RIUNIONE EIC_NET- Referee 31/8/2023

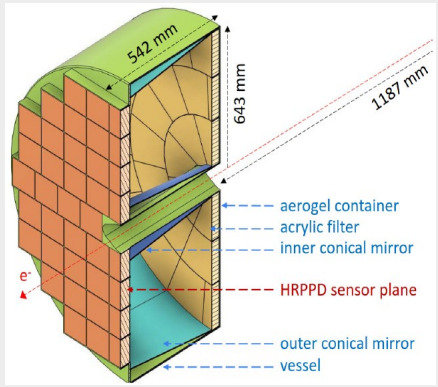
LAPPD

S. Dalla Torre
(per GE & TS)

Pro-memoria: motivazioni

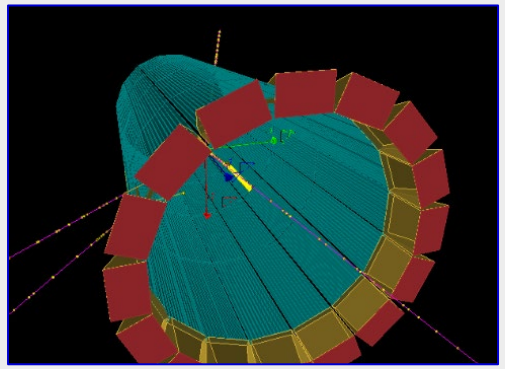
OVERVIEW dei sensori di singolo fotone per PID a ePIC

Backward: mRICH
Proximity focusing aerogel RICH with Extended proximity gap



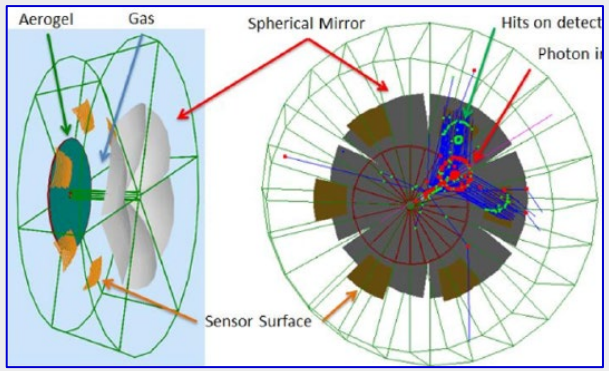
pfRICH: fotosensori
- **HRPPD** (campo B, aspetti generali relative a prestazioni e ingegnerizzazione)
  - Offre in parallelo misure di TOF
- Backup: MCP-PMT commerciali riducendo la superficie instrumentata a scapito di minor risoluzione)

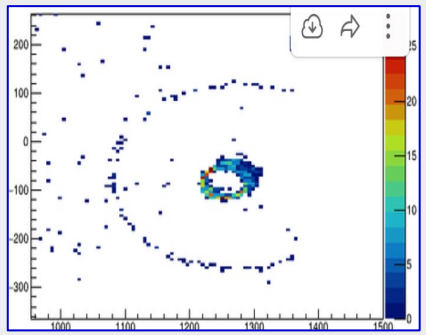
Barrel: high-performance DIRC
Focusing DIRC with lenses



hpDIRC: fotosensori
- **MCP-PMT, Photonis** (come in PANDA, allineamento campo B, costo!)
- **Alternativa: HRPPD**, se validati !

dRICH
2 radiators: Aerogel & gas

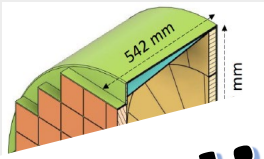




dRICH: fotosensori
- **SiPM** (validazione del principio, hit rate in streaming read-out)
- Backup: LAPPD (sfavorevole allineamento del campo magnetico), se validati !

OVERWIEW dei sensori di singolo fotone [illegible] a EIC

Backward: mRICH
Proximity focusing aerogel RICH with Extended proximity ga[illegible]

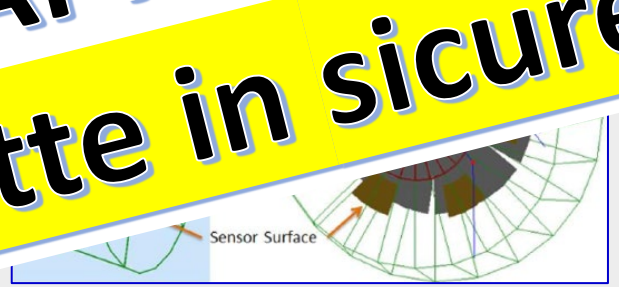


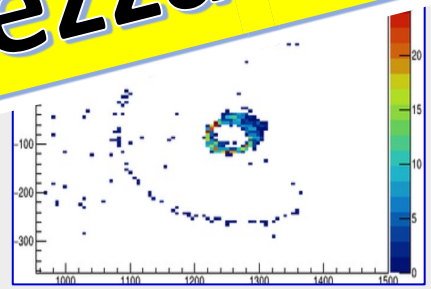
ali relative
e)
TOF

ata a

, se validati !

dRI[illegible]
2 ra[illegible]
Aerc[illegible]





dRICH: fotosensori
- **SiPM** (validazione del principio, hit rate in streaming read-out)
- Backup: LAPPD (sfavorevole allineamento del campo magnetico), se validati !

