# Preliminary Analysis of the New Focusing DIRC Prototype Beam Data

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# Accumulation of Beam Data: July 24 to August 4, 2006



**Plots From Joe** 

# **Statistics**





# Tracking and Calorimetry



### Hodoscope 2



### Lead Glass Adc



#### **Correlation of Hodoscopes:**

#### **Difference Beam in Positions**



### **Event Time: Local start counters**

### 1) Run 12b:

Start counter 1:

### **Start counter 2:**

### Average of Start 1 & 2:



Use the last run correction constants (no new tuning).

Plots From Jerry

# **Cherenkov Ring Occupancy**



Slot 1 Burle 5

Slot 2

Slot 3 Hamamatsu 2

Hamamatsu 2

Slot 4 Burle 4



Slot 5 Burle 15

ι	2	17	LS.	33	34	49	50
3	4	۱9	20	35	36	51	52
5	6	21	22	37	33	53	54
7	8	23	24	39	49	55	56
9		25	26			57	
u	12	27	28	43	44	59	60
13	14	29	30	45	46	61	62
15	16	31	32	47		63	64

Slot 6 Burle 14





_	_	_	_	_	_	_				
2	17	18	33	34	-19	50		64	-43	32
			_	_		_		63	47	31
4	19	20	35	36	51	52		62	-46	30
					_			61	45	29
6			37	38	53	54		60	44	28
						_		59	43	27
-8	23	24	39	-40	55	56		53		
	_			_				4	41	25
lO	25	26	-41	42	57	58		56	40	24
	_		_	-	_	-		55	39	23
12			43	44	- 59	60				
								53	37	21
14	29	30	-45	-16	61	62		52	36	20
			_	_		_		51	35	19
16	31	32	47	48	63	64		50	34	18
								-19	33	17
		Sle	ot 2	2					Slo	ot 3
	2 4 6 8 10 12 14 16	2 17   4 19   6 21   8 23   10 25   12 27   14 29   16 31	2     17     18       4     19     20       6     21     22       8     23     24       10     25     26       12     27     28       14     29     30       16     31     32	2     17     15     33       4     19     20     33       6     21     22     37       8     25     24     39       10     25     26     41       12     27     25     43       14     29     30     45       16     31     32     47	2     17     15     33     34       4     19     20     35     36       6     21     27     37     X3       8     25     26     40     42       10     25     26     41     42       12     27     30     45     46       14     29     30     45     46       16     31     32     47     48	2     17     15     33     34     49       4     19     20     35     36     51       6     21     22     37     33     53       8     22     47     9     40     55       10     25     26     41     42     57       12     27     36     43     44     59       14     29     30     45     46     61       16     31     32     47     48     63	2   17   13   33   34   49   50     4   19   20   35   36   51   52     6   11   22   17   33   53   54     8   22   24   39   40   55   56     10   25   36   41   42   57   35     12   27   28   43   44   59   60     14   29   30   45   46   61   62     16   31   32   47   48   63   64	2   17   18   33   34   49   50     4   19   20   35   36   51   52     6   11   22   37   35   53   54     8   23   24   39   40   53   56     10   25   26   41   42   57   53     12   27   28   43   44   59   60     14   29   30   45   46   61   62     16   31   32   47   45   63   64	2   17   18   33   34   49   50     4   19   20   33   36   51   52     6   11   22   37   35   54     8   23   24   39   40   55   56     10   25   26   41   42   37   35     14   29   20   43   46   61   62     10   25   26   41   42   97   35     14   29   30   43   46   61   62     14   29   30   43   46   61   62     16   31   32   47   48   63   64     33   34   49   60   55   55   55     16   31   32   47   48   63   64     33   34   46   61   62   51   51     34   35   48   63   64   51     35   34	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$

Hamamatsu 4

Geant4

run 22 data



Slot 4 Burle 4

ι	2	17	13	33	챼	49	5
3	4	19	20	35	36	51	5
5	6	21	22	37	38	53	5
7	3	23	24	39	8		s
9	ιο	25	26	ш	12	57	5
п	12	27	28	43	#	59	6
13		29	30	45	\$	61	6
LS	16	31	32	47	43	63	é

