



KL

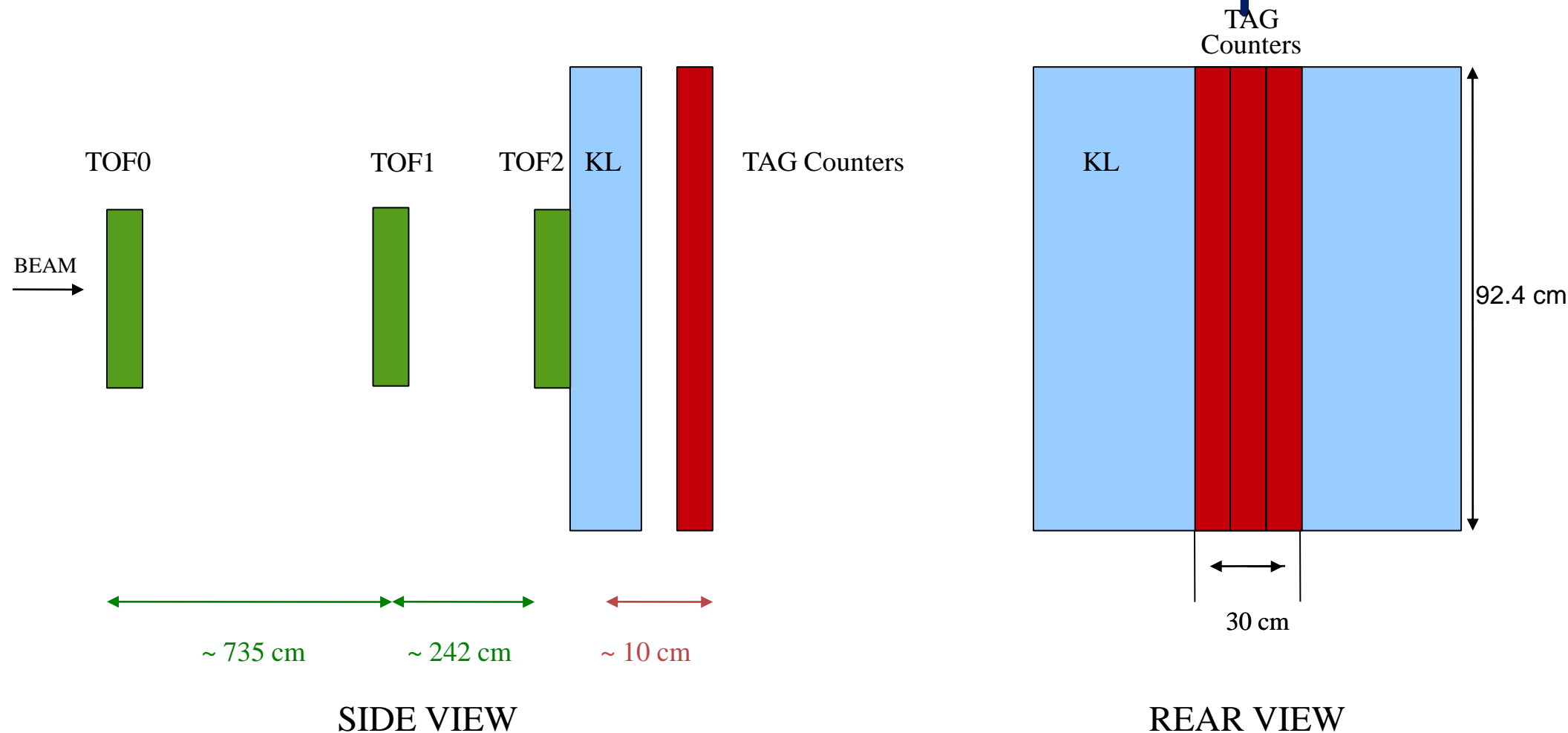
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KL remarks

