Beam test of LAPPD at CERN PS: The setup

(05-19 October 2022)

Deb Sankar Bhattacharya[1], Chandradoy Chatterjee[1], Silvia Dalla Torre[1], Mauro Gregori[1], Alexander Kiselev[3], Saverio Minutoli[2], Mikhail Osipenko[2]

INFN Trieste[1], INFN Genova[2], BNL[3]

26 October 2022

Our first beam test of LAPPD

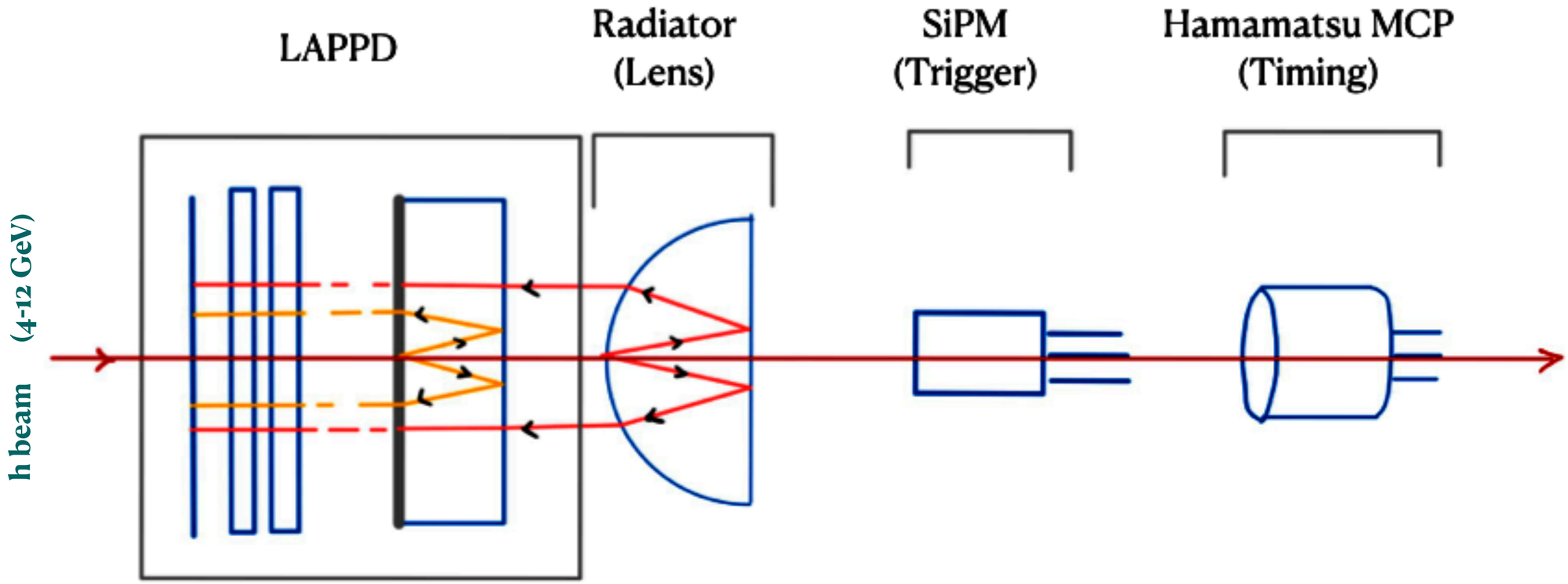
- **We just had a beam test of LAPPD at CERN PS, from 5 - 19 Oct 2022**
- **This is a joint effort by INFN Trieste, INFN Genova, and BNL**
- **Our goal is to measure the single photoelectron time resolution of the LAPPD**

  - **There are 3 talks followed by discussion to consider entirety of the aspects**

12:20 → 12:30	**INFN test beam at CERN, overview** **Speaker**: Deb Sankar Bhattacharya (INFN, Trieste, Italy)	10m
12:30 → 12:40	**INFN test beam at CERN, observed LAPPD issues** **Speaker**: Silvia Dalla Torre (INFN, Trieste)	10m
12:40 → 12:50	**INFN test beam at CERN, first hints about the data** **Speaker**: Mikhail Osipenko	10m
12:50 → 13:00	**INFN test beam at CERN, questions and discussion**	10m