Slot 5 Burle 15

ι	2	17	L8	33	34	49	50
3	4	۱9	20	35	36	51	52
5	6	21	22	37	33	53	54
7	8	23	24	39	40	55	56
9	10	25	26	41	42		53
ш	12	27	28	43	44	59	60
13	14	29	30	45	-16	61	62
15	16	31			43	63	67

Slot 6 Burle 14

### **Plots From Joe**

#### Hamamatsu 4

# Separation of Direct and Indirect Photons by Timing

Time Of Propagation for all Detected Photons



# **New Slot3 Pixels**

### old 6x6mm pixels



H2Occupancy Slot3

#### θ Distribution



#### new 3x12mm pixels



#### θ Distribution



New TDC and SLAC ADC Calibration Using PILAS Laser



All 12 TDCs: ps/count vs. tdc counts

ps/count All Channels





tdc counts

25 25.5 26 26.5

23.5

24

24.5

ps/count

27.5

27



All 12 TDCs: ps/count vs. tdc counts

ps/count All Channels





All 4 ADCs: ps/count vs. adc counts

ps/count All Channels



ThetaC Resolutions: Preliminary Analysis by Jerry

## **Cherenkov angle resolution based on TOP**

1) Run 12b, pos. 1, analysis of the 2-nd peak (Ivan's constants):

542

pased 42

- Cherenkov angle -

Cherenkov angle - based on pixels



2) Run 22, pos. 1, analysis of the 2-nd peak (Jose's constants):



Chromatic correction using the empirical correlation (Data-driven shape).

Plots From Jerry

Assume:  $\beta = 1$ 

1) Run 12b, pos. 1, analysis of the 2-nd peak (Ivan's constants):



#### 2) Run 22, pos. 1, analysis of the 2-nd peak (Jose's constants):



• Chromatic correction using the <u>theoretical</u> correlation (45° angle).

**Plots From Jerry** 

Assume:  $\beta = 1$ 

### 1) Run 12b, pos. 1, analysis of the 2-nd peak (Ivan's constants):

#### Chromatic correction using Fit a quadratic curve over an entire Raw **TOP/Lpath (Spreadsheet)** region of the efficiency profile: All slots & pads, 2-nd peak: chromatic corr. off All slots & pads, 2-nd peak: chromatic corr. on (spreadsheet) The chromatic correction (spreadsheet) Entries 48950 9000 Entries 48950 $= [\theta_c(\lambda) - \theta_c(\lambda) - \theta_c(\lambda) = 410 \text{ n}$ Mean 47.05 Mean 46.94 BMS 0.9038 8000 10000 RMS 0.863 Integral 4.895e+04 dTheta = -5.0241\*(dTOP/Lpath)<sup>2</sup> + 5.401\*(dTOP/Lpath 4.893e+04 y² / nd 6385/12 Inte gra 0.8 $\chi^2 / ndf$ 596.5 / 12 7000‡ Narrow Norm 6951±54.7 FWHM Narrow Mean $47.02 \pm 0.00$ Narrow Norm $9552 \pm 71.4$ 8000 0.6 Narrow Sigma $0.5859 \pm 0.0039$ Narrow Mean $47.02 \pm 0.00$ 6000 E dTheta [deg] Wide Norm $1000 \pm 18.7$ Narrow Sigma $0.5209 \pm 0.0035$ 0.4 835.8 ± 13.9 Wide Norm 5000 F 6000 Wide Mean $46.45 \pm 0.03$ .0.2 ~10mrad 4000 $\sigma_1 \sim 10.2 \text{ mrad}$ 4000 -0.0 0.05 0.10 0.15 $\sigma_1 \sim 9.1 \text{ mrad}$ 10 0 20 3000 2000‡ A 410nm photon -0.4 2000 Blue photons **Red photons** 1000 dTOP/Lpath [ns/m] = [TOP/Lpath ( $\lambda$ ) - $\frac{0}{43}$ TOP/Lpath ( $\lambda = 410$ nm)] 45 52 44 48 49 50 51 46 47 43 44 45 46 47 48 49 50 51 52 Cherenkov angle - uncorrected (deg) Cherenkov angle - corrected using dTOP/Lpath (spreadsheet) (deg)

