

Status of Aerogel (AC1, AC2, and AC3) Detectors

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Jefferson Lab
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Aerogel Gain Match Test: ESB Building Summer 2022



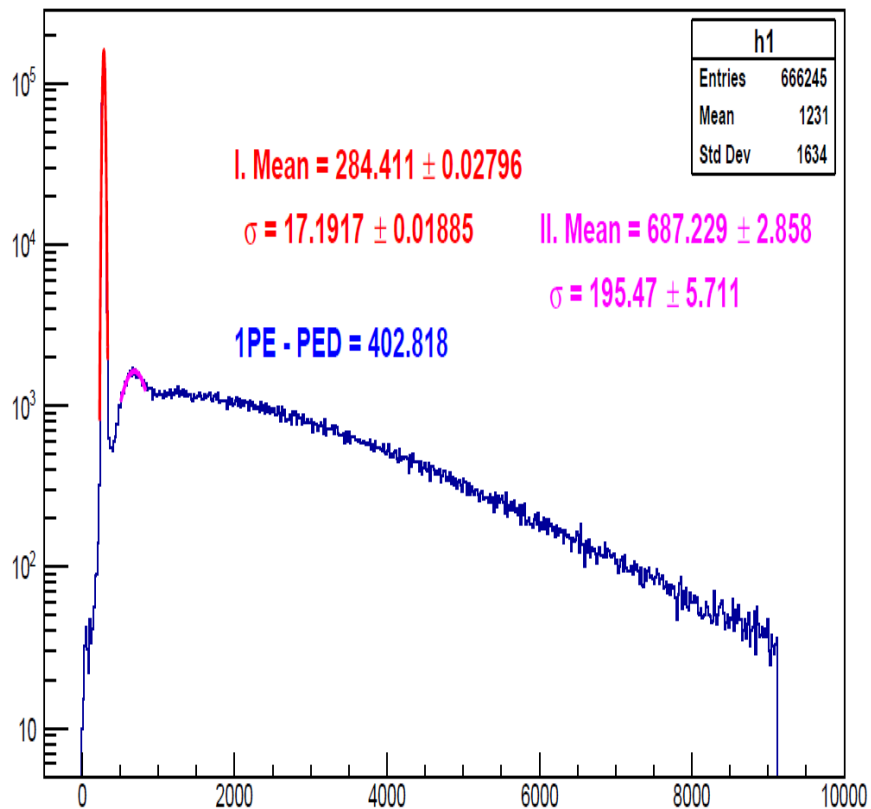
Introduction:

- The aerogel Cerenkov detectors will be used for the future hypernuclear experiments at Jefferson lab.
- All 3 layers of aerogel detectors (AC1, AC2, and AC3) were tested during the summer of 2022.
- For each PMT, the gain is matched ($\sim 400 \pm 5$ of ADC channel) and the corresponding high voltage is recorded.
- For each segment, efficiency and approximate no of photo-electrons are calculated.

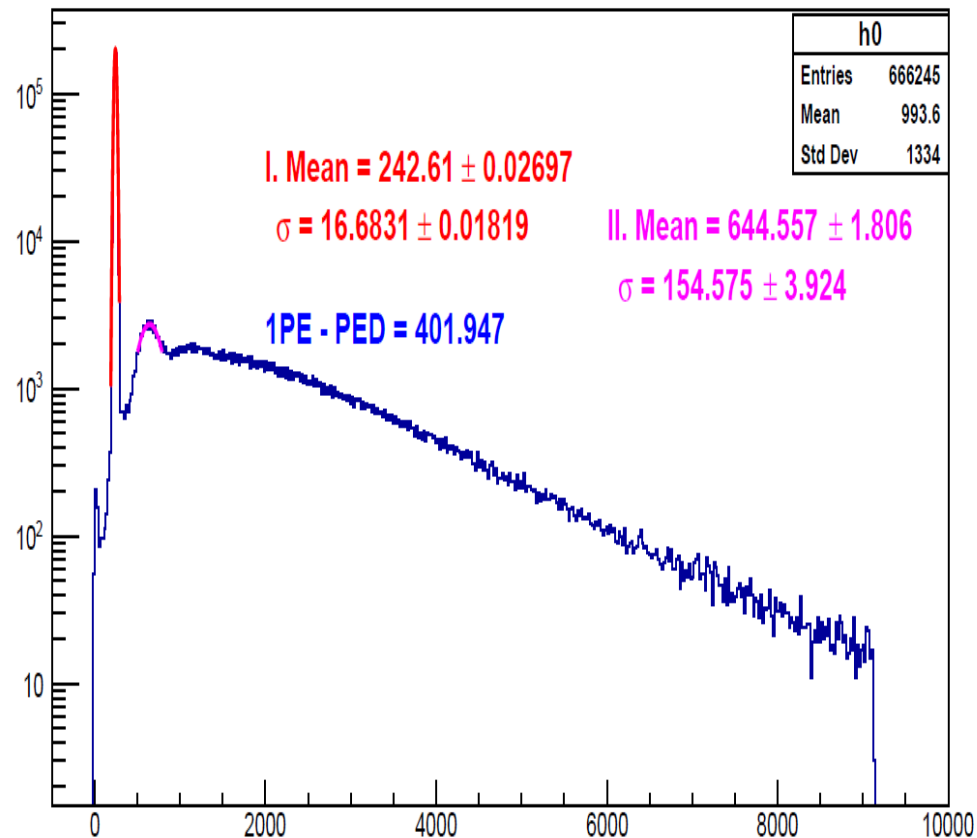
AC3 Detector

Segment # 1 (PMT #1 and 14)

D.A01 (AC3 PMT#1, CH32 HV = 1548 V), Run 2101

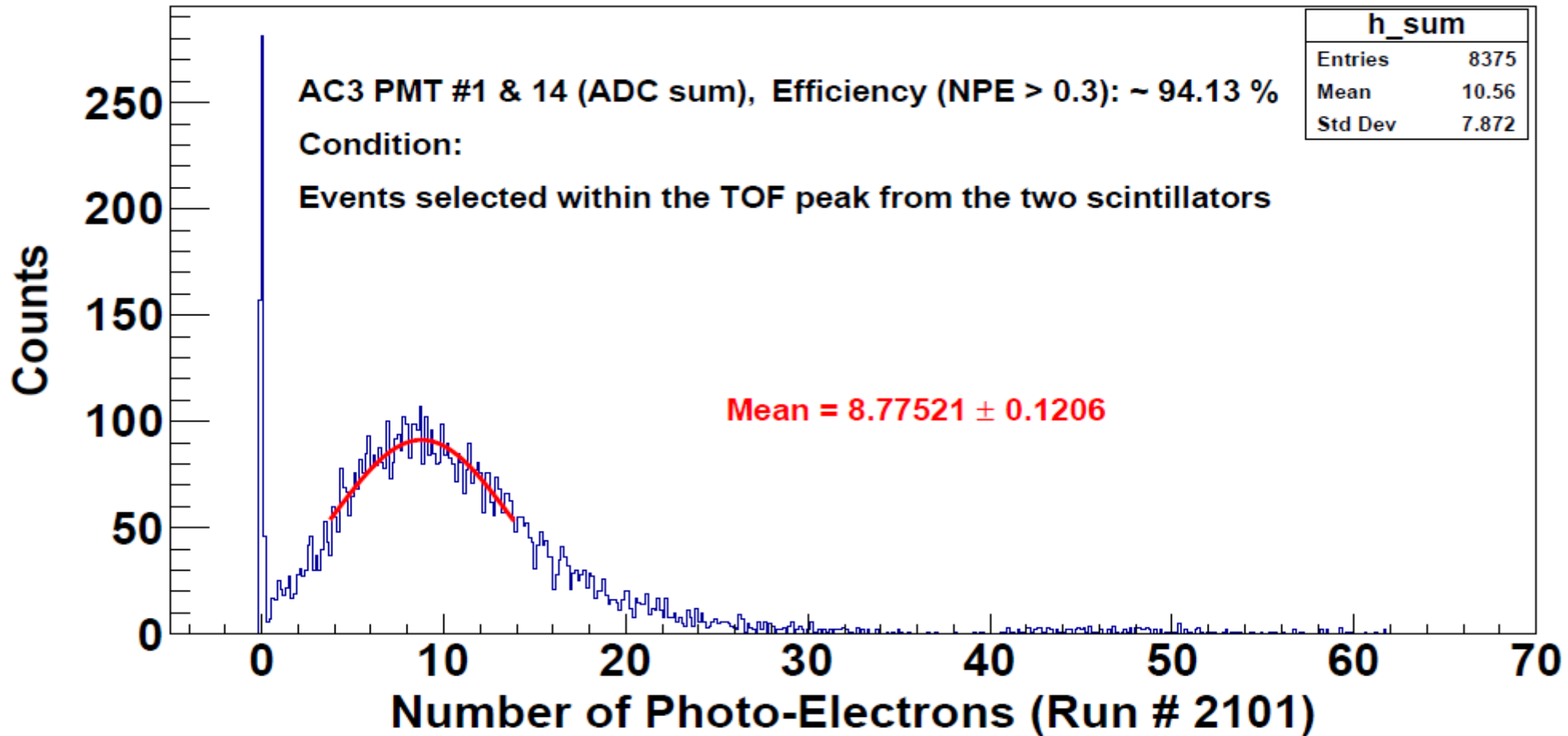


D.A00 (AC3 PMT #14, CH33 HV = 1663 V), Run # 2101



AC3 Detector

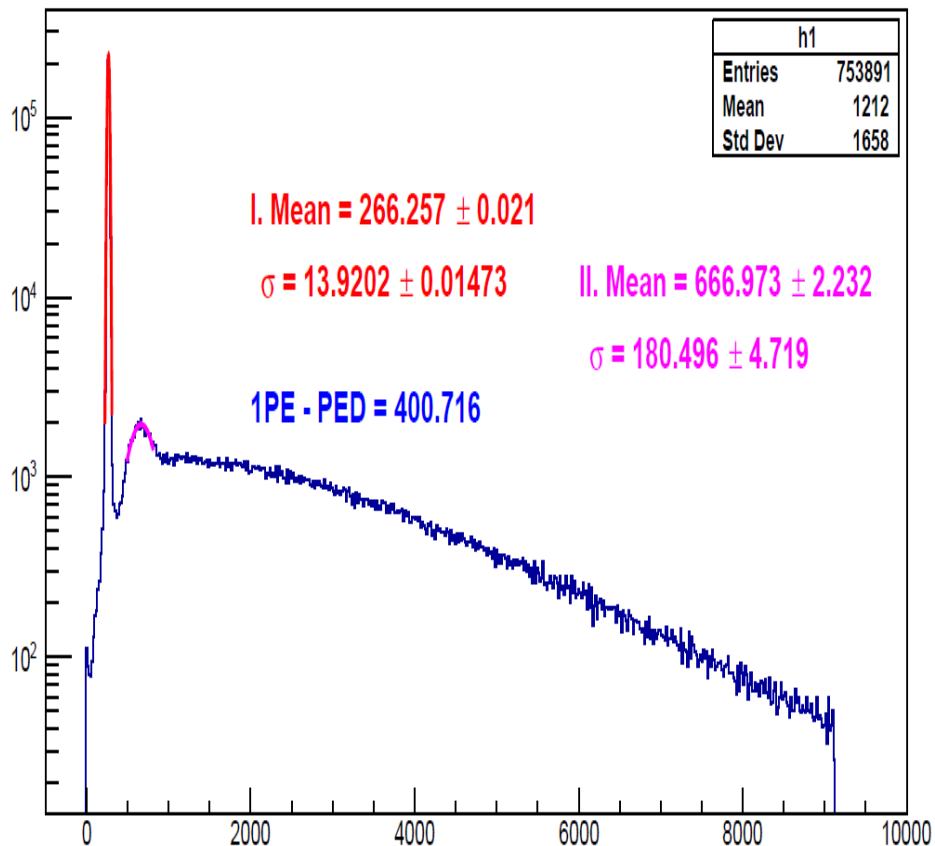
Segment # 1 (PMT #1 and 14)



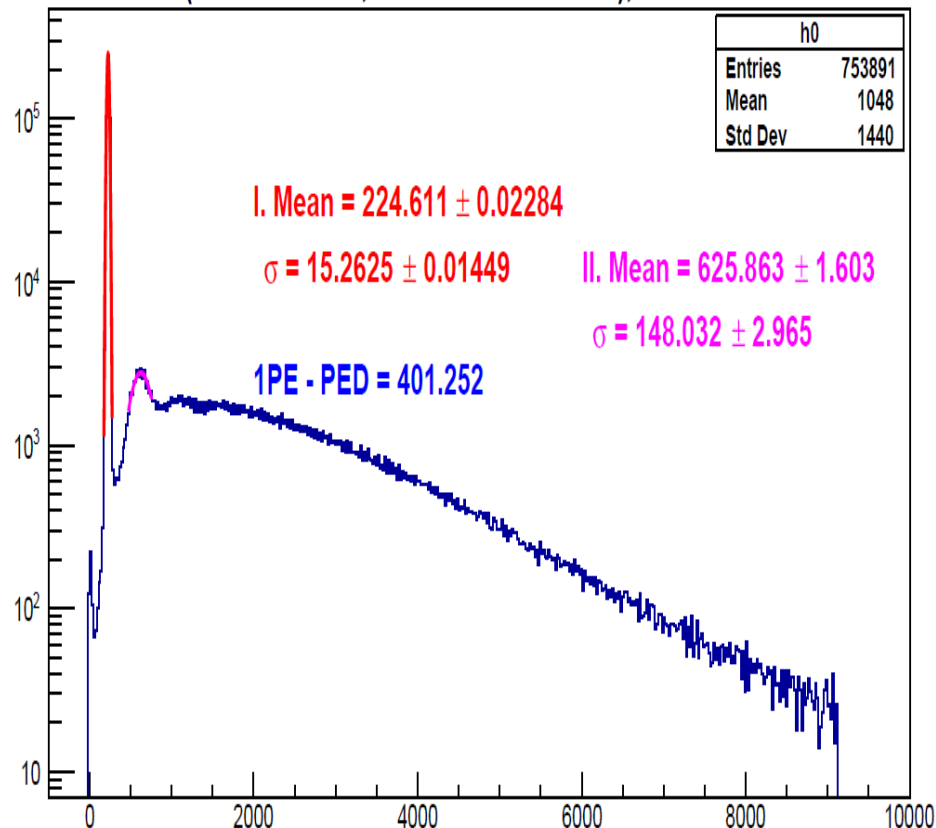
AC3 Detector

Segment # 2 (PMT #2 and 13)

