Summary of the project status

TOFpRad 06/07/2024

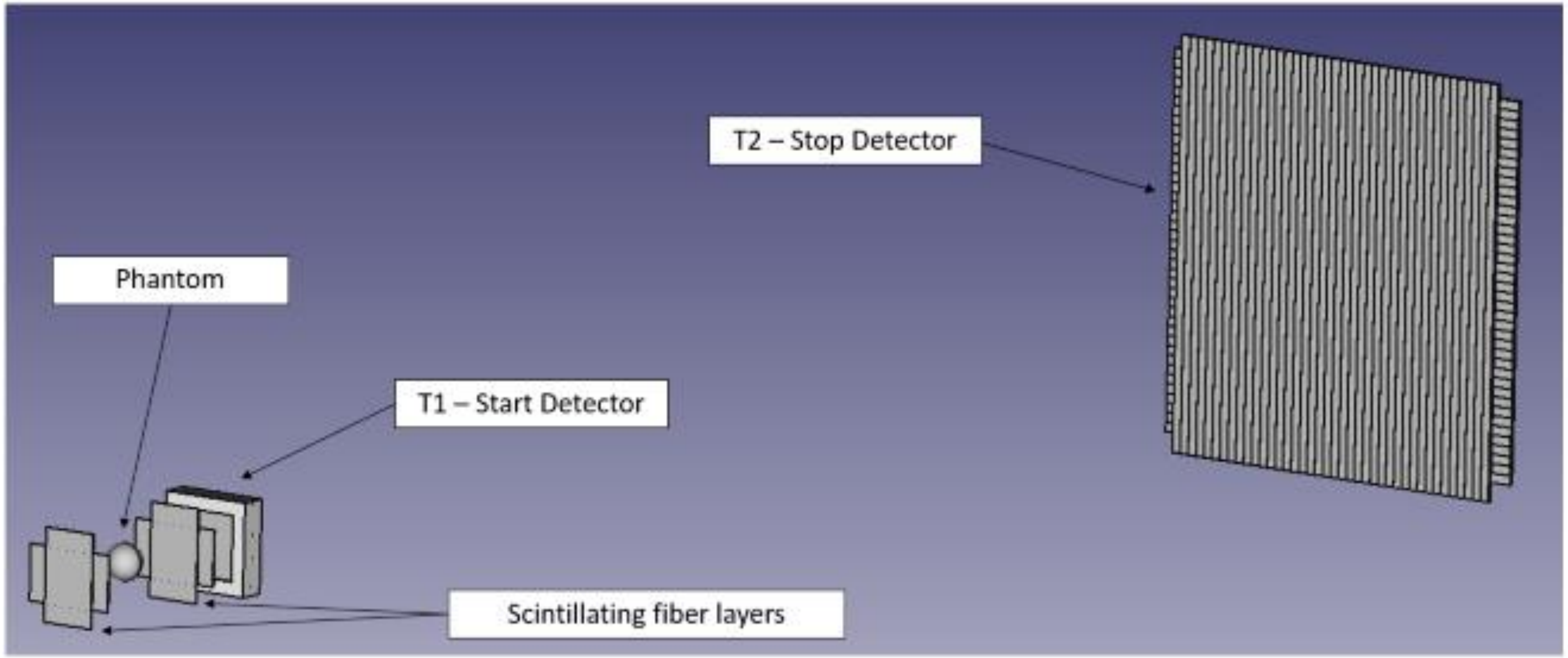
Where we are…

- We performed a measurement well before the expected timeline
- We almost finalized the analysis: part of the results are encouraging, other results are important to understand how to improve the system, however…
  - We know that the trigger scheme was not optimal for the data acquisition
  - Better results can be obtained with this same setup optimizing the synchronization
- We have a good simulation setup to estimate the performance of the system

- What now?
  - Are these results enough for a first publication? Considering both data and simulations
  - How can we improve these results?

Further steps

Let's recall what we expect to develop in the PRIN:



- Two beam monitors composed of a x-y plane each
- A start counter (the one used in the first data taking was good)
- A Stop detector optimized for the proton detection

Further steps

A limit appeared very clear in the project, the 1 kHz data rate will never be compatible with proton radiography applications (and is also critical in our data takings due to time constraints). Can we overcome this limitation?

A possibility is to change the DAQ system, adopting a new CAEN DAQ with a reduced number of channels (64 or 128) but capable to acquire up to few hundreds of kHz.

Possible structure of the next prototype

SF Layers

- Two modules, 6 x 6 cm^2 active area each (something more?)
- Readout needs to be optimized to reduce the number of required channels… see next
- The number of 1 x 1 mm^2 SiPMs scales as 4xL(mm)

  → 6 cm - 240 SiPMs; 10 cm - 400 SiPMs
- The required fibers with 1 mm lateral side scales as 4xLx(L+80?)(mm)

  → 6 cm - about 40 m; 10 cm - about 72 m

Stop Detector

A first demonstrator of reduce dimension

- Two layers with 10 bars each
- Each bar with size 5 x 10 x 260 mm^3
- Possibility to use them as two orthogonal layers or as a single layer with 20 cm x 26 cm active area.
- Tw0 4x4 mm^2 SiPMs on each side (SiPM board will be reusable in a larger TW)
- 40 channels total.