### 2) Run 22, pos. 1, analysis of the 2-nd peak (Jose's constants):



 Chromatic correction using the <u>theoretical</u> correlation (Refraction indexdriven).
Plots From Jerry

1) Run 12b, pos. 1, analysis of the 2-nd peak (Ivan's constants):

#### Chromatic correction using Fit a quadratic curve over an entire Raw **TOP/Lpath (Spreadsheet)** region of the efficiency profile: All slots & pads, 2-nd peak: chromatic corr. off All slots & pads, 2-nd peak: chromatic corr. on (spreadsheet) $= [\theta_c(\lambda) - \theta_c(\lambda = 410 \text{ nm})]$ Entries 48950 The chromatic correction (spreadsheet) 9000 Entries 48950 Mean 47.05 Mean 46.94 BMS 0.9038 8000 10000 RMS 0.863 Integral 4.895e+04 4.893e+04 y² / nd 6385/12 Inte gra dTheta = -5.0241\*(dTOP/Lpath)<sup>2</sup> + 5.401\*(dTOP/Lpath) $\chi^2 / ndf$ 596.5 / 12 7000‡ Narrow Norm 6951±54.7 0.8 Narrow Mean $47.02 \pm 0.00$ Narrow Norm $9552 \pm 71.4$ 8000 Narrow Sigma $0.5859 \pm 0.0039$ Narrow Mean $47.02 \pm 0.00$ 0.6 6000 E Wide Norm $1000 \pm 18.7$ Narrow Sigma $0.5209 \pm 0.0035$ dTheta [deg] 0.4 Wide Norm $835.8 \pm 13.9$ 5000 E 6000 Wide Mean $46.45 \pm 0.03$ 0.2 ~10mrad 4000 ~ 10.2 mrad σı 4000 $\sigma_1 \sim 9.1 \text{ mrad}$ 3000 0.00 0.10 0.05 0.10 0.15 -0.0 0 20 2000‡ 410nm photo 2000 Blue photons Red photons 1000 dTOP/Lpath [ns/m] = [TOP/Lpath ( $\lambda$ ) - $\frac{0}{43}$ 45 49 51 52 44 48 50 43 46 47 44 45 46 47 48 49 50 51 52 TOP/Lpath ( $\lambda = 410 \text{ nm}$ )] Cherenkov angle - uncorrected (deg) Cherenkov angle - corrected using dTOP/Lpath (spreadsheet) (deg)

### 2) Run 22, pos. 1, analysis of the 2-nd peak (Jose's constants):



 Chromatic correction using the <u>theoretical</u> correlation (Refraction indexdriven).
Plots From Jerry

Raw

1) Run 12b, pos. 1, analysis of the 2-nd peak (Ivan's constants):

#### Use epsilon time offsets:



### Chromatic correction TOP/Lpath (Empirical)



#### 2) Run 22, pos. 1, analysis of the 2-nd peak (Jose's constants):



• Chromatic correction using the <u>empirical</u> correlation (Data-driven shape).

### **Plots From Jerry**

## Do we benefit from the wing slots ?

Run 22, pos. 1, Forward pfotons only (Jose's constants):



20000 10000

44

45

47 48

46

49 50

Cherenkov angle (pixels) - uncorrected (deg)

Plots From Jerry

51 52

## Fits used in the previous plot

### Run 22, pos. 1, Forward pfotons only (Jose's constants):



- Fix the "background" amplitude to 5% of the main Cherenkov peak amplitude.
- "Background photons" = Cherenkov photons which scattered away from the main peak.

### **Plots From Jerry**

# Summary/Outlook

• Preliminary analysis of the hodoscopes gives good track angle resolution.

•Lead Glass shows good separation of multi-particle pulses.

•Start counters give good timing resolutions as before so beam trigger is stable.

•We obtained about 2x the statistics as we had before for each beam position.

•Cherenkov ring coverage is almost complete; added new slot1 and covered some holes.

•New MCP in slot3 has smaller pixel size giving better theta resolution.

•Waiting for new Cherenkov angle assignments obtained from Geant Simulation.

•Timing needs to be looked at on a finer scale.

•ThetaC resolution from time and chromatic correction need to be looked at more closely.

•New method of analysis for chromatic correction is coming.