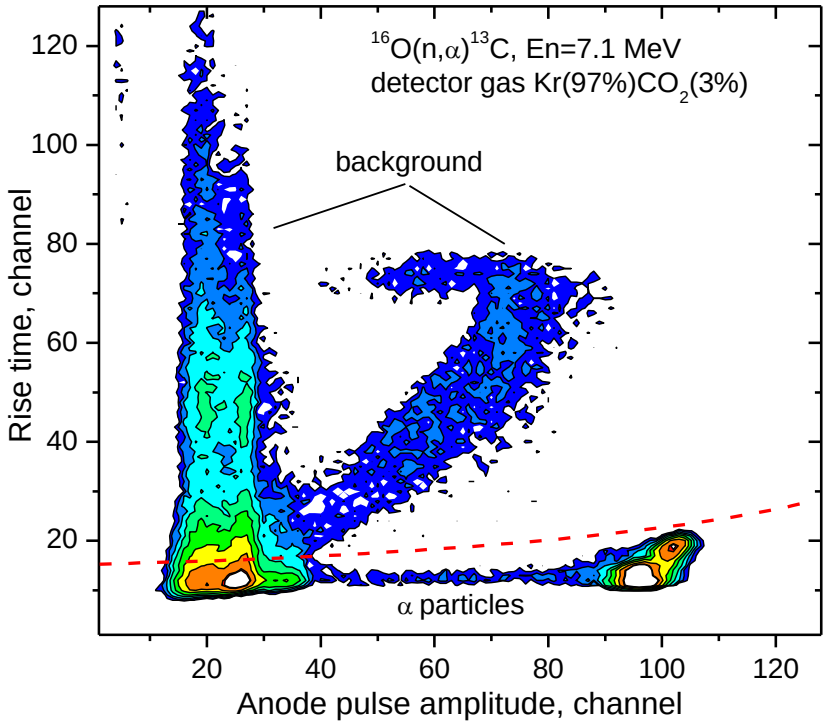


- Together with the known beam profile this results in the volume of the gaseous target (constant number of gas atoms in the chamber).

Determination of Particle Type

- The rise time changes according to the range of the particles in the gas.
- The particle types can hence be distinguished from each other.



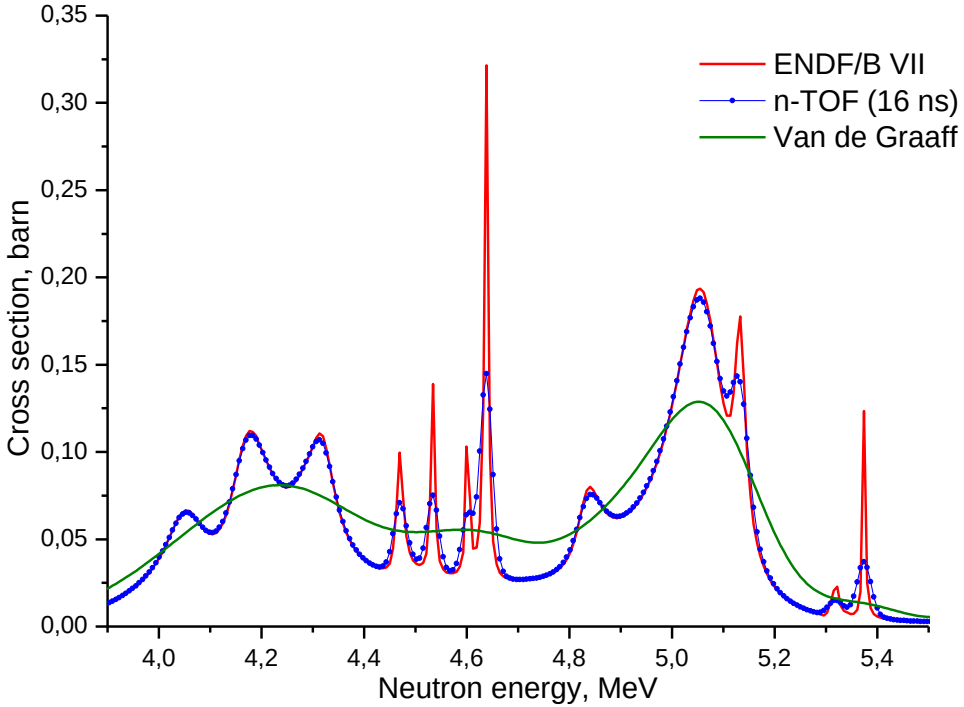


Neutron Energy Resolution

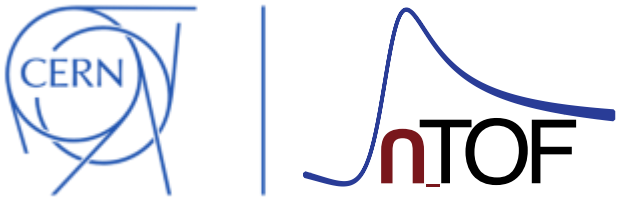
- Previous measurement performed at mono-energetic neutron sources (Van de Graaff accelerators):

  ⇒ neutron energy resolution not sufficient to resolve the structures.

