

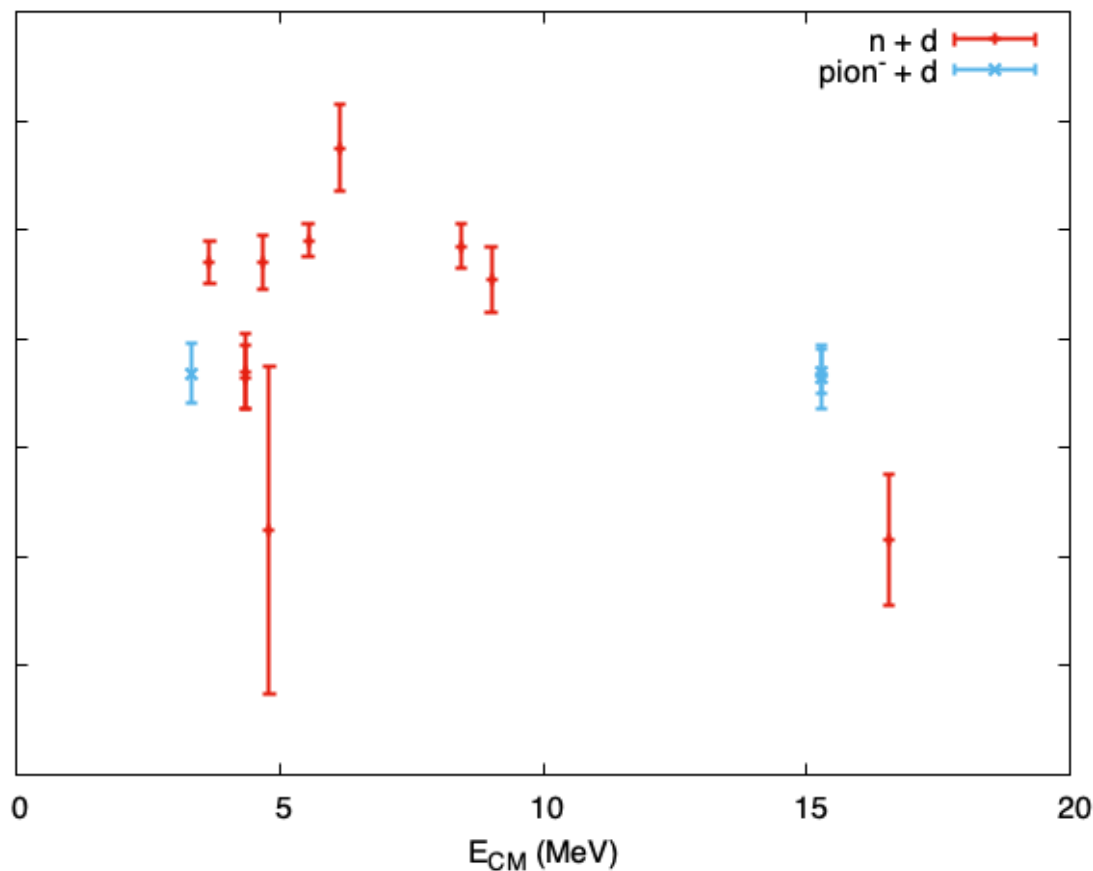
# Neutron neutron scattering length & TARAT

C. Massimi, A. Musumarra, R. Mucciola, M. G. Pellegriti

+ studenti

(e tanti altri)

# 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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<sup>8</sup> [www.cern.ch/n\\_TOF](http://www.cern.ch/n_TOF)

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**Abstract:** We propose to exploit the interaction of the two neutrons in the final state of the neutron-induced deuteron breakup reaction  ${}^2\text{H}(n,p)nn$  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.

