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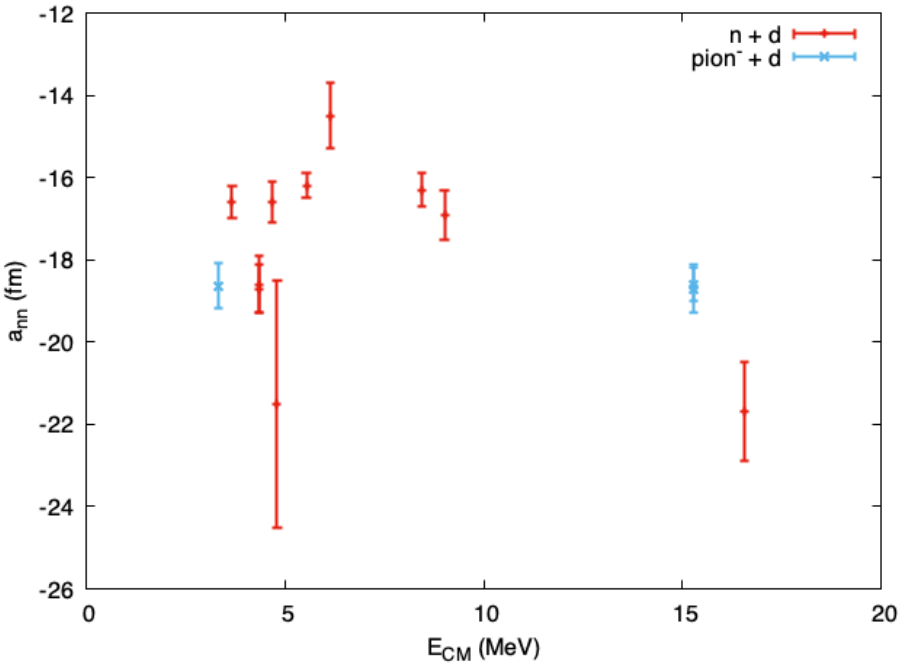
Status of NN scattering length experiment

Cristian Massimi for the working group

Department of Physics and Astronomy

Recap



EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Letter of Intent to the ISOLDE and Neutron Time-of-Flight Committee

Measurement of the neutron-neutron scattering length at the CERN n_TOF facility

September 21, 2020

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[2] *Ag. naz. per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile, ENEA, Italy*
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[4] *University of Ioannina, Greece*
[5] *Dipartimento di Fisica e Astronomia, Università di Bologna, Bologna, Italy*
[6] *Helmholtz-Zentrum Dresden-Rossendorf, Germany*
[7] *Dipartimento di Fisica ed Astronomia, Università di Catania, Catania, Italy*
[8] *www.cern.ch/n_TOF*

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Technical coordinator: O. Aberle (oliver.aberle@cern.ch)

Abstract: We propose to exploit the interaction of the two neutrons in the final state of the neutron-induced deuteron breakup reaction ^{2}H(n,p)nn for determining the neutron-neutron scattering length in a wide energy range (namely between 10 and 100 MeV) in a single experiment. By taking advantage of the unique features of the updated n_TOF facility, the measurement can be carried out at EAR2. The experiment is based on the detection of the three outgoing particles in kinematic coincidence, leading to a full three-body kinematic reconstruction. The feasibility of this challenging experiment requires a preliminary experimental activity in order to investigate the possibility of using an active target, based on liquid scintillation detector, highly enriched in deuterium.

Requested protons for the test: 5×10^{17} protons on target
Experimental Area: EAR2

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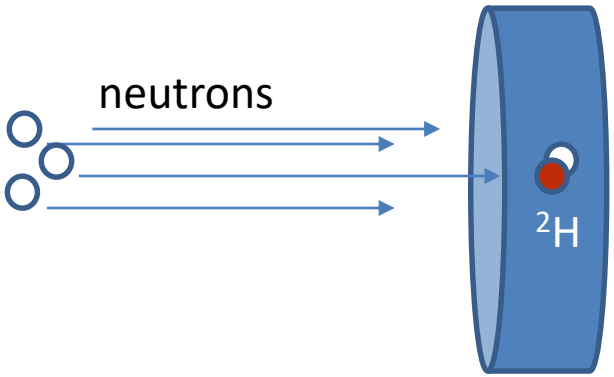
Recap



