Cern TB Summary

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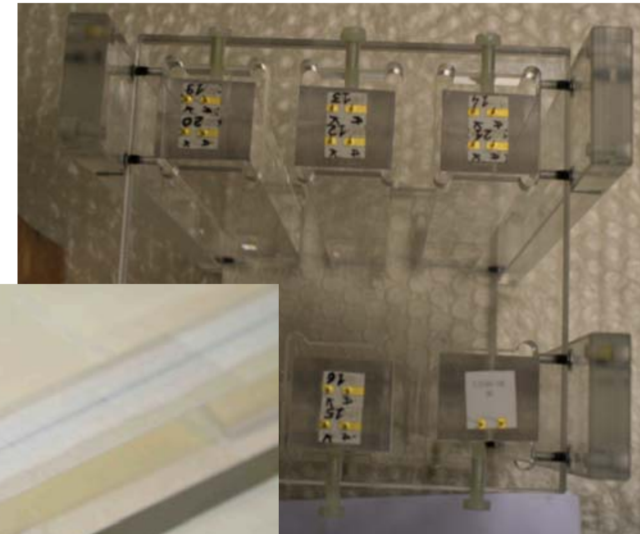
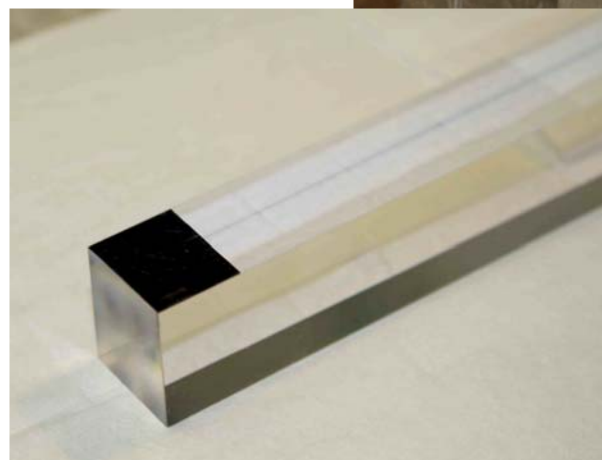
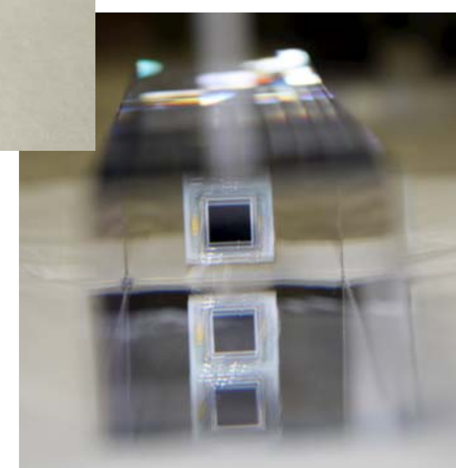
LYSO Crystal

- Sensors glued with DownCorning RTV3140
- Each crystal was painted with a 15mm black strip on the smaller end
- White reflective pain around APD/PiN on the back face







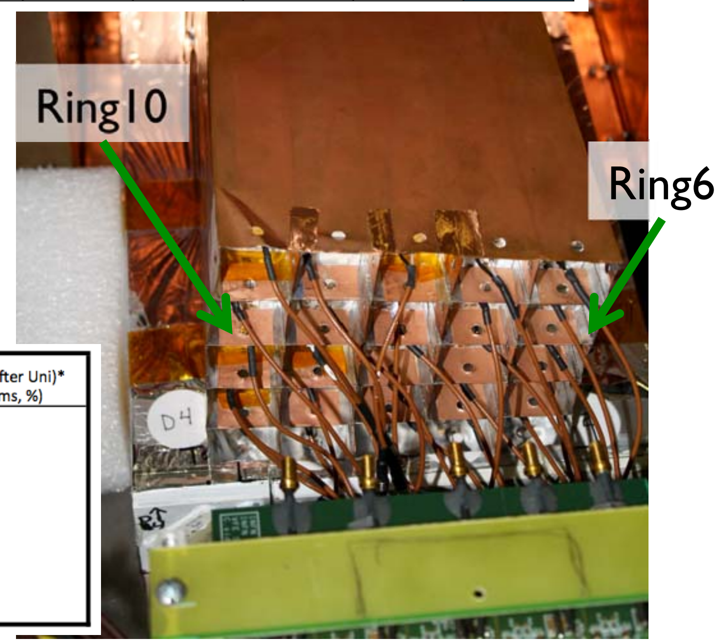
  - Not best solution:
    - For a better uniformization each crystal need a specific black strip width