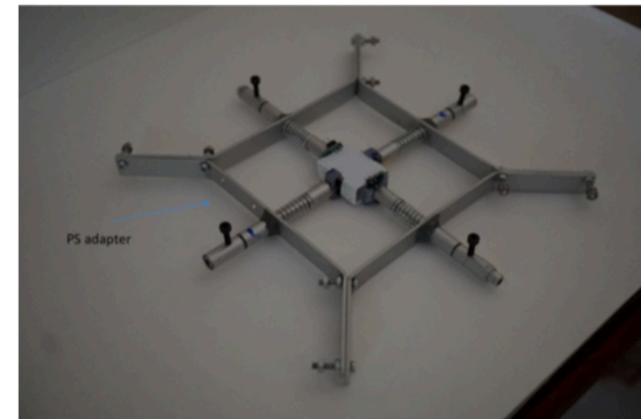
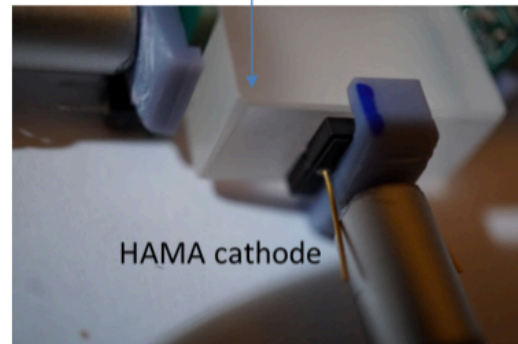
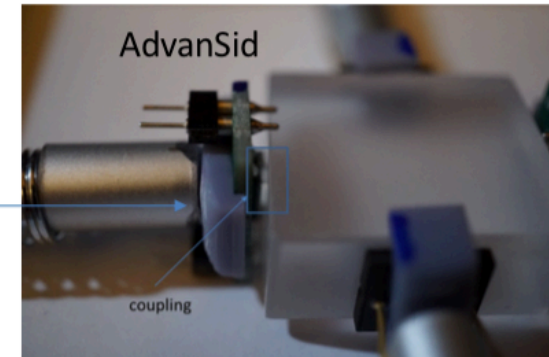
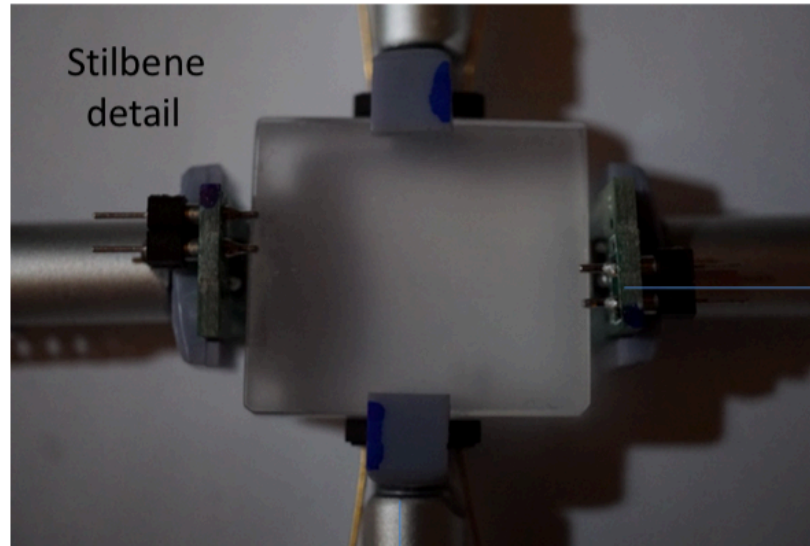
**Requested protons for the test:**  $5 \times 10^{17}$  protons on target

