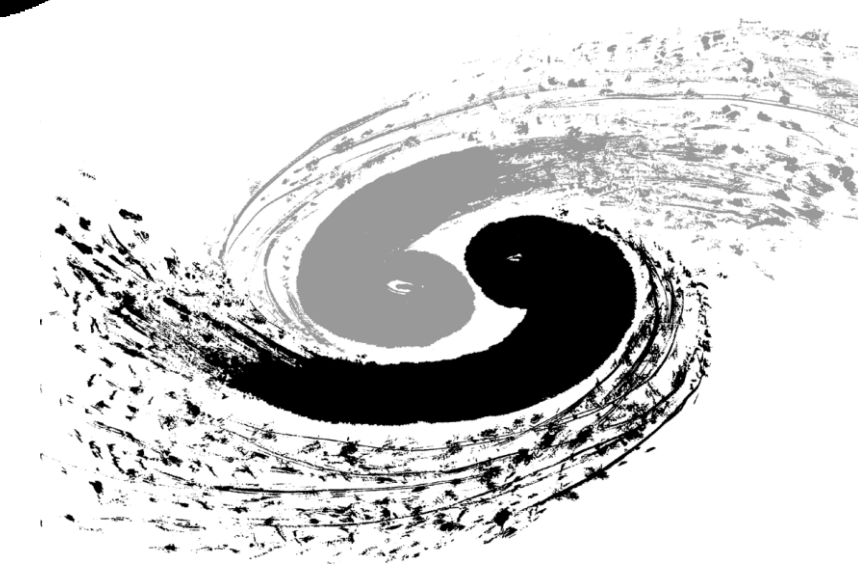


# Development of Detector and Trigger System for 1.6 GeV Proton Test Beam at CSNS

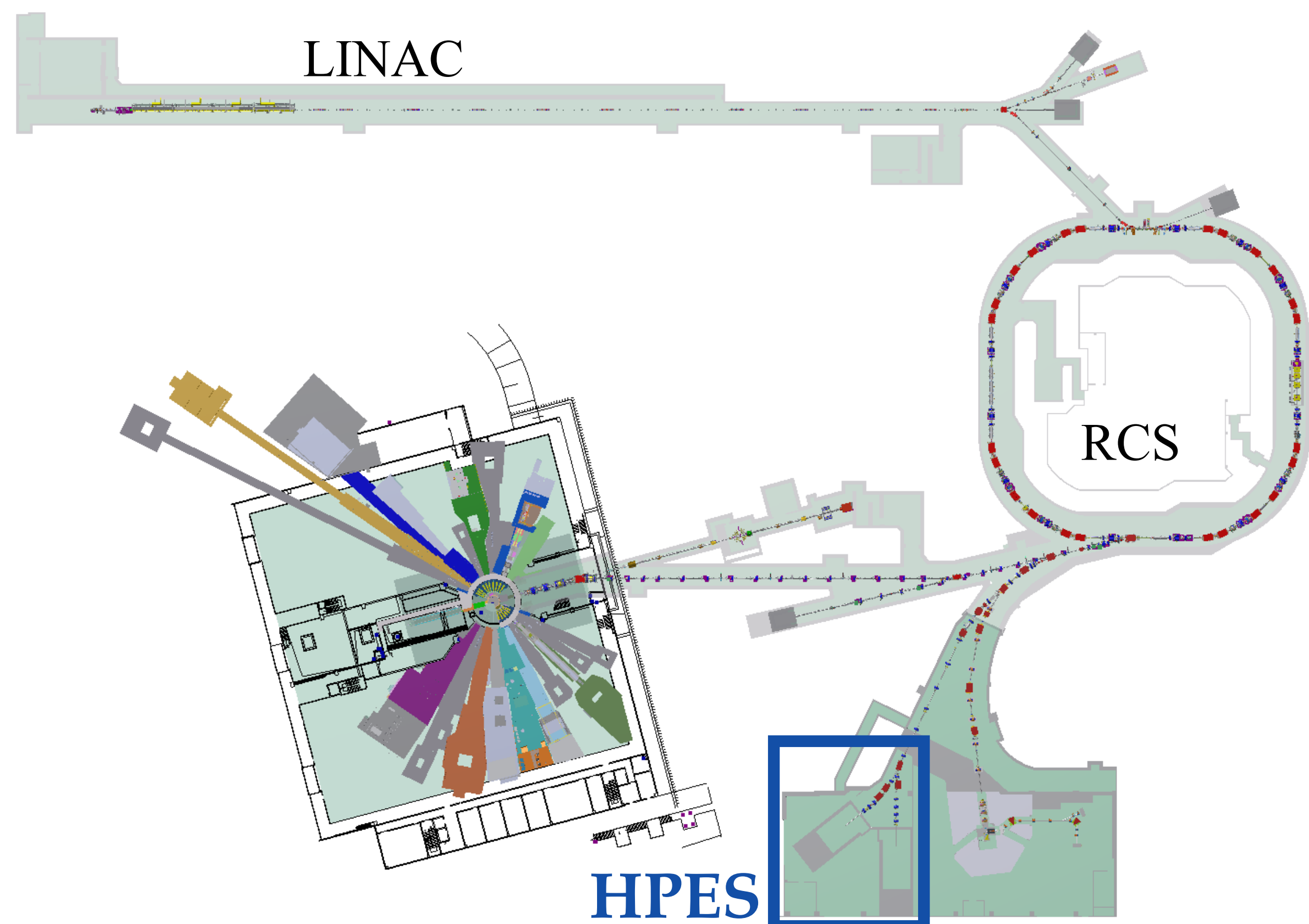


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## 1. HPES introduction

A 1.6 GeV proton test beam is under construction in in Dongguan, Guangdong, China.