Matrix Configuration

- 10 crystals measured at CalTech
- 10 crystal (SG) measured at Perugia (only PMT)
  - All SGs LY are within 10%
- 4 crystals (SIPAT L9,7-4,7-3,7-2) not measured

As seen from beam

	Ring 6	Ring 7	Ring 8	Ring 9	Ring 10
Shaper 0 PiN	Sipat 13	Sipat 7-4	Sipat 12	SG X	SG X
Shaper 1 APD	Sipat 14	Sipat 7-3	SG 005-3	SG X	SG X
Shaper 2 APD	Sipat 17	Sipat 18	Sipat 11	SG X	SG X
Shaper 3 APD	Sipat 15	Sipat 19	SG 005-4	SG X	SG X
Shaper 4 APD	Sipat 16	Sipat 7-5	Sipat L9	SG X	SG X



ID	Type	LT @ 420 nm (%)	LY & ER by PMT* (% of candle 1), (FWHM, %)	LY, ER & Uniformities by APD (before Uni)* (p.e./MeV), (σ, %), (δ, %) (rms, %)	LY, ER & Uniformities by APD (after Uni)* (p.e./MeV), (σ, %) , (δ, %) (rms, %)
SIPAT-11	8	82.3	53.2, 10.7	1420, 15.5, 12.9, 6.5	770, 27.4, 4.1, 2.5
SIPAT-12	8	82.2	51.9, 10.4	1440, 15.1, 14.2, 7.1	750, 26.7, 3.4, 2.8
SIPAT-13	6	82.6	58.6, 11.5	1440, 14.9, 6.8, 3.6	940, 22.6, 4.6, 2.4
SIPAT-14	6	82.7	62.0, 10.9	1500, 14.9, 14.4, 7.4	830, 24.7, 4.5, 2.7
SIPAT-15	6	80.7	58.9, 10.5	1580, 13.7, 11.9, 6.0	960, 21.5, 4.9, 2.7
SIPAT-16	6	81.1	57.8, 10.1	1550, 13.5, 9.7, 5.0	950, 20.9, 4.7, 2.5
SIPAT-17	6	82.1	59.2, 12.2	1250, 17.1, 9.8, 4.9	830, 26.1, 4.5, 2.6
SIPAT-18	7	76.0	50.1, 11.0	1340, 15.3, 4.8, 2.5	1340, 15.3, 4.8, 2.5
SIPAT-19	7	70.4	46.1, 11.5	1190, 17.3, 3.7, 1.9	1190, 17.3, 3.7, 1.9
SG05-04	8	80.8	59.2, 10.5	1360, 17.3, 9.7, 5.2	900, 23.8, 4.7, 2.4

Test Area Setup

- Cherenkov Detector
- Two finger scintillators (2x2 cm^2)
- 4 Si planes (2x and 2y)
- LYSO Matrix (APD bias 311V and 310V)
- CsI(Tl) crystal arroud the matrix
- Downstream Scintillator Pad (10cm^2, not in photo, only in last runs)

Data Acquisition

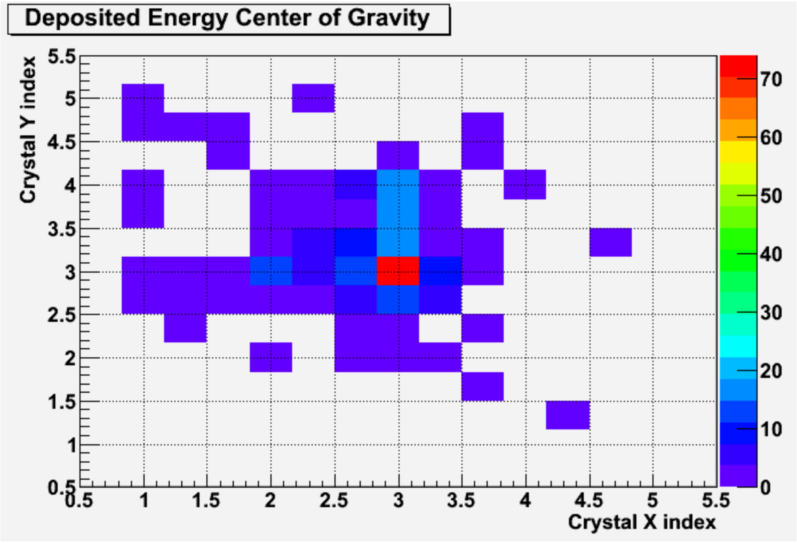
- Trigger:
  - Until Run329 : Finger counters coincidence
  - From Run329: Finger counters and cherenkov coincidence plus downscale pions
    - LOGIC: Fingers × (Chv + Fingers/2^n)
- 25 LYSO channels: Sampling ADC Caen V1720 (12bit)
  - Sampling Rate: 250MHz
  - Number of samples: 384
- 1536 silicon channels: Caen V550 ADC (10bit)
- Cherenkov, 5 temperature, 12 CsI channels and Downstream PAD: Caen V785 Peak ADC (12bit)