- Fully operational since July 2008
- Stable work since then – no hardware failure
- Three “well” defined periods of KL running:
 - Commissioning with cosmic July 2008;
 - Sep2008 – Dec2008;
 - Dec2009 – now.
- For KL description (hardware components, HV settings, naming convention, cable configuration...) please visit <http://mice.iit.edu/mico/manuals/KL-manual-15Dec09.pdf>
- Software:
 - KLMonitor runs online (thanks Vassil)
 - KL offline software in place (not frozen, but developing)
 - KL simulation skeleton exists (but needs work)

Sketch of current setup



TAG Counters – 3 scintillator slabs, 10 cm wide each, 2.5 cm thick

Runs, Variable and Criteria

Runs Feb - May 2010

- 200 MeV/c pion: 1480
- 210 MeV/c pion: 1642, 1643, 1644, 1645
- 230 MeV/c pion: 1646, 1647, 1648, 1649, 1650, 1651, 1652
- 250 MeV/c pion: 1513, 1514
- 270 MeV/c pion: 1508, 1509
- 290 MeV/c pion: 1510, 1511, 1512
- 300 MeV/c pion: 1478
- 200 MeV/c electron: 1477, 1487
- 210 MeV/c electron: 1653, 1654, 1655, 1656, 1657
- 220 MeV/c electron: 1658, 1659, 1688, 1689, 1690
- 250 MeV/c electron: 1476, 1488
- 300 MeV/c electron: 1470
- 350 MeV/c electron: 1635, 1636, 1637, 1638, 1639, 1640, 1641
- 390 MeV/c electron: 1625, 1626, 1628, 1629
- 430 MeV/c electron: 1630, 1632, 1633, 1634

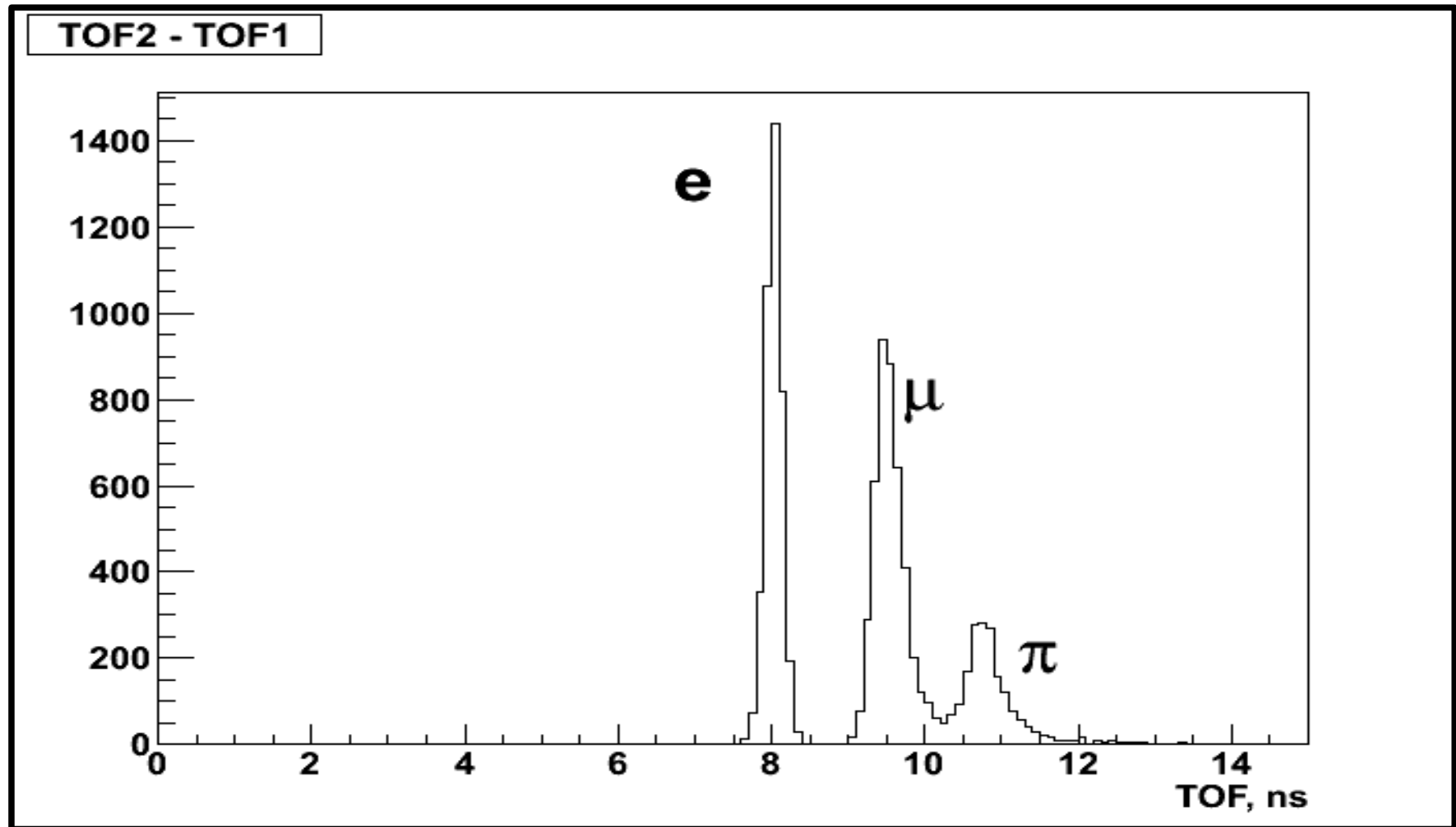
Variable: $\text{ADC Product} = 2 * (\text{ADC}_{\text{left}} * \text{ADC}_{\text{right}}) / (\text{ADC}_{\text{left}} + \text{ADC}_{\text{right}})$