Validare per applicazioni Cerenkov a immagine
- **SiPM**
- **LAPPD**

Mette in sicurezza l'intero PID a EIC

Pro-memoria: stato settembre 2022

LAPPD – 2022 activity

Estratto dalle slide mostrate 31/8/2022

2022

- collaboration within the EIC NET between TS and GE groups to perform this R&D in collaboration is operative:
  - Task distribution organized;
  - Periodic meetings in zoom;
  - 2 periods of common lab activity (second one on next week)

- Equipment:
  - **dark box equipped according to needs** (initially an existing one, non optimized; then a dedicated one adequate also for test beam and future studies in mag. Field);
  - **digital scope** (initially: LeCroy6200A, 2 GHz; when delivered: LeCroy OSCILLOSCOPE WAVERUNNER 9254, 2.5 GHz)
  - **PICOQUANT** pulsed laser source; device existing, equipped with a **new head providing visible light** (405 nm)
  - **Pulser**: AGILENT: 33220A

- Equipment, cont.:
  - Operation of the **read-out chain** consisting in the **32-channel V1742** by CAEN based on the front-end ASIC DRS4; basic **acquisition/reconstruction software** developed
  - *Amplifier (single channel) developed and test → 8-ch boards being produced for the October test beam*

- LAPPD characterization
  - Study of the dark count rate at different voltage/gain
  - Study of the charge spectrum
  - Contributing to the analysis of an LAPPD-dedicated test beam by US colleagues at Fermilab
  - Time resolution [presently w/o including the transit time spread] estimated
  - *Time resolution including transit time: test beam to study timing properties (parasitic dRICH/SiPM test beam) in Oct. 2022*

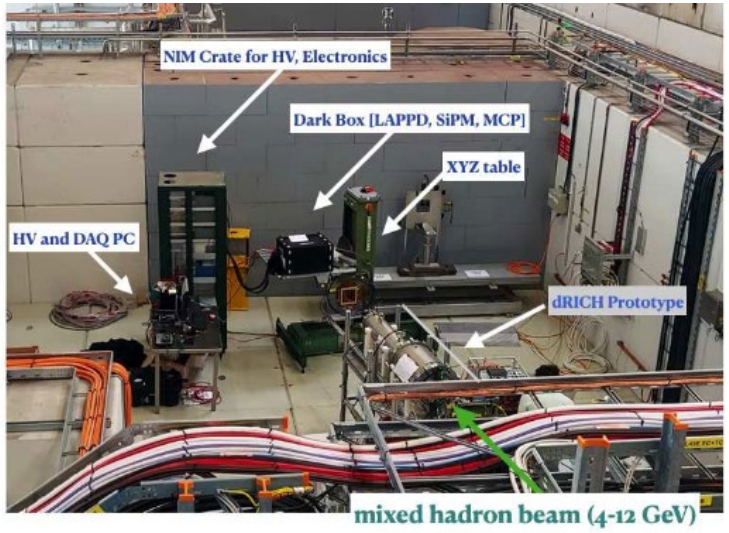
- Building-up world-wide synergies:
  - First LAPPD workshop on 21 March 2022, organized by INFN TS, BNL and ANL (https://indico.bnl.gov/event/15059/)
  - A following-up workshop at the end of October