First days

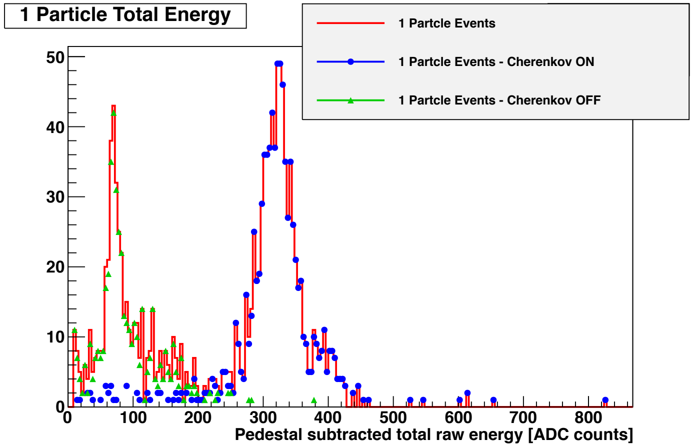
- We had some difficults to find the correct alignment between the beam and the matrix
  - The beam was wider than what we expecte
- We didn’t have a shaper for the Cherenkov signal
  - Until run 275 non Chv acquisition
  - From run 275 to 308 acquisition of binary Chv info
  - From run 309 acquisition of analog Chv Signal
- We had only 3 V1720 (24Chs)
  - 25 chs only from run 321
- No CsI electronics
  - CsI acquired only from run 328

First Data and Intecalibration

- The first "good" run is 275 (24chs but may be usefull for calibration and cross-check)
- correct alignment and all detectors acquired
- 279: Very long run at 1GeV

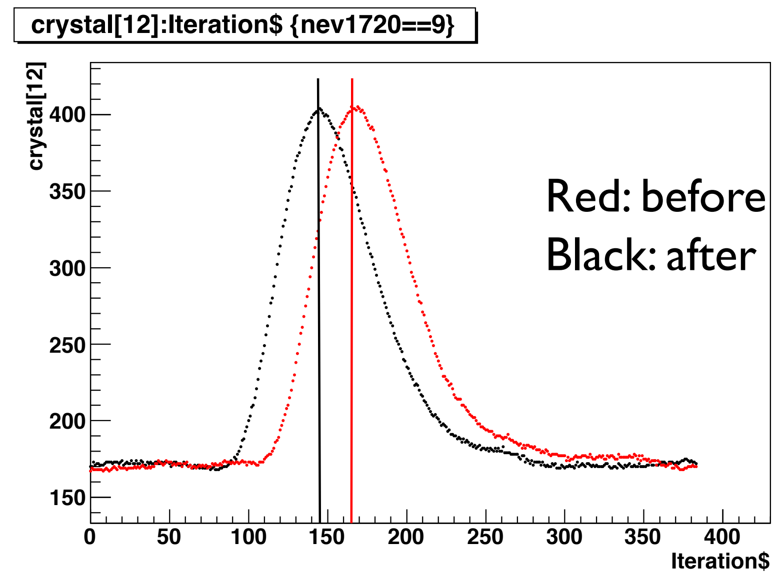


- From this point we start a scan at 1GeV of 3x3 central crystal to make intercalibration
  - Run 280-324



Energy Scan

- With the inside 9 crystals intercalibrated we start the energy scan
- To do this we changed the trigger to downscale pions
  - Small delay added to the finger counts
    - Signal Peak moved of ~20samples