The LAPPD, mounted backward

Illustrative Schematic: NOT TO SCALE

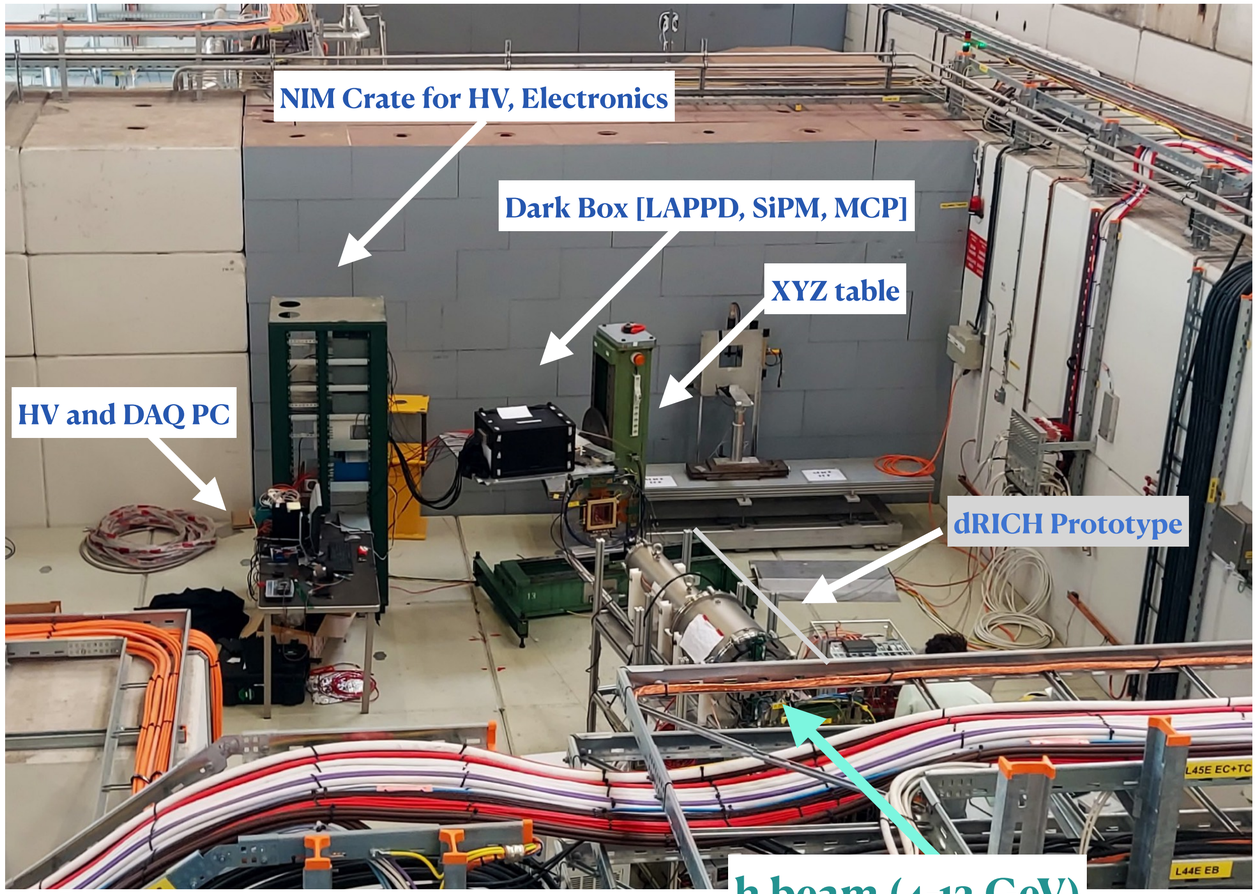


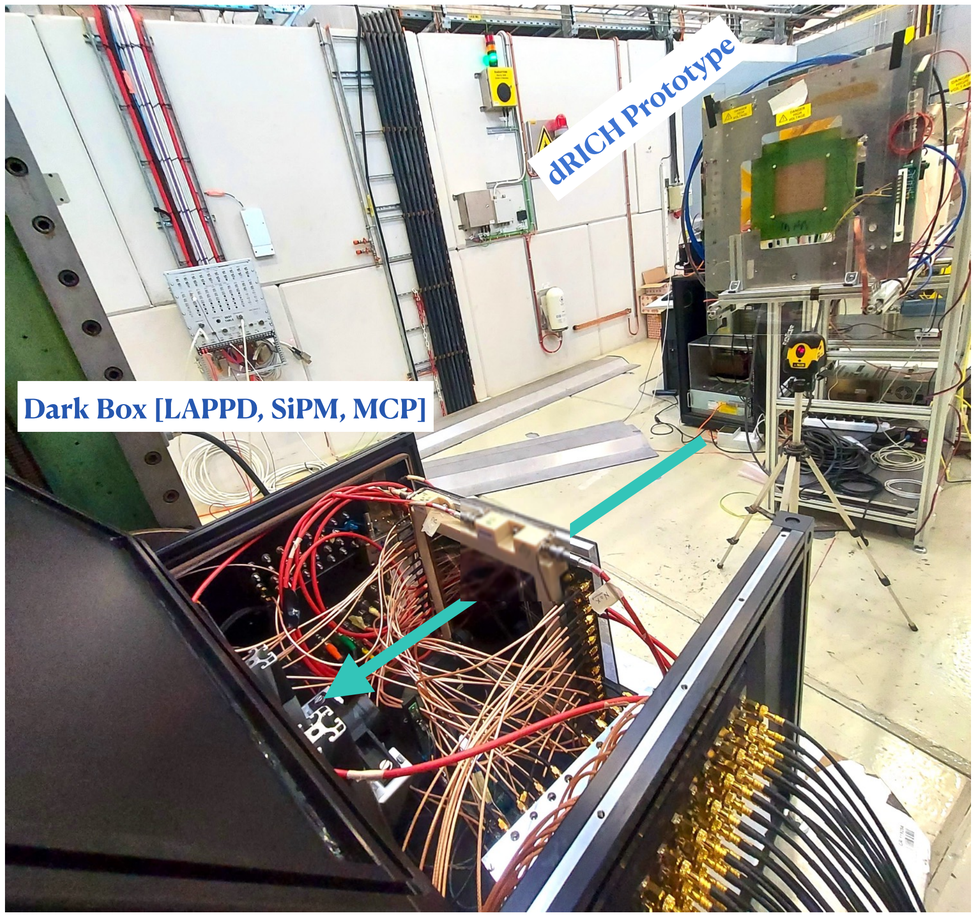