D.A01 (AC3 PMT#2, CH32 HV =1486 V), Run 2104

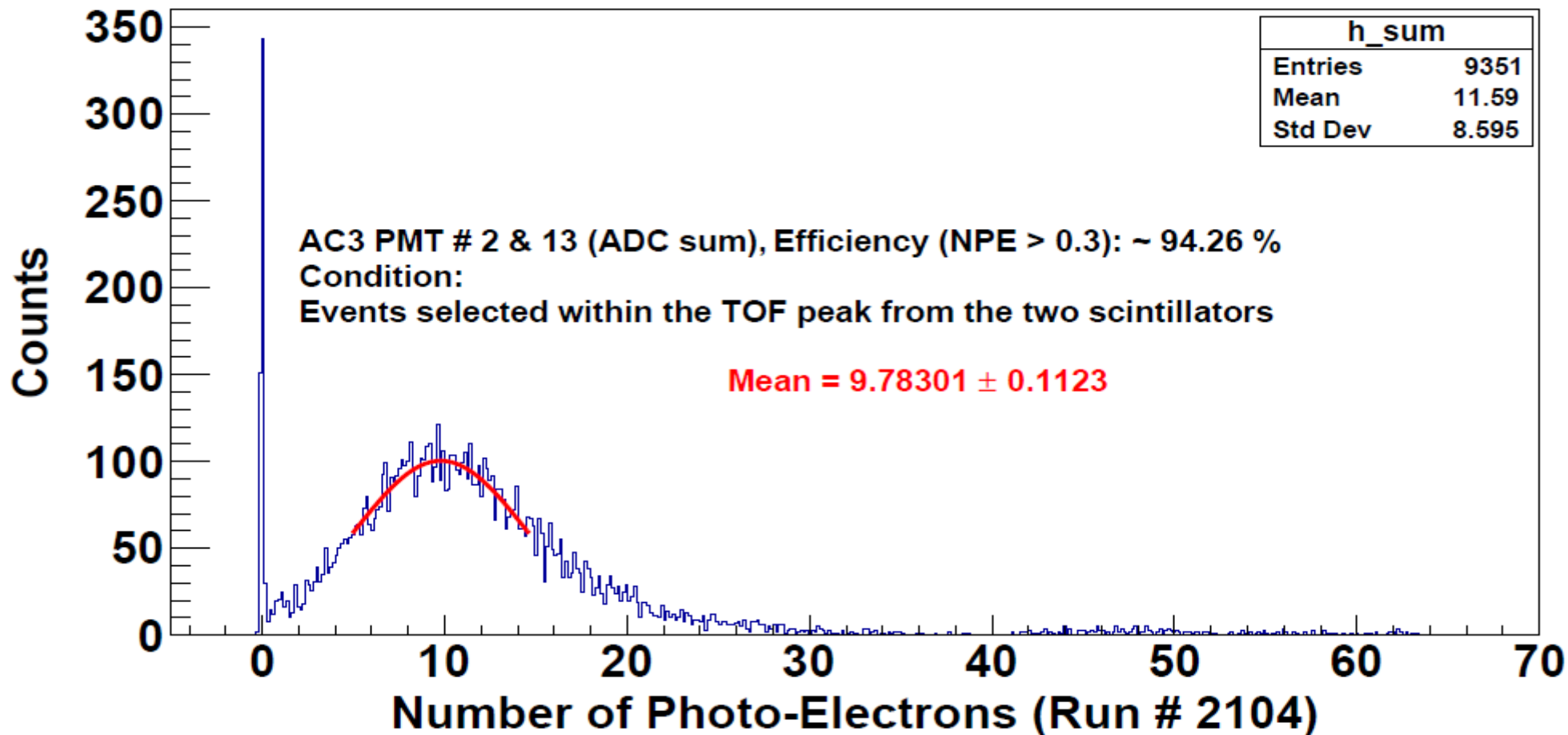


D.A00 (AC3 PMT #13, CH33 HV = 1772.4 V), Run # 2104



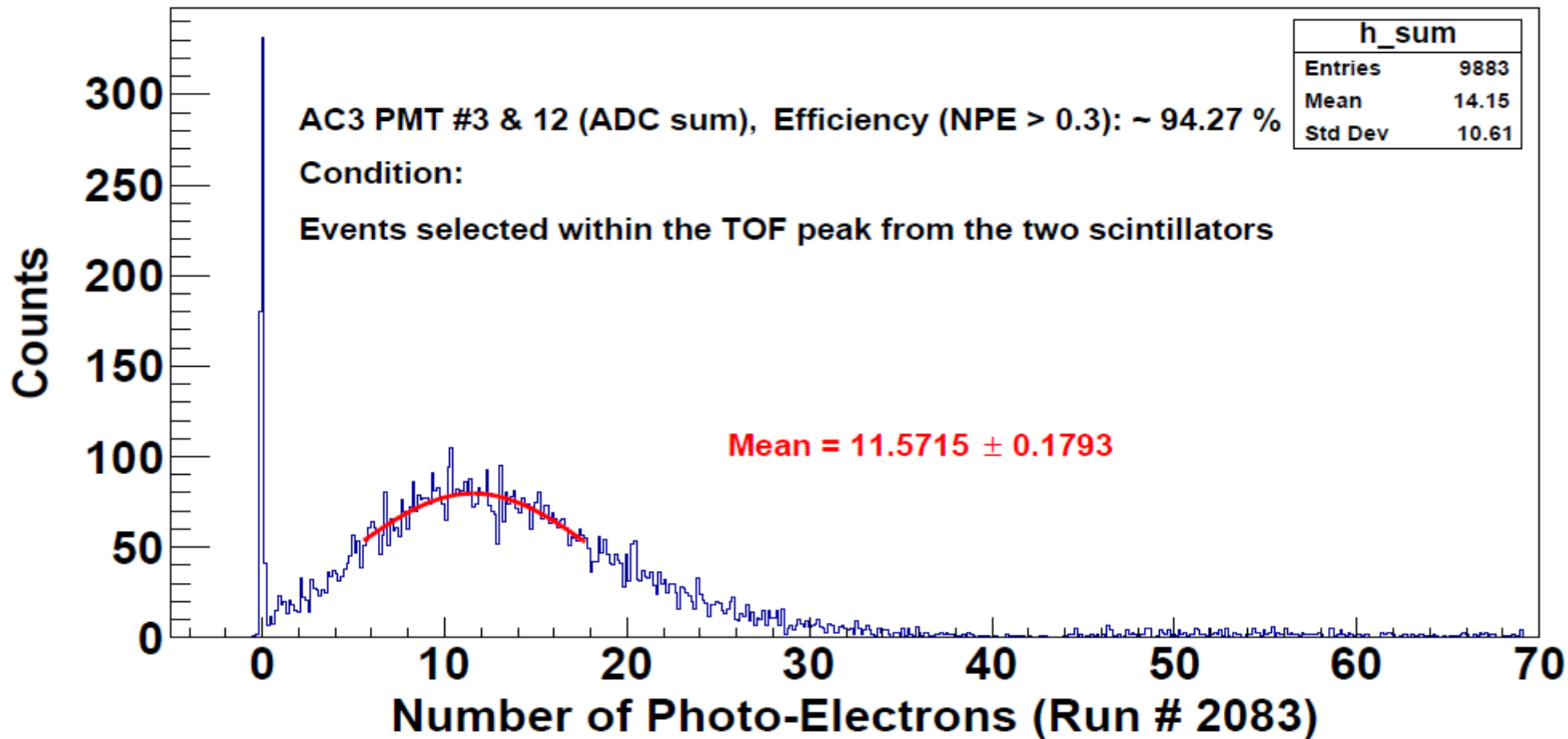
AC3 Detector

Segment # 2 (PMT #2 and 13)



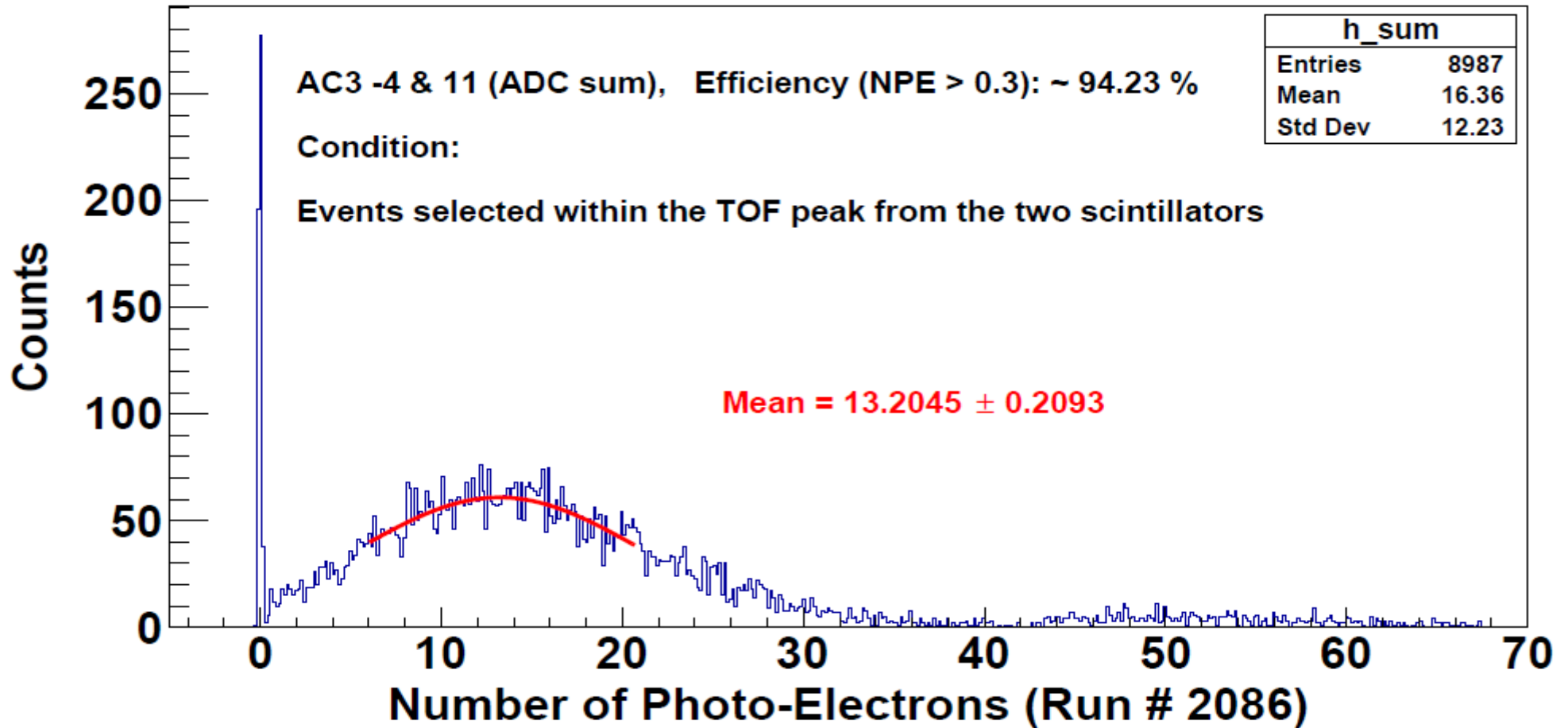
AC3 Detector

Segment # 3 (PMT #3 and 12)