Criteria:

- 1 track in TOF detector
- hit in TOF2 horizontal slabs 3, 4, 5, 6 and TOF2 vertical slabs 4, 5
- => a spot area of $24 \times 12 \text{ cm}^2$ taken into account
- selection of particle type by TOF (next page)

TOF spectra

(typical example)



Muons, pions, electrons and KL

Muons are “contamination” in “electron” and “pion” run.

Pions are “contamination” in “electron” run.

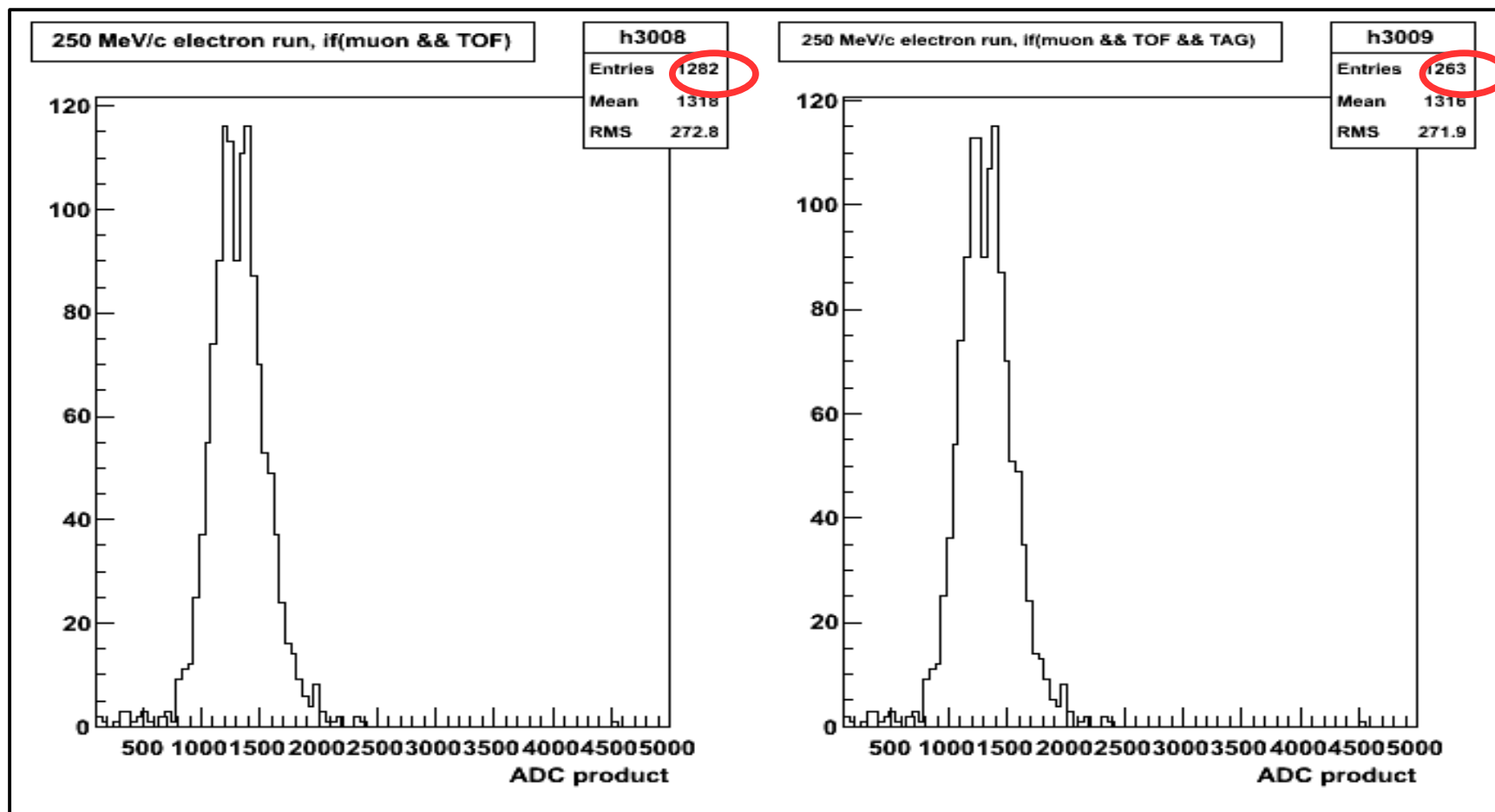
Electrons are “contamination” in “pion” run.