**Experimental Area:** EAR2

# RECAP

## *Stilbene-d12 crystal kindly provided by LLNL*

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



# RECAP

*EAR1@n\_TOF setup*

14 November  
 $2 \times 10^{16}$  protons

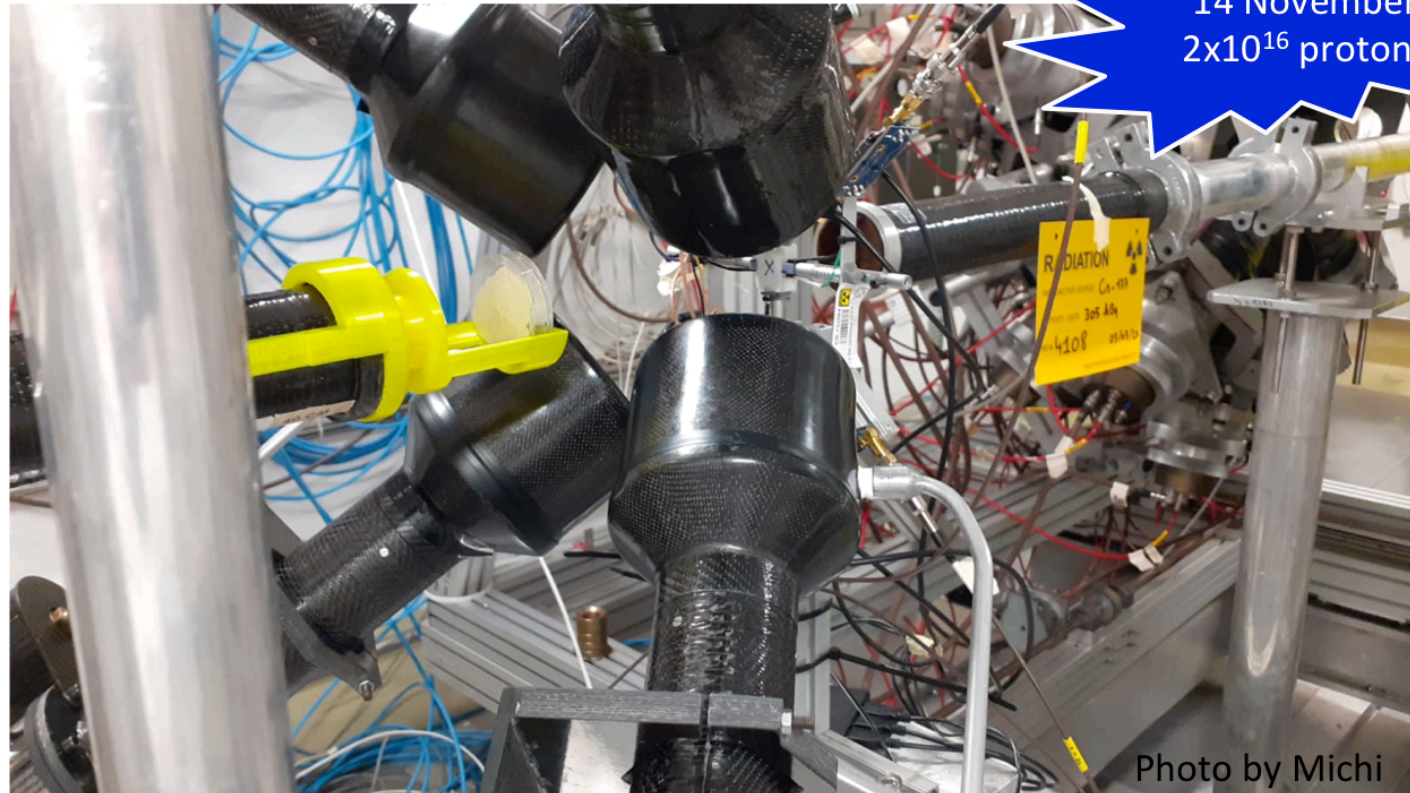


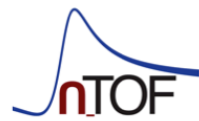
Photo by Michi

- 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  $\gamma$ -flash to be quantified as function of beam intensity

