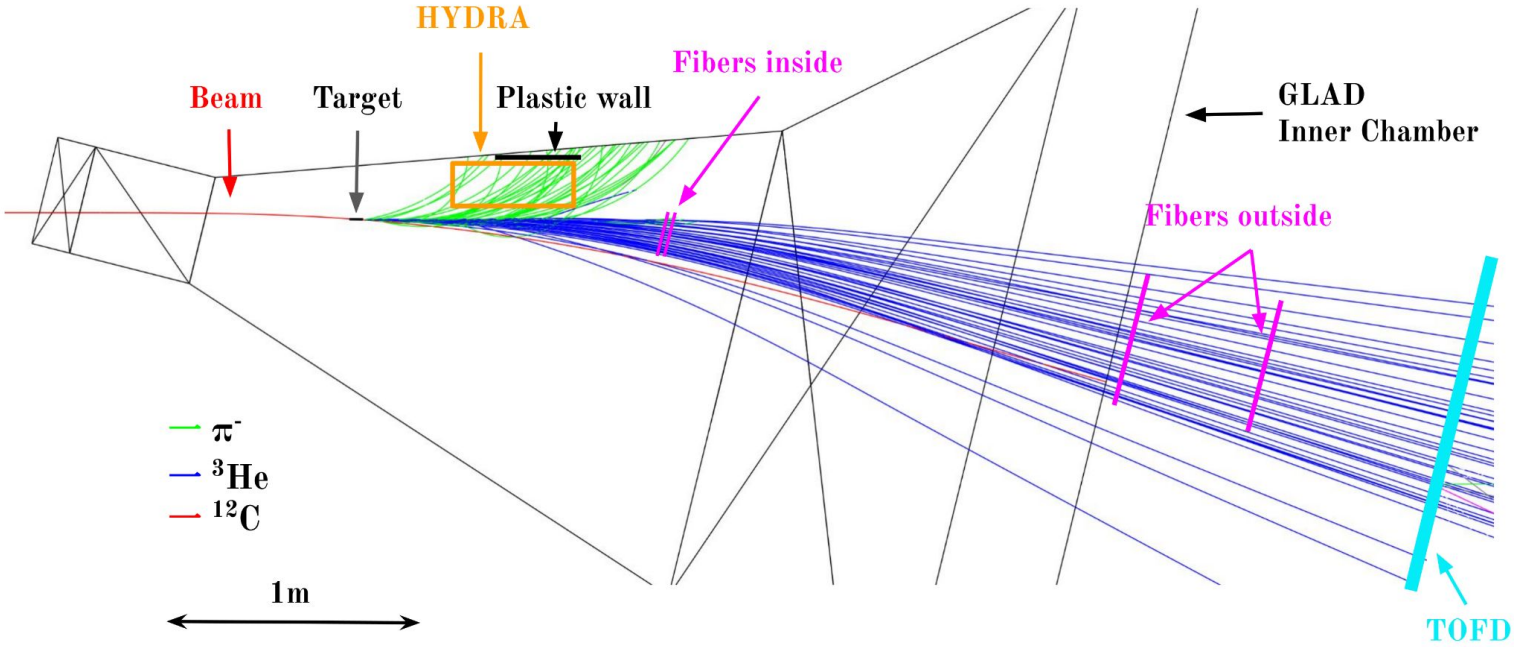
HYDRA

TECHNISCHE UNIVERSITÄT DARMSTADT

Simone Velardita

R^3B Collaboration meeting

16/11/2022



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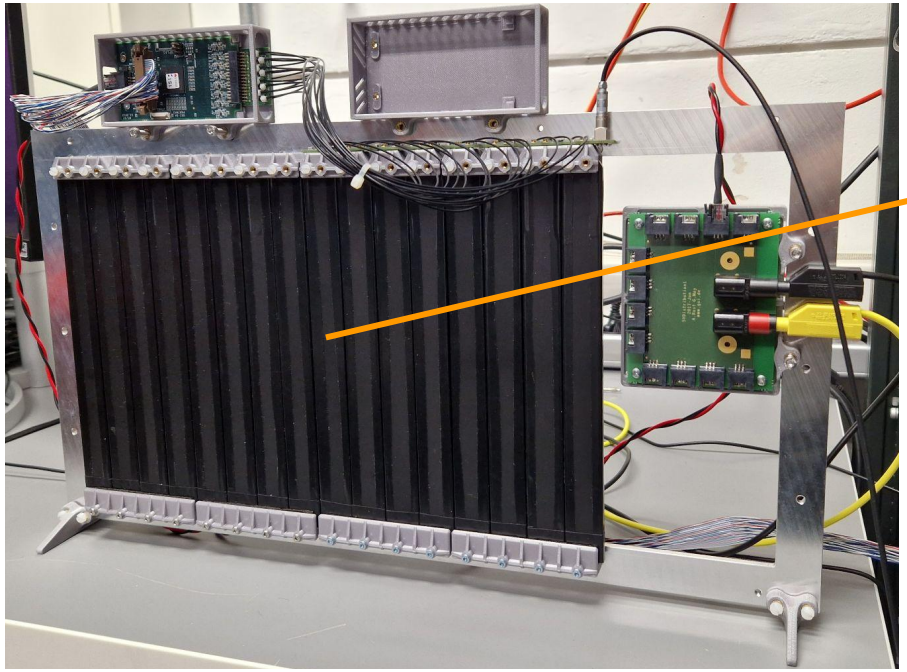
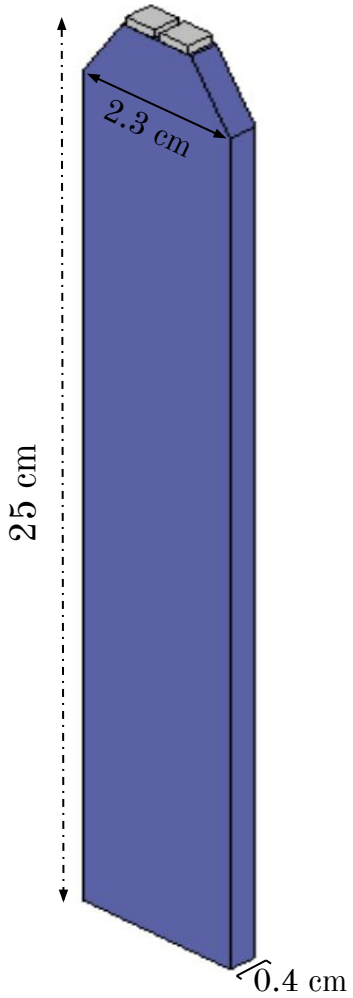
HYDRA plastic wall status

HYDRA plastic wall