Problem: we don't know apriori approximate muon, electron and pion momentum at KL entrance from the beam setting in above cases because we don't know their momentum at the target.

Solution for muons and pions: estimate momentum by TOF. Then using beam line table we fit estimated momentum in the middle between TOF1 and TOF2 table momenta.

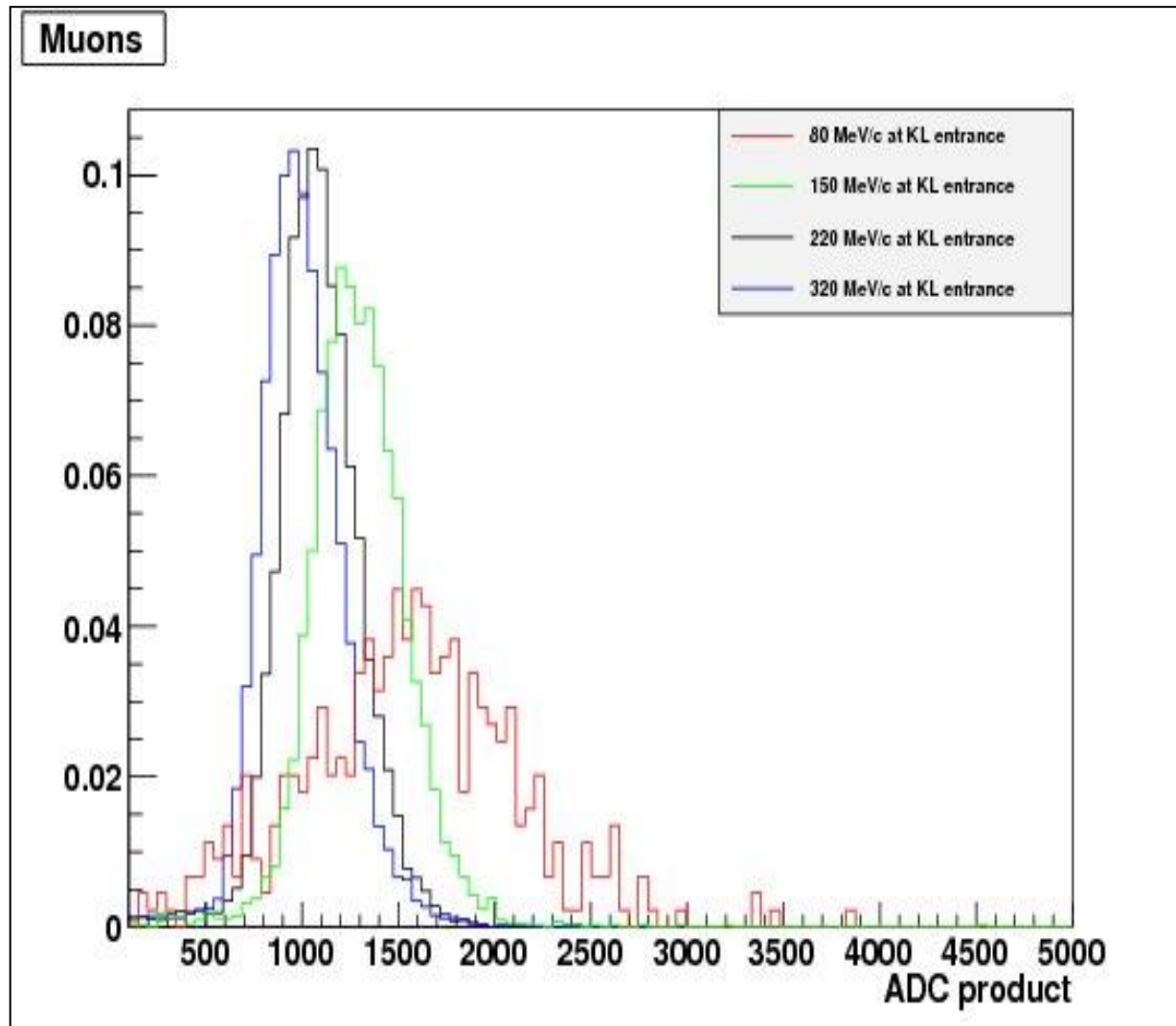