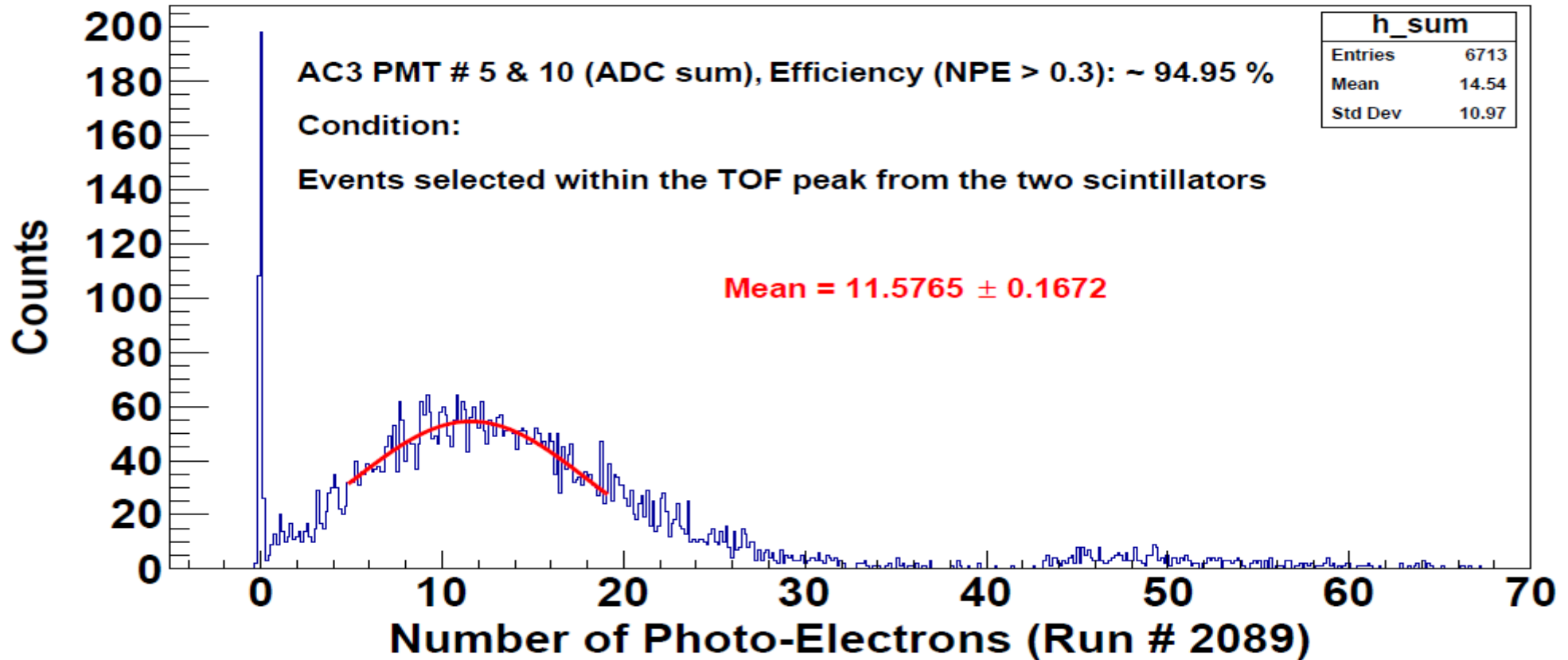
AC3 Detector

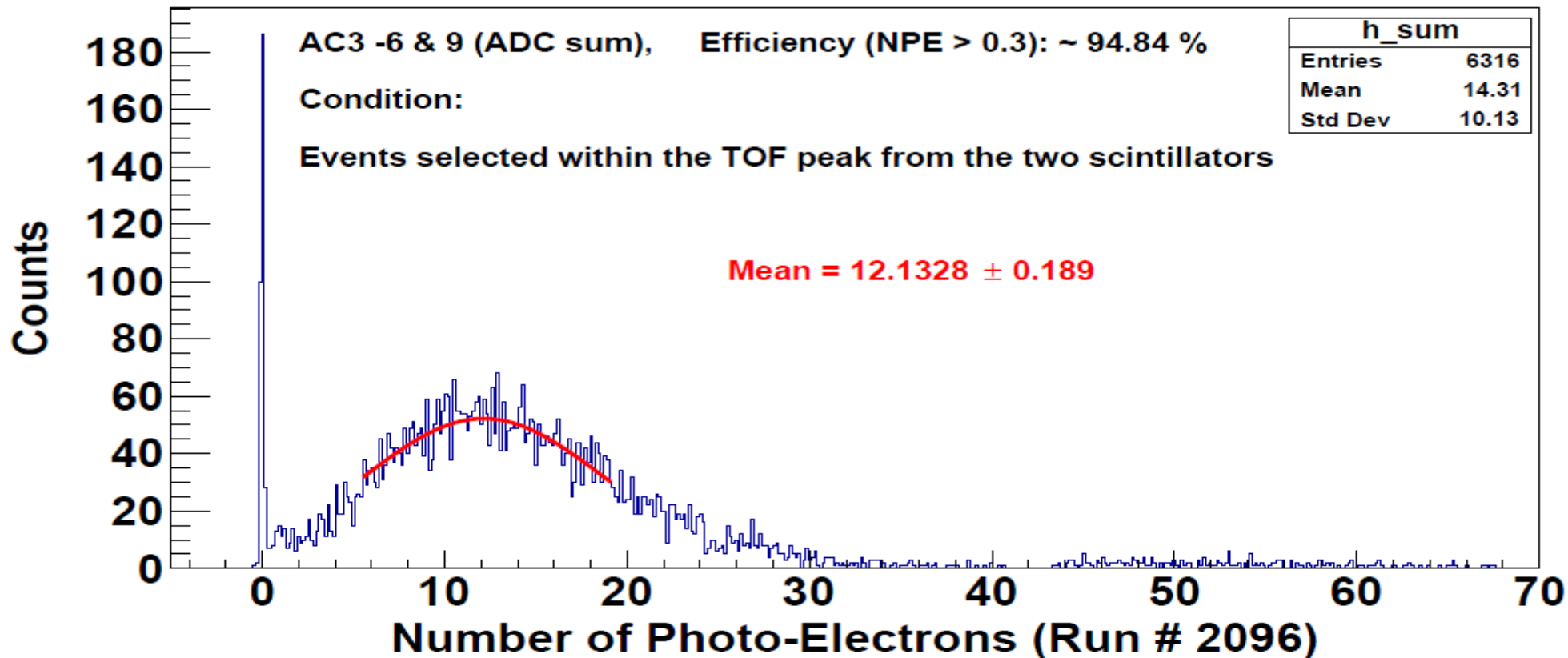
Segment # 4 (PMT #4 and 11)

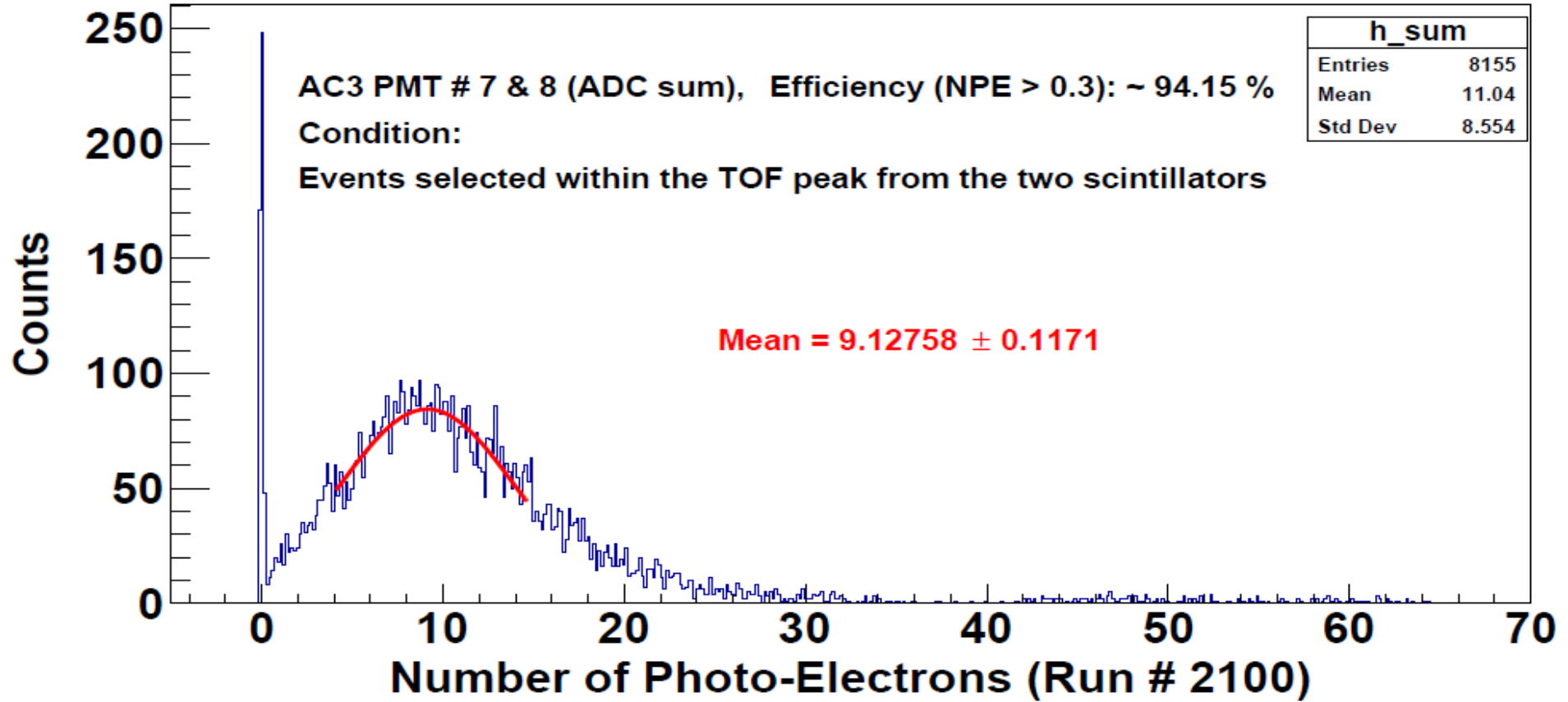


AC3 Detector

Segment # 5 (PMT #5 and 10)







Summary: AC3 Detector:

Segment No.	PMTs	Run number	NPE	Efficiency %
1	1 and 14	2101	8.77±0.12	94.13
2	2 and 13	2104	9.78±0.11	94.26
3	3 and 12	2083	11.57±0.17	94.27
4	4 and 11	2086	13.20±0.20	94.23
5	5 and 10	2089	11.57±0.16	94.95
6	6 and 9	2096	12.13±0.18	94.84
7	7 and 8	2100	9.12±0.11	94.15

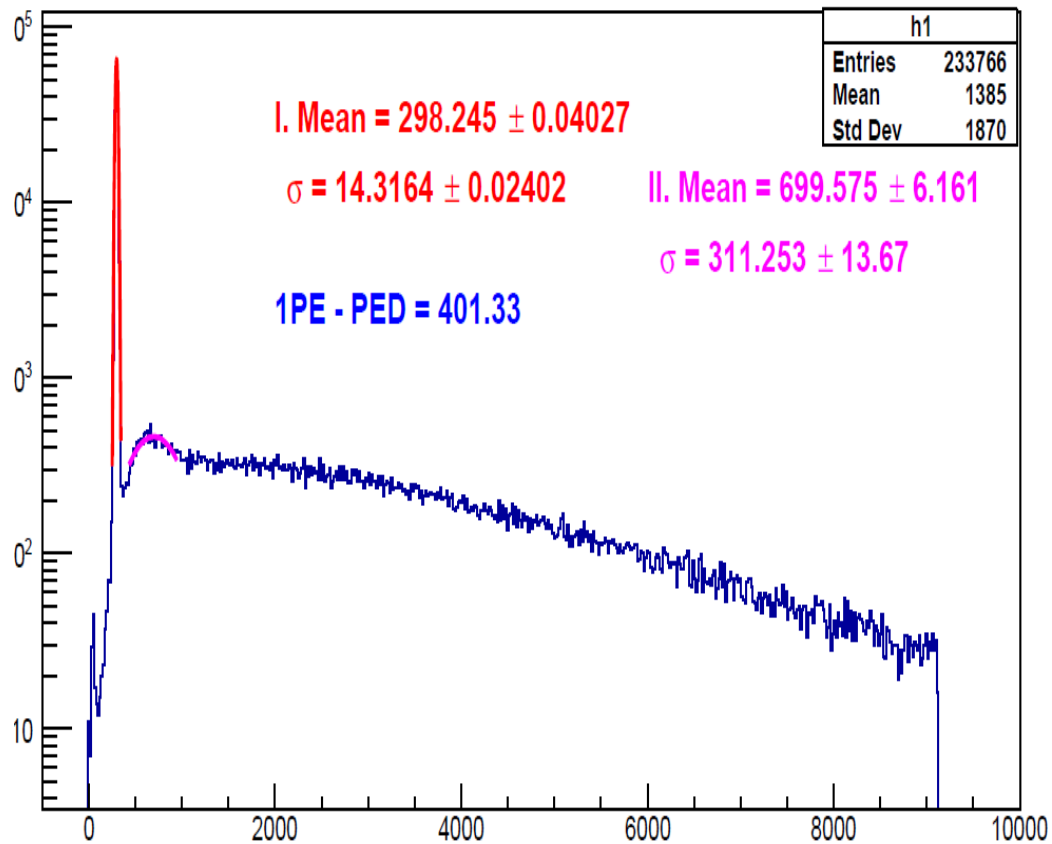
High voltage Summary: AC3 Detector

AC3 PMT #	HV (applied) Volts	HV (measured) Volts
1	1548	1550
2	1486	1488.2
3	1348	1349.6
4	1312	1314.4
5	1374	1376.6
6	1536	1538.6
7	1566	1568.2
8	1462.4	1463.8
9	1408	1409.9
10	1628	1630.2
11	1369.6	1371.6
12	1454	1455.20
13	1772.4	1774.6
14	1663	1664.8