TARAT

deuterated active target

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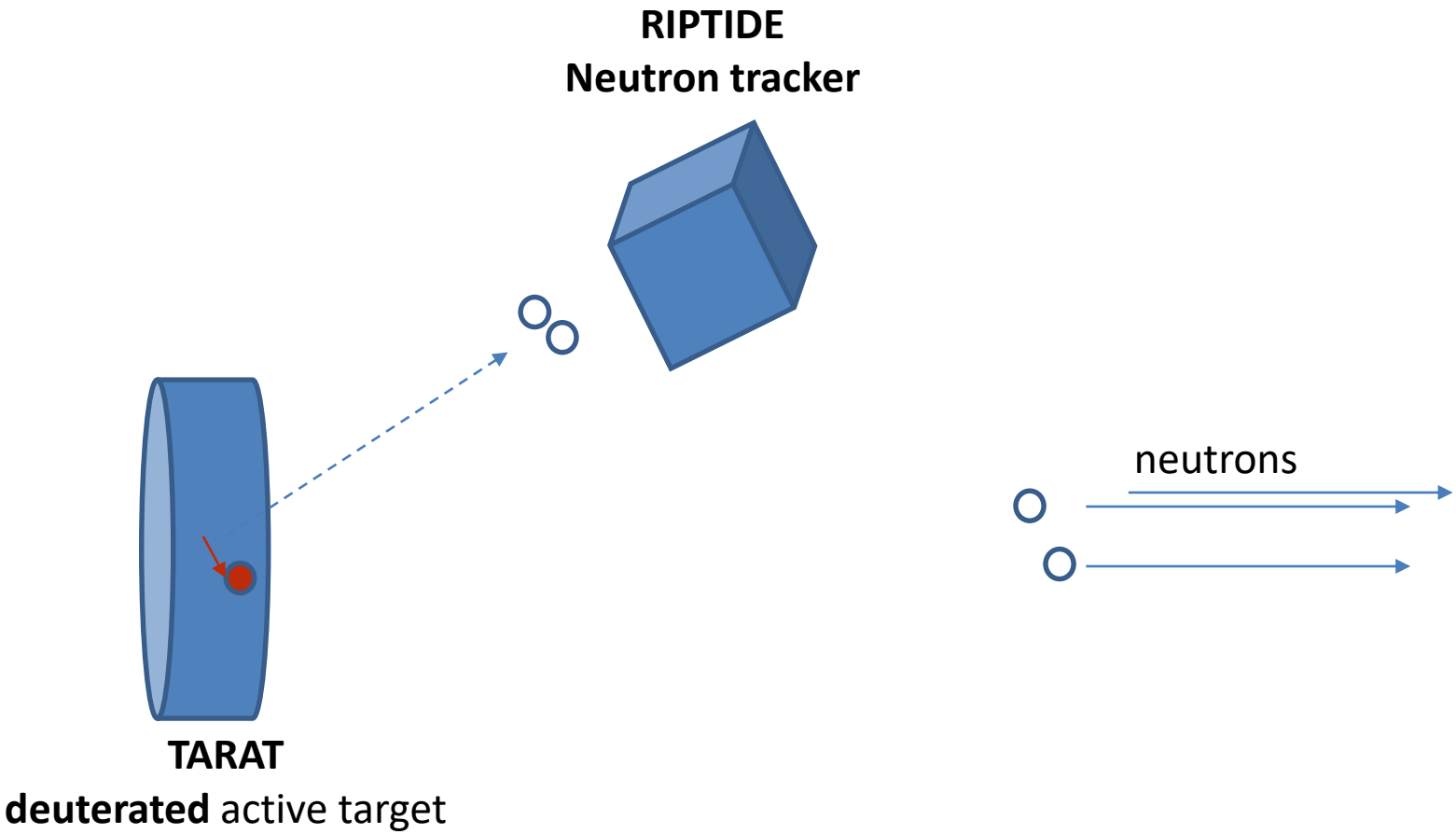
Recap



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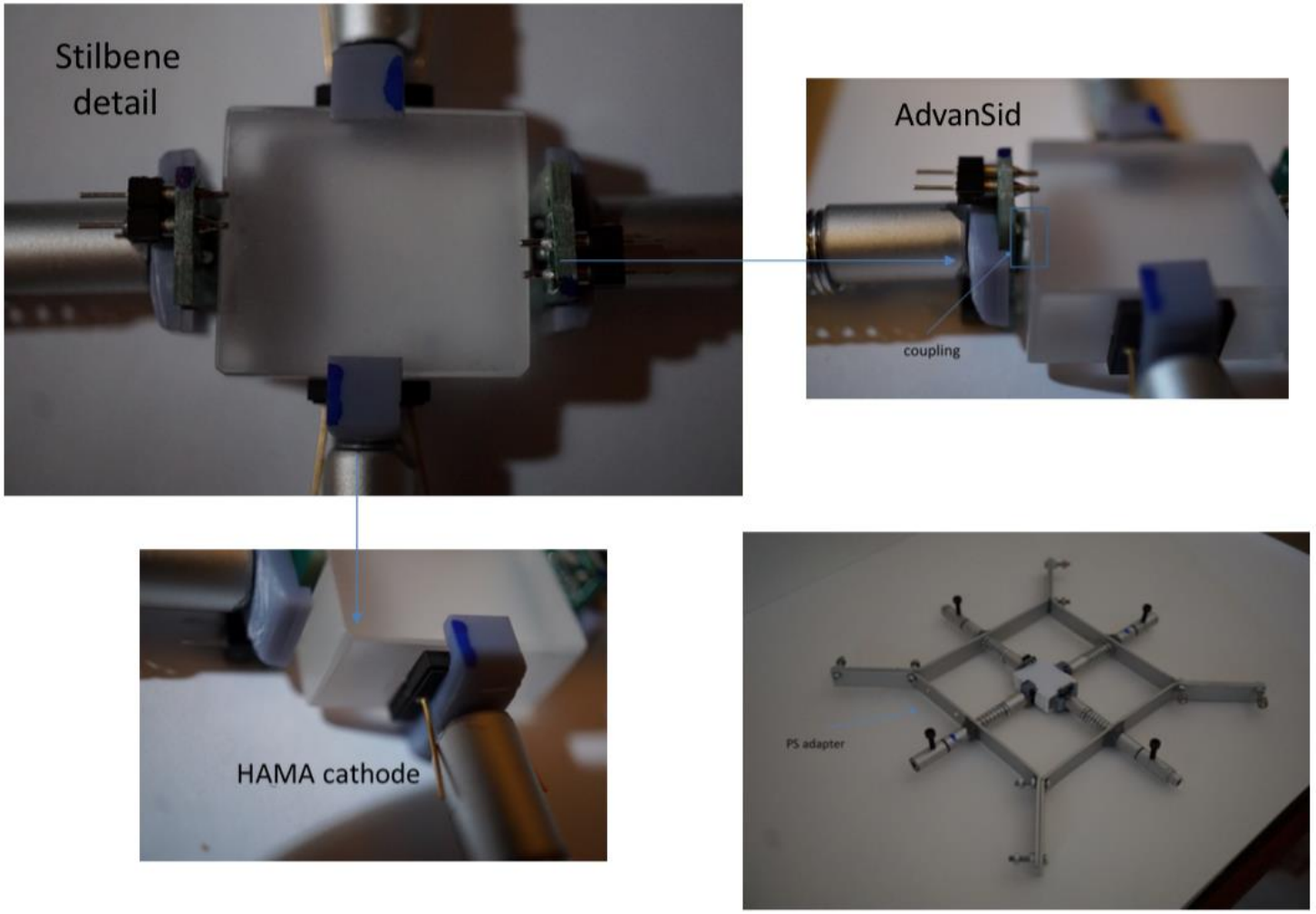
Recap: deuterated active target TARAT 2021