### High-energy Proton Experiment Station (HPES)

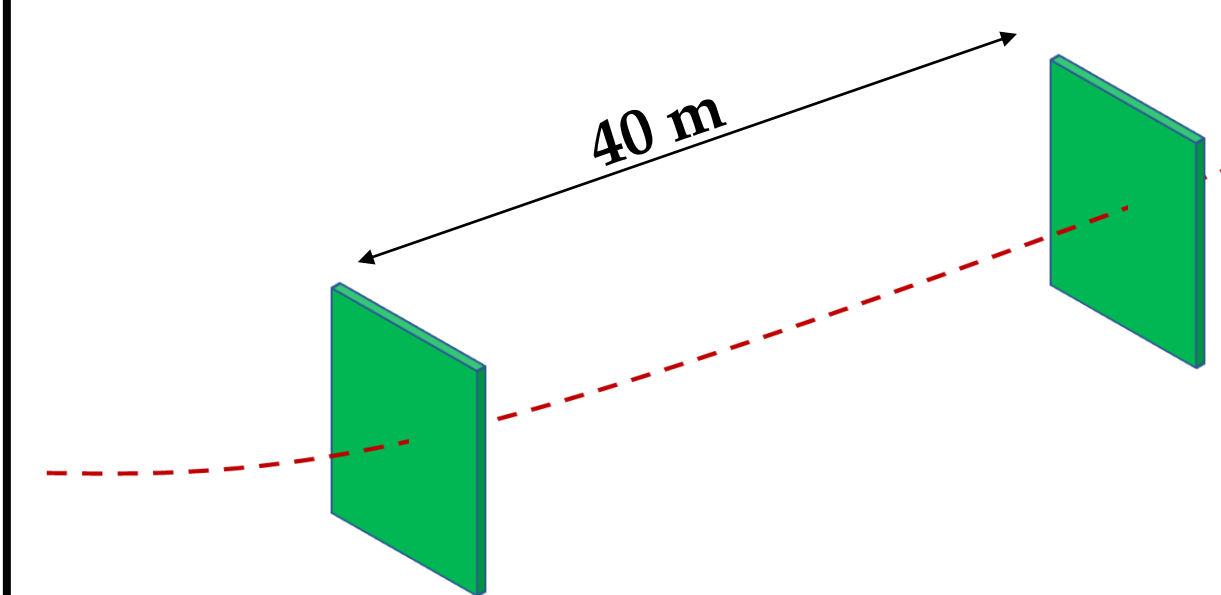
- Proton Energy 1.6 GeV.
- Energy adjustable in 0.8~1.6 GeV by degrader.
- Intensity is  $\sim 5$  k p/s distributed in 25 Hz pulses.
- Approximate single particle beam.
- Scientific target: advanced detector test.