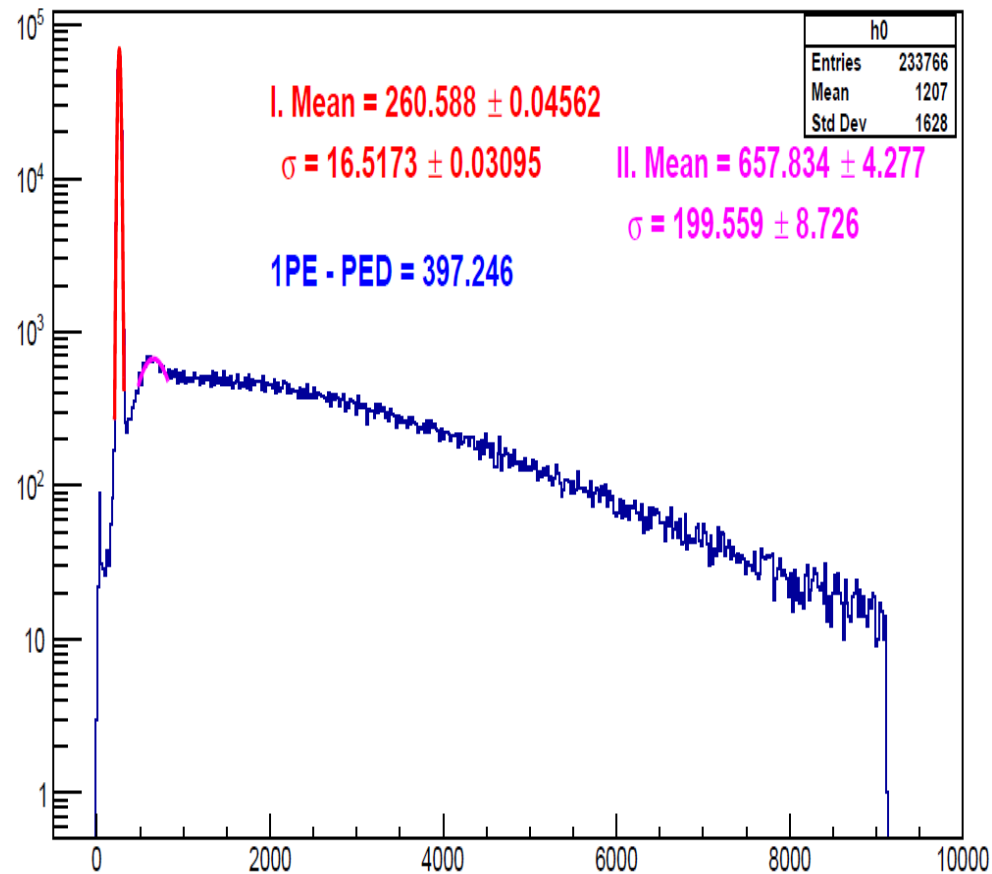
AC2 Detector

Segment # 1 (PMT #1 and 14)

D.A01 (AC2 PMT #1, CH32 HV = 1334 V), Run #2145

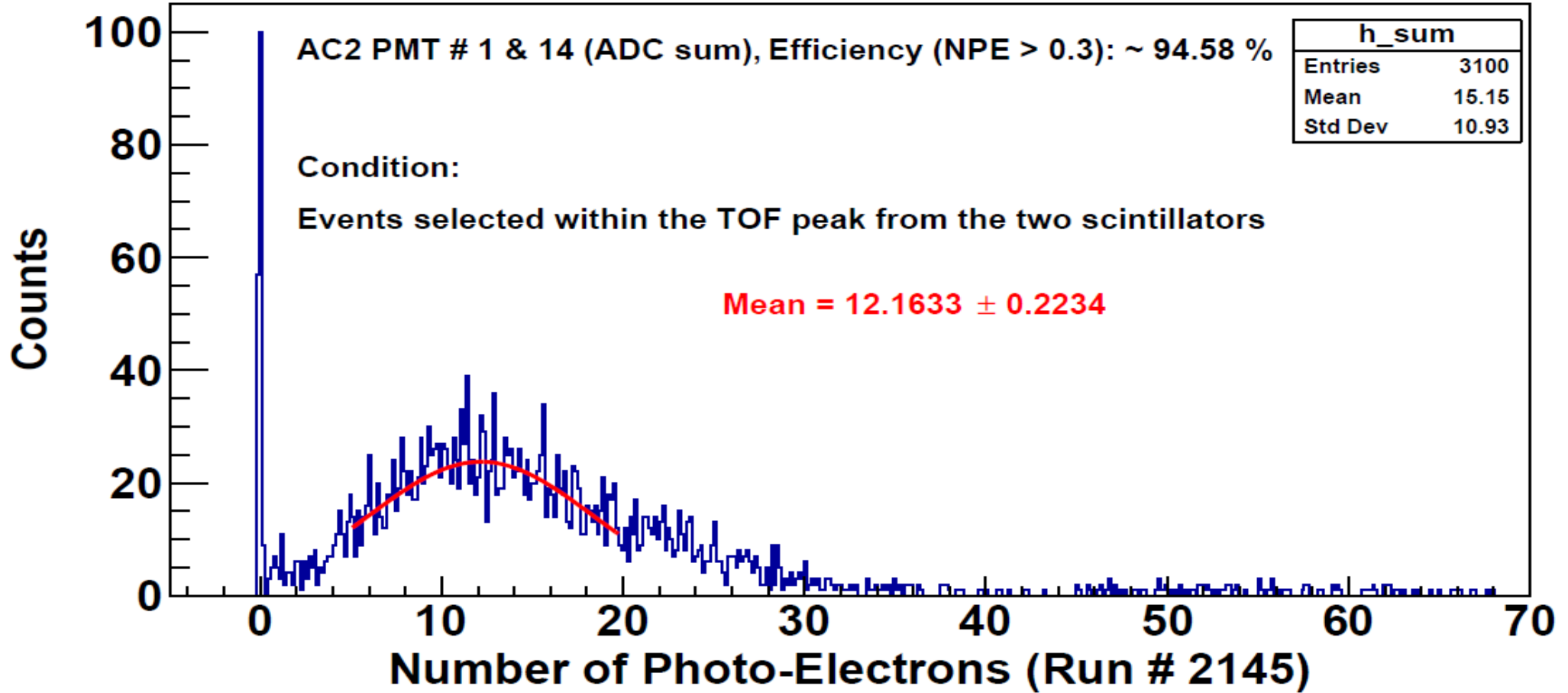


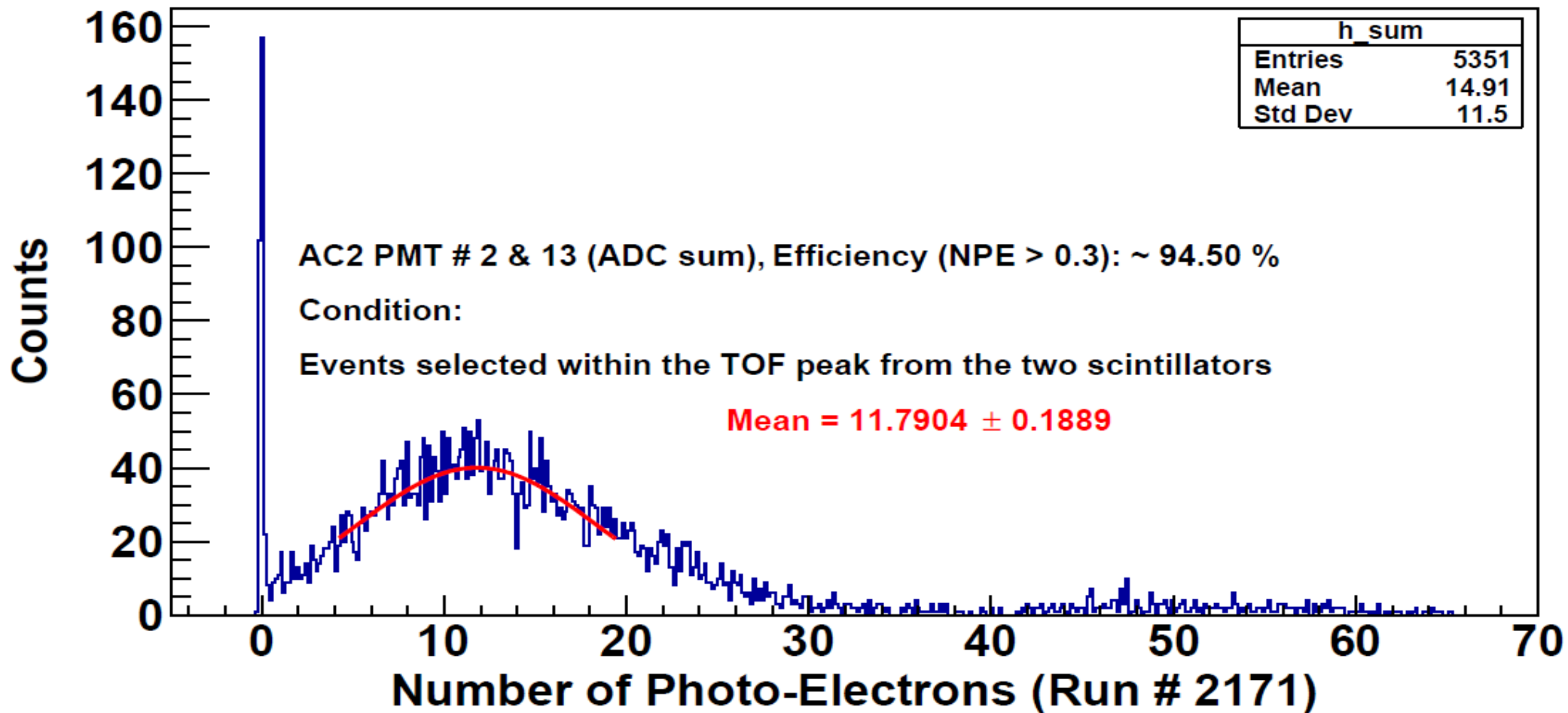
D.A00 (AC2 PMT #14, CH33 HV = 1471.6 V), Run # 2145



AC2 Detector

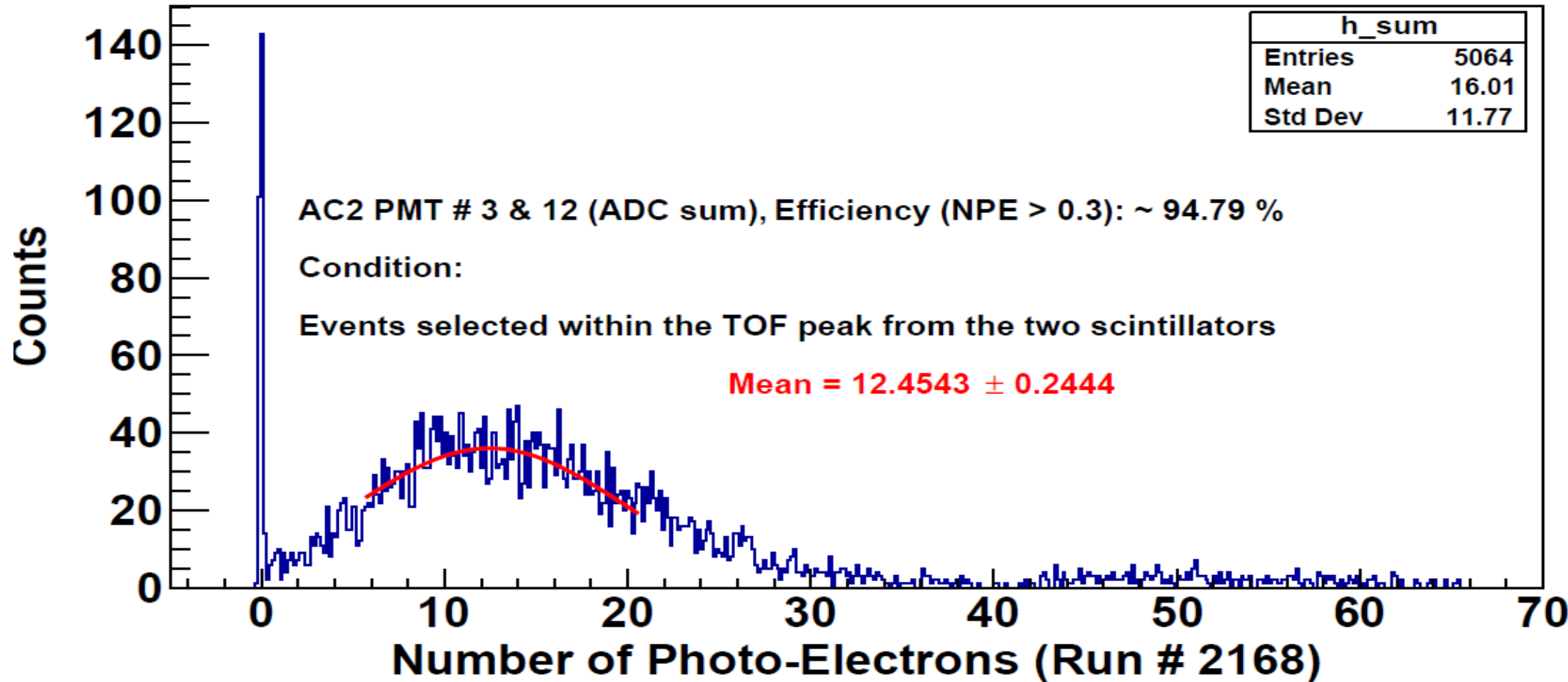
Segment # 1 (PMT #1 and 14)