No way to calculate electron momenta from TOF. The only solution is to use “theoretical” electron momenta from beam line settings in electron runs.

Muon spectra in KL

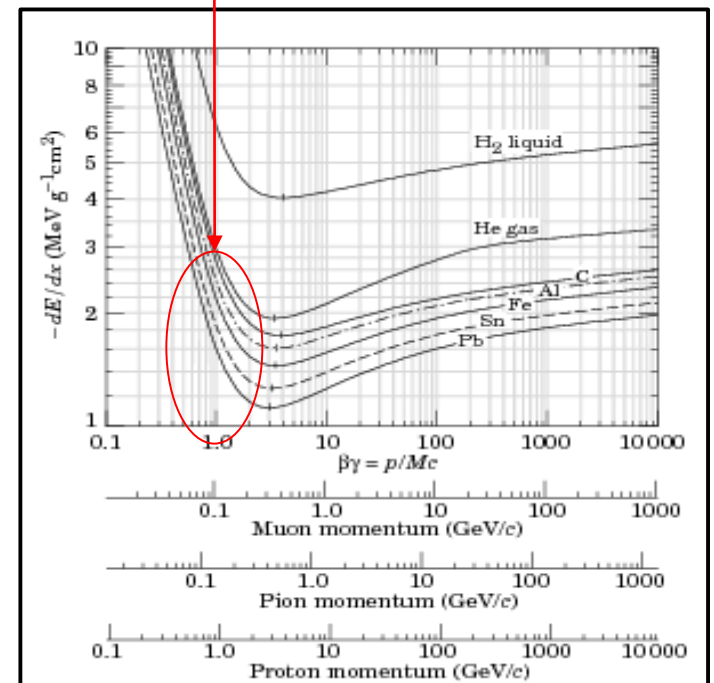


An example of electron run with momentum **250 MeV/c** at the target.
Estimated muon momentum through beam line tables at KL entrance **~ 165 MeV/c**.
Fraction of muons reached TAG counters **~ 98%**.