A detector and trigger system has been designed for HPES to serve the user tests.

## 2. Detector System of HPES

Table. List of Dominate Devices of HPES Detector System

Device Name	Core Detector	Key Parameters
Proton Energy Detector	LGAD	Energy resolution $< 1\%$
Beam Telescope	Pixel detector	DUT positioning resolution $< 10 \mu\text{m}$
Trigger Supplier System	Scintillation optical fiber	Trigger timing resolution $< 1$ ns
Proton Intensity Monitor	Plastic scintillator	Intensity dynamic-range $1\sim 10^8$ p/s
Proton Profile Detector	Micromegas	Positioning resolution $< 150 \mu\text{m}$

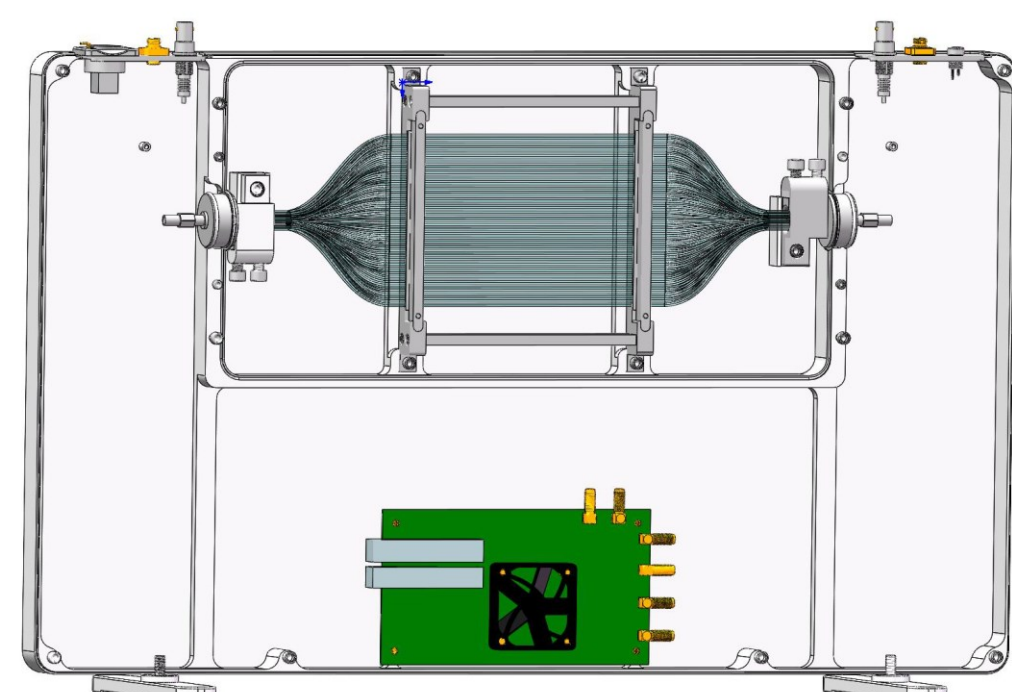
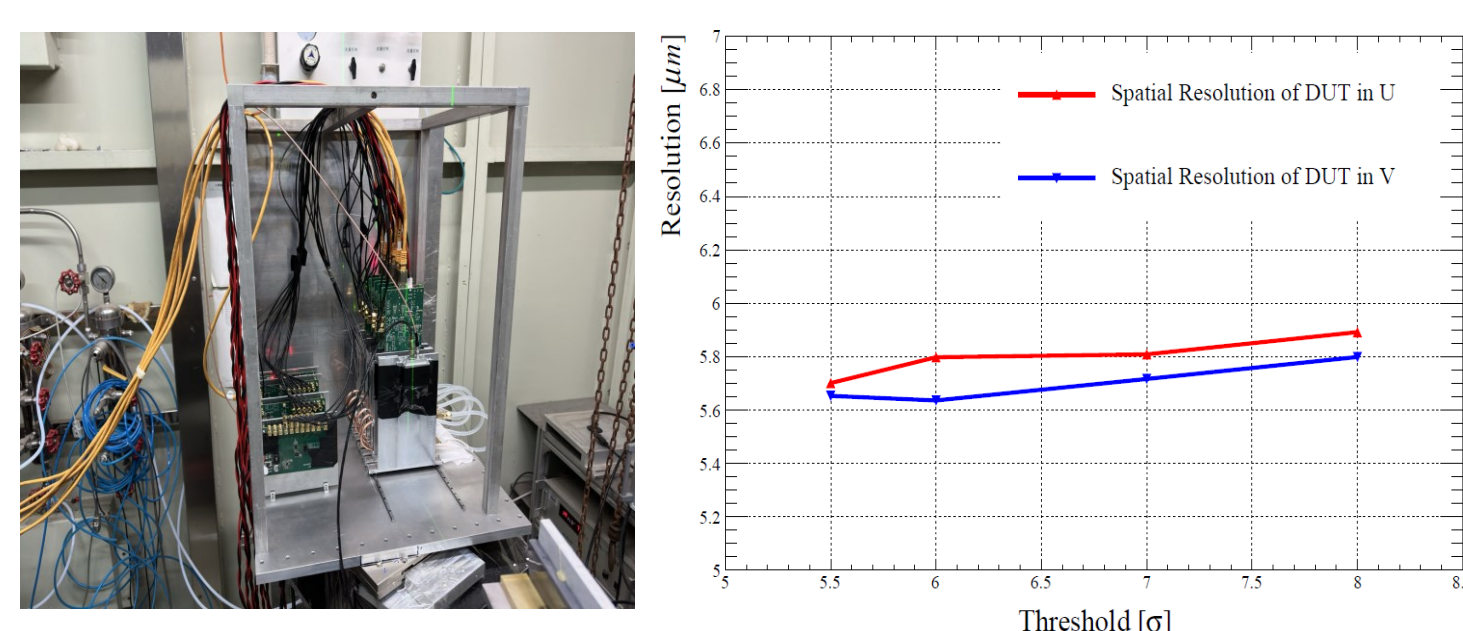


### Proton Energy Detector

- 2 x LGAD detector,  $< 100$  ps timing res.
- Proton energy determined by time-of-flight method.
- Energy resolution  $< 1\%$  @ 1.6 GeV

### Beam Telescope

- 6 x MIMOSA 28 pixel detector.
- DUT spatial resolution  $\sim 6 \mu\text{m}$  in 1.3 GeV electron beam test.
- Aims to reach  $10 \mu\text{m}$  on proton beam.