Stilbene-d12 crystal kindly provided by LLNL

F.D. Becchetti et al., NIM A 908(2018)376



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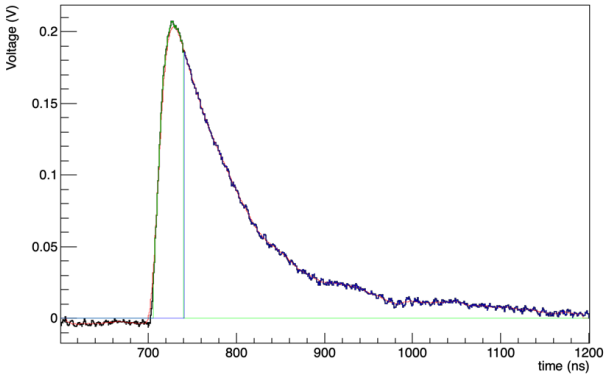
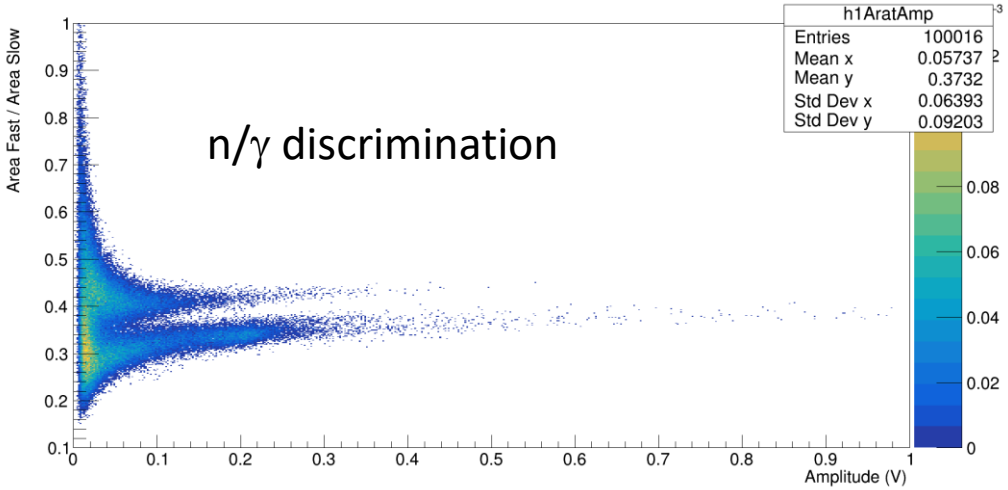
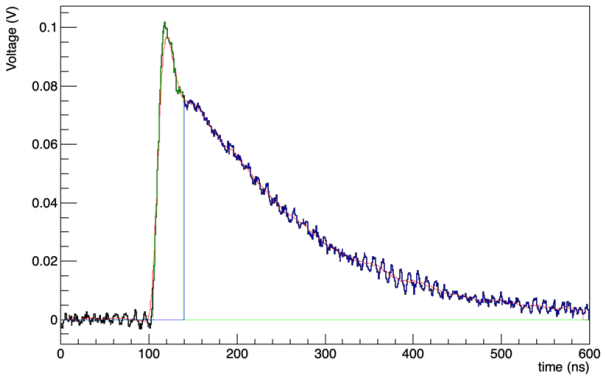
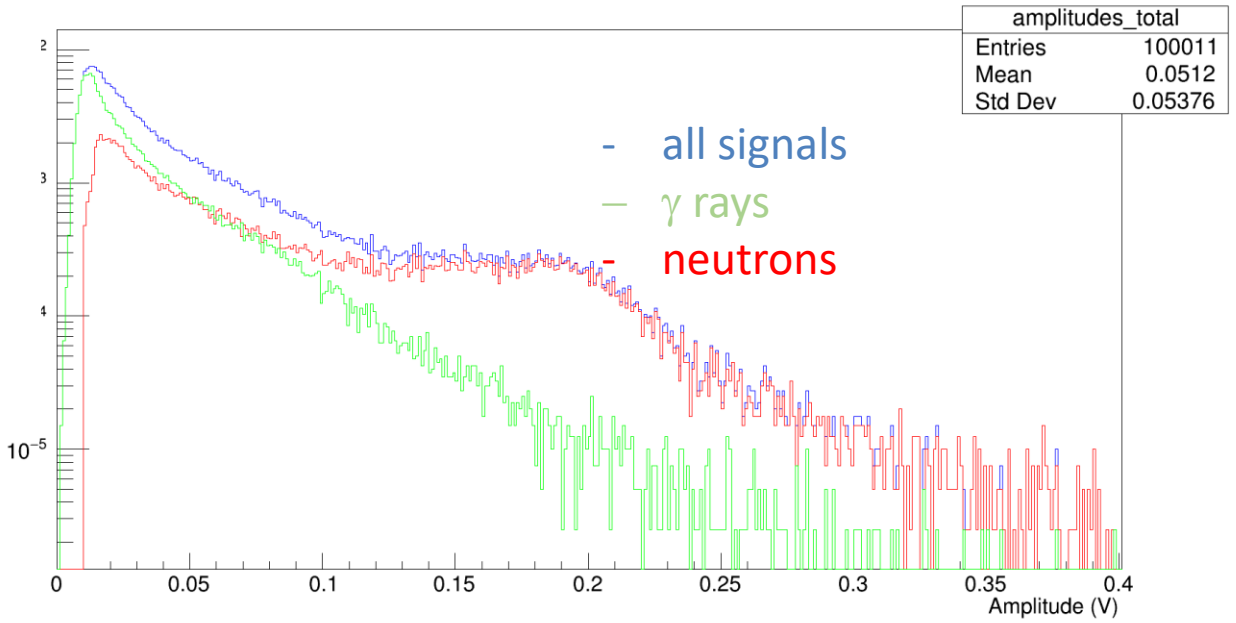
Recap: deuterated active target TARAT 2021