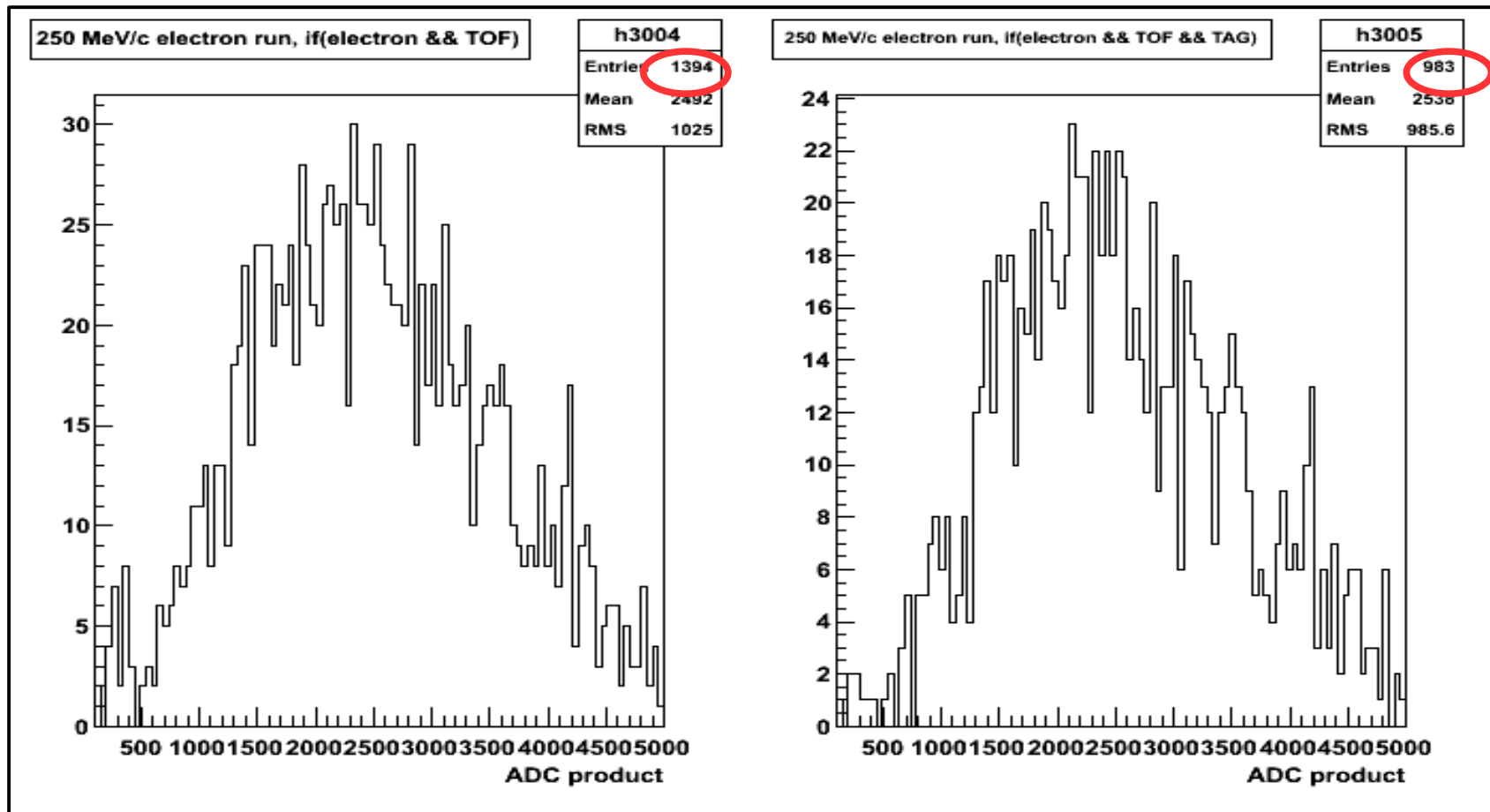
Energy response to muons



Muon dE/dx for Pb (the heaviest ingredient in KL) becomes smaller with momentum increasing. Energy deposit difference fits well with calculated momenta.