➔ 16 EJ-200 plastic bars with total coverage: 25*37*0.4 cm^3





HYDRA plastic wall

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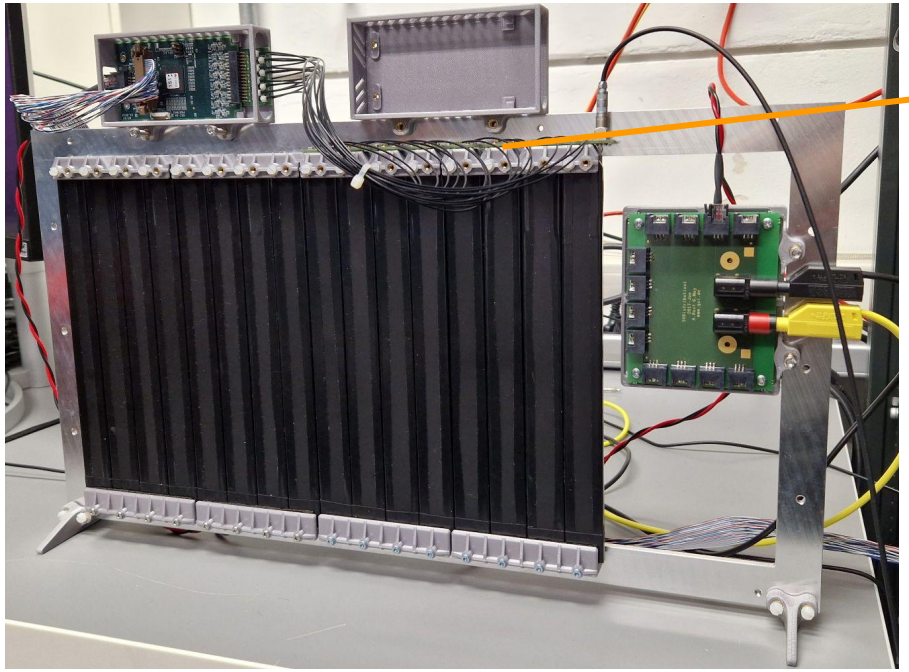
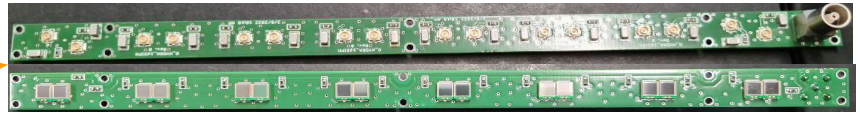
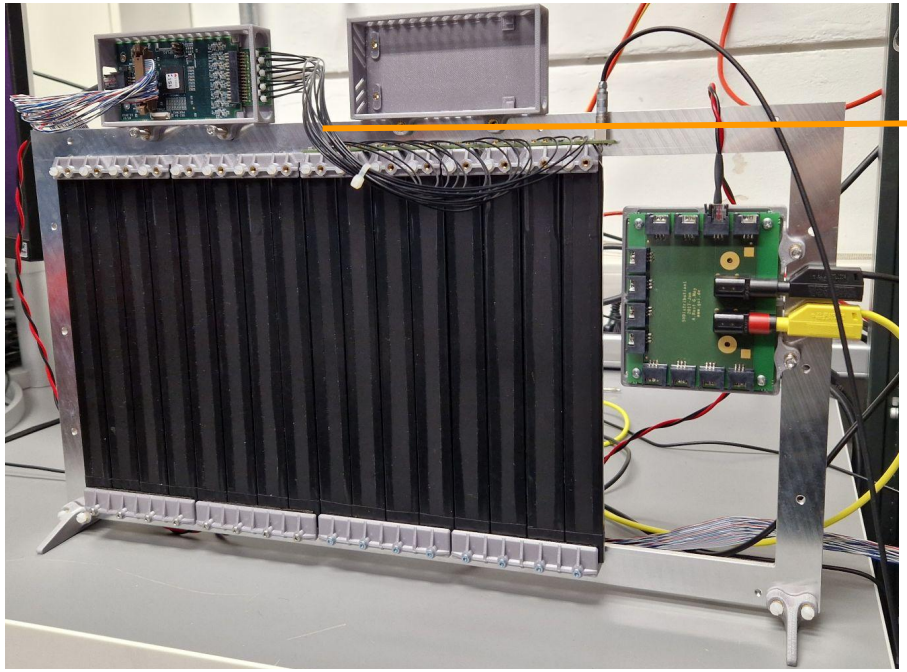
- ➔ 16 EJ-200 plastic bars with total coverage: 25*37*0.4 cm^3
- ➔ 32 SiPMs Hamamatsu S13360-3050PE