Everything is within a dark box

Where we are

CERN PS, Hall T10

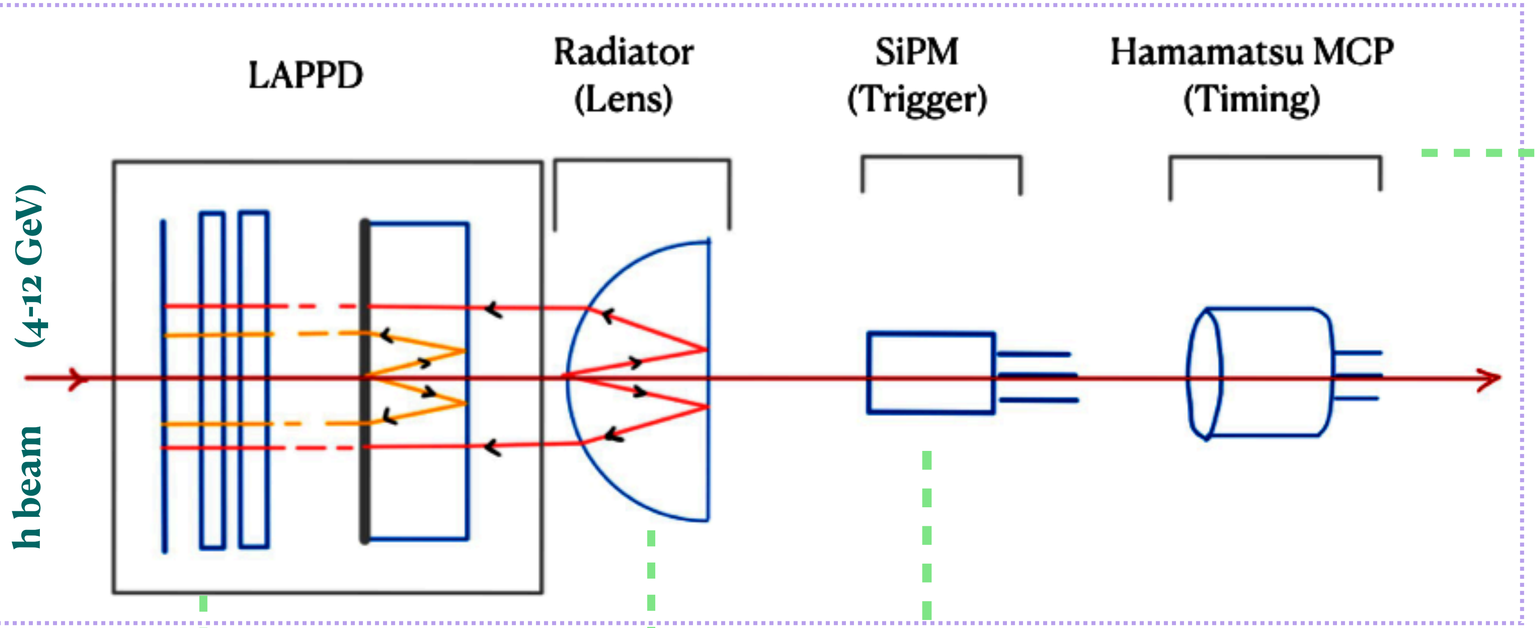
LAPPD installed downstream of dRICH prototype