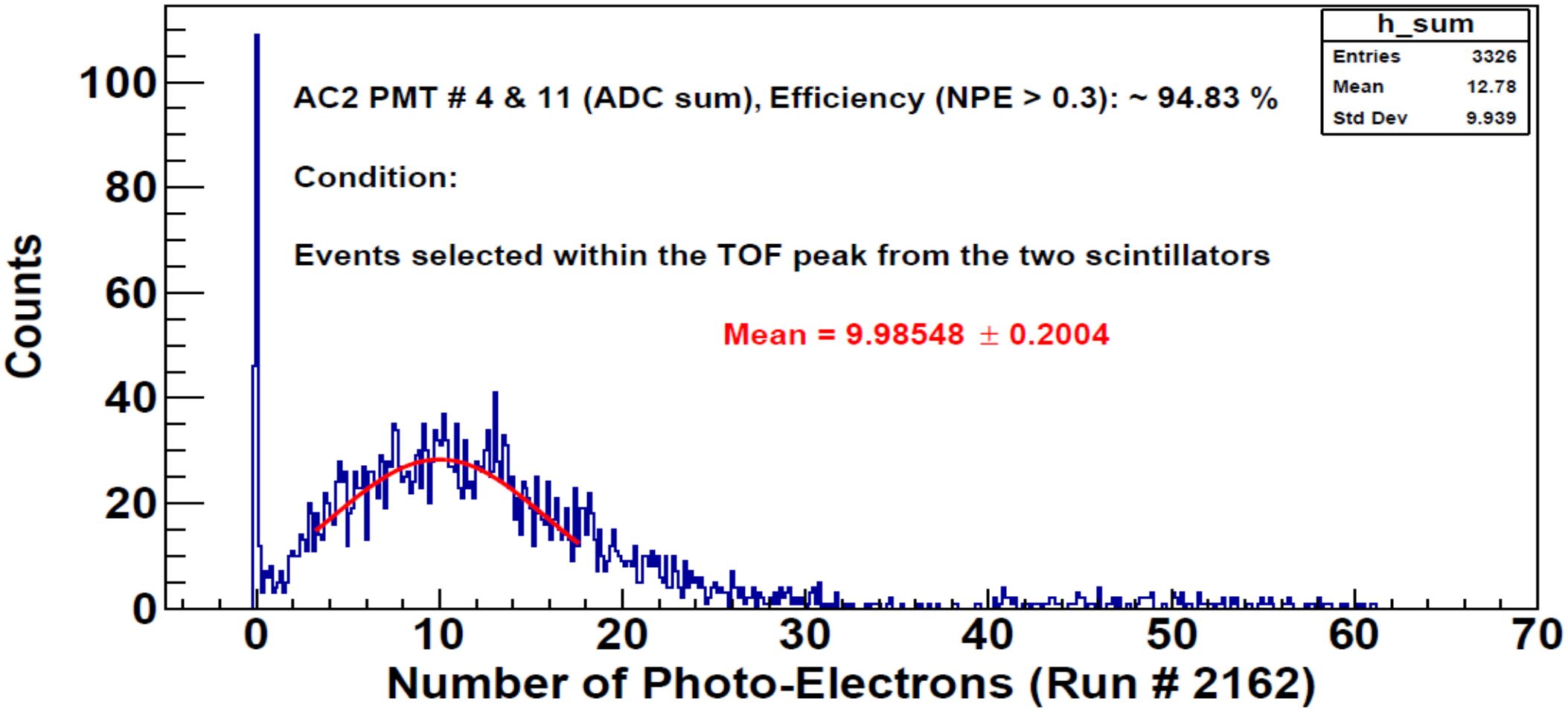
AC2 Detector

Segment # 3 (PMT #3 and 12)



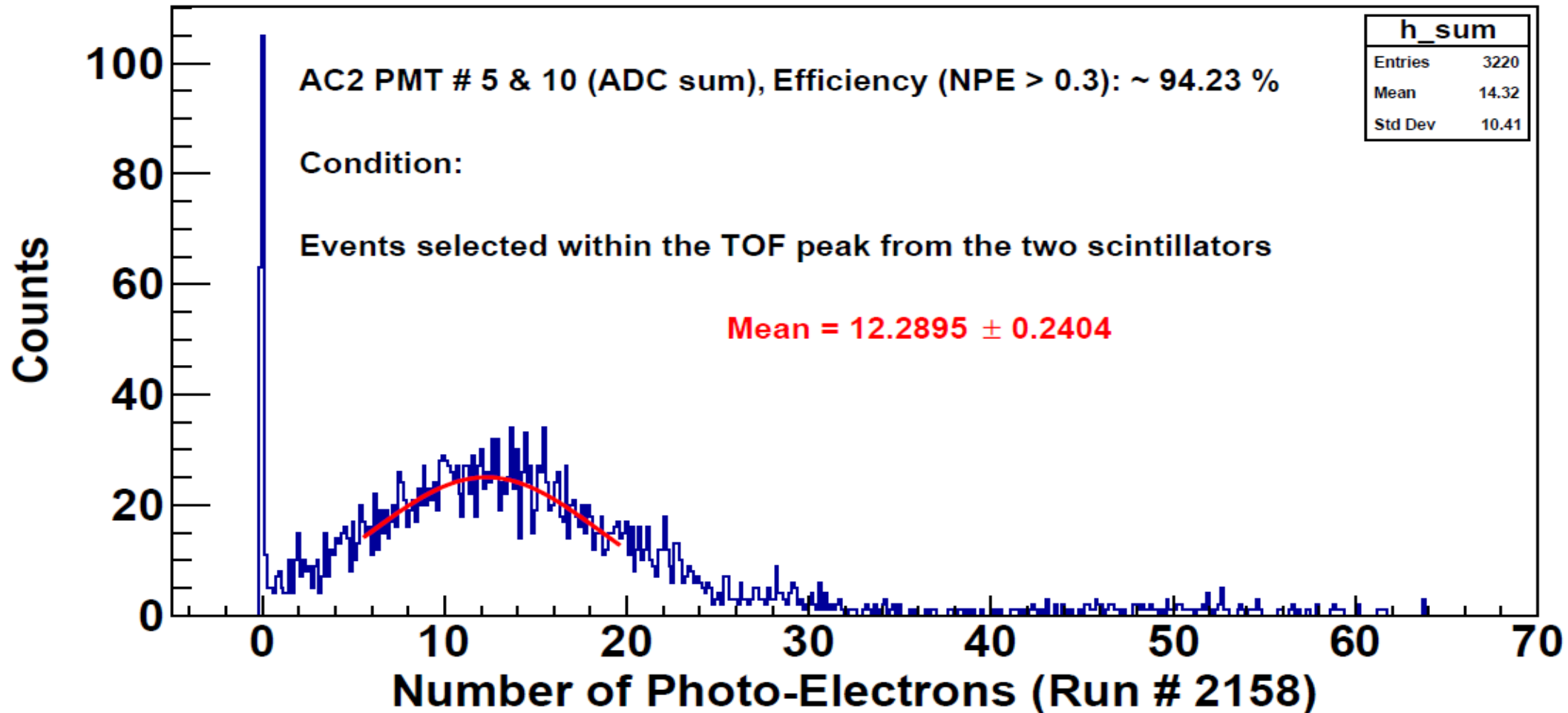
AC2 Detector

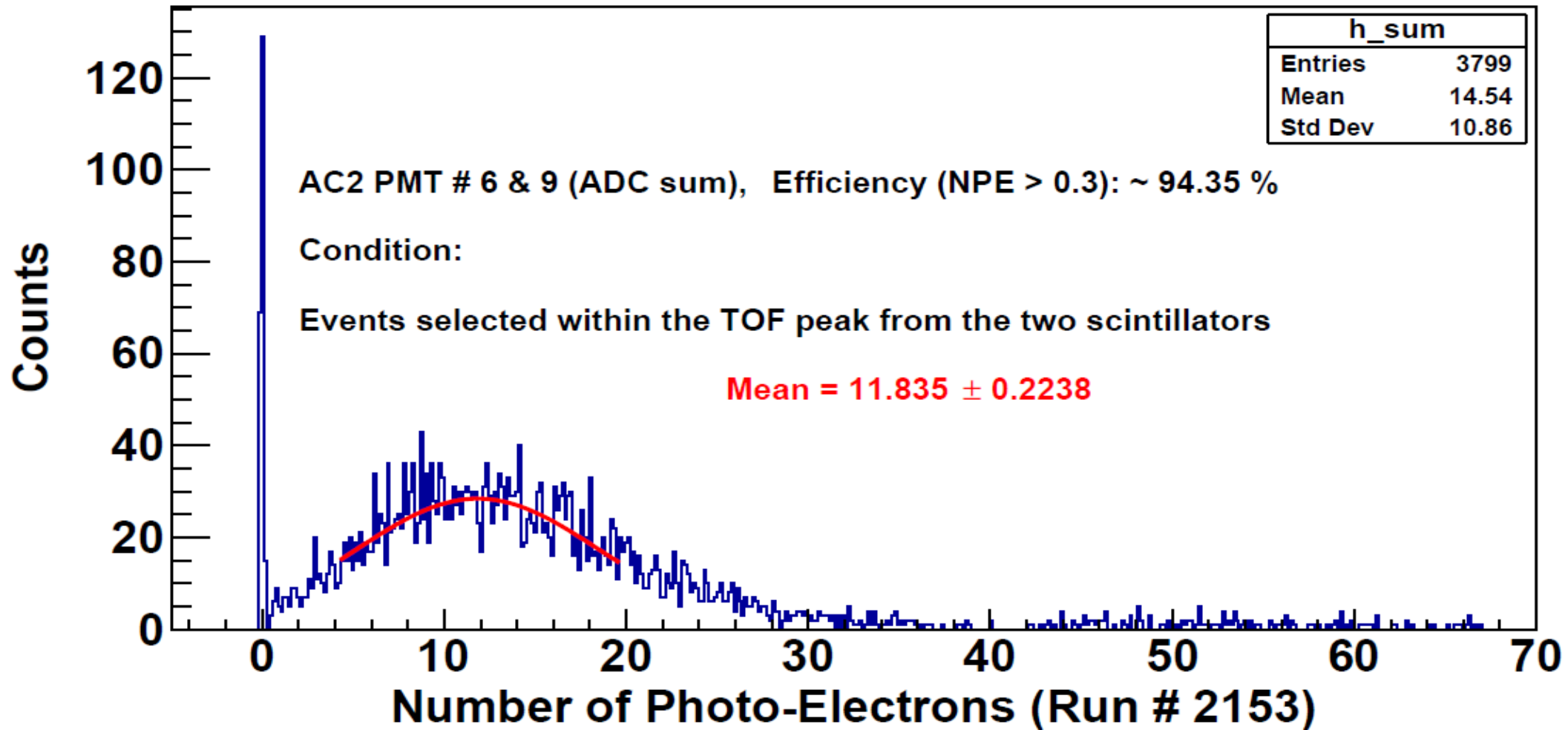
Segment # 4 (PMT #4 and 11)



AC2 Detector

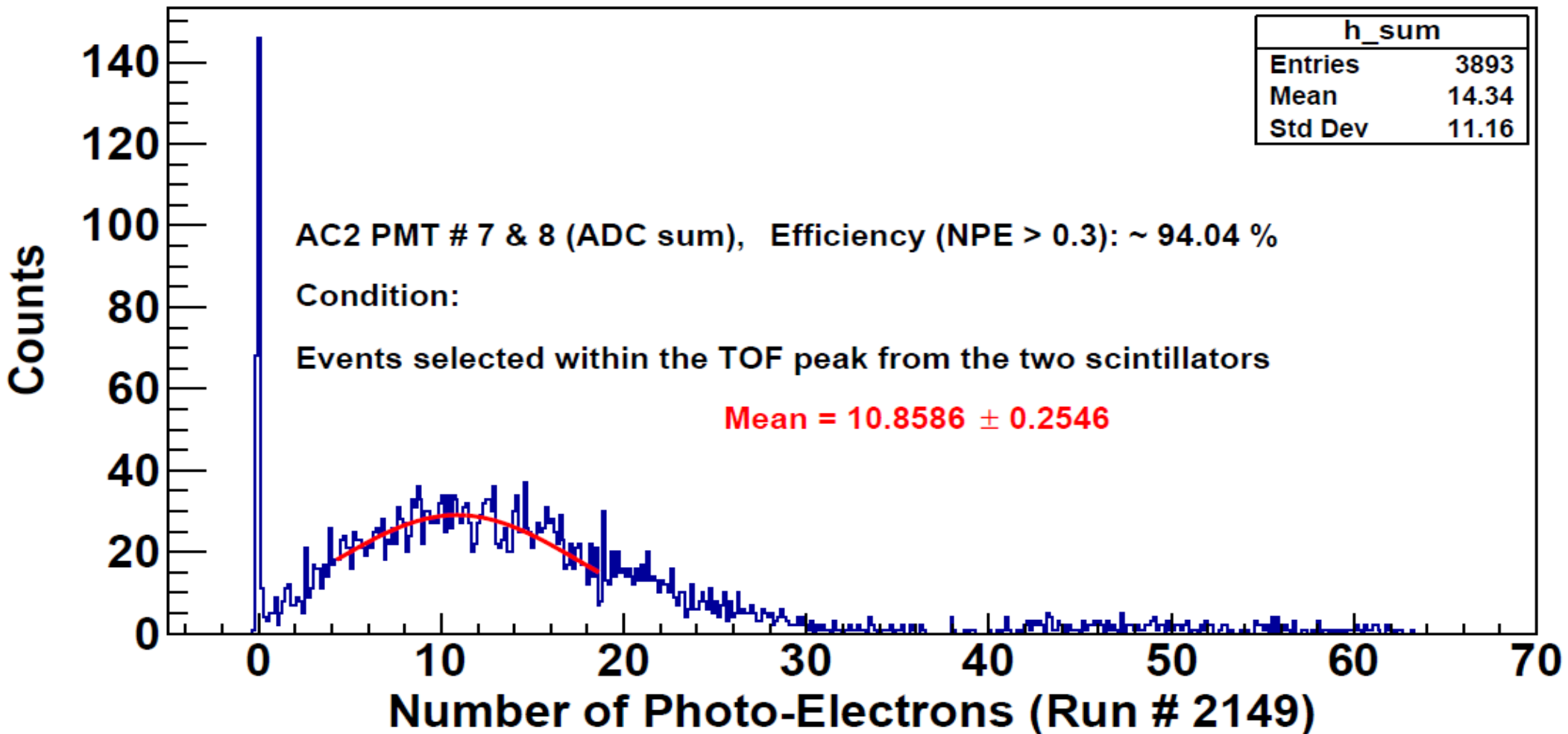
Segment # 5 (PMT #5 and 10)