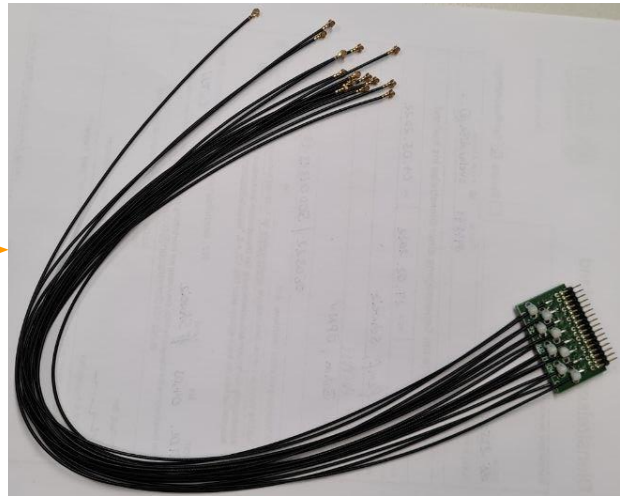




HYDRA plastic wall

- 16 EJ-200 plastic bars with total coverage: 25*37*0.4 cm^3
- 32 SiPMs Hamamatsu S13360-3050PE
- 2 Concentrator boards 16 MML connectors





HYDRA plastic wall

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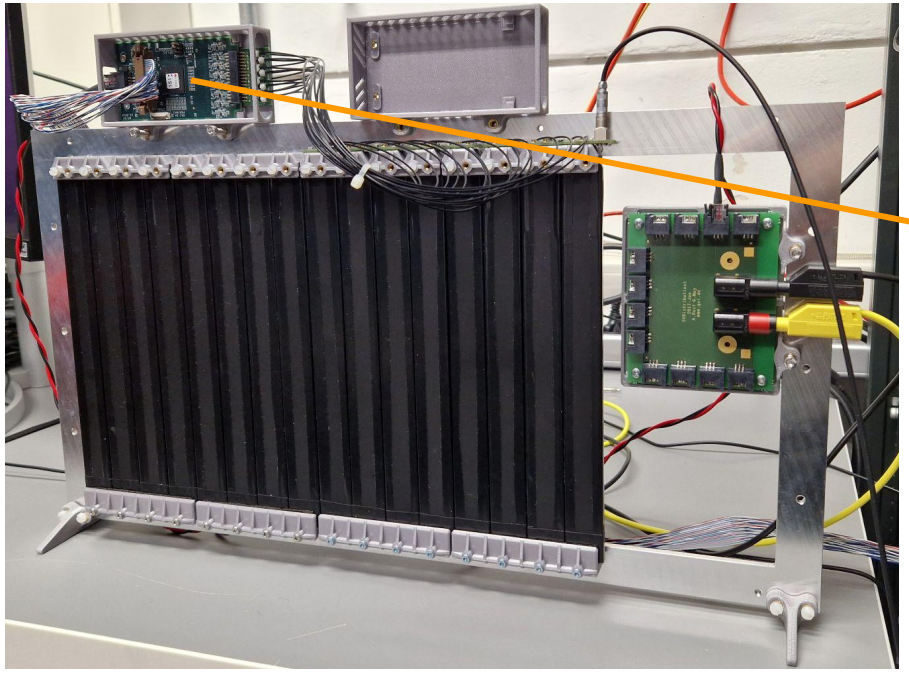
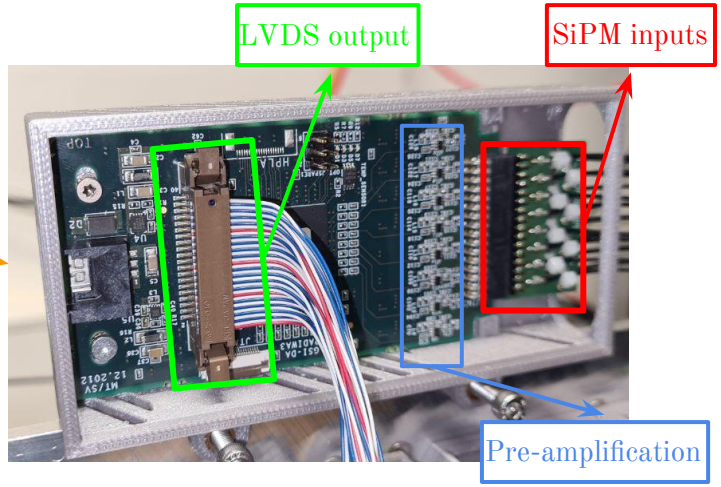
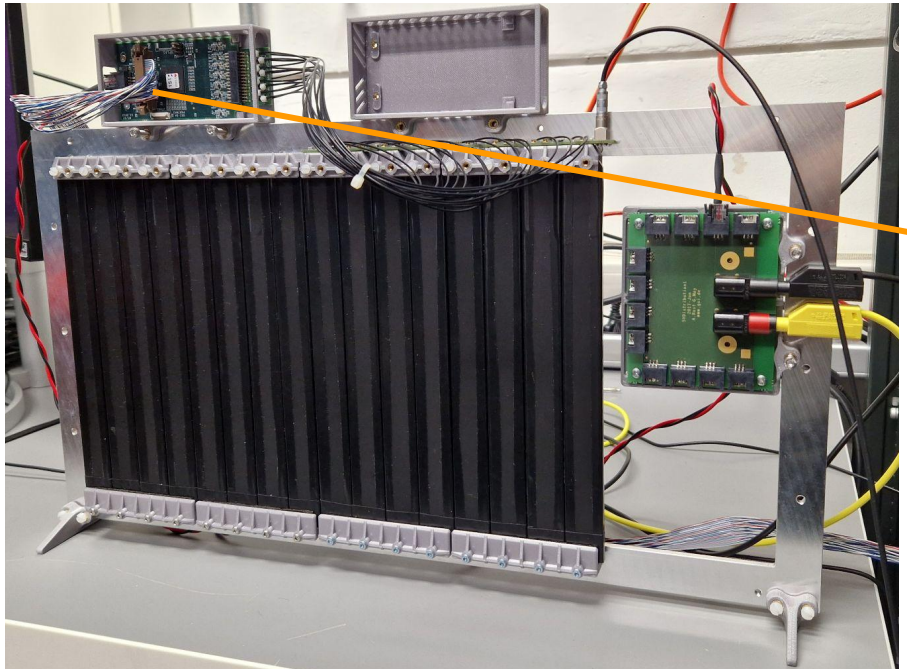
- ➔ 16 EJ-200 plastic bars with total coverage: 25*37*0.4 cm^3
- ➔ 32 SiPMs Hamamatsu S13360-3050PE
- ➔ 2 Concentrator boards 16 MML connectors
- ➔ 2 PADIWA3s: front end electronics