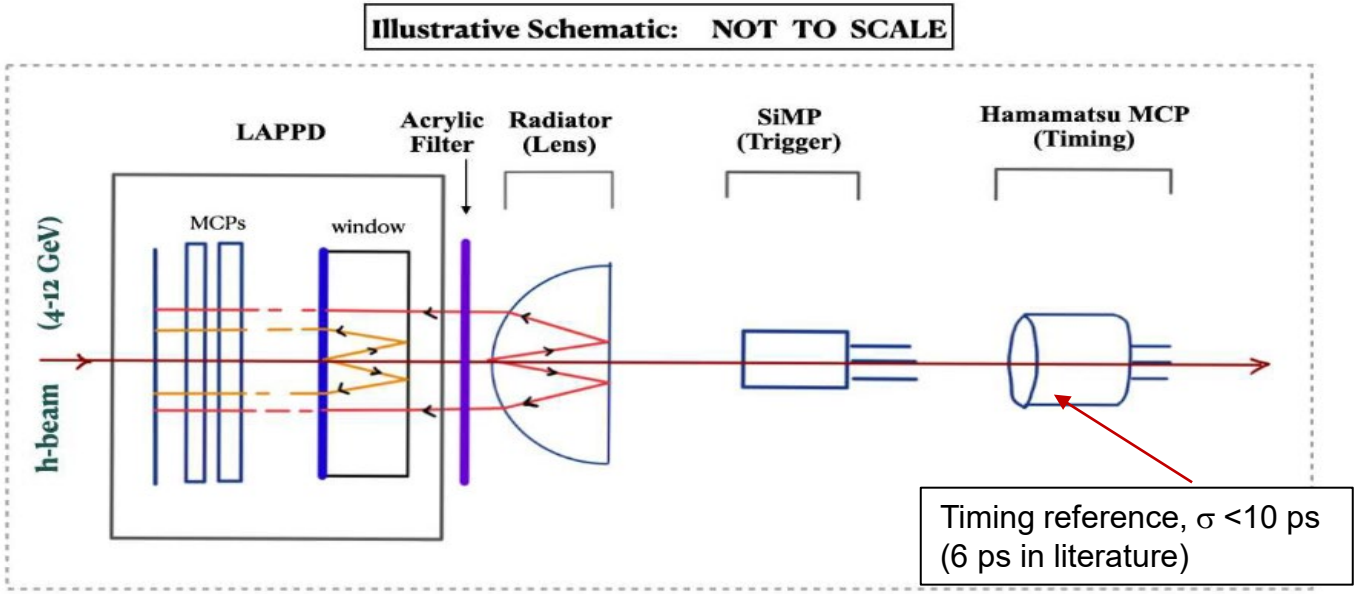
Attivita’
Settembre 2022 – Agosto 2023

IX 2022 – VIII 2023 LAPPD activity, highlights

Testbeam setup and preparation

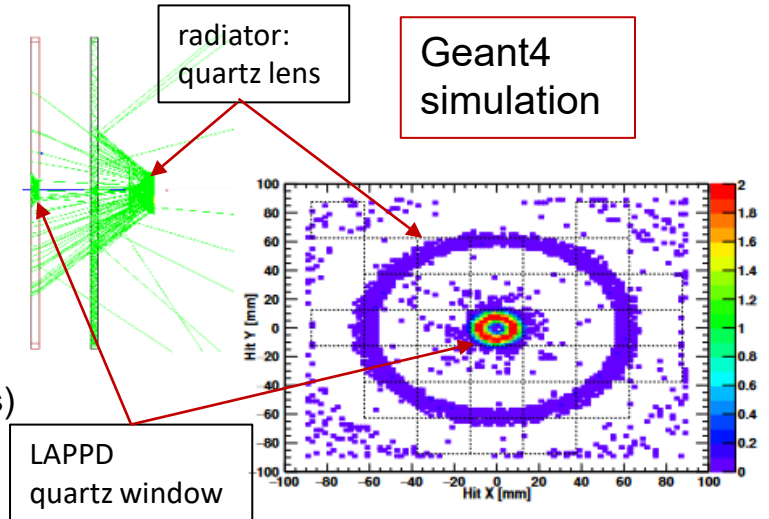
Characterization of LAPPD timing at CERN PS testbeam

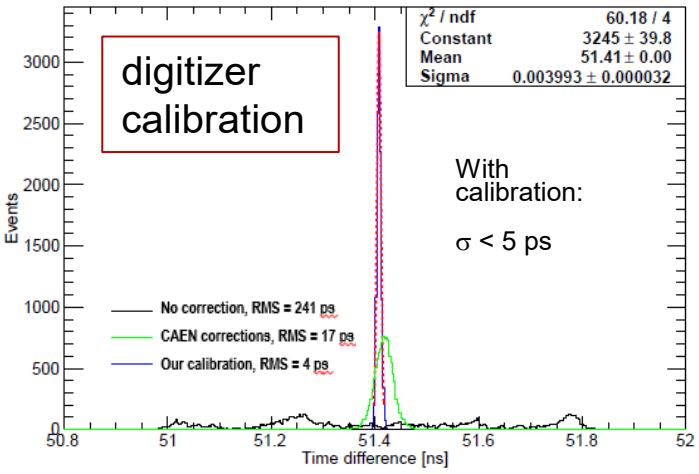




Preparatory and complementary exercises :

- LAPPD characterization in the lab (FY2022 activity)
- Complete simulation by Geant4
- Construction of dedicated amplifiers (~ x 10)
- development of a beam monitor counter by scintillating fibers and SiPM R-O with 5x5 mm^2 cross-section
- Calibration of the digitizer (V1742 by CAEN using DRS4 ASICs)



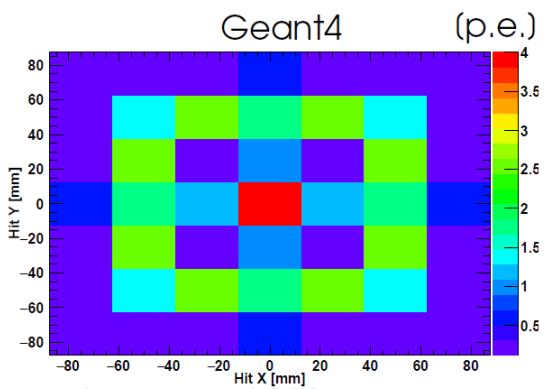


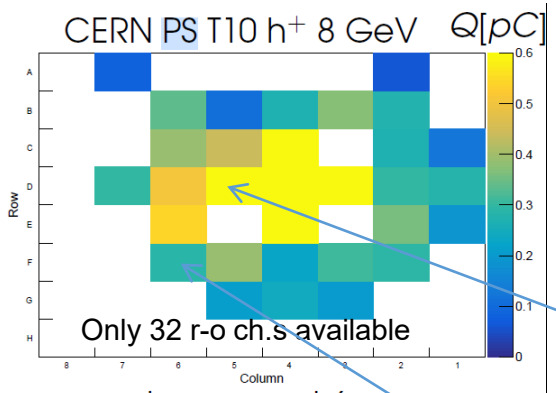
IX 2022 – VIII 2023 LAPPD activity, highlights

Results, highlights

Characterization of LAPPD timing at CERN PS testbeam, cont.

"Ring" image



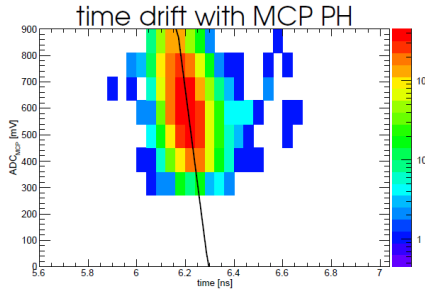


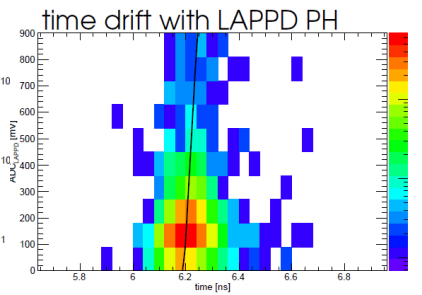
beam spot 180 p.e. ↔ beam spot 6 p.e.