AC2 Detector

Segment # 7 (PMT #7 and 8)



Summary: AC2 Aerogel Detector:

Segment No.	PMTs	Run #	NPE	Efficiency %
1	1 and 14	2145	12.16	94.58
2	2 and 13	2171	11.79	94.90
3	3 and 12	2168	12.45	94.79
4	4 and 11	2162	9.98	94.83
5	5 and 10	2158	12.28	94.23
6	6 and 9	2153	11.83	94.35
7	7 and 8	2149	10.85	94.04

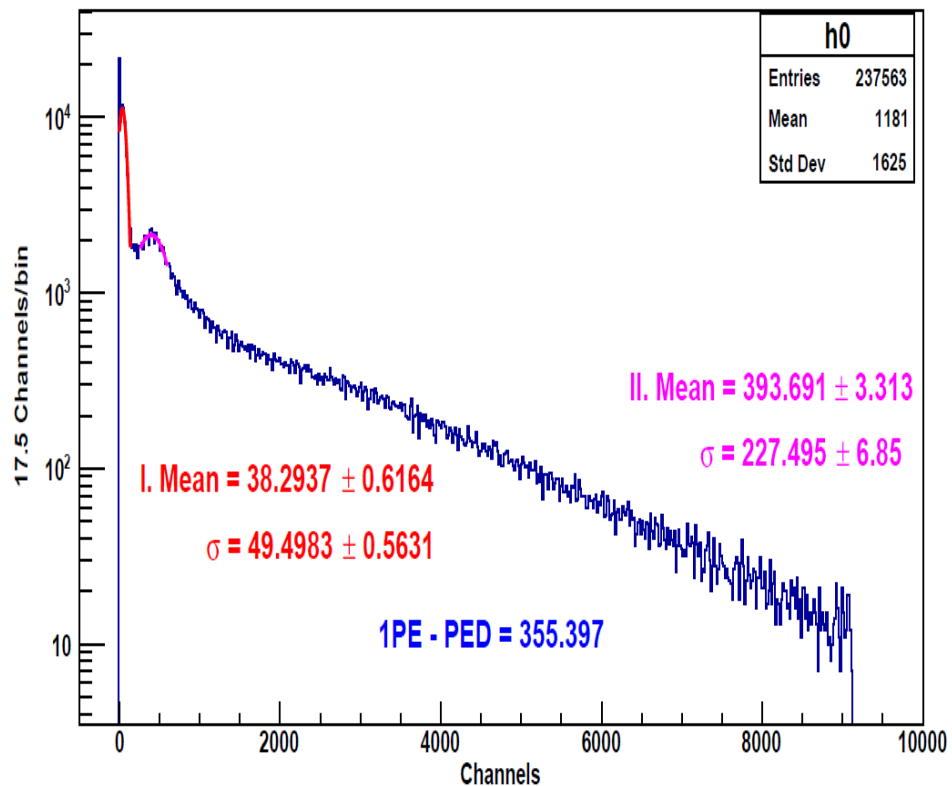
- Segment #4 has least no of NPE, can be swapped with segment #1

High Voltage Summary: AC2 Detector

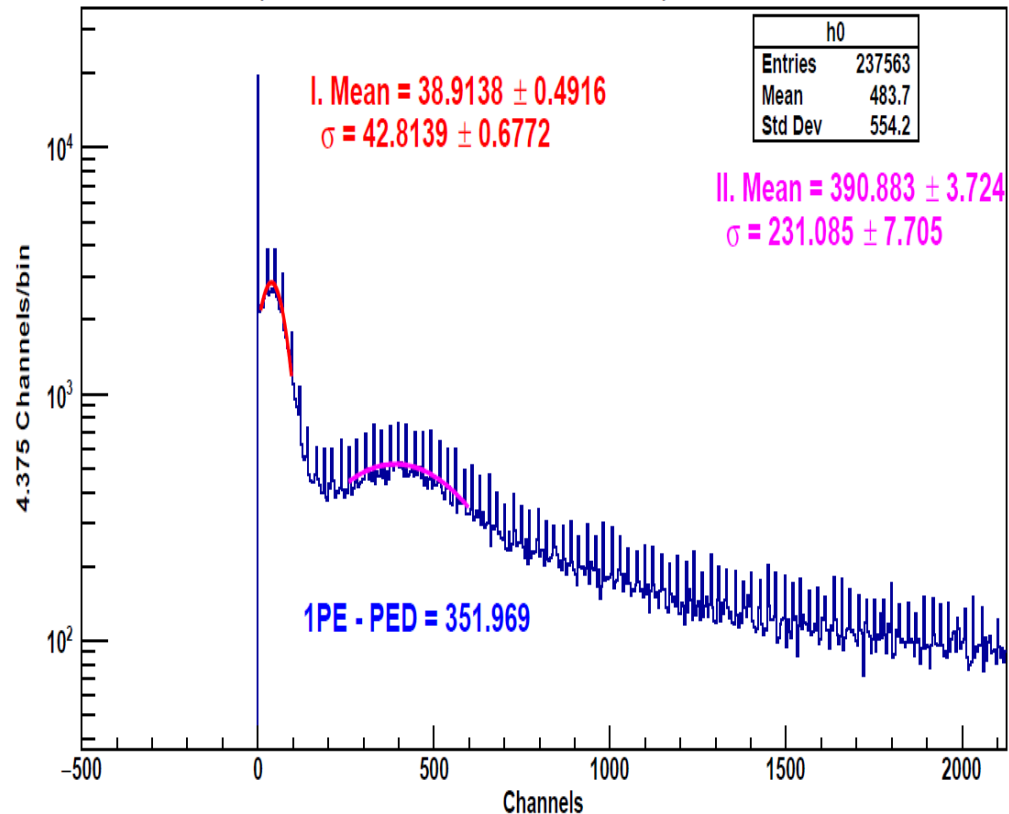
AC2 PMT #	HV (applied) Volts	HV (measured) Volts
1	1334	1335.2
2	1348	1350.4
3	1342.4	1344.2
4	1409	1410.4
5	1338	1340
6	1385	1386.2
7	1284	1285.6
8	1348	1349.6
9	1332	1333.8
10	1343.6	1345.2
11	1318.4	1320
12	1345	1346.2
13	1427	1428.8
14	1471.6	1473.0

AC1 Detector PMT #14

D.A00 (AC1 PMT #14, CH33 HV = 1510 V), Run # 2140



D.A00 (AC1 PMT #14, CH33 HV = 1510 V), Run # 2140

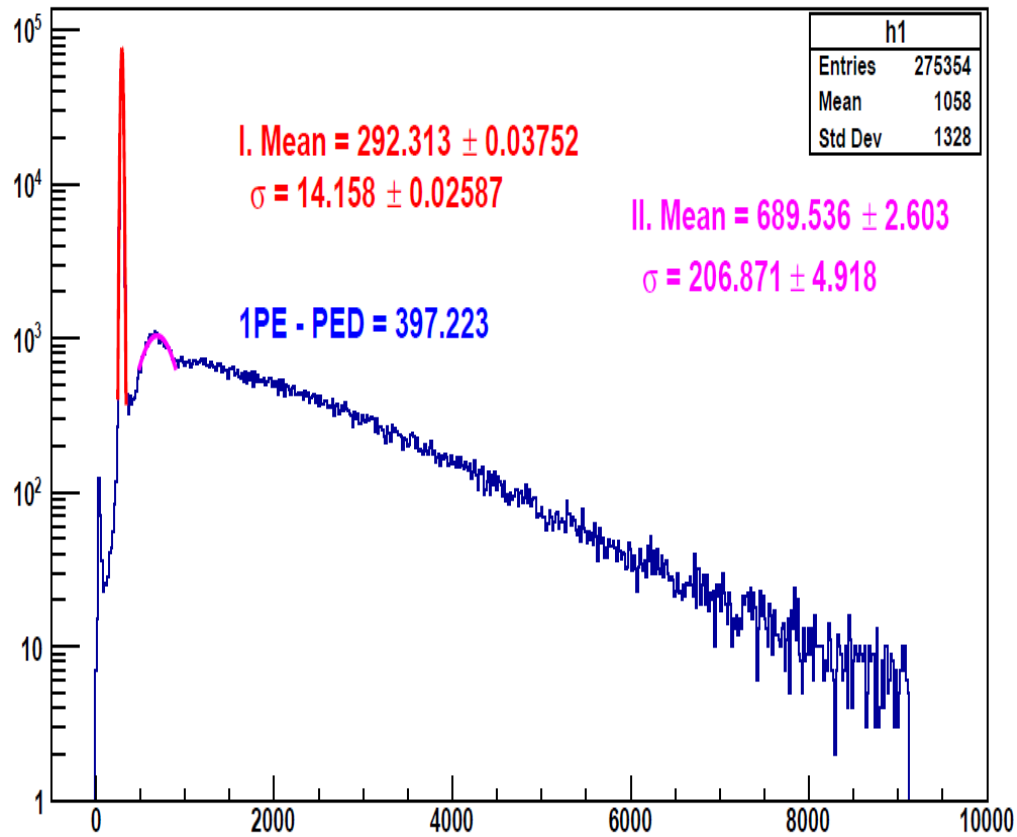


- For AC1 detector, PMT#14, light leak is observed.
- The light leak is fixed by adding extra black tape on the base of the PMT.

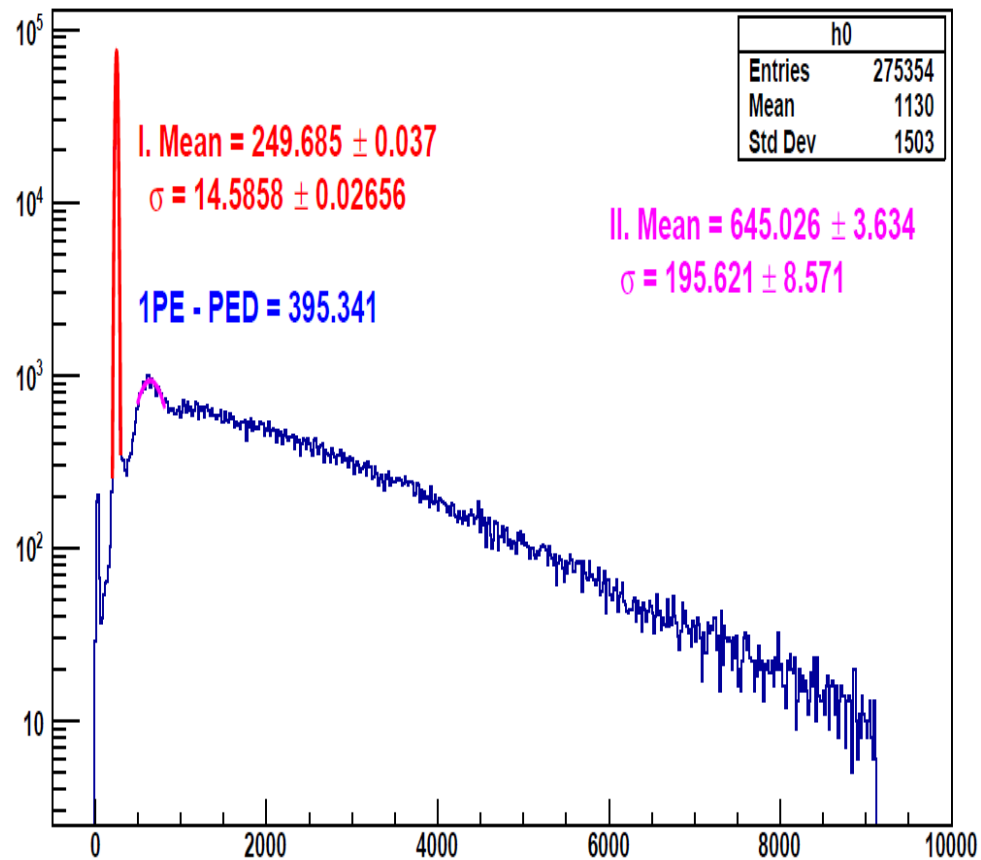
AC1 Detector

Segment # 1 (PMT #1 and 14)