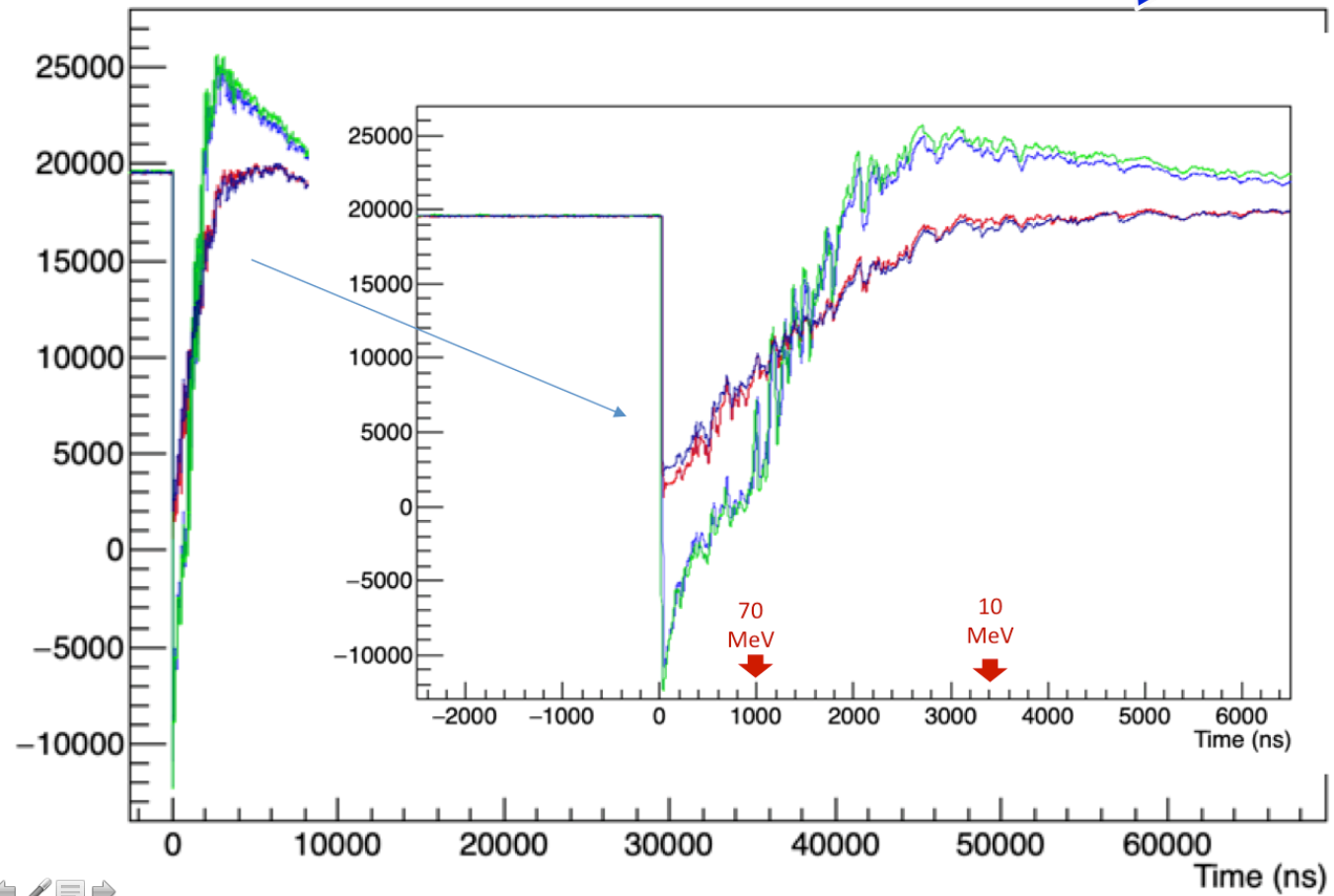
# RECAP



Some data: response to  $\gamma$ -flash

EAR 1

112146 nominal beam intensity, Pb filter



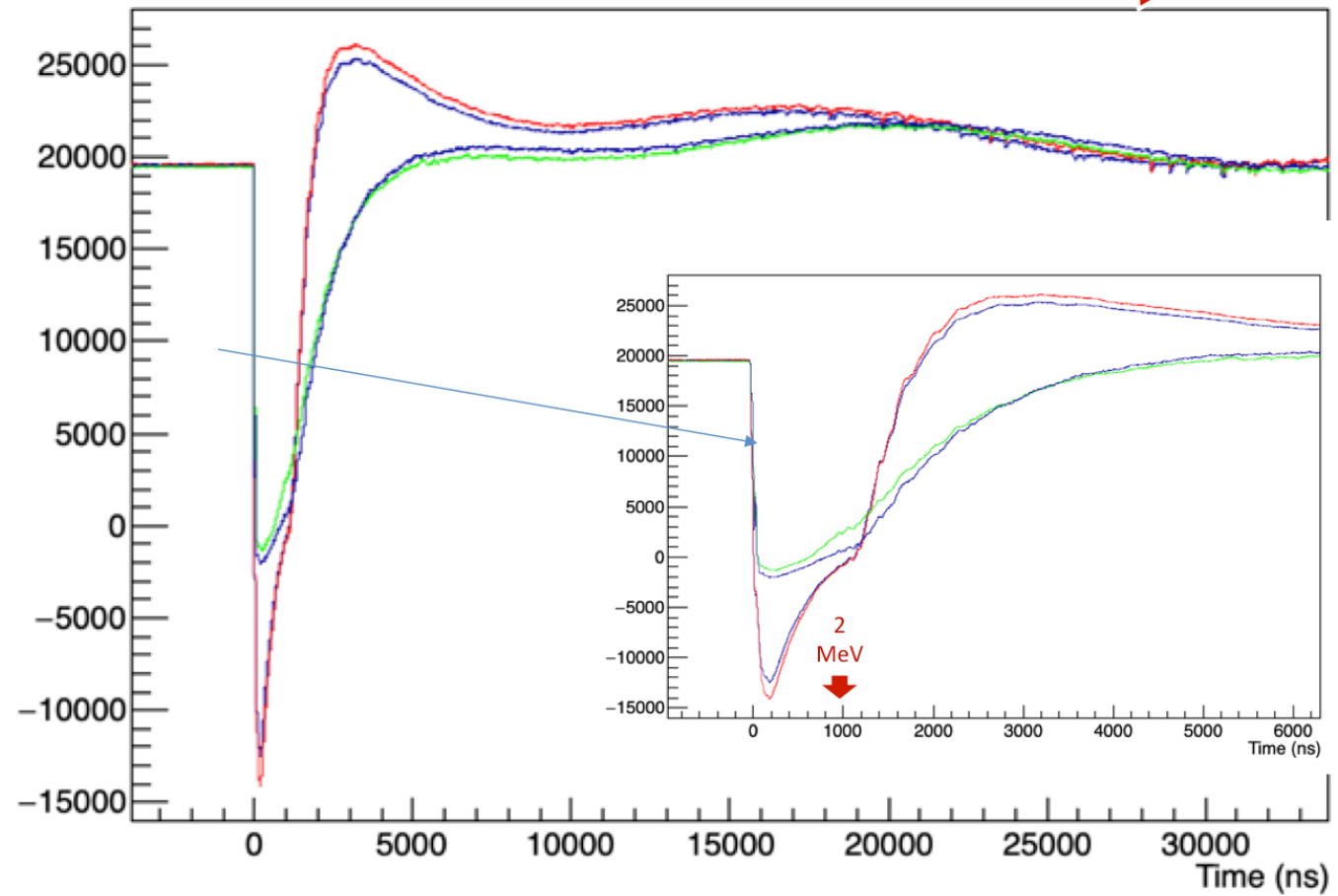
# RECAP



Some data: response to  $\gamma$ -flash