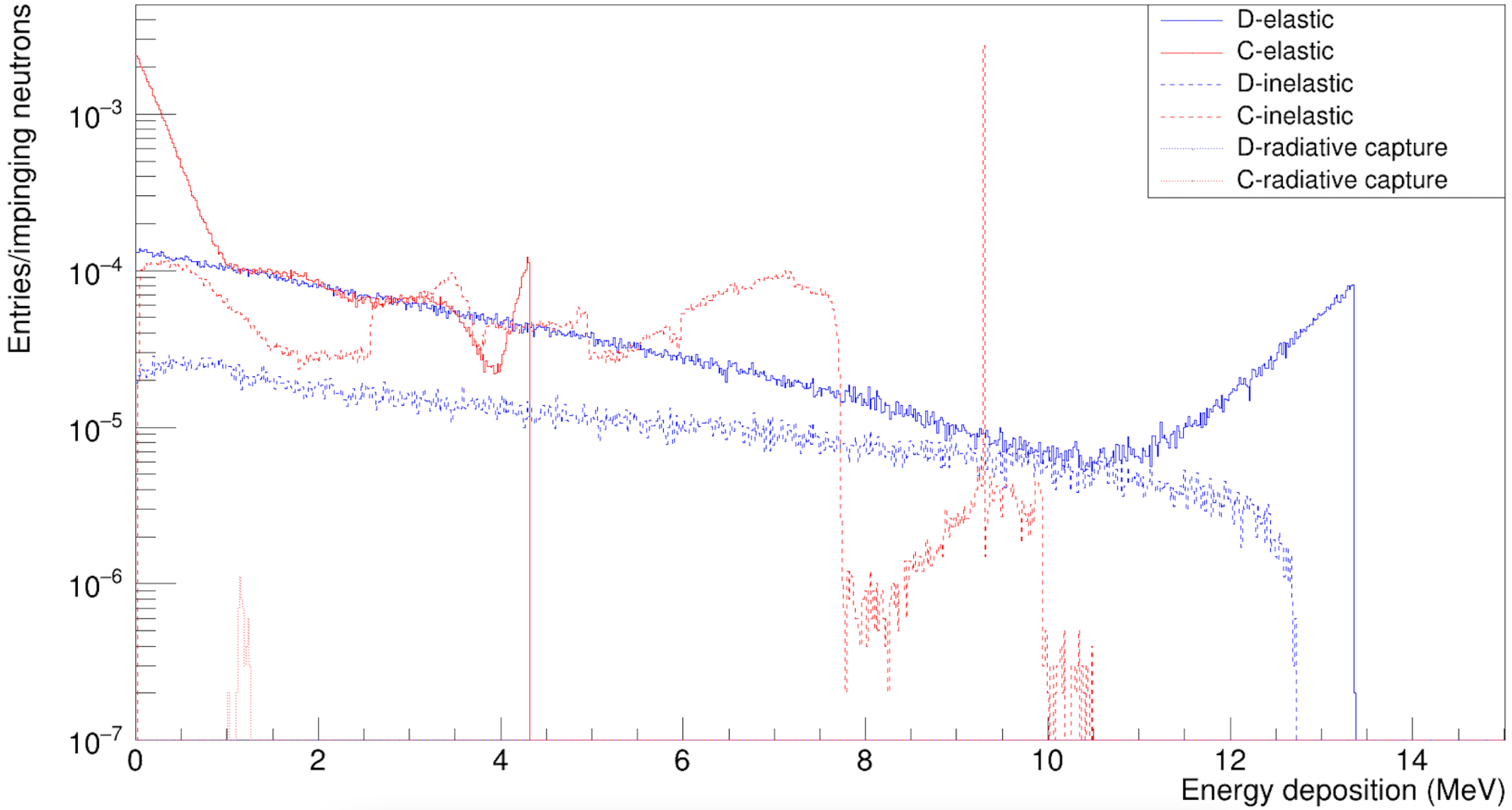
n/γ discrimination





- all signals
- γ rays
- neutrons

Recap: deuterated active target TARAT 2021



Geant4 Simulations:

- 3-body calculation for ^{2}H breakup (here developed)
- NRESP for n + ^{12}C reactions