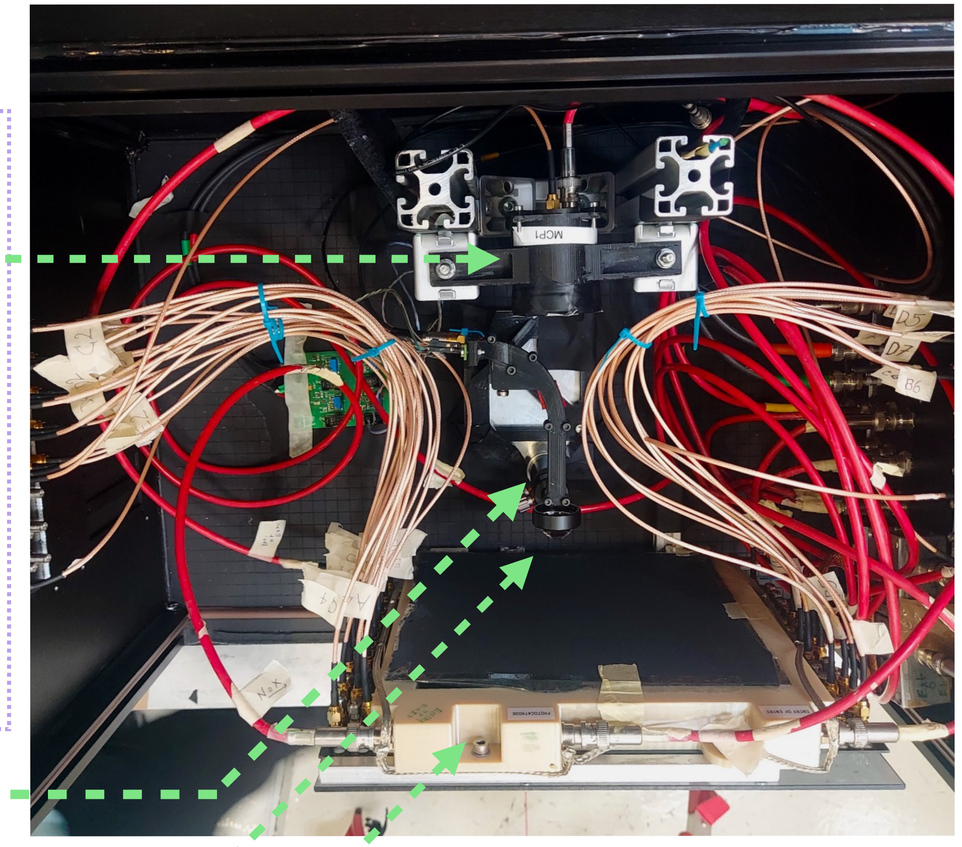




Inside the dark box

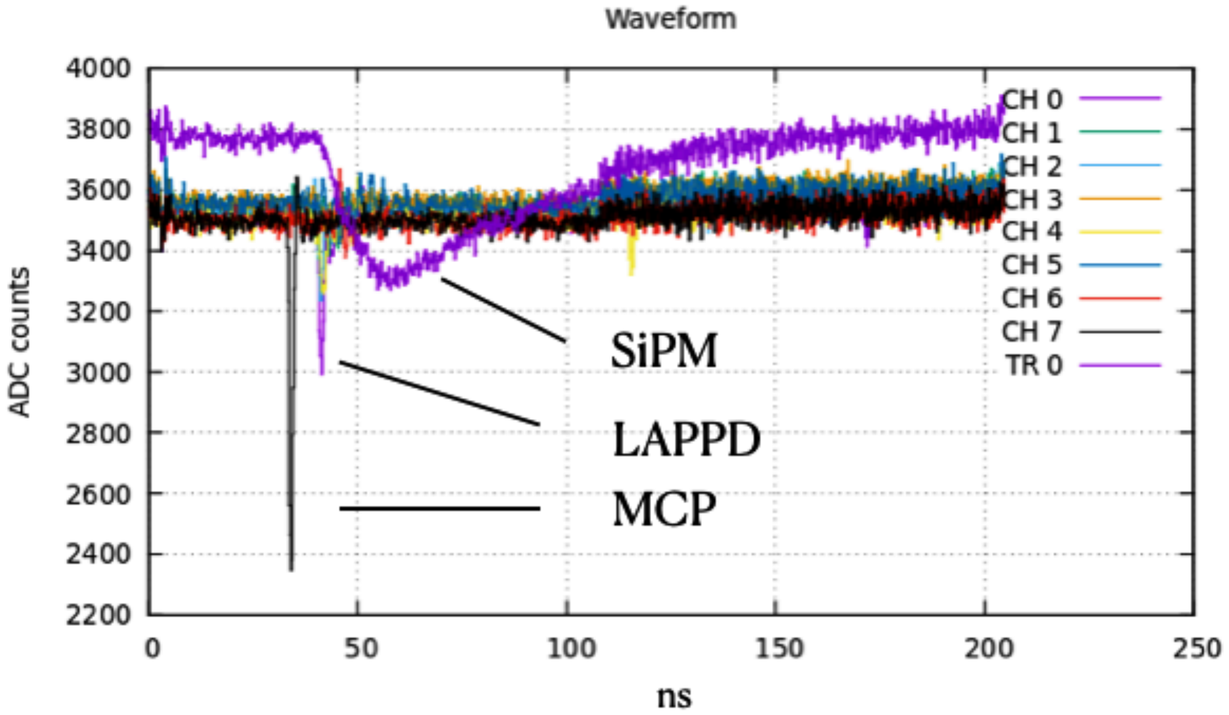
Illustrative Schematic: NOT TO SCALE



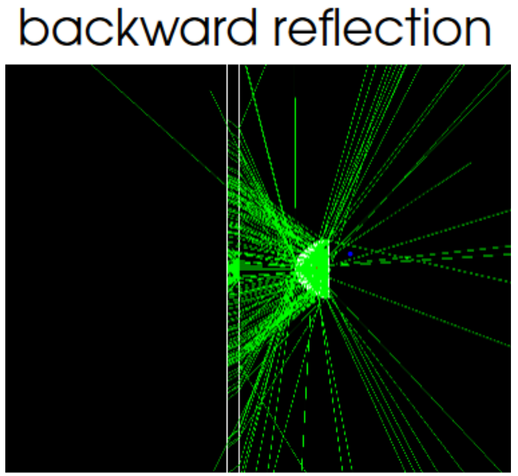


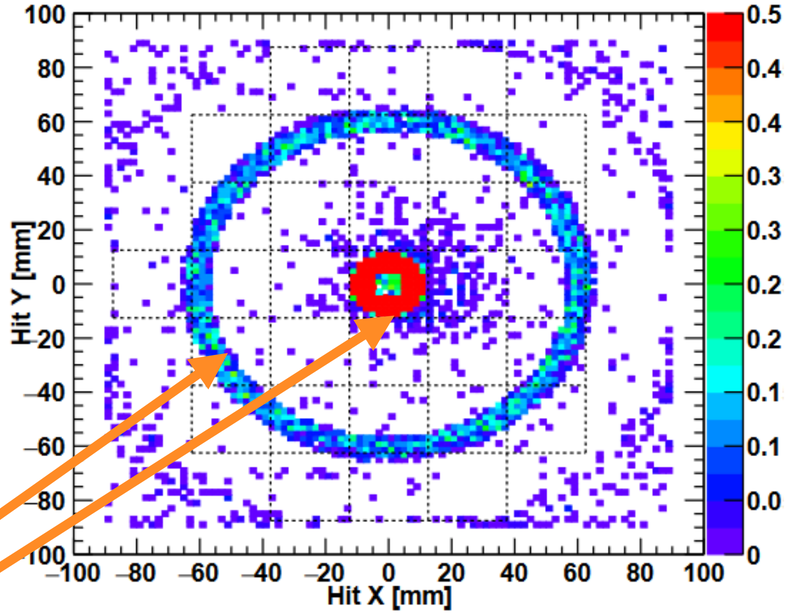
LAPPD window is covered by a protection card in this picture.

The output



Online signal monitor





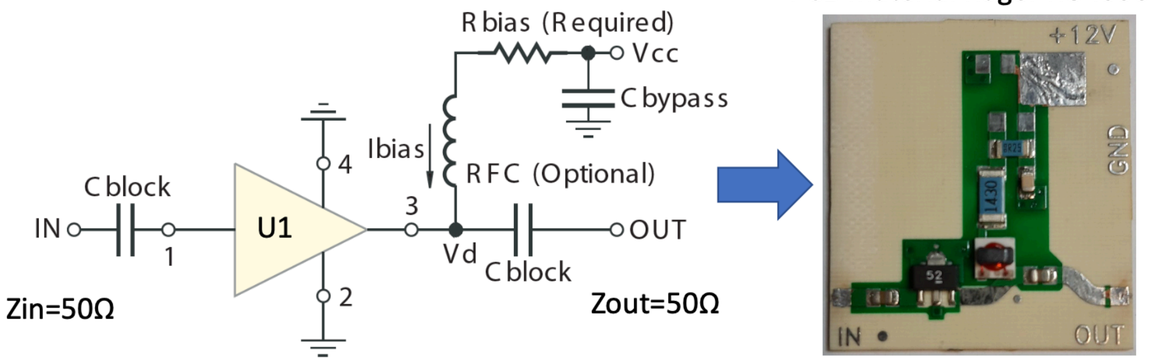
Cherenkov ring
produced at the radiator
produced at the window