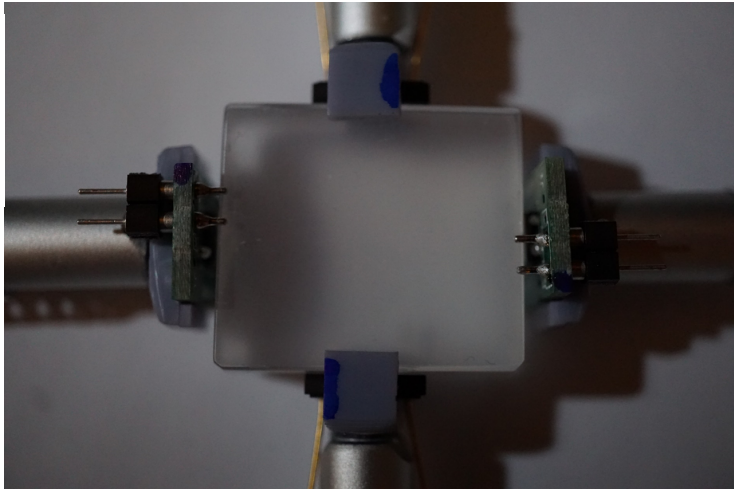
EAR 2

212147 nominal beam intensity, ALL filters

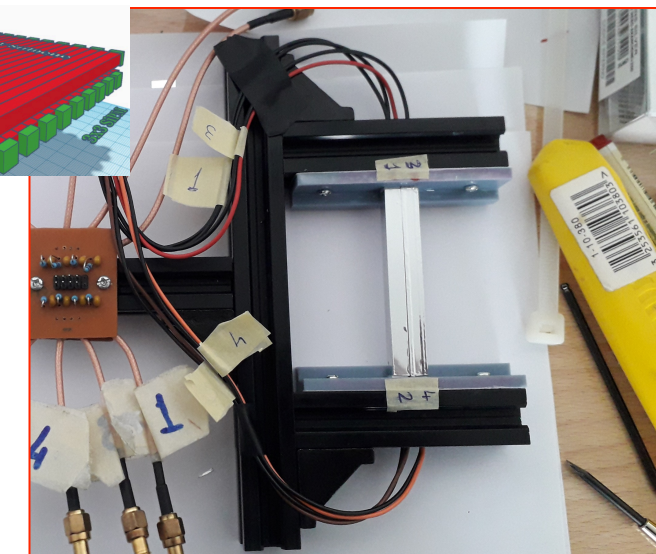


# Alcune attività 2022

Stilbene deuterato su fascio (1° test, 2021)