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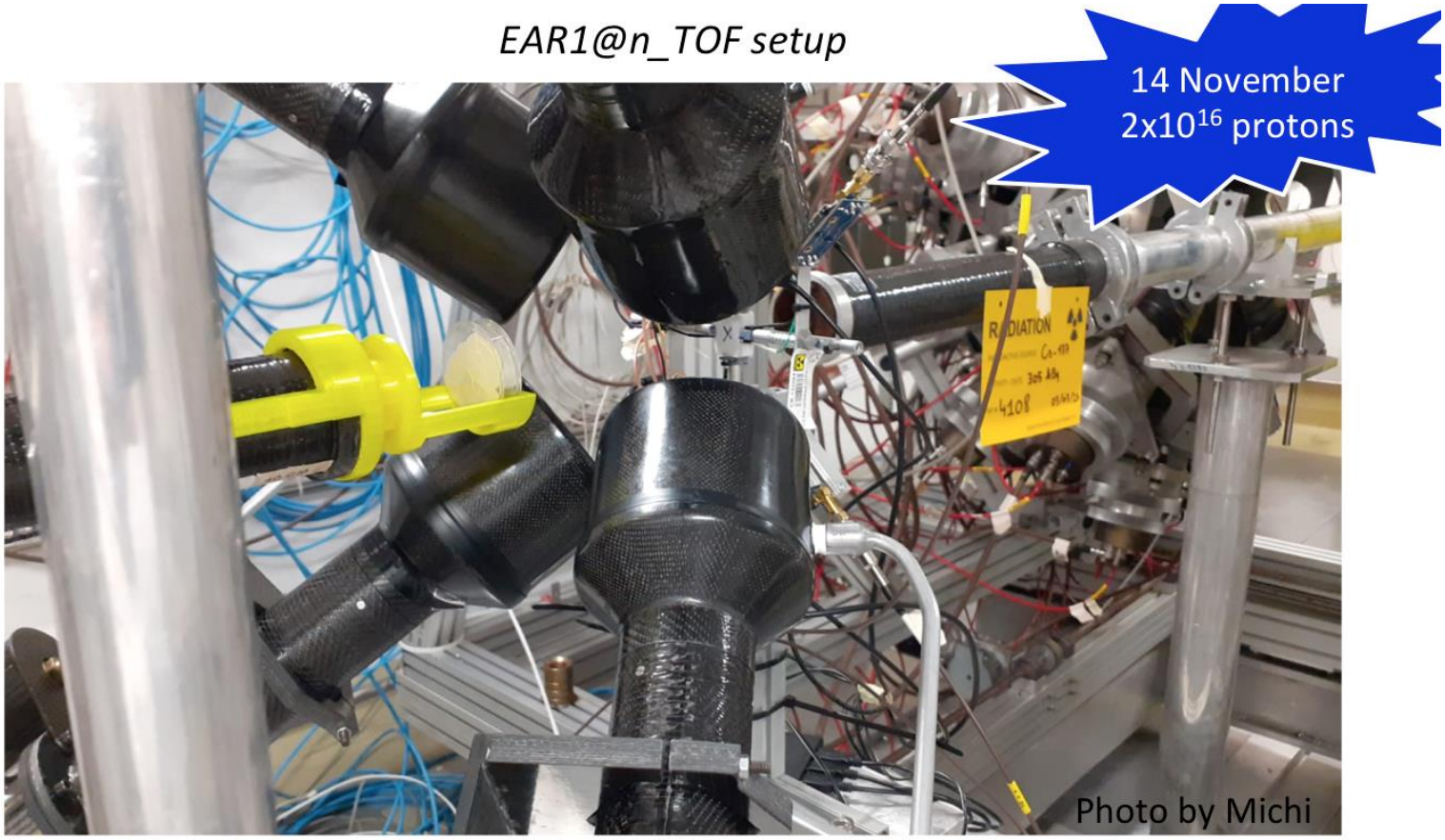
Recap: deuterated active target TARAT

2021

EAR1@n_TOF setup



- SiPM survived to all the test measurements, small degradation (increased noise) was just observed in the HAMAMATSU devices
- No significant noise trouble (good HF noise rejection)

CERN data (on-beam and off-beam) are under analysis

reduced dynamics due to γ−flash to be quantified as function of beam intensity

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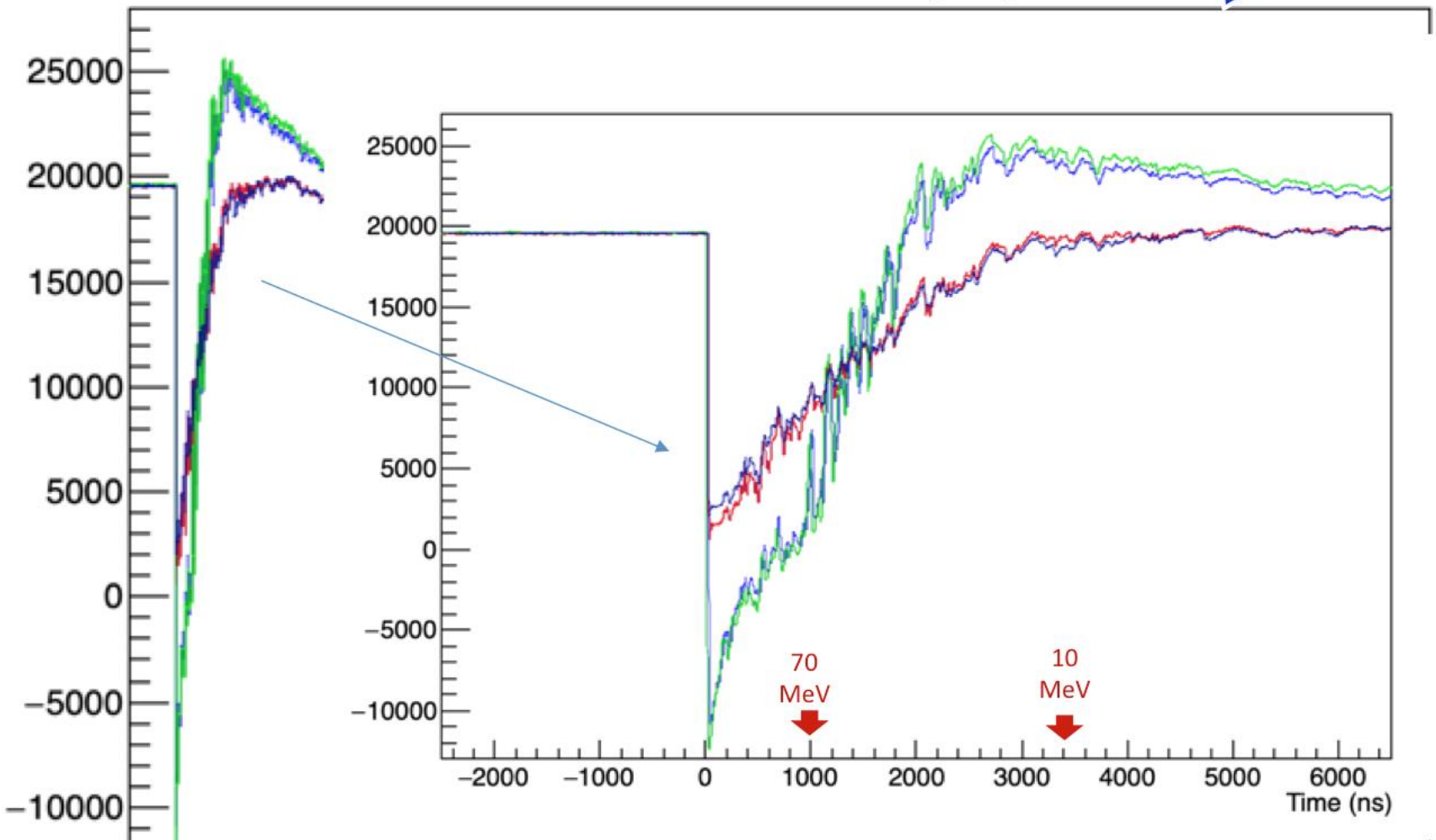
Recap: deuterated active target TARAT