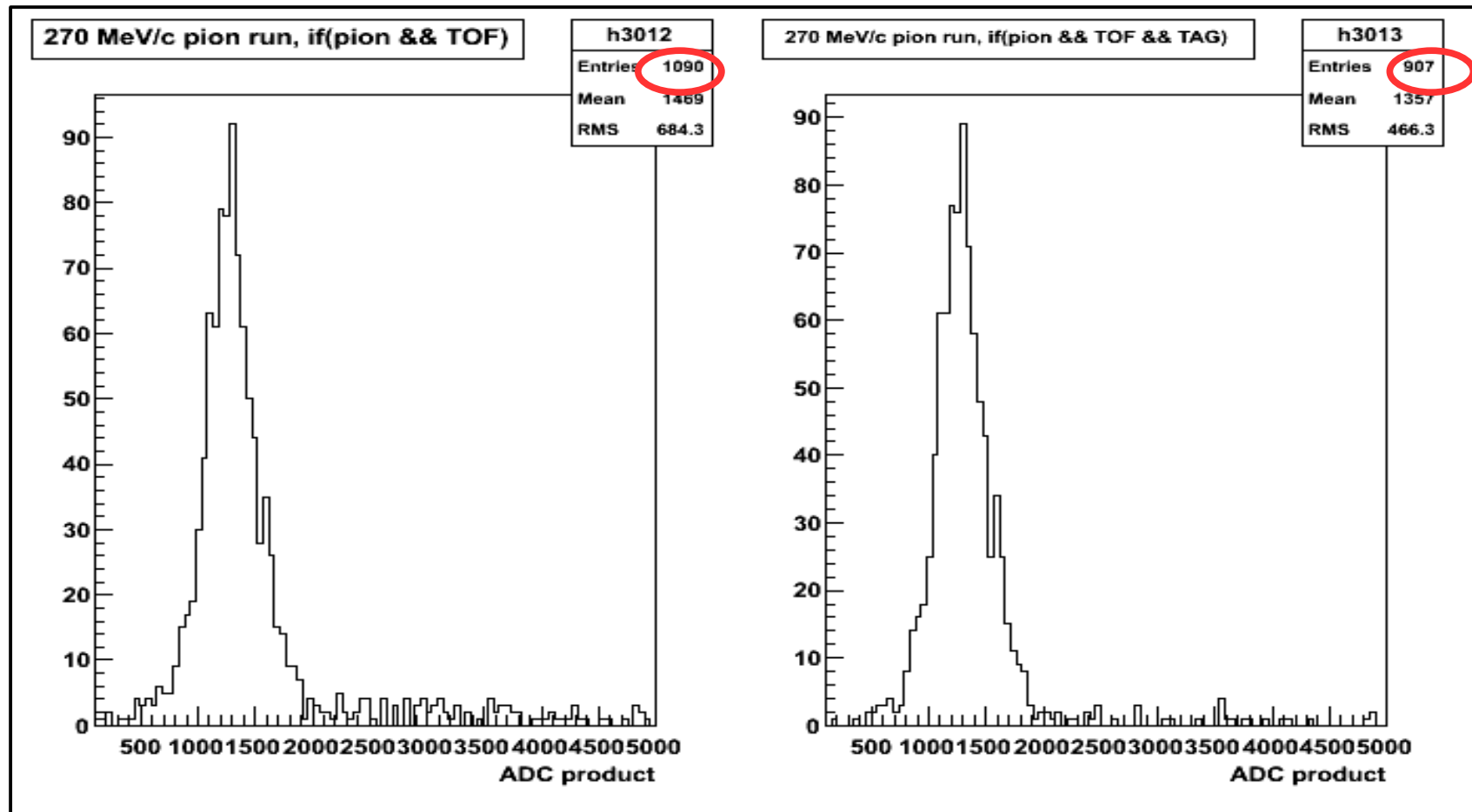


Electron spectra in KL



An example of electrons at **250 MeV/c** at the target.
Estimated electron momentum through beam line tables at KL entrance **~85 MeV/c**.
Fraction of showering electrons reached TAG counters **~70%**.