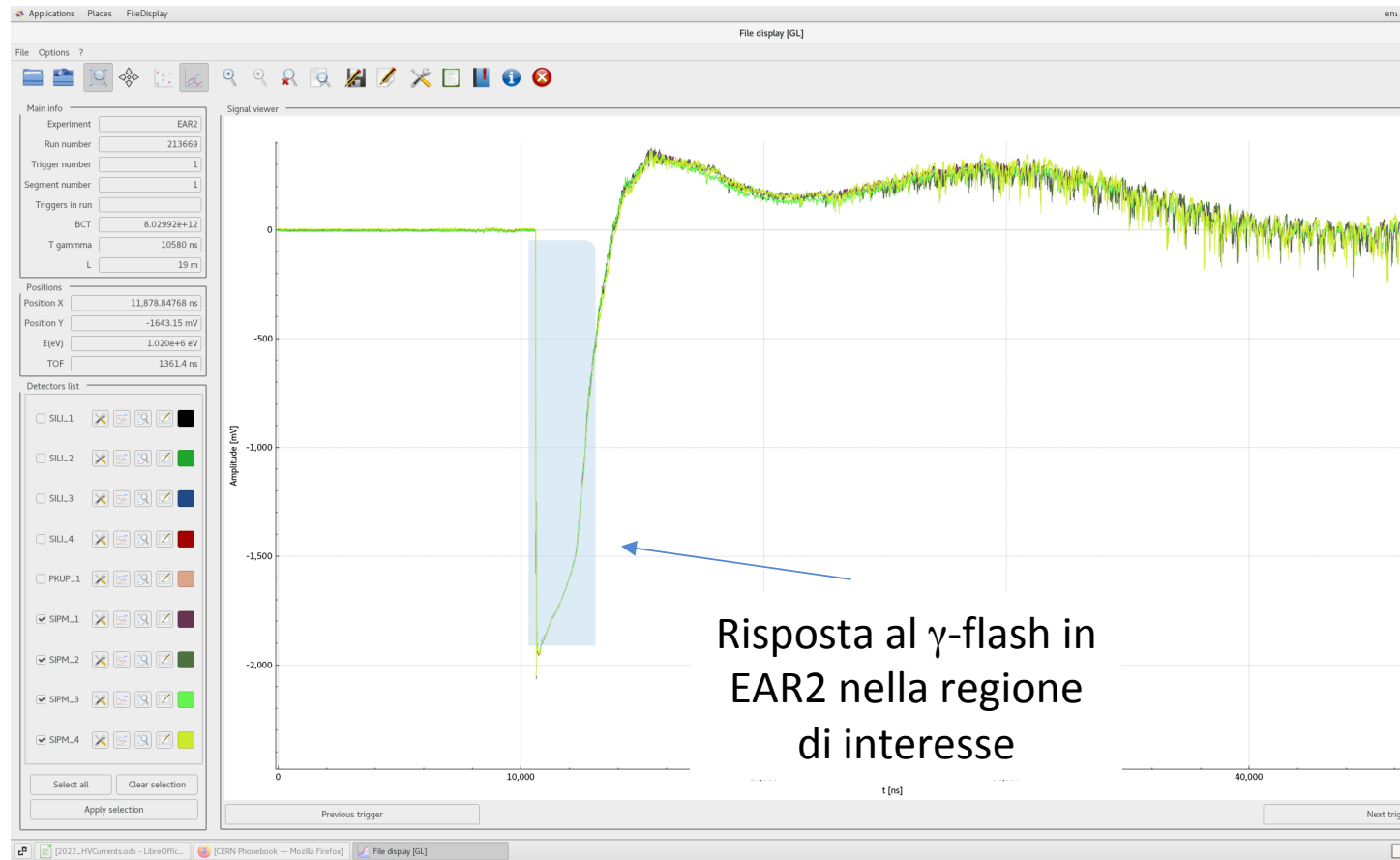


Riv. segmentato su fascio (2° test, 2022)