2021

EAR 1

Some data: response to γ-flash

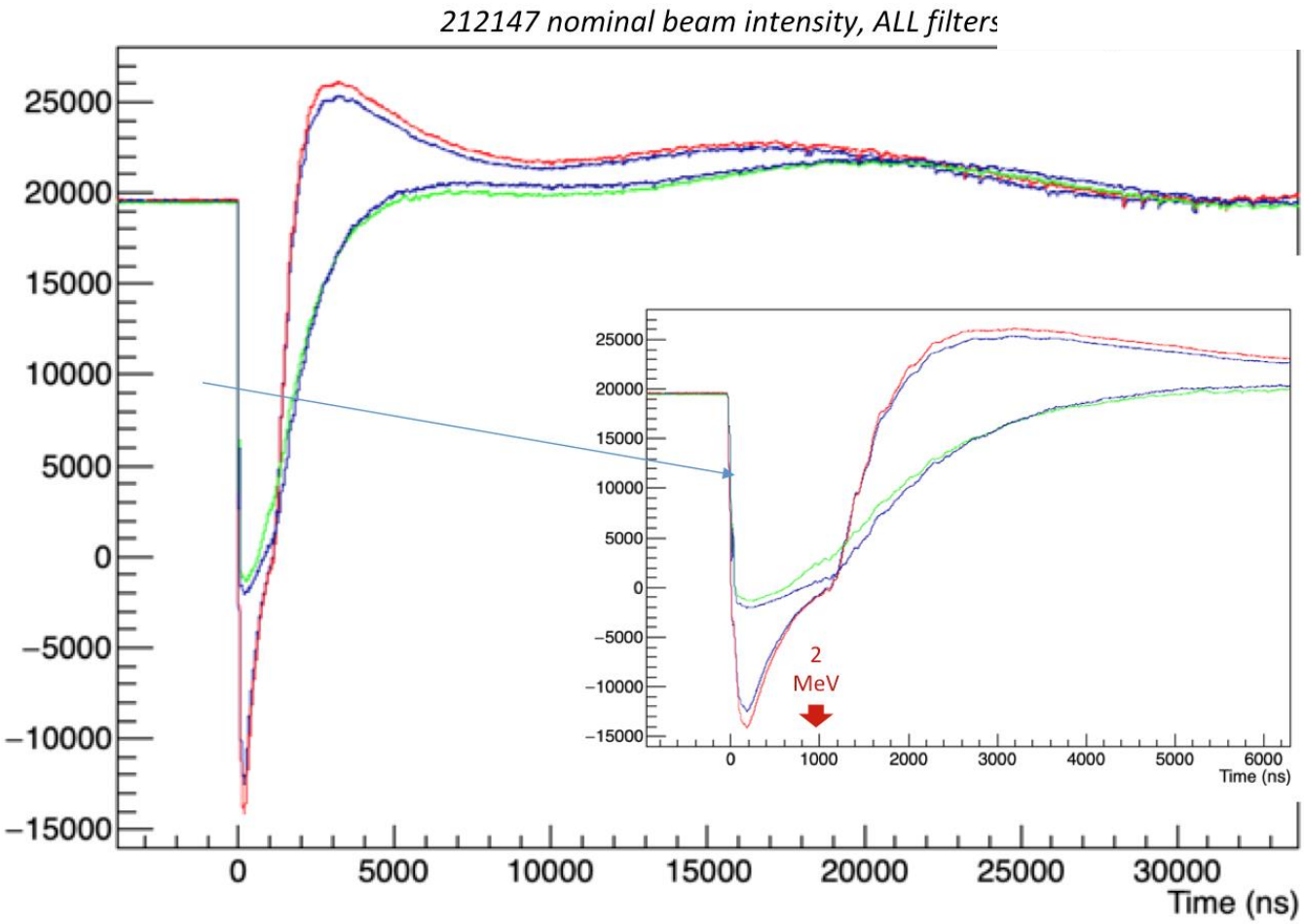
112146 nominal beam intensity, Pb filter