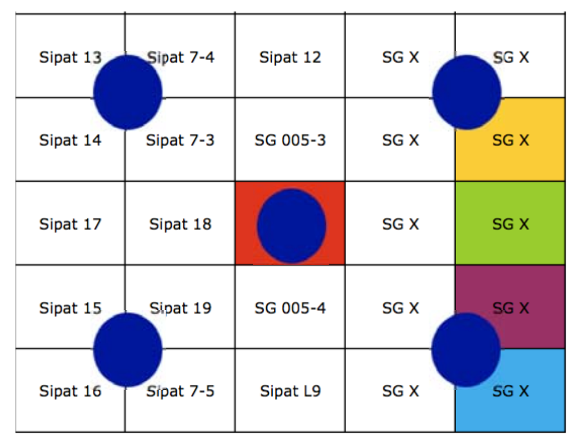


- Took data at 2,3 and 4 GeV

LYSO outer ring and CsI calibration

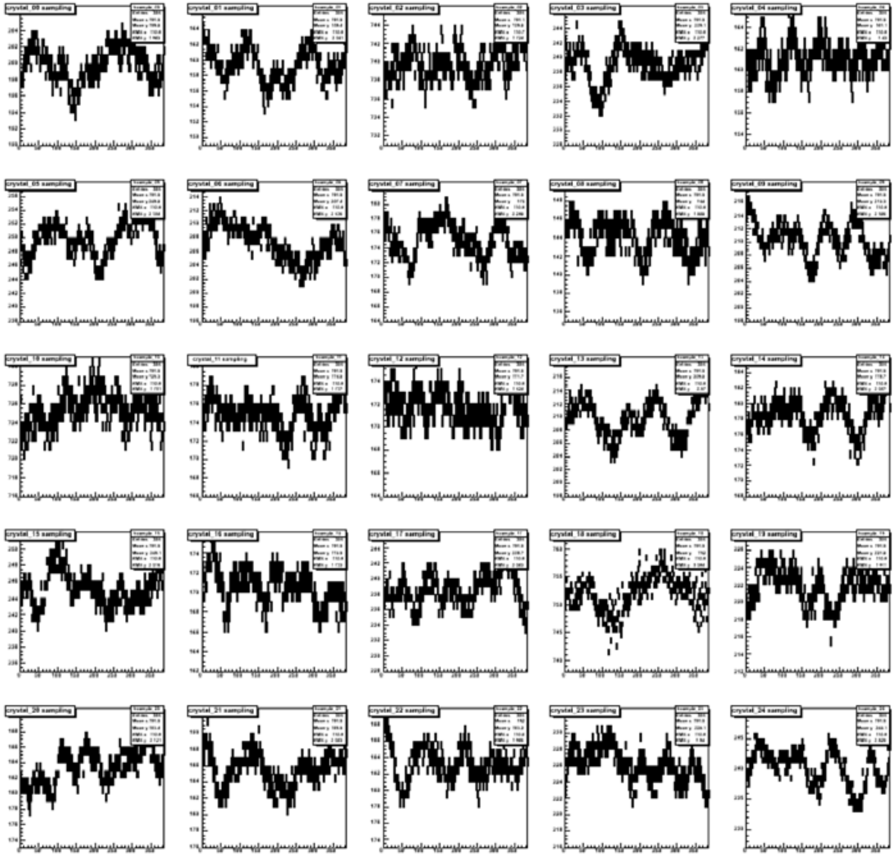
- To intercalibrate the outer LYSO crystals and the CsI we took some run with a different trigger
- Instead of the fingers we used the coincidence between two big pads (~6x6 cm^2)
- We can intecalibrate several crystals with only one run

- Run from 337 to 346 @ 3GeV



Noise

- With this first data we found a resolution worse than what we expected from MC simulation (5% against ~2%)
- We found oscillations in the signal baseline
- we decided to raise the APD voltage (and accordingly the gain) to increase the S/N
  - APD HV from Run349 ~380V