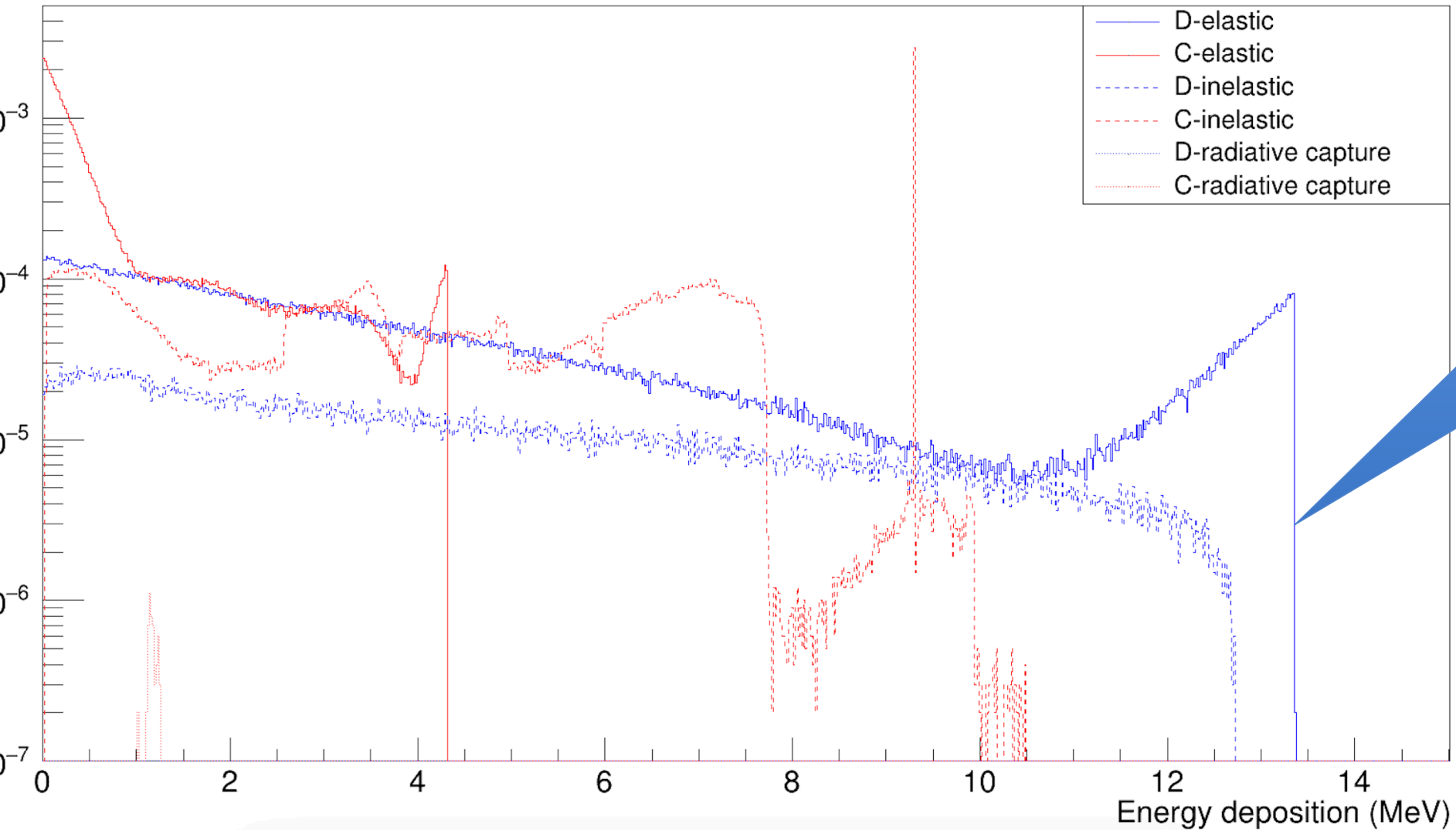
## TaraT

Target attivo per la misura della lunghezza di scattering neutrone neutrone, tramite breakup di  $^2\text{H}$



# Alcune attività 2022

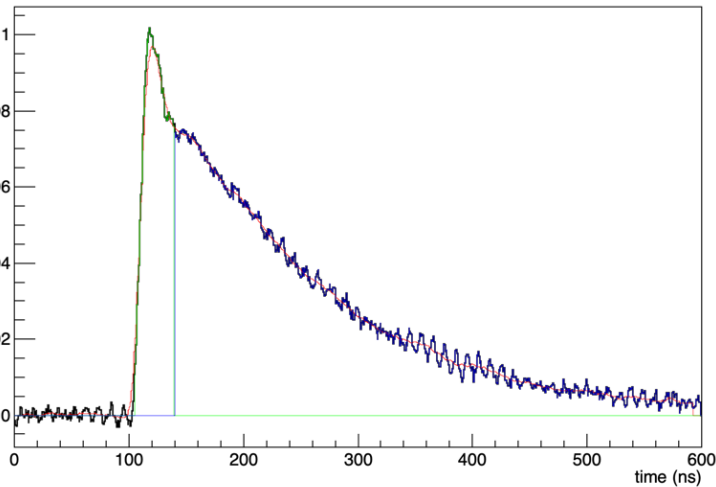
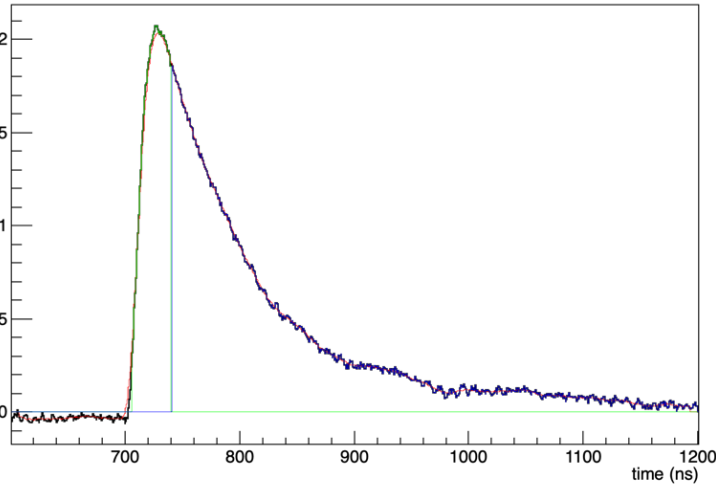
TaraT