Recap: deuterated active target TARAT

2021

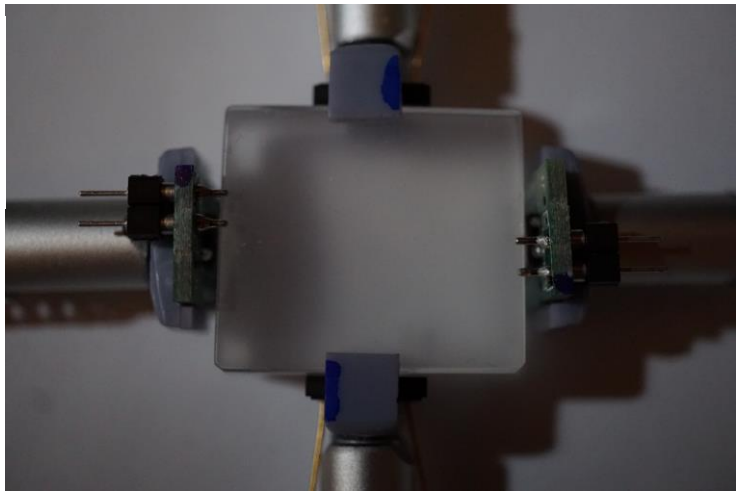
Some data: response to γ-flash



EAR 2

What's new

2022



1ST test in 2021 prototype of TARAT

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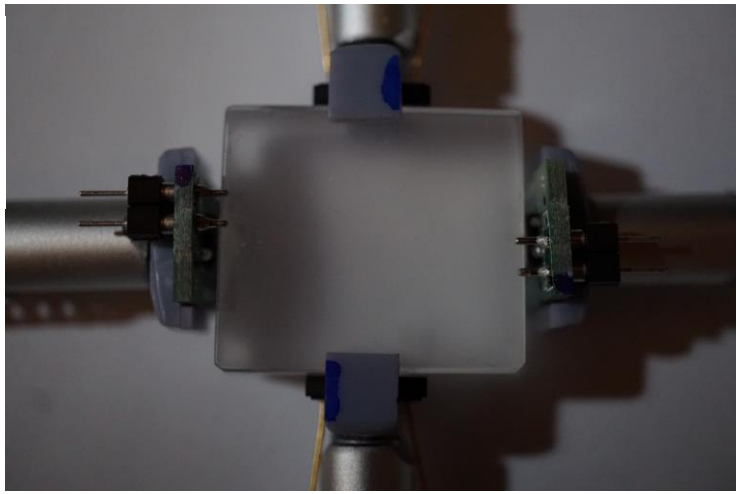
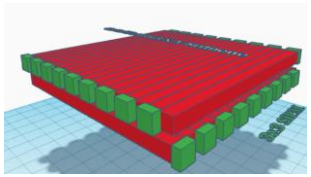
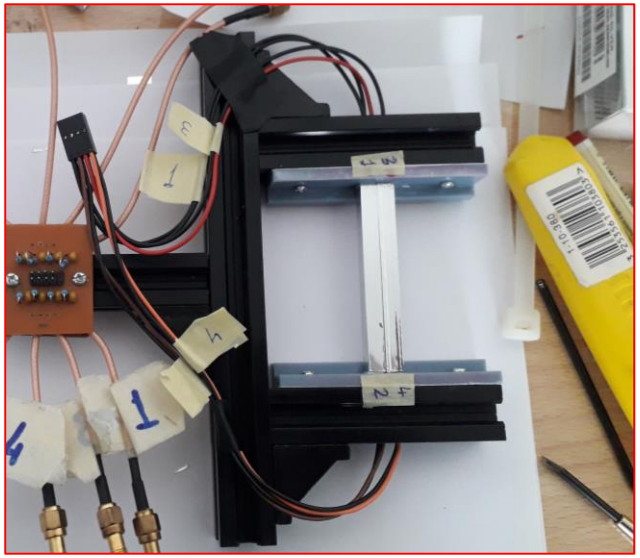
What's new

2022



1ST test in 2021 prototype of TARAT





2ND test in 2022

SEGMENTED TARAT

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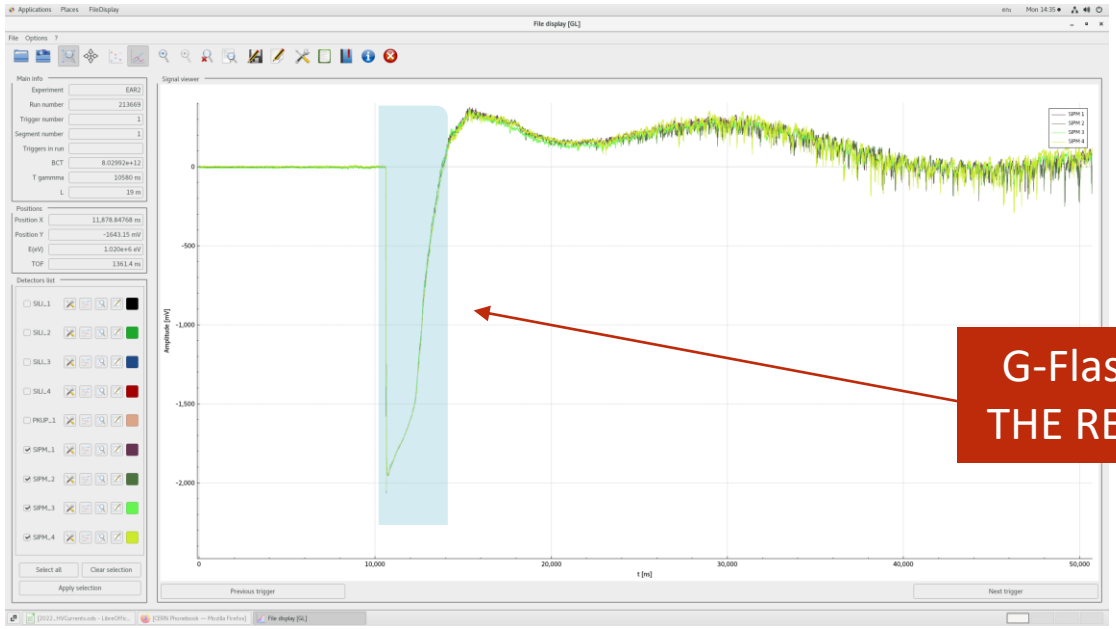
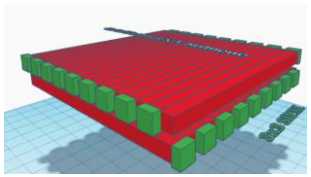
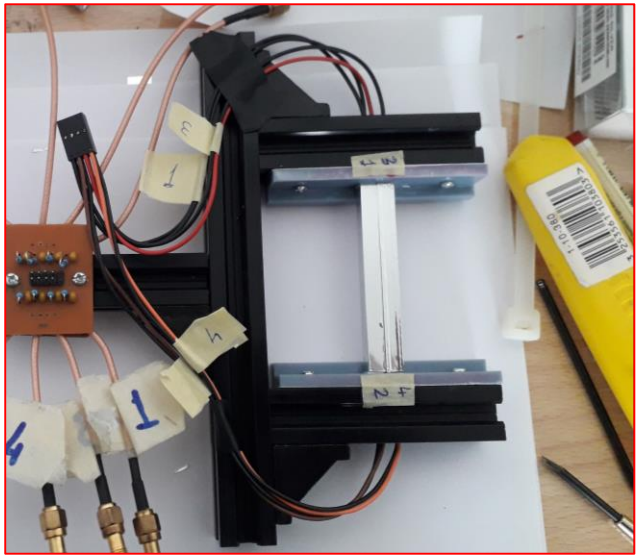
What's new