Scintillating fiber layers

How can we further reduce the number of the SF layers? Up to now each 6-cm layer needs 60 channels. (total of 240 chn. required)

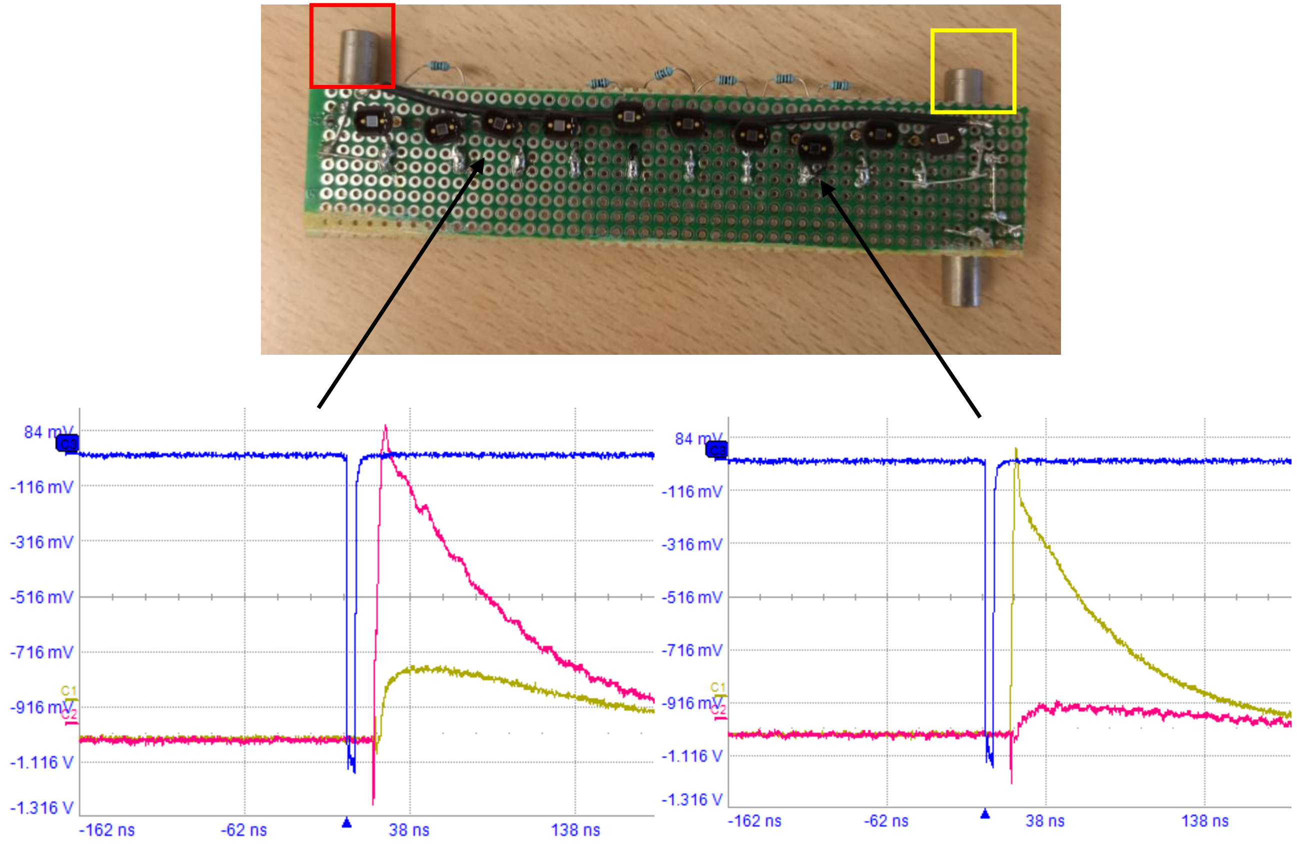
Larger SiPMs

- One to one coupling may not be needed to decode the fibers

(timing info is not important here!)

Resistive chain

- SiPM connected in a resistive chain



Some open questions

- Are we sure that we want to keep the bar-like design for the stop detector of the small demonstrator?
  - Needs more channels, not the easiest mechanical solution (neither the cheaper)
  - Proven geometry, we know how to deal with propagation delays, x-y position
- Which fiber readout configuration do we want to use?
  - I think that tests need to be performed, also with the next DAQ (test performed with the oscilloscope may give an indication but are not exhaustive!)
- What is the data rate goal?
  - Also studies on the beam structure are important here!

Timeline

In my dreams…

- We buy the DAQ and the other materials in a short amount of time (2-3 months)

- We perform tests in lab and complete the demonstrator by the end of the year

- We perform a data taking with all we have (not the complete system) at high data rate with the new DAQ (and maybe with the oscilloscope) to investigate the performance of the DAQ and the pile-up probability.
    - Not a large amount of beamtime needed (also depending on which detectors are ready)

- We will be ready for the test of the TOFpRad demonstrator at 6 months from the end of the project.