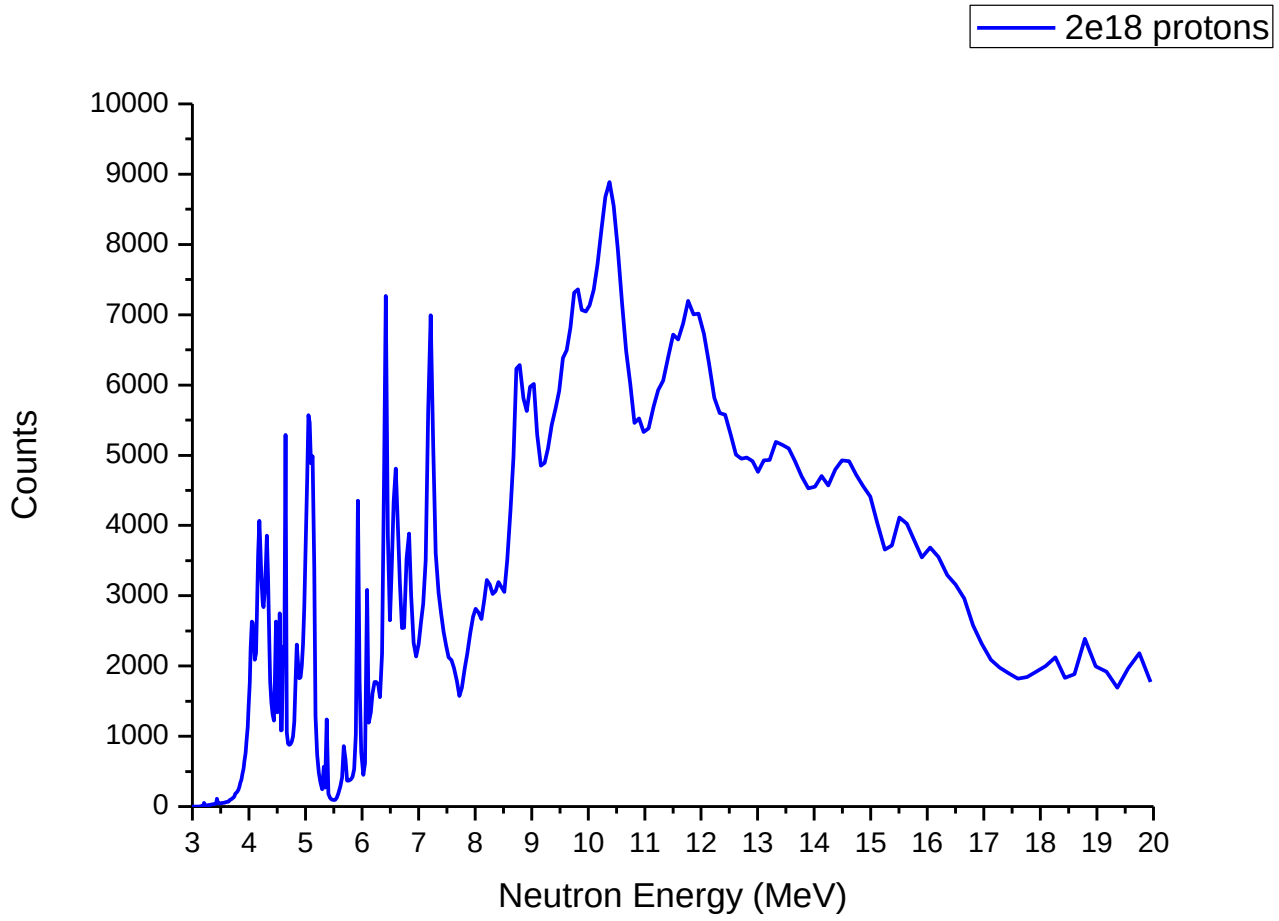
  ⇒ measurement proposed at n_TOF EAR1 (185 m).



Summary



Count Rate Estimation



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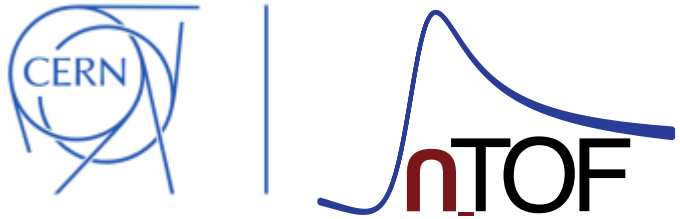
We propose to measure the
$^{16}O(n,\alpha)$ reaction cross-section for $E_n < 20$ MeV
using a gaseous target
in n_TOF EAR1.

Requested protons:
$2*10^{18}$ protons on target.



Thank you for your attention.