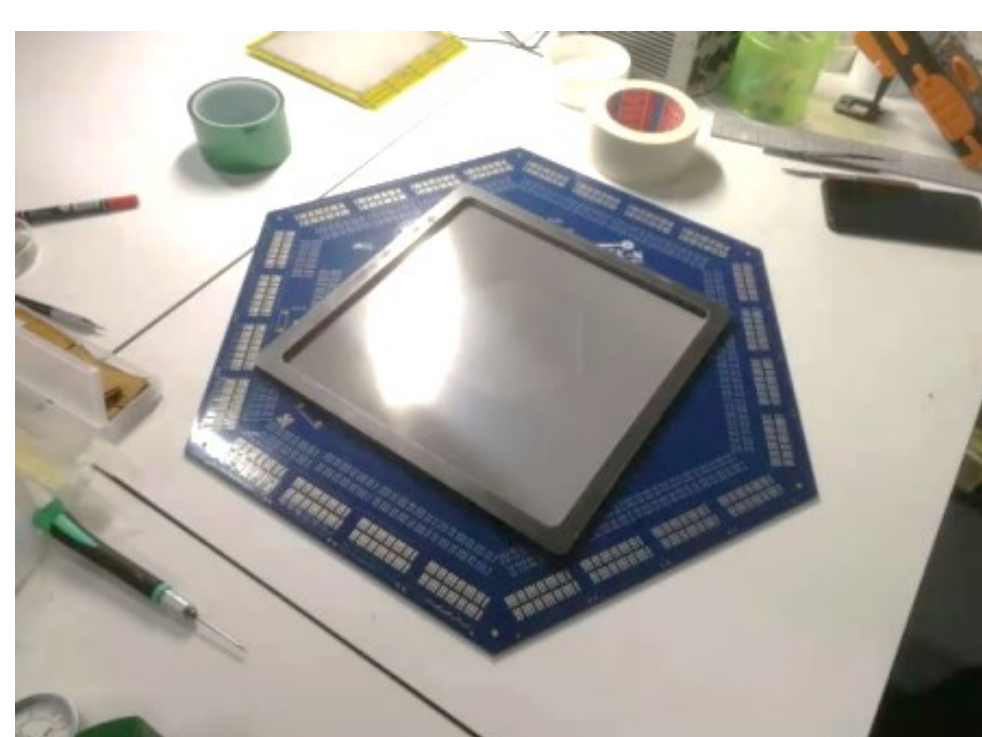
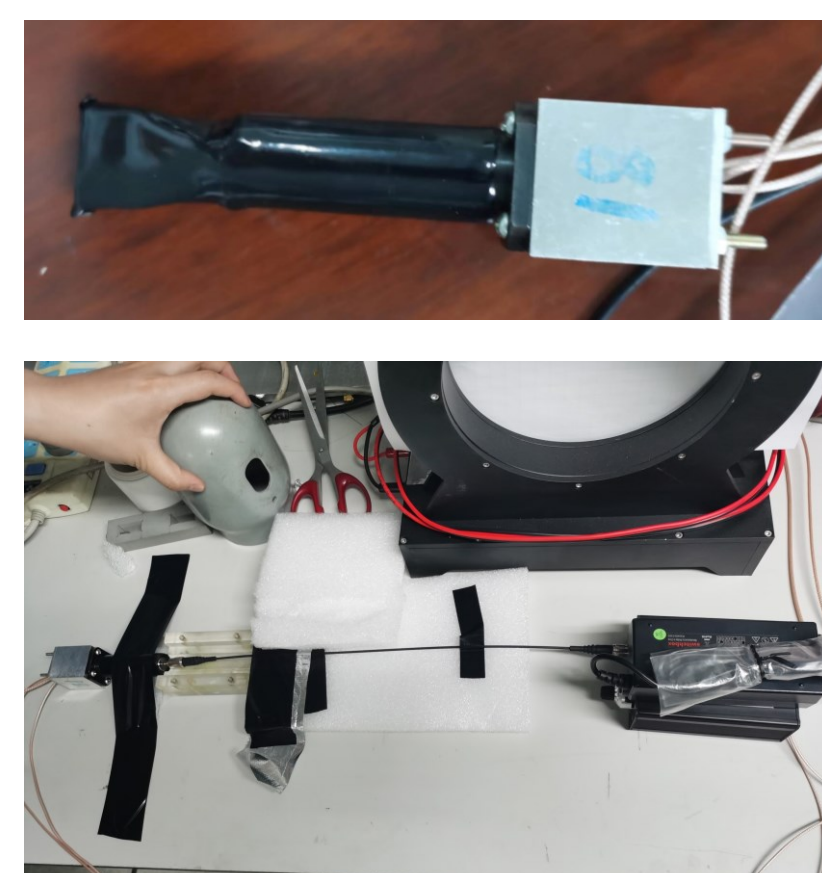


### Trigger Supplier System

- Scintillation optical fiber + FPMT
- Trigger timing res.  $< 1$  ns.
- Could provide event ID for each devices with trigger logic unit.