Hit map of a Cherenkov ring from GEANT4 simulation

The LAPPD and the pre-amplifier

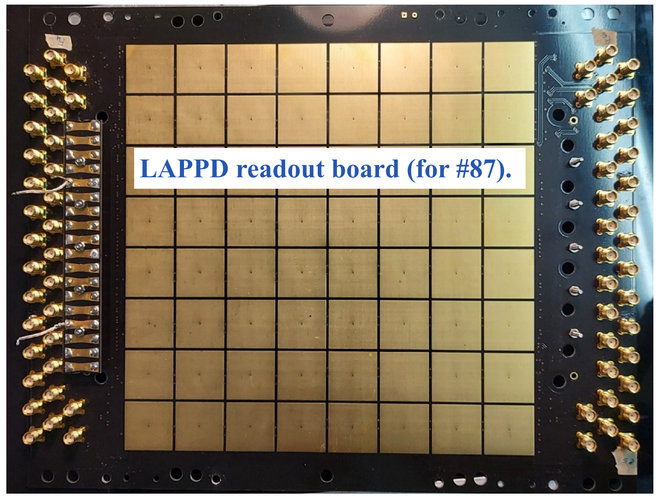
Can you spot an important difference between the two LAPPD tiles?

Custom made preamplifiers by INFN, Genova

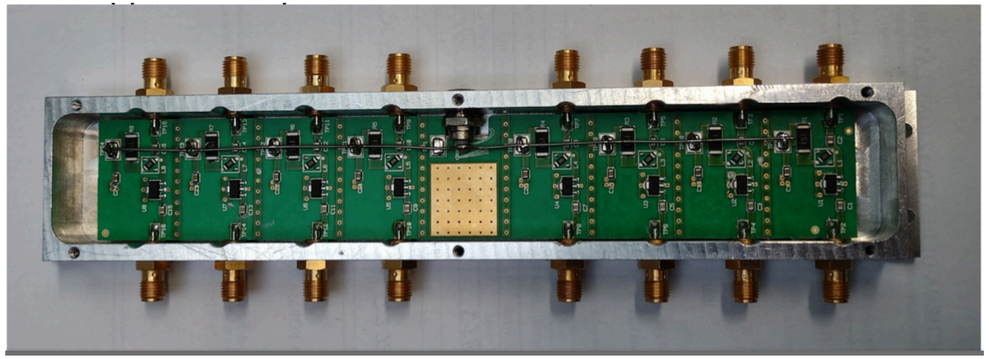


Gain = 10 (20 dB), BW = 2 GHz, output = inverting

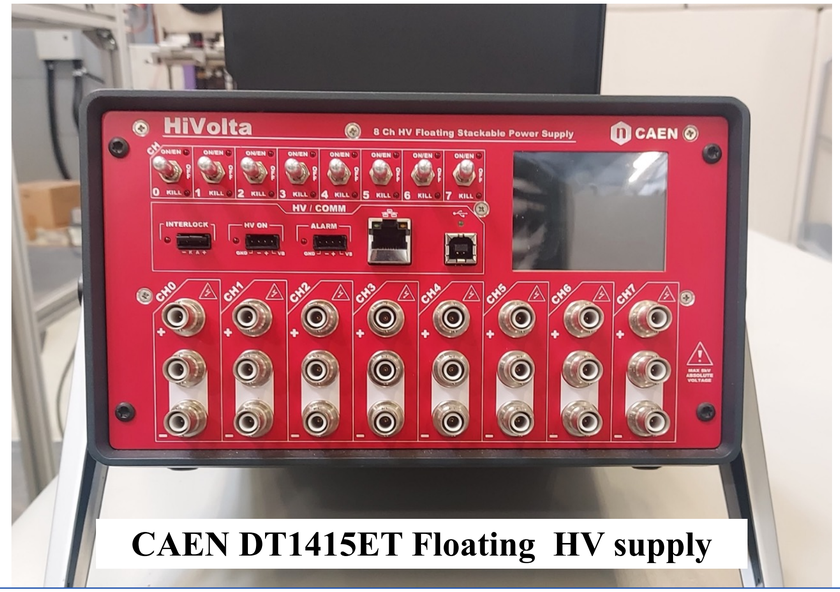
additional PCB for grounding anode



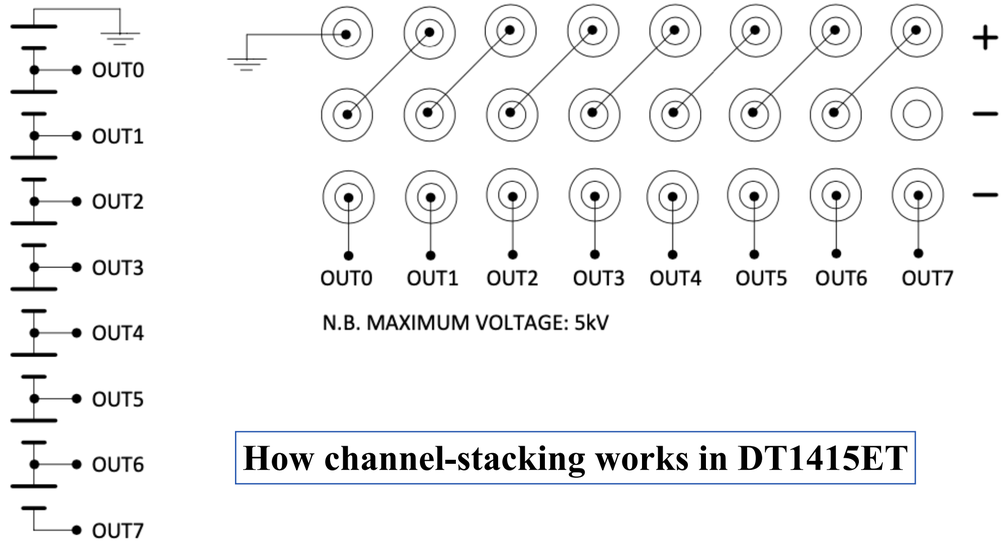
Present version comprises 8 input/output per unit