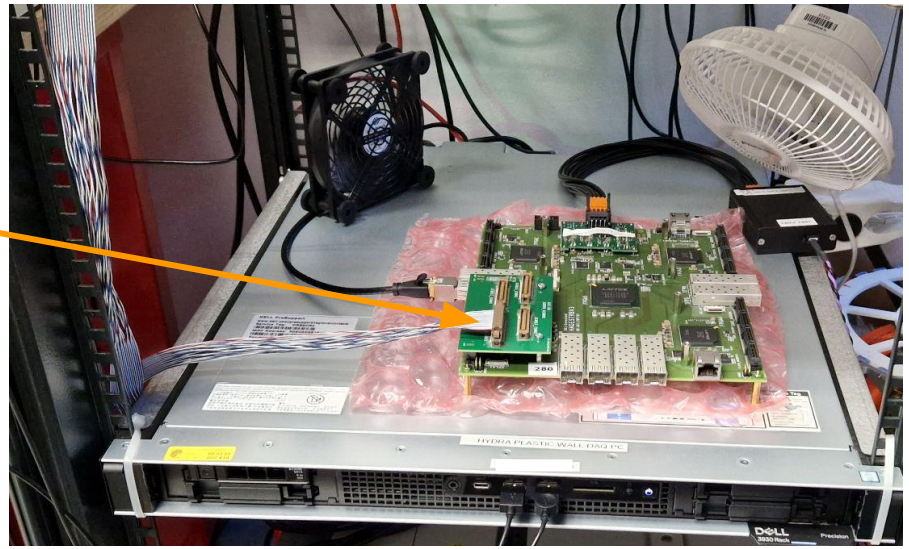




HYDRA plastic wall

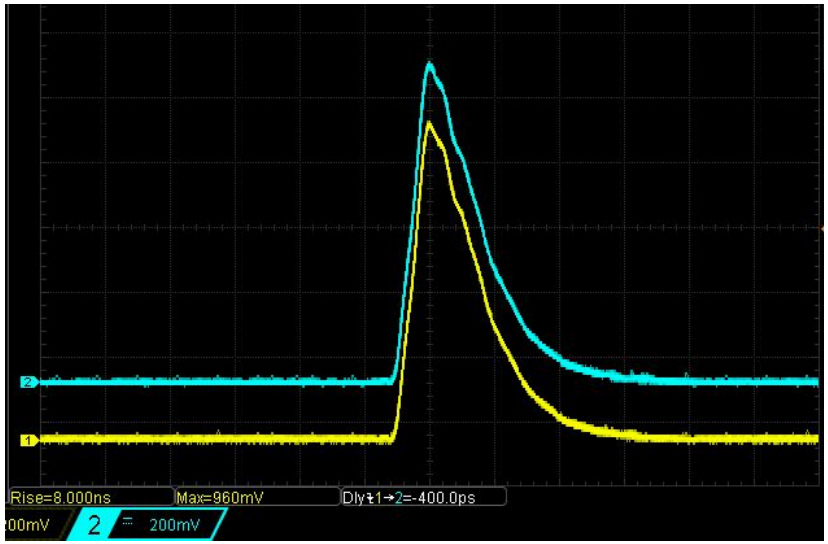
- 16 EJ-200 plastic bars with total coverage: 25*37*0.4 cm^3
- 32 SiPMs Hamamatsu S13360-3050PE
- 2 Concentrator boards
- 2 PADIWA3s: front end electronics
- TRB3 board: back end electronics