### Proton Intensity Monitor

- Plastic Scintillator
- Intensity Dynamic range:  $1\sim 10^8$  p/s.
- Multi dynode readout for multiple intensity measuring range.
- Used to tune the single particle beam.

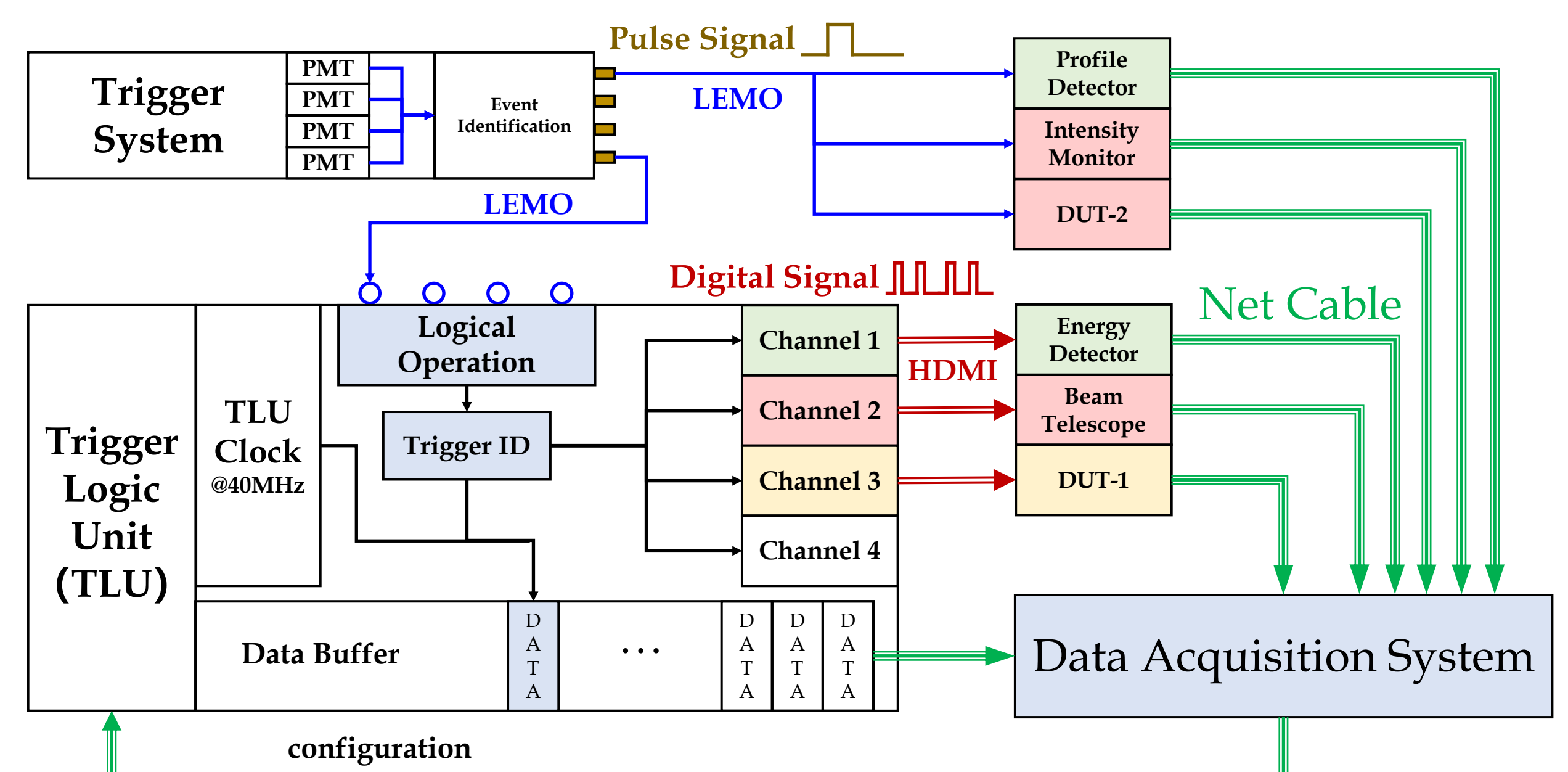


### Proton Profile Detector

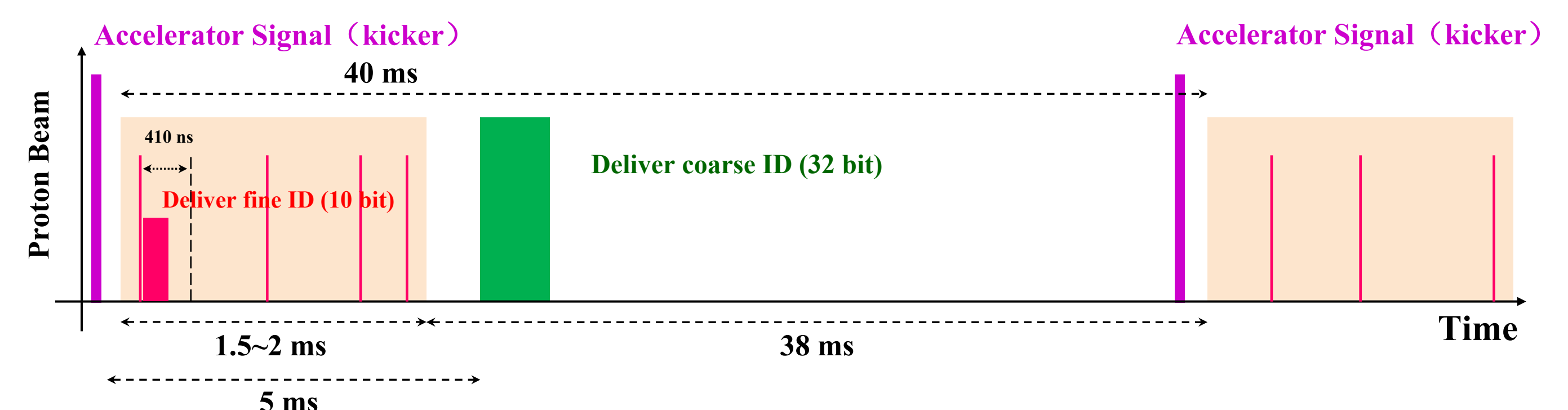
- Micromegas detector, using hot pressing technology to produce mesh gain structures
- Gain depth  $\sim 100 \mu\text{m}$ .
- Positioning resolution is expected to reach  $150 \mu\text{m}$ .

## 3. Trigger System of HPES

- Many test need strict event alignment, which need a triggerID to be distributed to HPES detectors and the DUT.
- This would be processed by the Trigger Logic Unit of HPES.
- The HPES-TLU is designed based on the AIDA device with consideration of the special beam time structures of HPES.



- TriggerID is divided into coarse ID and find ID to finish the delivering within 410 ns, which is the minimum interval of the neighbor protons.



- The HPES-TLU is compatible with the devices following AIDA trigger signal standard.

## 4. Summary

- The construction of HPES will be finished by 2029 and serve as an advanced detector test beam.
- A complex of detector and trigger system is designed to support the user experiments in high performance.

# 12th Beam Telescopes and Test Beams Workshop



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