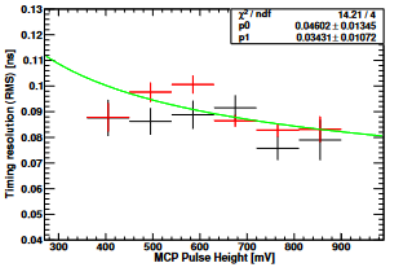
A large fraction of the beam spot p.e. absorbed applying locally on the LAPPD window a piece of black tape couple with optical grease

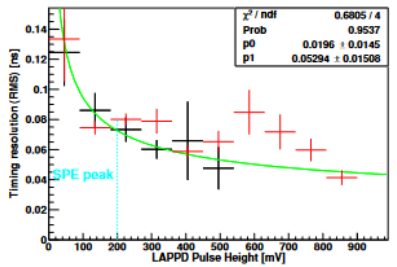
Accurate check of the systematics:

- correct for the "CFD" effect
- estimation of the residual uncertainty

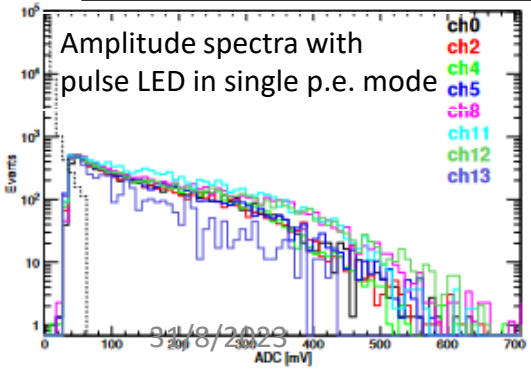


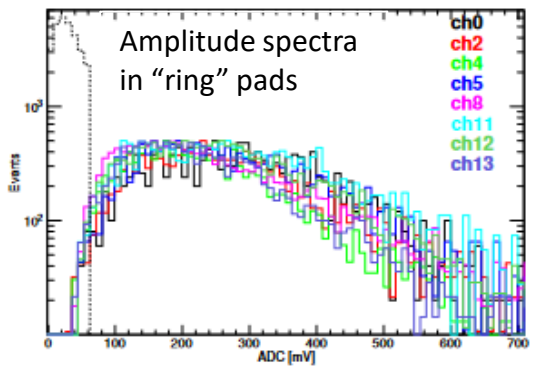




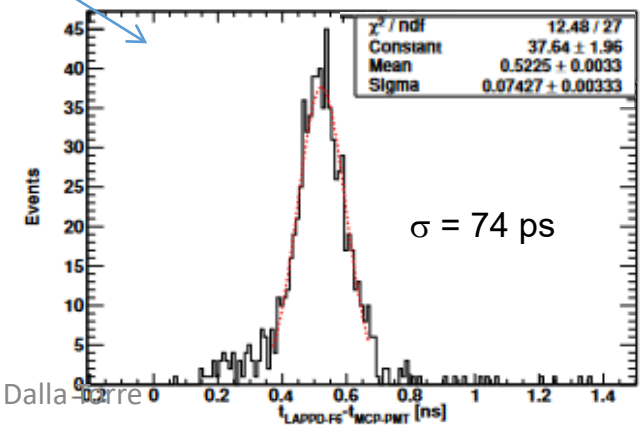


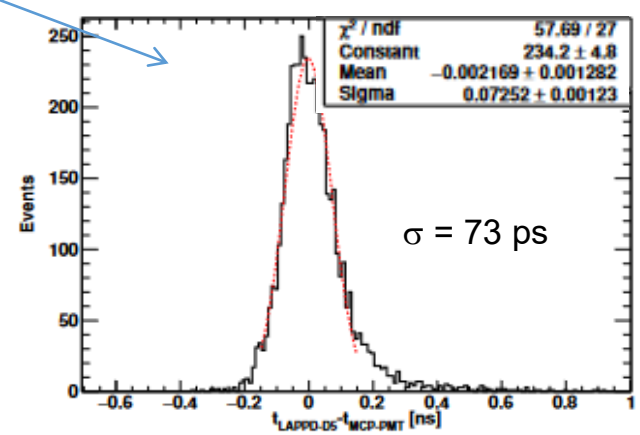
Conferming the single p.e. mode in the ring pads





Time resolution: here for 2 different pads





IX 2022 – VIII 2023 LAPPD activity, highlights

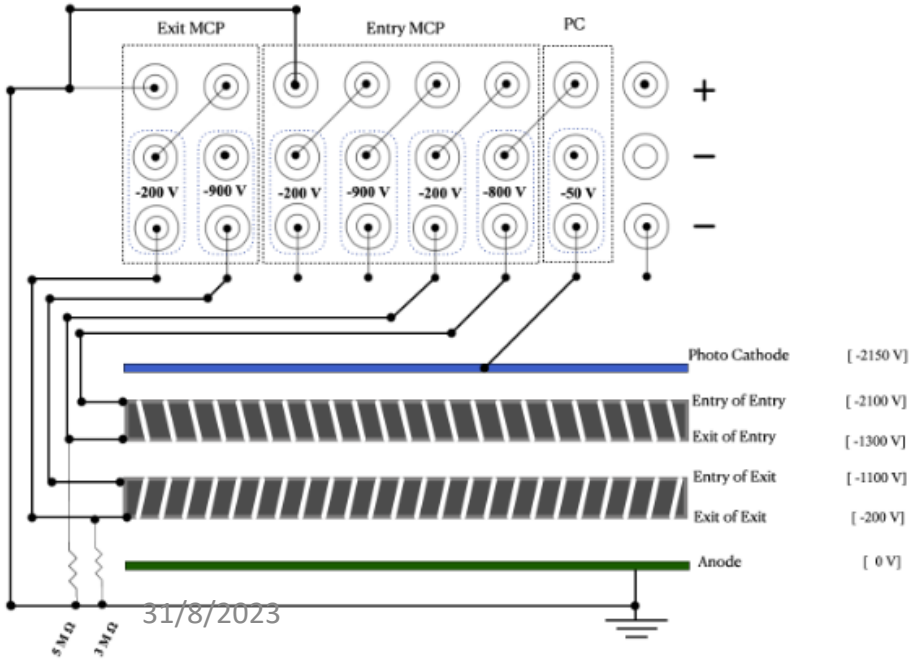
Testbeam by-products

Characterization of LAPPD timing at CERN PS testbeam, cont.