The HV setup

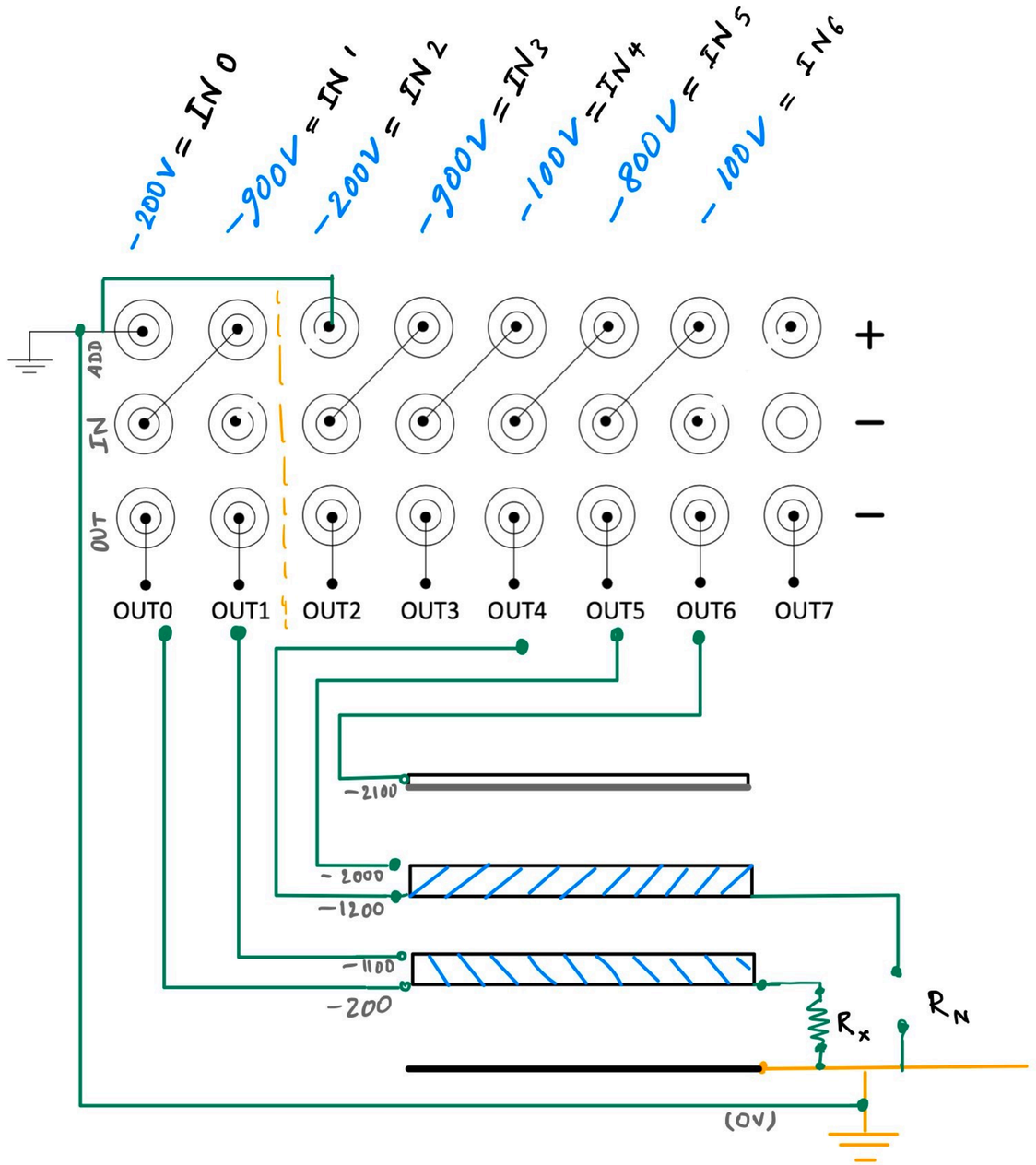


CAEN DT1415ET Floating HV supply



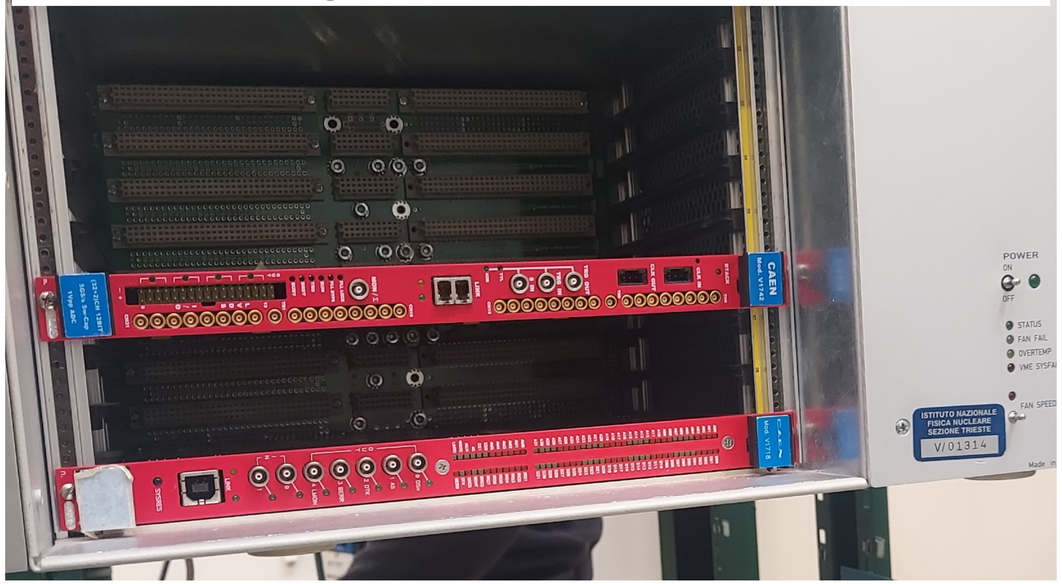
How channel-stacking works in DT1415ET

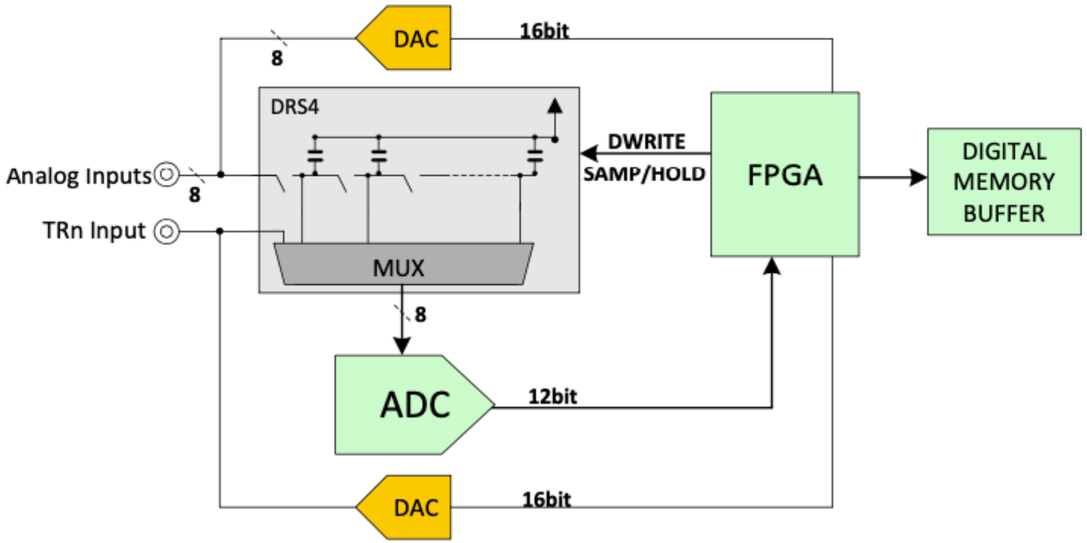
How we used it: An example set of voltages

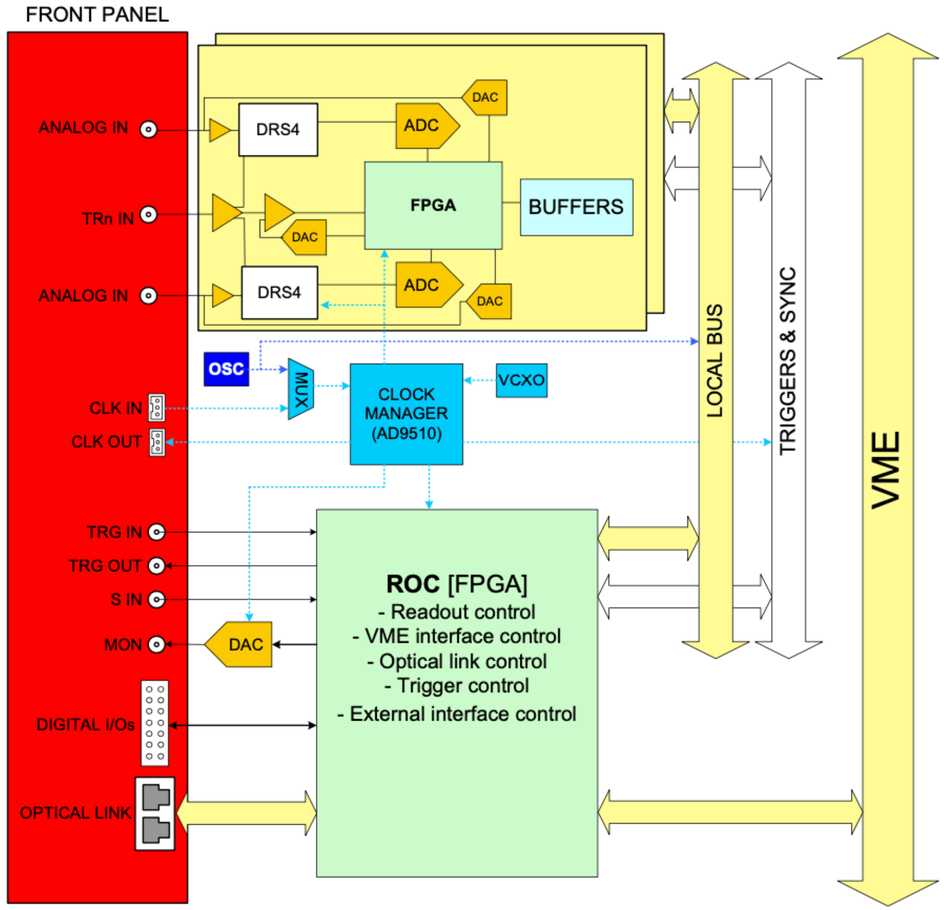


The Digitizer