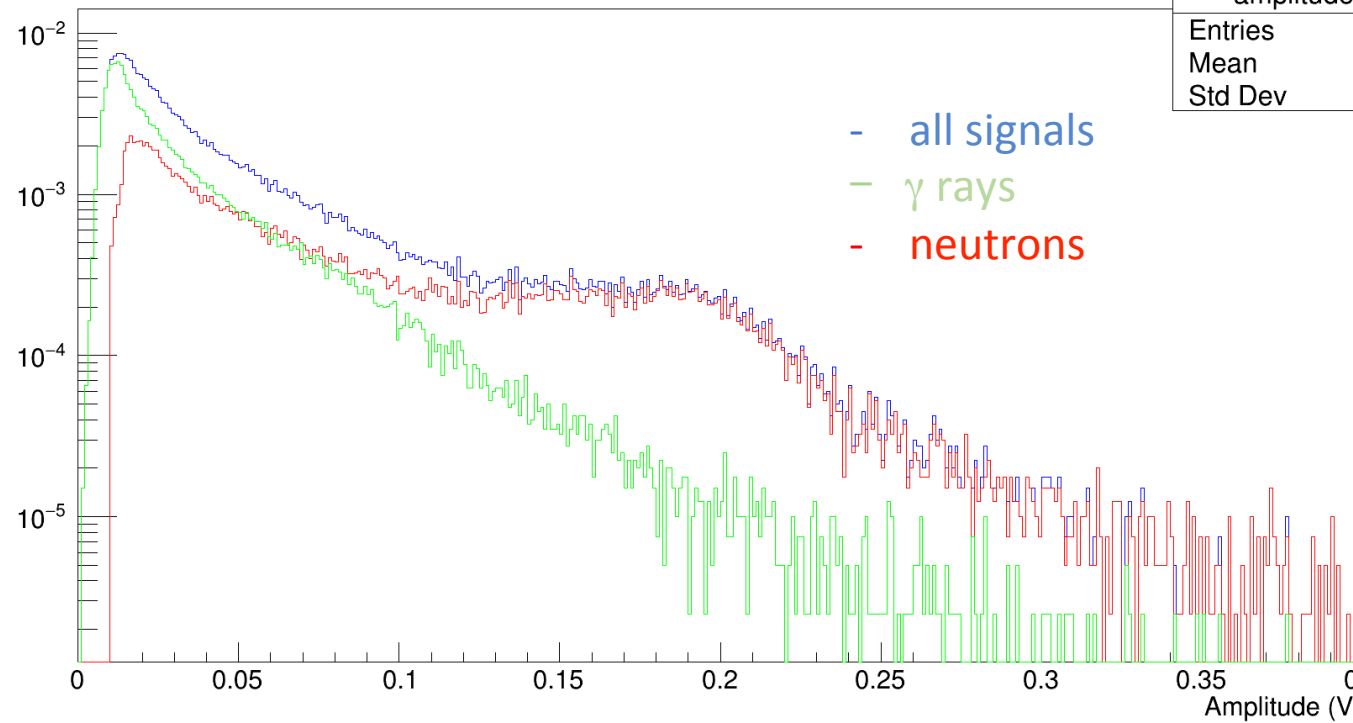
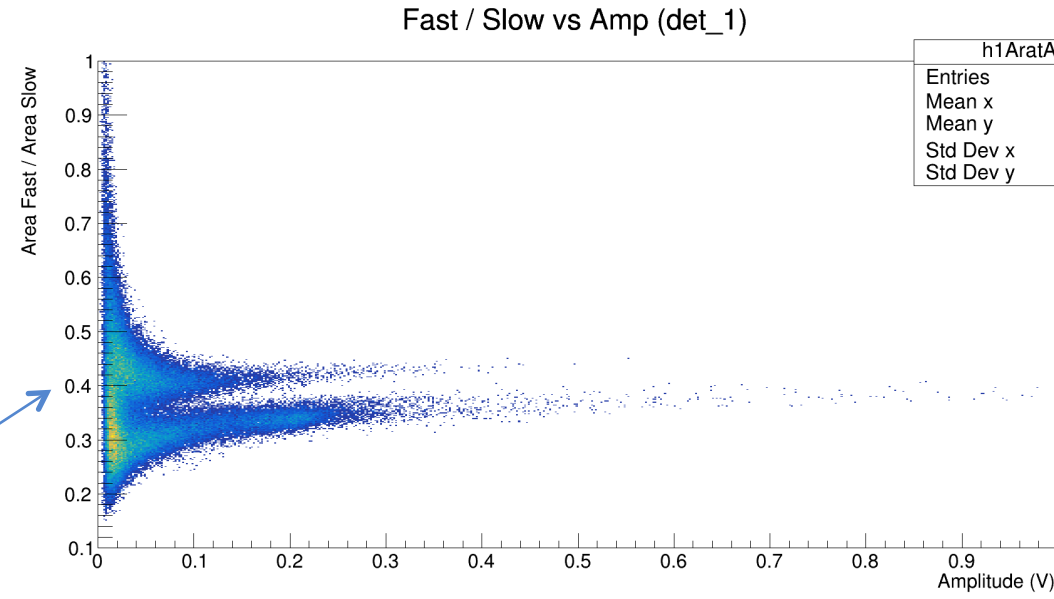
**Geant4**  
Simulation  
+  
Ad hoc  
3-body  
calculation  
+  
NRESP



# Alcune attività 2022



n/ $\gamma$  discrimination  
(3 different ways  
CONSISTENT)



## Conclusioni

## TaraT

Target attivo per la misura della lunghezza di scattering neutrone neutrone, tramite breakup di  $^2\text{H}$

- L'idea del target attivo è valida, ma in EAR2 funziona solo per tempi di volo al di fuori della regione di interesse per la misura (esperimento non possibile in EAR2)
- In EAR1 l'esperimento sarebbe possibile in via di principio (con count rate ridotto). Tutto dipende dallo sviluppo del rivelatore di neutroni (RIPTIDE) e gioverebbe un aumento di flusso istantaneo a EAR1