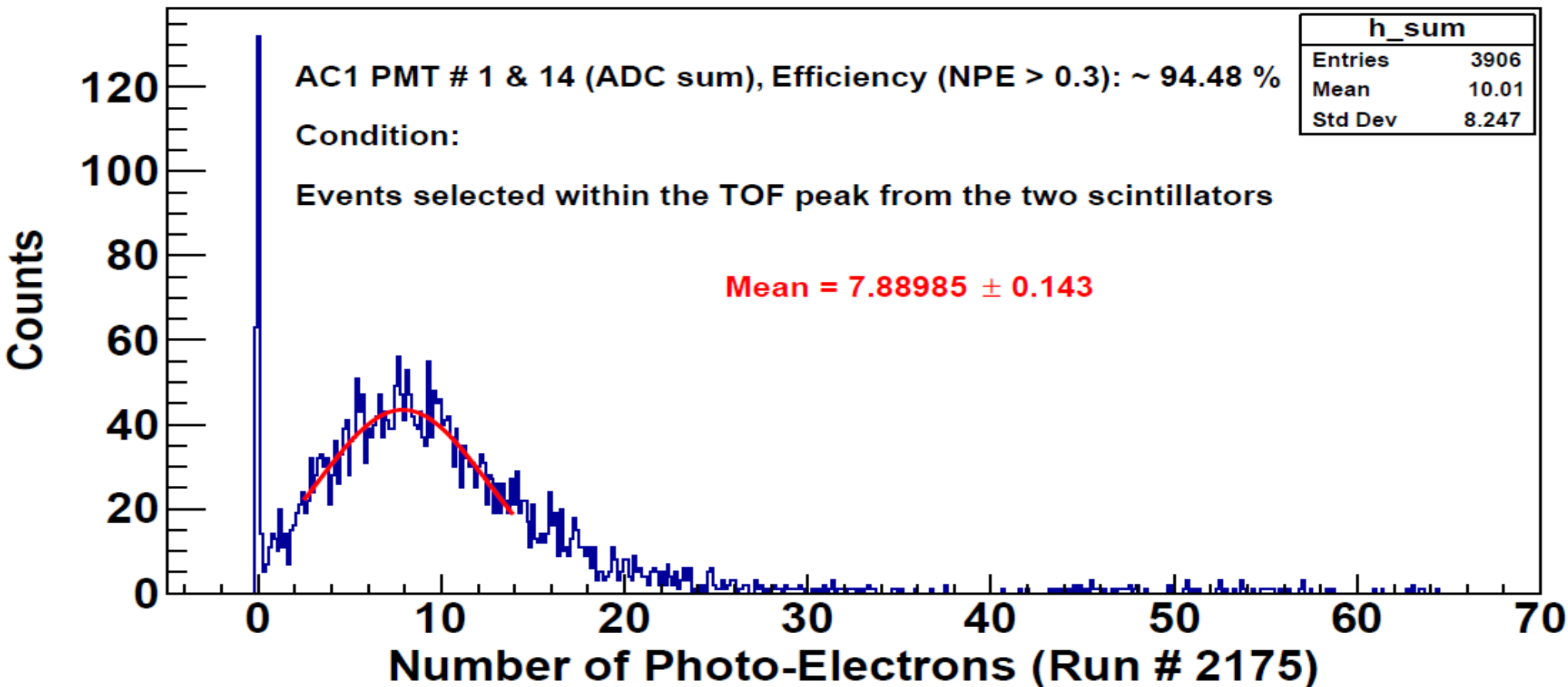
D.A01 (AC1 PMT #1, CH32 HV = 1392 V), Run # 2175

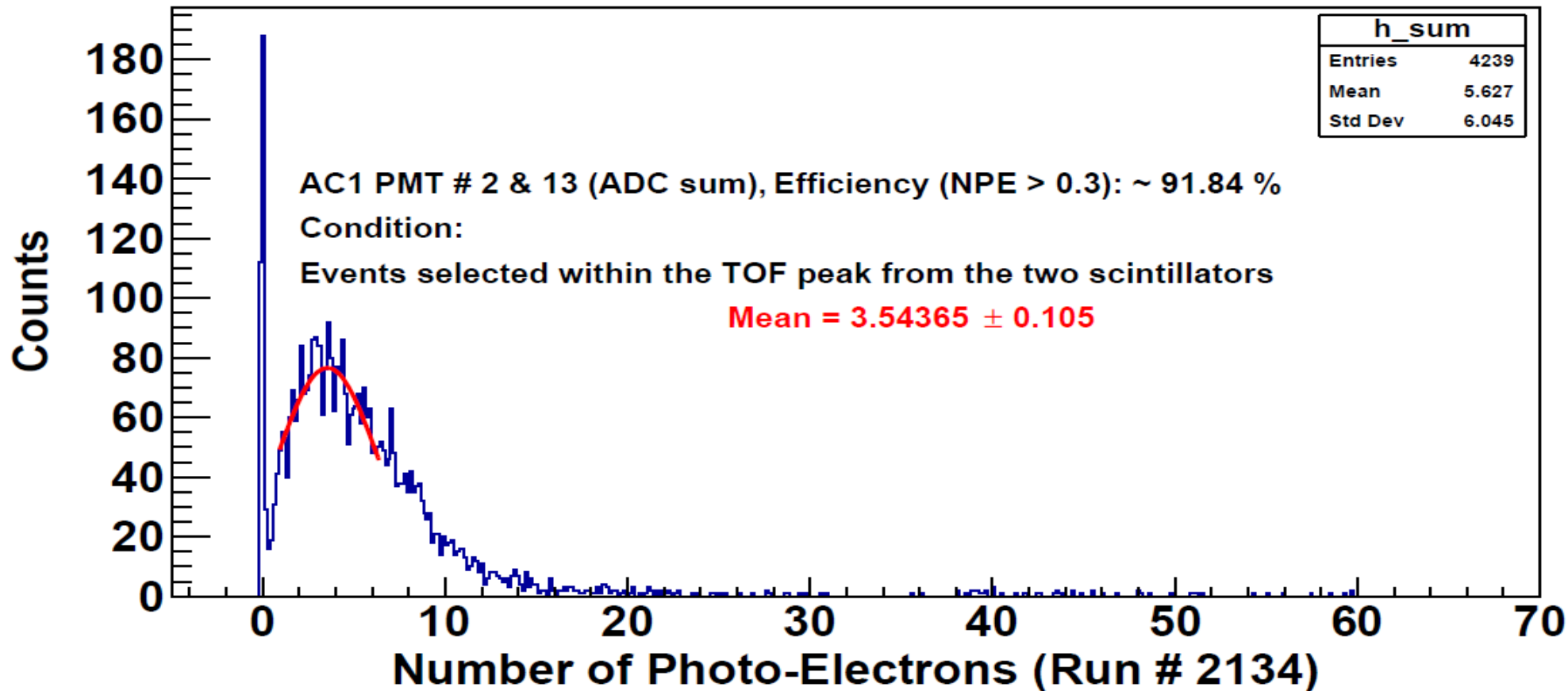


D.A00 (AC1 PMT #14, CH33 HV = 1493.4 V), Run # 2175



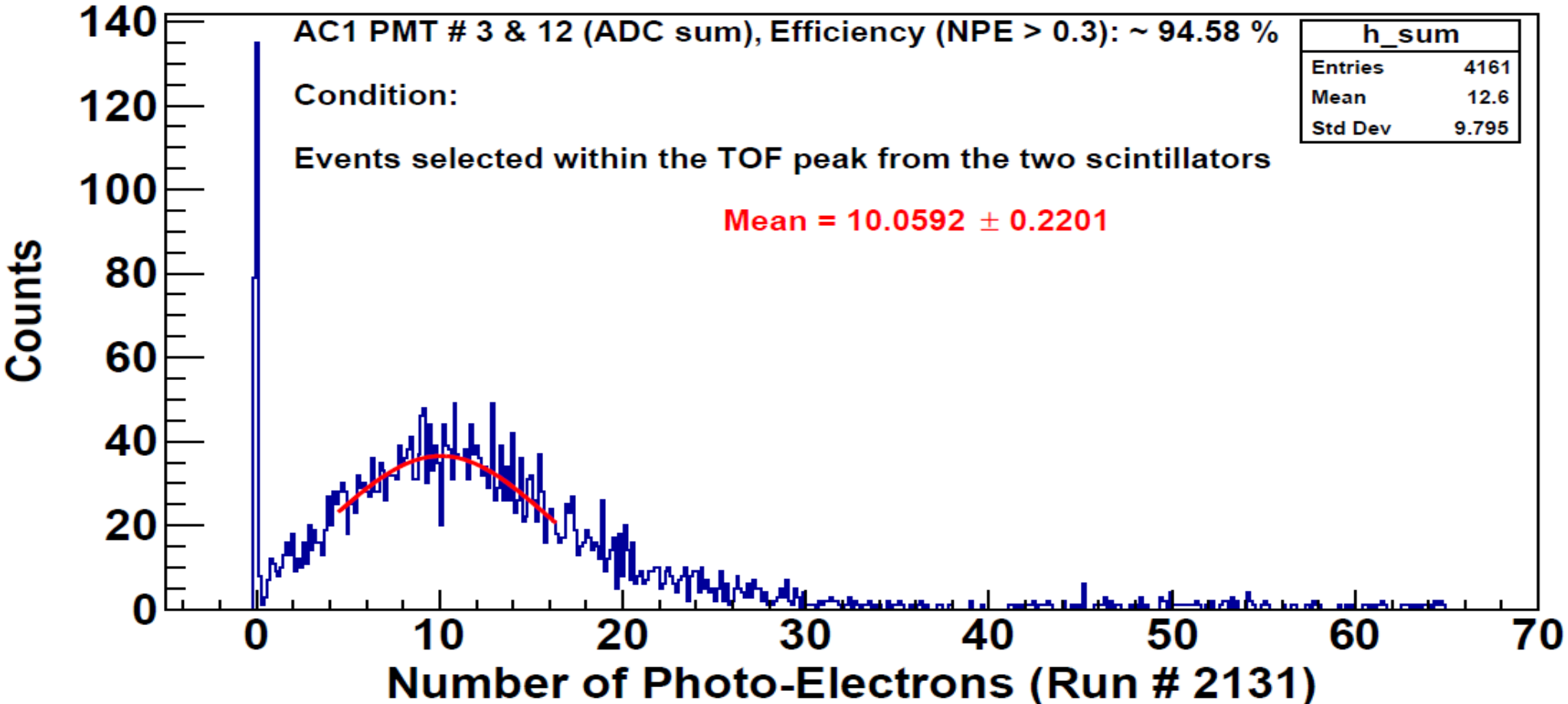
- After putting the black tape, the PMT #14 behaves normally.