Correct powering of LAPPDs

- **Scheme:** HV stacking connection scheme (daisy chain)
- **Power supply :** no common grounding of the HV channels !

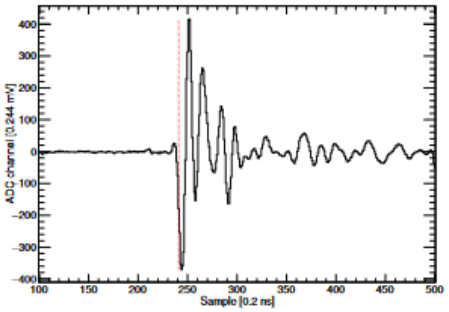
Used: CAEN power supply, model DT1415ET (developed for GEMs)



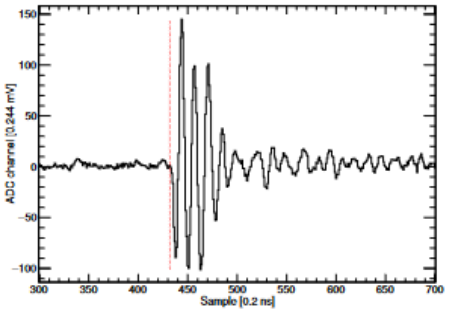
LAPPD (resistive anode) Cross-Talk

- Dumping oscillations generated by parge signals
- Long-range effect (propagated in the whole sensor)
- Effect cross-check in the lab

Observed at the test beam

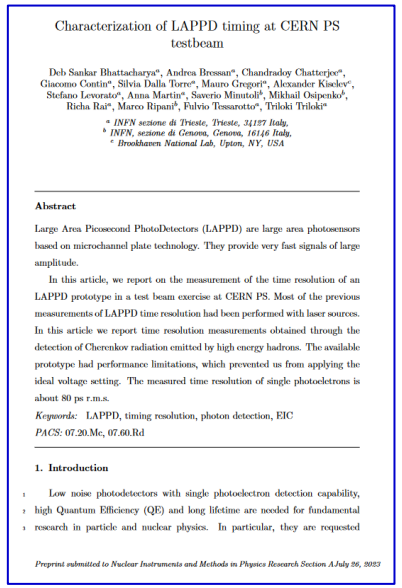


Detected in laboratory exercises



Test beam, summarizing:

- **First ever performed measurement of LAPPD TTS with Cherenkov light !**
- **Testbeam Data analysis and complementary investigation now completed**
- **A manuscript ~ready for submission to NIMA**



Characterization of LAPPD timing at CERN PS testbeam

Deb Sankar Bhattacharya[a], Andrea Bressan[a], Chandradoy Chatterjee[a], Giacomo Contin[a], Silvia Dalla Torre[a], Mauro Gregori[a], Alexander Kiselev[c], Stefano Levorato[a], Anna Martin[a], Saverio Minutoli[b], Mikhail Osipenko[b], Richa Rai[a], Marco Ripani[b], Fulvio Tessarotto[a], Triloki Triloki[a]

[a] INFN sezione di Trieste, Trieste, 34127 Italy,
[b] INFN, sezione di Genova, Genova, 16146 Italy,
[c] Brookhaven National Lab, Upton, NY, USA

Abstract

Large Area Picosecond PhotoDetectors (LAPPD) are large area photosensors based on microchannel plate technology. They provide very fast signals of large amplitude.

In this article, we report on the measurement of the time resolution of an LAPPD prototype in a test beam exercise at CERN PS. Most of the previous measurements of LAPPD time resolution had been performed with laser sources. In this article we report time resolution measurements obtained through the detection of Cherenkov radiation emitted by high energy hadrons. The available prototype had performance limitations, which prevented us from applying the ideal voltage setting. The measured time resolution of single photoelectrons is about 80 ps r.m.s.

Keywords: LAPPD, timing resolution, photon detection, EIC
PACS: 07.20.Mc, 07.60.Rd

1. Introduction

Low noise photodetectors with single photoelectron detection capability, high Quantum Efficiency (QE) and long lifetime are needed for fundamental research in particle and nuclear physics. In particular, they are requested

Preprint submitted to Nuclear Instruments and Methods in Physics Research Section A July 26, 2023

IX 2022 – VIII 2023 LAPPD activity, highlights

LAPPD response in magnetic field

Planning

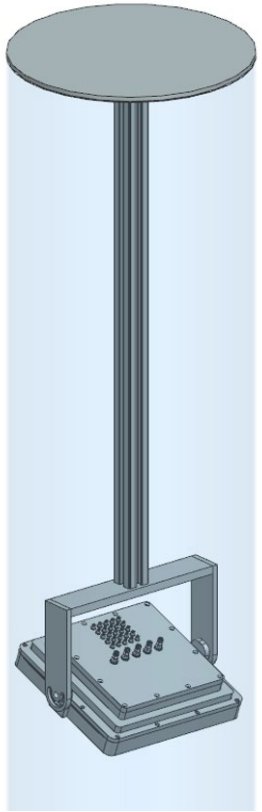
- **Measurements at 2 field intensities:**
  - **0.5 T – September 2023**
  - **1.5 T – October 2023**
- **Measurements at different inclinations respect to the field lines**