WEINER VME crate:
CAEN V1718 controller board
CAEN V1742 Digitizer board with 32 readout channels







V1742 Board:

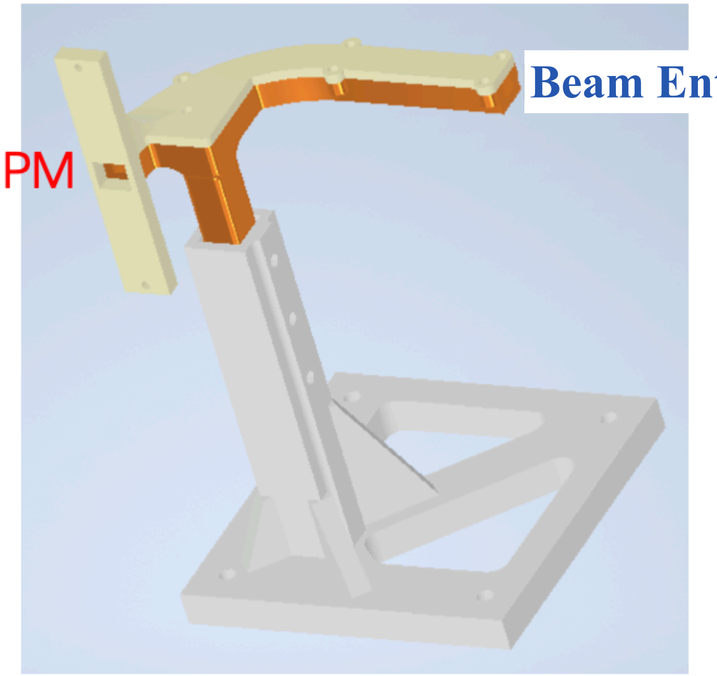
> 4 DRS chips
> 5 GS/s -> 200 ps
> 32 Analog channels
> 2 fast triggers (1 global trigger)
> each channel has 1024 SCA (Cells)
> one 12 bit ADC in each chip