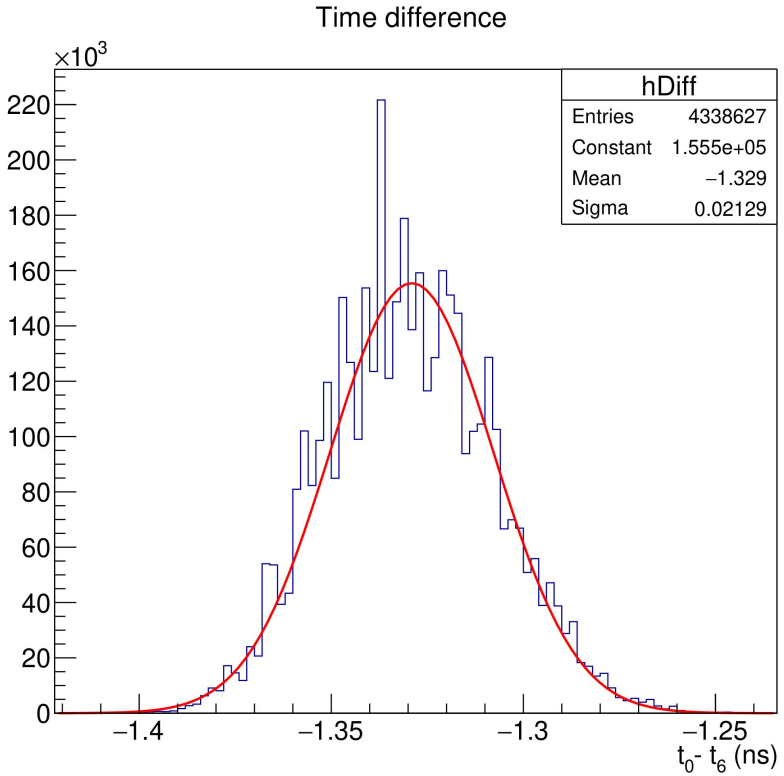




HYDRA plastic wall electronics- pulser test

Generated signal: 0.8 V, 1kHz

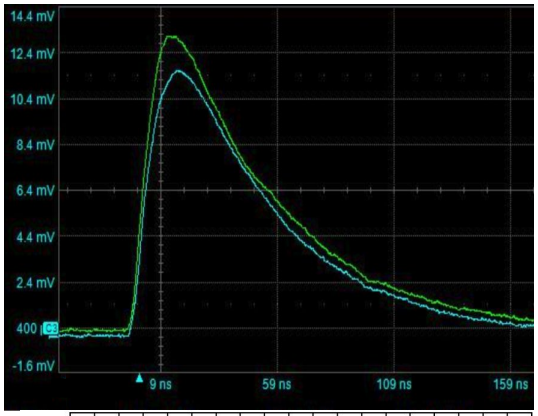


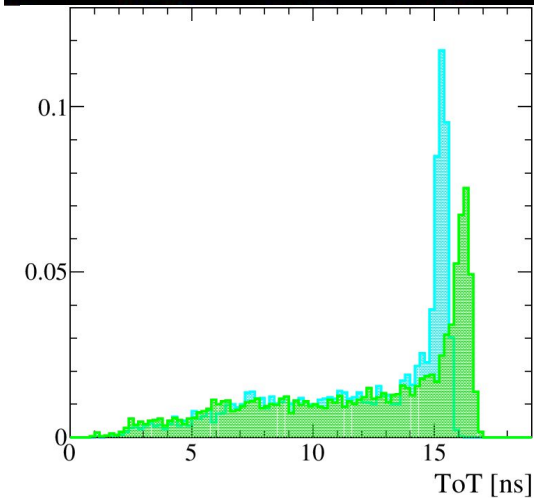


Intrinsic time precision 21 ps consistent with the designed value
J. Inst., 8:C01035, 2013

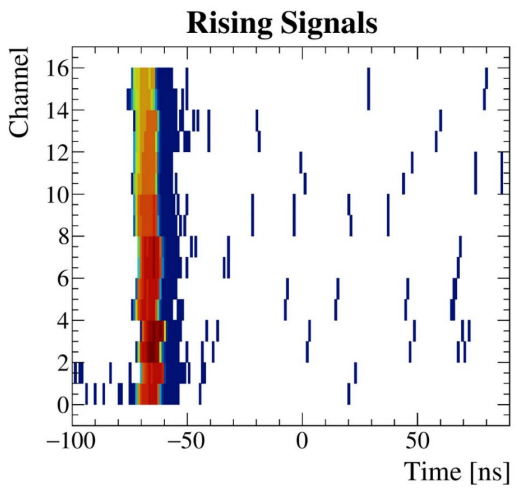
HYDRA plastic wall electronics- cosmic test

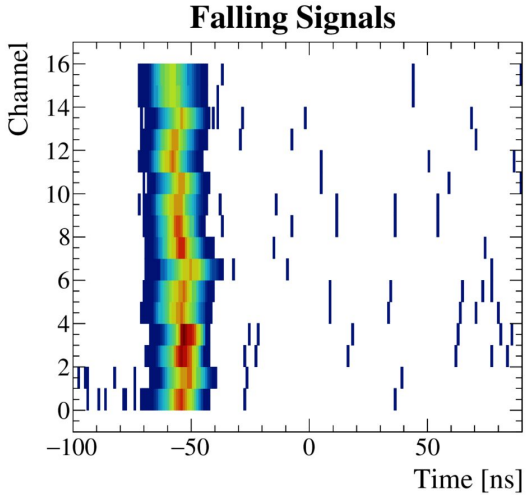
Cosmic signal 1 bar





All channels