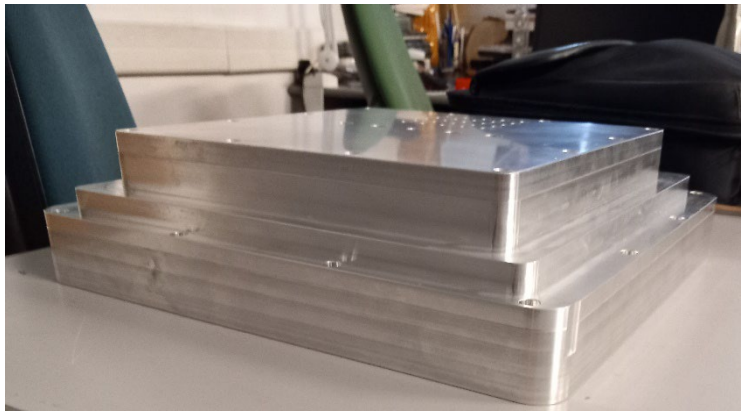
- **Measured parameters:**
  - **Single PE pulse height distribution (gain)**
  - **Transit Time Spread**
  - **Effective efficiency**
  - **After pulse characterization**

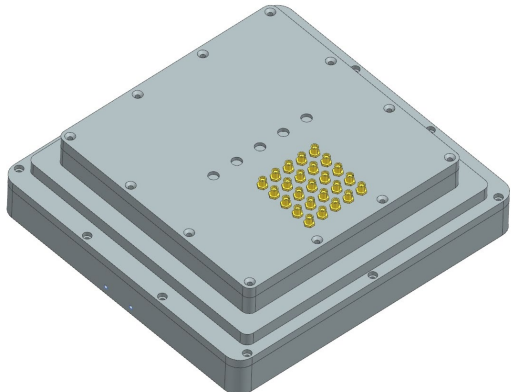
Electronics equipment for data collection:

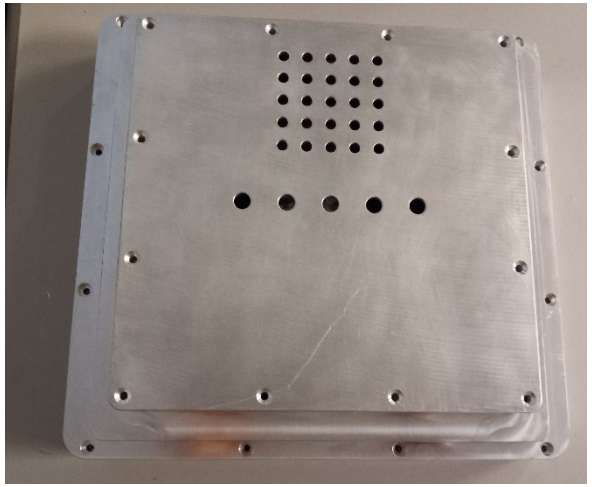
- digitizer V1742 by CAEN using DRS4 ASICs
- oscilloscope LeCroy OSCILLOSCOPE WAVERUNNER 9254, 2.5 GHz

Designing and building the dedicated darkbox









LAPPD WORKSHOPs, one every 6 months

Silvia Dalla Torre (INFN, Trieste),
Alexander Kiselev (BNL),
Deb Sankar Bhattacharya (INFN, Trieste),
Junqi Xie (ANL)

LAPPD Workshop

Monday 21 Mar 2022, 08:00 → 12:00 America/New_York

https://indico.bnl.gov/event/15059/

Description Organizers: Silvia Dalla Torre (INFN), Alexander Kiselev (BNL), Deb Sankar Bhattacharya (INFN), Junqi Xie (ANL)

Hosted by CFNS: https://stonybrook.zoom.us/j/98025752609?pwd=WTlicTlwTmxkNE9wODlOZEx2NU1sUT09

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Building-up world-wide synergies:

- Sensor, performance
- Sensor engineering
- R-O electronics
- Photocathodes
- …
- Up to 80 participants

New

LAPPD Workshop

Wednesday 26 Oct 2022, 12:00 → 17:45 US/Eastern

https://indico.bnl.gov/event/17475/

Description Organizers: Silvia Dalla Torre (INFN), Alexander Kiselev (BNL), Simona Malace (JLab), Deb Sankar Bhattacharya (INFN), Junqi Xie (ANL)

Hosted by CFNS: https://stonybrook.zoom.us/j/97182934798?pwd=TGJ2dkNwdUlqYS9Yc2owUVVTd05iUT09

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New

LAPPD Workshop

Thursday 20 Apr 2023, 10:00 → 15:00 US/Eastern

https://indico.bnl.gov/event/18642/

Description Organizers: Silvia Dalla Torre (INFN), Alexander Kiselev (BNL), Simona Malace (JLab), Deb Sankar Bhattacharya (INFN), Junqi Xie (ANL)

Hosted by CFNS: https://stonybrook.zoom.us/j/99257031544?pwd=VDhvbi9RT3B5RkJPZWRkQldPcE4wdz09

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Attivita’ 2024

LAPPD –2024 activity

HRPPD response in magnetic field

- capitalizing on the tools and experience gained in 2023 → **travelling resources requested**