For Trigger:

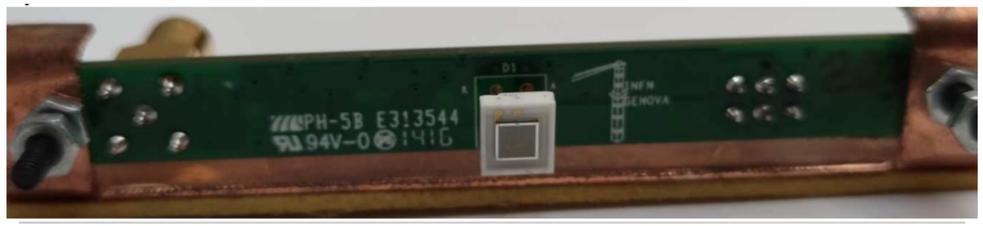
Hamamatsu MPPC SiPM (S13360-6025CS)

Scintillating fibers
Kuraray 3HF(1500)MJ
diameter = 500 µm
array = 10×10

SiPM = 6×6 mm²
gain = 10 mV/p.e
risetime = 20 ns
falltime = 100 ns



The SiPM and the Lens mount



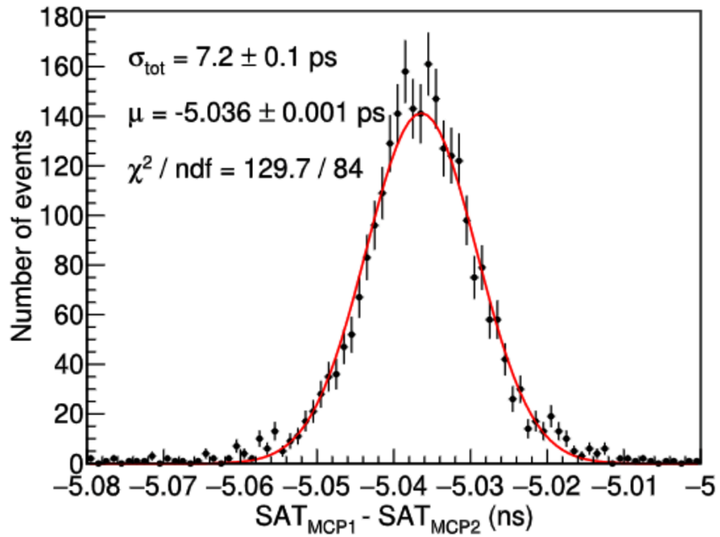
SiPM onboard amplifier

For Timing:

Hamamatsu MCP-PMT (R3809U-50)

Tube diameter = 45 mm

Signal Arrival Time (SAT) difference between two identical MCP-PMTs in µ beam



NIM A 960 (2020) 163592

Photocathode
Window = quartz, diameter = 11 mm
Spectral response : 160 to 850 nm; peaks at 430 nm

Typical Characteristics
Gain = 2 × 10^5 ; Dark current = 10 nA
Rise time = 150 ps
Transit time = 550 ps
Transit time spread = 25 ps

The distribution of work during the beam test

14 days of beam time in parasitic mode, Availability of the beam = ~ 50% of time

- **Installation of the setup = 2 days**

- **Exit MCP of LAPPD #87 found short**
- **Change of LAPPD tile to #124**
- **Reinstallation of the setup and conditioning of the photocathode (2 days)**
- **Ground mismatch of the anode of tile #124 and the readout PCB of #87 was found**
- **Debugging and fixing the problem**

7 days

- **Several other optimisations like**
- **Debugging rining (crosstalk)**
- **Masking the beam-pad with black tape + optical grease**

3 days

- **Good data taking = ~last 36 hours**

for a 'Ring' Imaging Cherenkov detector

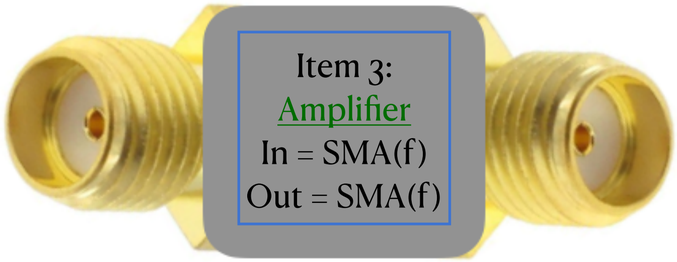
Thank you for your attention!

Question/Comments

Bonanza

Item 1:
LAPPD
INCOM Board
out = SMA(f)

Item 2:
SMA(m)-SMA(m)
Cable = 0.5 m



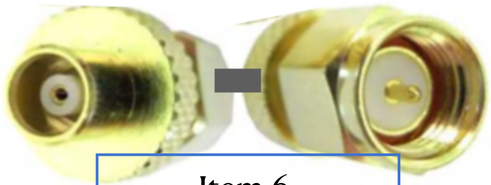
Item 3:
Amplifier
In = SMA(f)
Out = SMA(f)

Item 4:
SMA(m)-SMA(m)
Cable = 0.5 m

Dark box patch panel

32+32 = 64 channels

Item 5:
In = SMA(f)
Out = SMA(f)
Connector = feedthrough



Item 6:
SMA(m)-MCX(f)
Connector/Adapter

Item 7:
MCX(m) - MCX(m)
Cable = 1.5 m

Item 8:
Digitizer
In = MCX(f)