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HYDRA '**Two-target method**'

Paper under preparation 2022

HYDRA day-one experiment 2024

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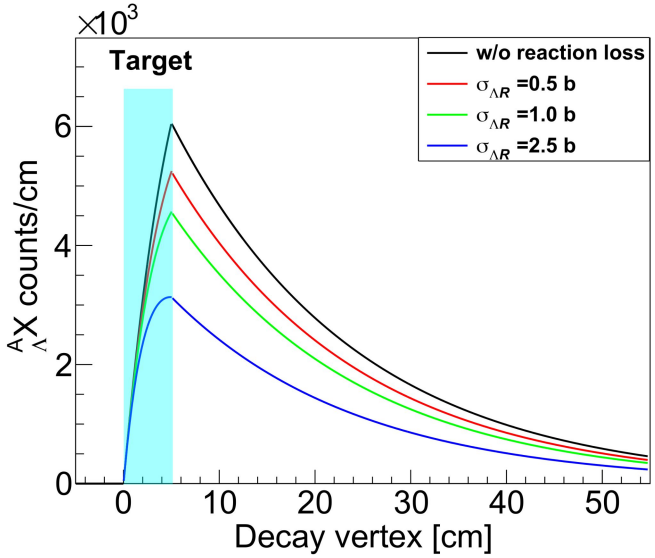
- We aim at producing ${}^{3}_{\Lambda}\mathrm{H}$, ${}^{4}_{\Lambda}\mathrm{H}$ and measuring their **interaction cross section** $\sigma_{\Lambda R}$ (size)
  - direct measurement is difficult due to the short lifetime (~200 ps)