HRPPD ageing

- **Motivations:**
  - **Fundamental study before equipping a detector that has to run > 10 y**
  - **Event more urgent, due to the very short lifetime of 2 preliminary HRPPD prototypes (QE failure)**
- **Strategy** (inspired by various past measurements described in literature)**:**
  - **Test only a small portion of the HRPPD** (not to compromise the whole sensor, repeated meas.s at different spots possible)
  - **Collect large integrated charge** by illuminating with a lamp with stable intensity and measuring the anode current

- **Strategy, cont.**
  - **Periodically, pause the illumination, use the pulsed laser source at low rate in single PE mode and check the performance parameters**
    (same as for the test in magnetic field)
    Single PE pulse height distribution (gain)
    Transit Time Spread
    Effective efficiency
    After pulse characterization

AGEING STUDIES - procedure cycle

performance check in SPE mode	collect charge by continuos illumination	performance check in SPE mode	collect charge by continuos illumination	...	performance check in SPE mode

- **Setup as for previous studies, apart:**
  - SUPER-QUIET MERCURY-XENON LAMP L2422 by Hamamatsu (**requested within AMBER**)
  - Keithley picoammiter 6485/E (available)
  - Both for studies in magnetic field and ageing studies, HV power supply unit requested (borrowed for 2022 test beam) → **resources requested**

LAPPD –2024 activity

HRPPD response in magnetic field

- capitalizing on the tools and experience gained in 2023 → **travelling resources requested**

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    (same as for the test in magnetic field)
    Single PE pulse height distribution (gain)
    Transit Time Spread
    Eff ficiency
    characterization

We also require traveling resources to continue the successful GE-TS collaboration

AGEING STUDIES - procedure cycle

performance check in SPE mode	collect charge by continuos illumination	performance check in SPE mode	collect charge by continuos illumination	...	performance check in SPE mode

- **Setup as for previous studies, apart:**
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RICHIESTE 2024

LAPPD – richieste 2024

LAPPD - richieste 2024

sede	capitolo	rich. (keuro)	rich. s.j.(keuro)	descrizione	note
TS	consumo	15		4 mesi di affitto LAPPD (12 keur) + pratiche di importazione - **attivita' sinergica con DRD4**	in sinergia con richiesta complementare AMBER (CSN1), **OFFERTA ALLEGATA**
		5		consumi di laboratorio e preparazione test beam - **attivita' sinergica con DRD4**	
	inventario	10.5		HV CAEN "DT1415ET - **attivita' sinergica con DRD4**	corretta alimentazione dei sensori LAPPD, **OFFERTA ALLEGATA (IVA inclusa)**
	missioni	4		Collaborazione TS-GE per LAPPD - **attivita' sinergica con DRD4**	2 settimane uomo a GE
		4		test in campo magnetico dell'LAPPD a Genova - **attivita' sinergica con DRD4**	2 persone x 2 settimane a GE
		5		testbeam dRICH ad alta pressione al CERN - **attivita' sinergica con DRD4**	2 persone x 2 w = 1 MU
GE	consumi	15		MCP di riferimento con alta risoluzione temporale <10 ps Hamamatsu R3809U-50 - Sinergico con il DRD4	al test beam2022, usato un MCP analogo in prestito
		2		Produzione e montaggio PCB per HRPPD	20x20 cm^2 (LAPPD) --> 10x10cm^2 (HRPPD)
	missioni	2.5		attivita' di collaborazione TS-GE sul LAPPD	2 viaggi x 2 persone
		2.5		test beam	2 settimane uomo a CERN

INFORMAZIONI COMPLEMENTARI

Contesto R&D LAPPD per applicazioni CERENKOV

Sinergie di vari progetti e gruppi

- EIC
  - Rivelatore per il PID (aerogel, hpDIRC, dRICH backup)
  - Gruppi USA (Argonne, U. of Chicago, BNL)
  - Gruppi INFN (TS, GE)
- AMBER
  - Necessita' RICH 0 per il programma di fisica di AMBER
  - Richieste 2024
    - Complemento missioni, consumi lab., noleggio LAPPD
    - Acquisto 1 unita' HRPPD
    - Acquisto lampada mercurio/xenon
- AIDAinnova
  - Concetto dei RICH compatti per collider (EIC, circular e+e-)
  - Il supporto e' usato per **personale**

eRD110 – EIC photon detectors

- Studi **LAPPD** inclusi
- FY 2023: 70 k$ assegnati alle attivita' INFN in questo settore (le usiamo prevalentemente per **personale**)
- Richieste FY2024: 46 k$ (per **personale**)

OFFERTE ALLEGATE

Noleggio LAPPD

INCOM BRIGHT IDEAS

Incom, Inc.
294 Southbridge Road
Charlton, Ma 01507
USA

Phone: (508) 909-2200
Fax: (508) 909-2323

Quotation To:

Silvia Dalla Torre
Istituto nazionale di Fisica Nucleare (INFN)
Sezione di Trieste
Padriciano 99
Trieste 34149
ITALY
Phone: 39 040 3756227
Fax:

Order and Delivery Questions, or to place a PO:

Salesperson: Danny Lippe
dlp@incomusa.com
508-909-2204
Tech Question:
Technical Contact: Michael Foley

Quote Num: Q000000832
Price Expires: 10/21/2023
Lead Time Expires: 08/29/2023

Terms	IncoTerms	Quote Date	Expiration Date	Salesperson	Customer Currency
Prior to Ship	Not Applicable	8/22/2023	9/21/2023	DPL	US Dollar

Line	Cust Item	Item	UM	Quantity	Unit Price	Extended Price
1		908-7591	EA	1.000	$12,000.00	$12,000.00