2022



G-Flash STILL COVERING THE REGION OF INTEREST





2ND TEST IN 2022

SEGMENTED TARAT

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Conclusions

1. The active target concept is valid, however, in EAR2 TARAT does not work in the energy region of interest. In other words: **NN experiment is not possible with the present setup (segmented target) in EAR2.**

2. With a reduced counting rate (hundreds of ^{2}H breakups per day), **in EAR1** the NN experiment **is possible in principle**.

3. The feasibility depends on the development of the neutron tracker RIPTIDE. Now ongoing.

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Working Group

R. Mucciola, A. Musumarra, M.G. Pellegriti, N. Patronis, M. Bacak, and many others

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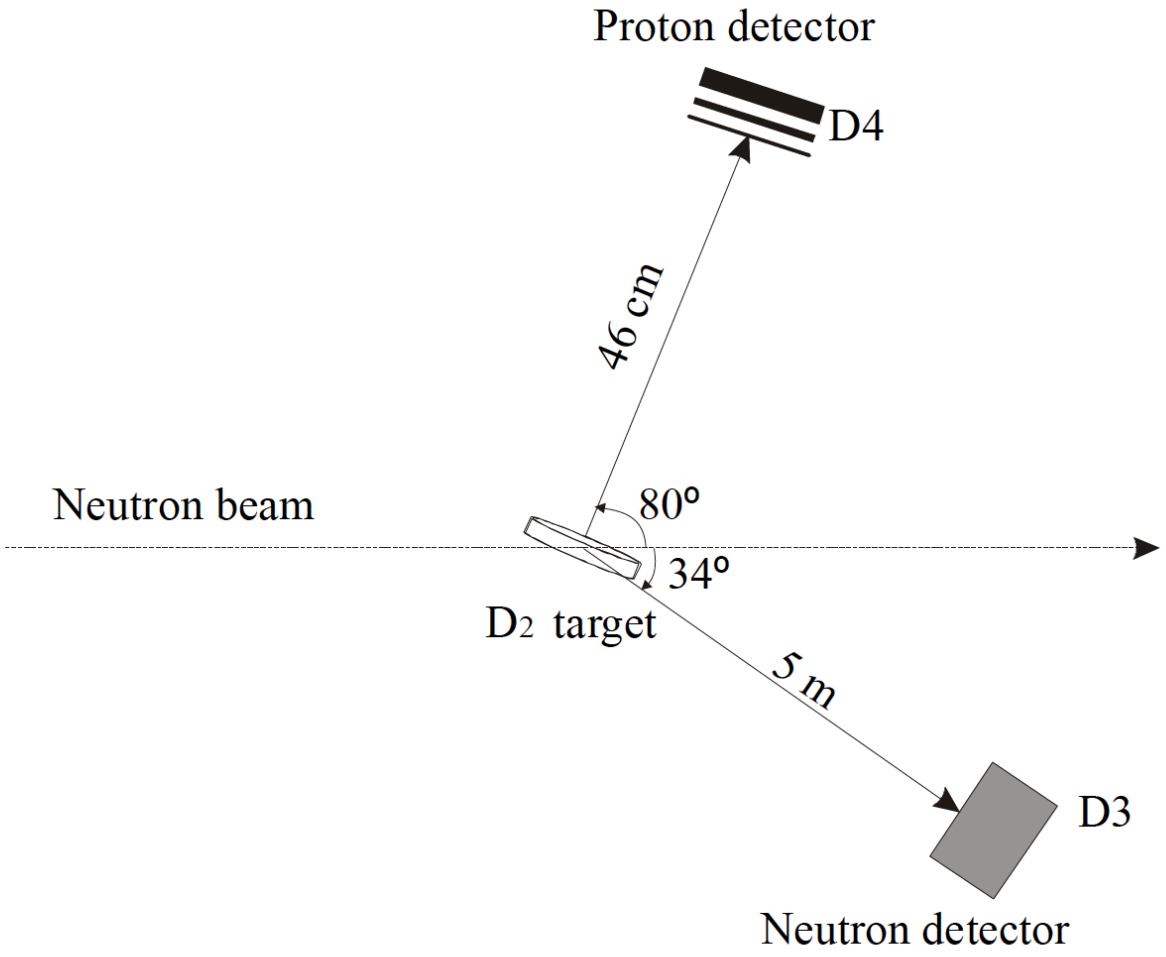
backup

P.A. Assimakopoulos 2006



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