Oscillations Amplitude independent from APD Capacitance

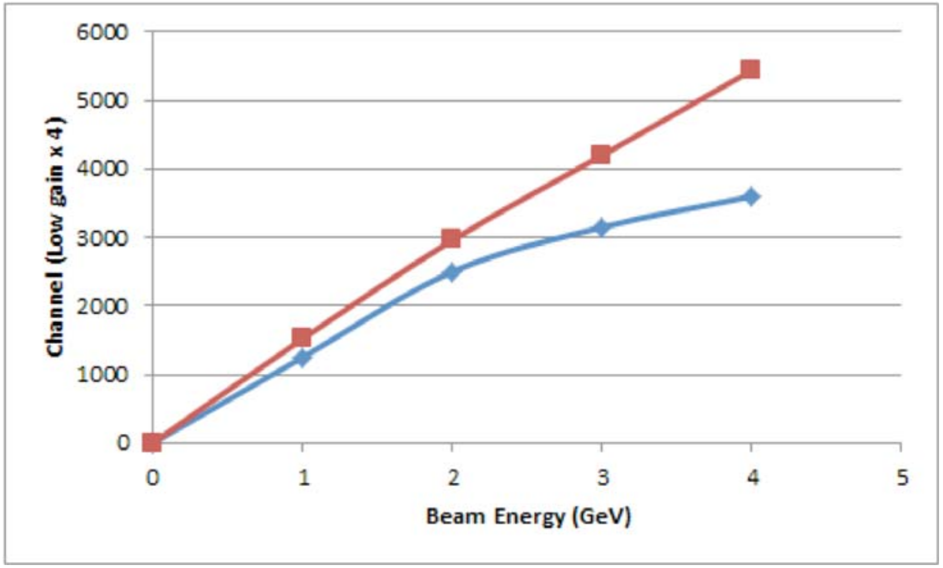
New Configuration

- With this new APD Bias we restart from the intercalibration:
  - Run from 350 to 387: scan centering the beam on each crystals with APD
- Resolution at 1GeV is now ~3.6%

- With this configuration we took also data with material in front of the matrix (run 392-397, 403-406, 446-447):
  - Alluminium: 20mm, 40mm and 80mm
  - Quartz: 5mm, 15mm and 30mm
  - Active Quartz Bar (DIRC like)

Saturation Problem

- Energy Scan with High APD bias (run 409-440)
  - 1.5, 2,3 and 4 GeV
- Going to higher energy we find that we lost the linearity with the energy



- This problem is due to the saturation of the Charge Sensitive Preamplifier
- With High Bias the max energy allowed is 2GeV

Data Summary

High Bias

Energy	Events	Electron %
1 GeV	95000	65
1.5GeV	20000	60
2GeV	40000	48
3GeV	9500	30
4GeV	650	25

Material	Events	Electron %
Alluminium	30000	65
Quartz	30000	65
Active Quartz	15000	65

Low Bias

Energy	Events	Electron %
1 GeV	110000	65
1.5GeV	13000	60
2GeV	21000	57
3GeV	47000	40
4GeV	9000	6

Material	Events	Electron %
Active Quartz	15000	65

Conclusions

- Despite many problems we encountered we were able to take a lot of data
- There are stil problems we have to better understand:
  - Baseline oscilations inpact on resolution
  - Silicon-EMC uncorrelation (D. Pinci)
  - CsI signal disapearence (B. Enchenard)
  - LowBias intercalibration (C. Cheng)
- We have many different configuration, data analysis is not so simple

Run List

- High Bias:

Energy	Run
1Gev	350, 351, 361, 362,369,370,371,390, 391, 407, 408, 413, 414,415, 435
1.5GeV	411, 412, 437
2GeV	409, 419, 420, 421, 422, 429, 441
3GeV	410, 430, 431, 432, 438, 439, 440
4GeV	436

Material	Run
Al 20mm	393
Al 40mm	395
Al 80mm	392
Qz 5mm	405
Qz 15mm	404, 406
Qz 30mm	403
Active Qz	447

Run List

High APD Gain – Crystal Scan

Crystal	Run	E [GeV]	Target	Crystal	Run	E [GeV]	Target
0		1			413-415,418	1	T4
1		1		13	355	1	
2		1		14	367	1	
3		1		15	365	1	
4		1		16	352	1	
5	363	1		17	353	1	
6	358	1			428	1	T4
7	357	1		18	354	1	
	427	1	T4	19	366	1	
8	356	1		20	387	1	
9	368	1		21	386	1	
10	364	1		22	385	1	
11	351	1		23	383	1	
12	350,407-408	1		24	380,382	1	
	362,369	1	T4				

Run List

- High Bias:

Energy	Run
1Gev	279, 310,325, 326, 329, 348, 448
1.5GeV	456
2GeV	330, 442
3GeV	331, 332, 333, 455
4GeV	334, 335, 336, 443

Material	Run
Active Qz	446

Run List

Crystal	Run	E [GeV]	Option	Crystal	Run	E [GeV]	Option
0	342	3	Wide Beam	11	289	1	
1	342	3	WB	12	275-279	1	Bin. chv
2					348	1	
3	341	3	WB		448	1	T4
4	341	3	WB	13	319	1	
5	342	3	WB	14	320	1	
6	286	1		15,16	343	3	WB
	342	3	WB	17	444	1	T4
7	285	1		18	318,321	1	
8	280-283	1	Binary Chv		323-324	1	
	341	3	WB	18,19	337	3	WB
9	341	3	WB	20,21	343	3	WB
10				23,24	337	3	WB