- we propose to deduce the interaction cross section by measuring the mesonic **decay vertex distribution**
  - e.g. ${}^{12}\mathrm{C}+{}^{12}\mathrm{C}\rightarrow \mathrm{X}+{}^{3}_{\Lambda}\mathrm{H}\rightarrow {}^{3}\mathrm{He}+\pi^{-}$

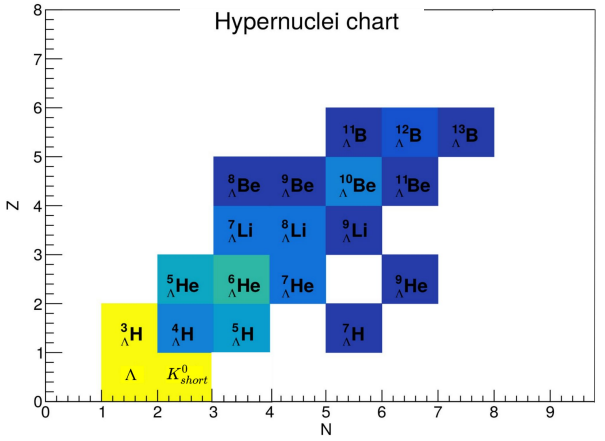


- **Two unknowns** (interaction and production cross sections) → two measurements (d_1=1, d_2=6 cm)

Invariant mass: background contribution

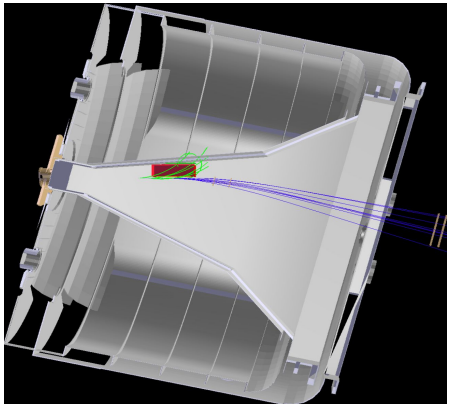
There are 3 main sources of background:

1. π^- and ^{3}He both from the fragmentation
2. π^- and ^{3}He both from heavier hyperfragment
3. **π^- from free Λ, K^0(short) or heavier hyperfragment and ^{3}He from the fragmentation**



The background generator used is:

➔ Dubna intranuclear Cascade Model (DCM) + Fermi break-up de-excitation model



Full realistic simulation implemented in the R3BROOT framework and is available on

https://github.com/R3BRootGroup/glad-tpc

Topological cuts to reduce background

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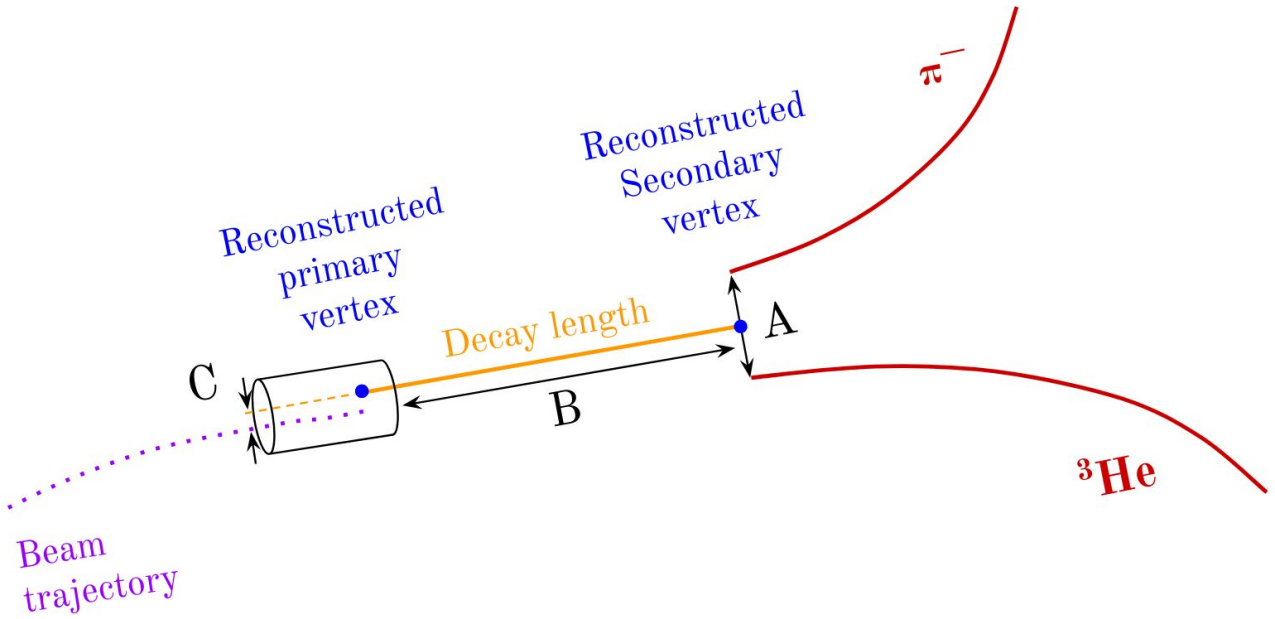
A. The tracks of the π^- and ^{3}He intersect (**5-mm** minimum distance)
B. The obtained decay vertex is outside the target by more than **10 mm**
C. The distance between the reconstructed hypertriton track and the beam trajectory is $\leq$**5 mm**