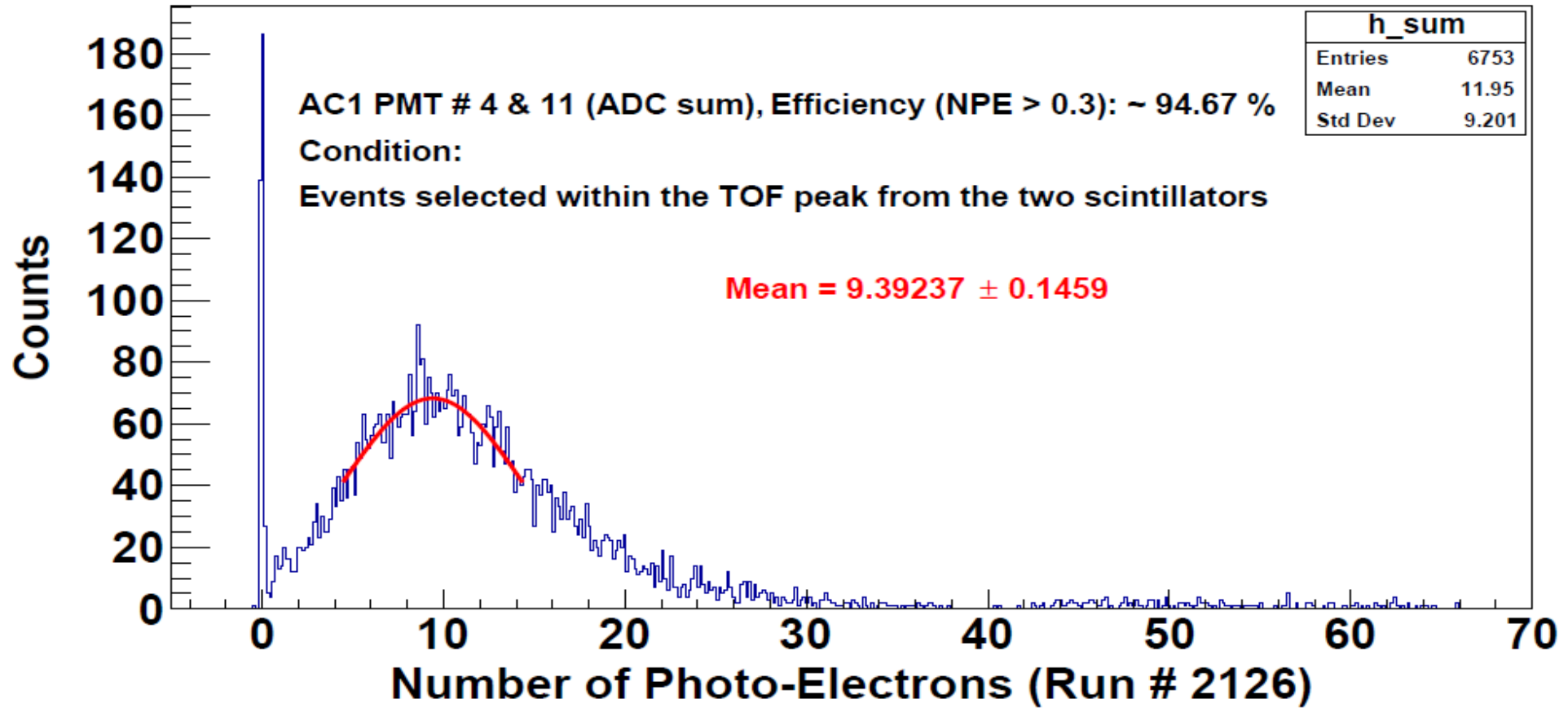




AC1 Detector

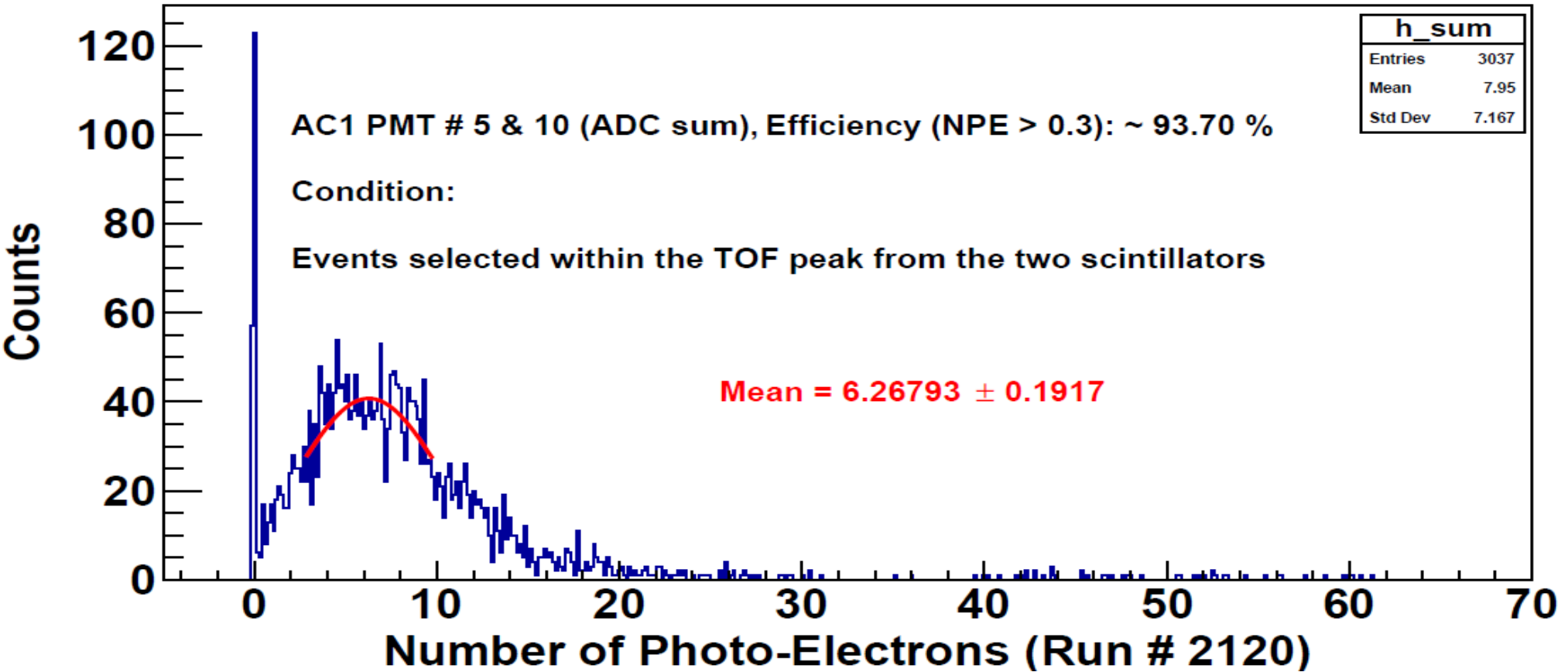
Segment # 3 (PMT #3 and 12)





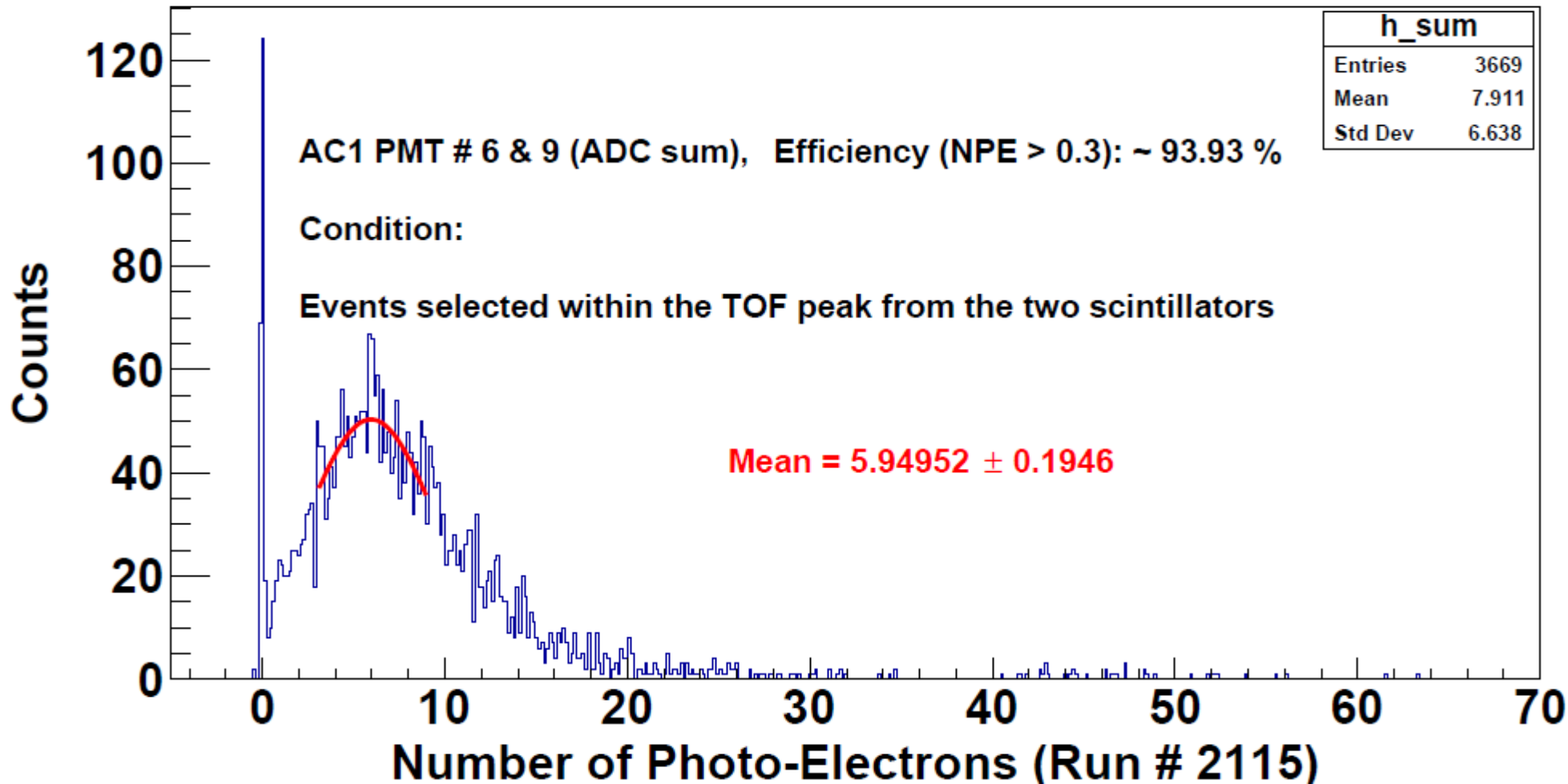
AC1 Detector

Segment # 5 (PMT #5 and 10)



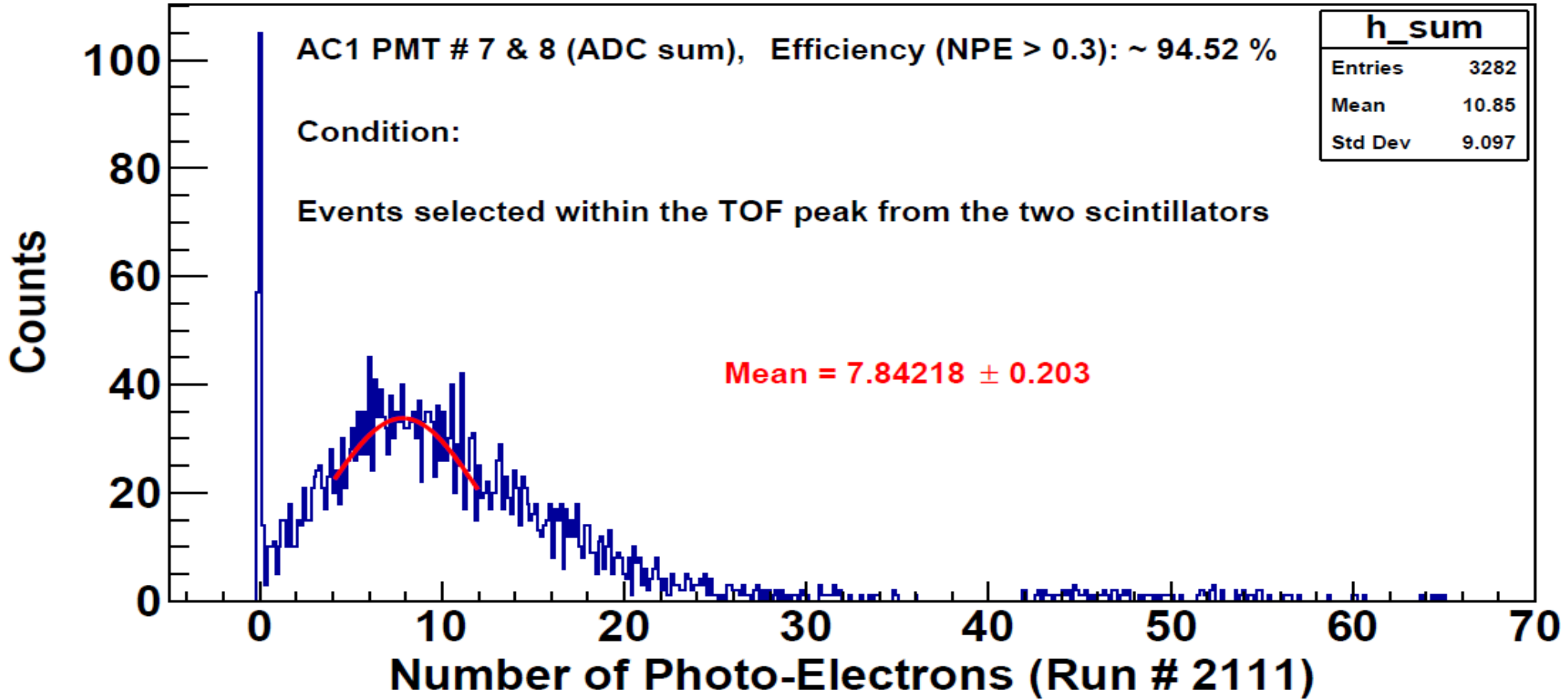
AC1 Detector

Segment # 6 (PMT #6 and 9)



AC1 Detector

Segment # 7 (PMT #7 and 8)



Summary:AC1 Detector

Segment No.	PMTs	Run number	NPE	Efficiency %
1	1 and 14	2175	7.88	94.48
2	2 and 13	2134	3.54 (least NPE)	91.84
3	3 and 12	2131	10.059	94.58
4	4 and 11	2126	9.39	94.67
5	5 and 10	2120	6.26	93.7
6	6 and 9	2115	5.94	93.93
7	7 and 8	2111	7.84	94.52

- The segment #2 has least number of NPE, can be swapped with the segment # 1.
- The segment #6 can be swapped with the segment 7.

High Voltage Summary: AC1 Detector

AC1 PMT #	HV (applied) Volts	HV (measured) Volts
1	1392	1394.4
2	1533.0	1534.8
3	1465.0	1467.0
4	1596.4	1598.0
5	1491.0	1493.4
6	1413.4	1415.2
7	1470.0	1472.4
8	1385.4	1387.2
9	1495.0	1497.0
10	1574.4	1576.6
11	1375.6	1376.8
12	1298.6	1300.0
13	1480.0	1481.0
14	1493.4	1495.4

Summary:

- All three layers of Aerogel Cherenkov has been tested during the summer of 2022.
-
- Gain for each PMT is matched at $\sim 400 \pm 5$ of ADC channel.
-
- The efficiency, NPE and corresponding HV for each PMTs are recorded.
-
- For AC1 detector, a few segments having small number of NPE's.

Thank You!

Efficiency Calculation:

No of events in the PED peak (below 0.3) = n_1

No of events above the PED (above 0.3) = n_2

Total events $n_3 = n_1 + n_2$

Efficiency = $1 - n_1/n_3$