RENTAL of Gen II Capacitively Coupled Anode LAPPD with 10 um MCPs
220 mm Square Photodetector with 229 x 220mm rectangular anode base- short LTA
229 x 220x 16.7mm(9.02 x 8.66 x 0.66")
Device consists of;
-Chevron pair of 203 mm × 203 mm ALD-GCA-MCPs with with 10 µm pores and 13 µm pitch
-Top window with deposited photocathode
-Independent control of voltage to the photocathode and MCPs
-LAPPD is mounted on a pixelated signal board with SMA connectors, and housed in an Ultem insulating frame (300 x 274 x 26.8mm) for easy connection and protection
The LAPPD targets the following specifications:
-Gain >/= 5E6
-Quantum Efficiency >/= 20%
-High temporal resolution (< 100 psec)
-Spatial resolution (< 3 mm)
Full Measurement & Test Report provided with the LAPPD

Quote Notes 8.22.23 LRC:
LAPPD #153 , on loan from Brookhaven, will be returned to Brookhaven when this proposed rental period (10/1/23 to 1/31/24) is over.
-BNL to handle export/import.
- Current Rental period (BNL) is from May 26th, 2023 to September 25th 2023.

For Incom Terms & Conditions click link below:
https://incomusa.com/sales-terms-and-conditions/

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Thank you for your Request

MRFoley

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HV power supply

Costruzioni Apparecchiature Elettroniche Nucleari C.A.E.N. S.p.A.
Via Vetraia, 11 - 55049 Viareggio (LU) - Italy
tel. +39.0584.388.398 - fax +39.0584.388.959
info@caen.it - www.caen.it

Offerta N. 22OFC.01264

Pagina 1

Spettabile
INFN - TRIESTE
LABORATORI AREA RICERCA
PADRICIANO 99
34149 TRIESTE (TS)
Italy

Luogo di Destinazione
INFN - TRIESTE
LABORATORI AREA RICERCA
PADRICIANO 99
34149 TRIESTE (TS)
Italy

Viareggio, 28/10/2022

Come da Voi richiesto, Vi sottoponiamo la nostra migliore offerta per la fornitura di:

Codice Prodotto *	Descrizione	Cons. **	Cons. ***	Q.tà	Prezzo unitario	Sconto %	Totale	Cod. IVA
WDT1415ETXAA	DT1415ET - 8Ch Floating Reversible 1kV/1mA (800 mW) Desktop HV Power Supply Module for MPGD		90G	1	6.821,00	5	6.479,95	IVA22SP
WESTGARAAAAA	Estensione garanzia da 1 a 3 anni . ** Sconto speciale, unico e non ripetibile **			1	545,00		545,00	IVA22SP
LOTTO1	ACCORDO QUADRO - LOTTO 1 - CIG 869303683D							

INFORMATIVA BREVE:
CAEN S.p.A. - con sede in via Vetraia, 11 - 55049 Viareggio (LU), Tel +39 0584 388 398 - nella qualità di Titolare del trattamento dei Suoi dati personali, ai sensi e per gli effetti della normativa vigente in materia di privacy, La informa che i dati personali da Lei forniti saranno trattati nel rispetto delle finalità, modalità e dei tempi previsti dagli obblighi legislativi o contrattuali. Per maggiori informazioni La invitiamo a prendere visione dell'informativa estesa allegata e/o consultabile sul sito www.caen.it.

Descrizione IVA	Imponibile	Importo IVA	Totale Imponibile	Totale IVA
IVA22SP IVA 22% Split Payment	7.024,95	1.545,49	**7.024,95**	**1.545,49**
				Totale Fattura **8.570,44** EUR

Condizioni Pagamento
bonifico 30gg d.f.f.m.

Banca d'Appoggio CASSA RISPARMIO VOLTERRA C/C - 098
ABI/CAB: 06370 24800 C/C:000010000042
IBAN: IT05F0637024800000010000042 SWIFT: CRVOIT3V

Prezzi	Validità dell'offerta	Garanzia	
Porto Franco	60G	1A	

Note ****

(*) In caso di ordine si prega di riportare il codice prodotto.
(**) Tempo di consegna in caso di ricezione ordine entro 5 giorni (i tempi di consegna si intendono dal ricevimento ordine)
(***) Tempo di consegna in caso di ricezione ordine oltre 5 giorni (i tempi di consegna si intendono dal ricevimento ordine)
(****) L'acquirente intende accettate le condizioni di vendita visibili sul sito web.

In attesa di Vostre gradite notizie, porgiamo distinti saluti.

Alessandro Cortopassi

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BACKUP

LAPPD – assegnazioni 2023

LAPPD - assegnazioni 2023

sede	capitolo	rich. (keuro)	rich. s.j.(keuro)	descrizione	note
TS	consumo	7		2 mesi noleggio LAPPD	
		3		metabolismo laboratorio per studi LAPPD	
	inventario	17		Sistema di movimentazione a 3 assi	**anticipato a fine 2022**
	missioni	1		attivita' di collaborazione TS-GE sul LAPPD	
		2.5		misura della risposta degli LAPPD in forte campo magnetico	
GE	consumi	10		Sviluppo scheda custom per PicoTDC + NINO o FastIC	in ritardo per nuova destinazione personale tecnologo a GE
	inventario	9.5		digitizer CAEN V1742 32 ch	
		1.5		A4818 - USB 3.0 to CONET Adapter	
		3		6533N - 6 Channel VME Programmable HV	
	missioni	2		attivita' di collaborazione TS-GE sul LAPPD	
		2.5		misura della risposta degli LAPPD in forte campo magnetico	