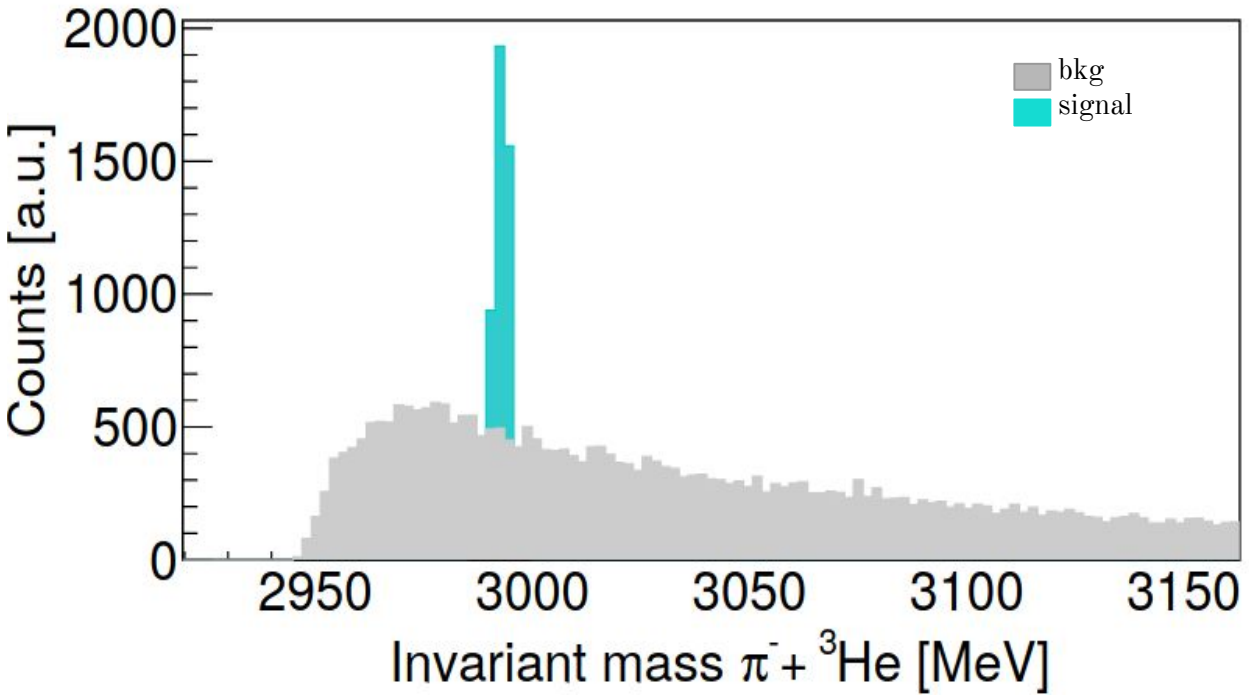


The **position** and **momentum resolution** of the tracking algorithm is under investigation by Y. Ayyad and H. Alvarez (next talk)

Invariant mass spectrum

Applying topological cuts results in:

- ➔ background rejection of 95%
- ➔ signal-over-Background ratio 3
- ➔ reduction of the statistics for good events by 20%



Outlook

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- Ensure light tightness
- Extend Cosmic ray measurement with the plastic wall
- Integration of the plastic wall with the TPC for cosmic ray test
- Integration of the TRB3 electronics into the R^3B daq
- Finalize the HYDRA method paper