Pion spectra in KL



An example of pion with momentum **270 MeV/c** at the target.
Estimated pion momentum through beam line tables at KL entrance **~195 MeV/c**.
Fraction of pions reached TAG counters **~ 83%**.

Energy response to pions

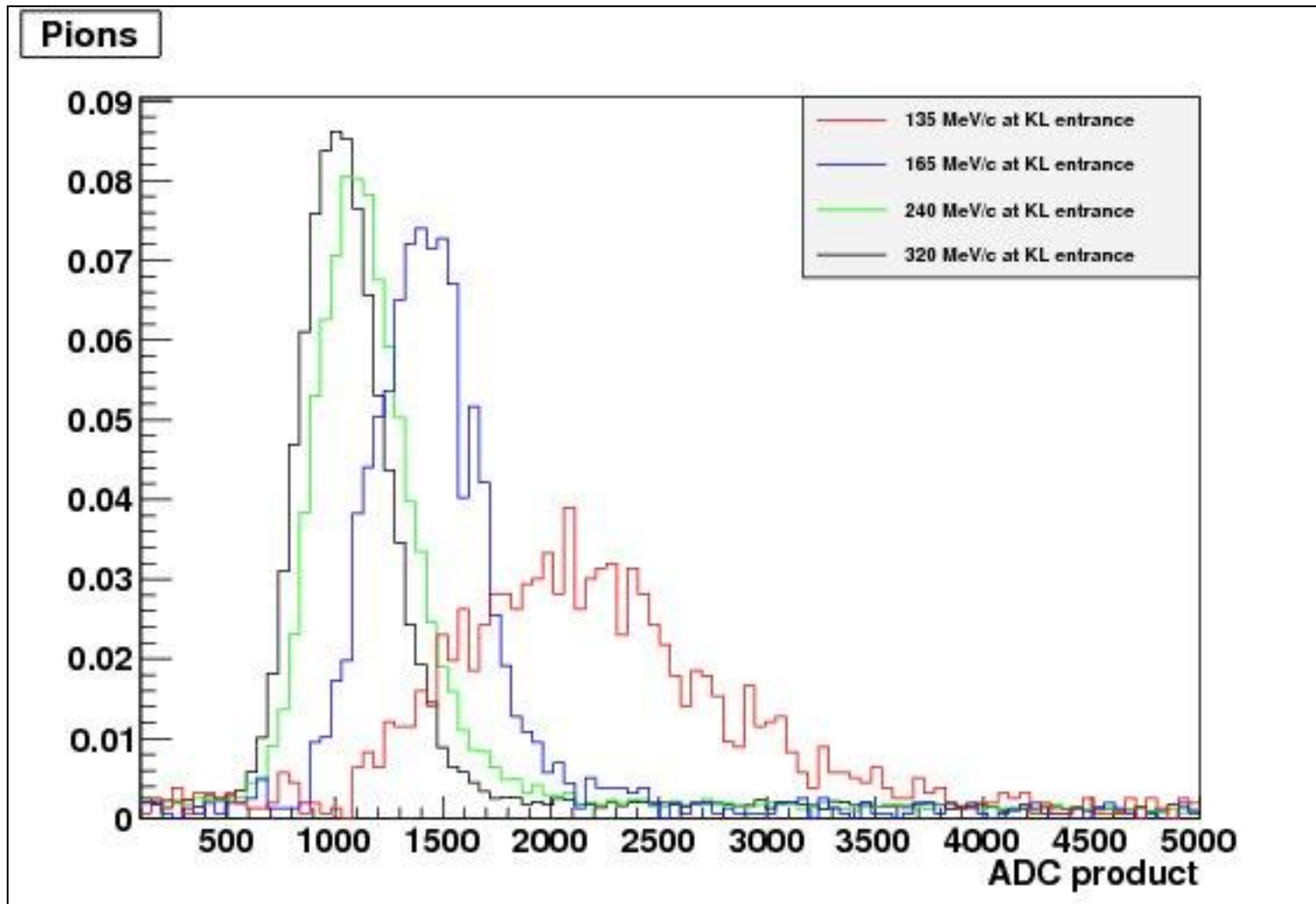
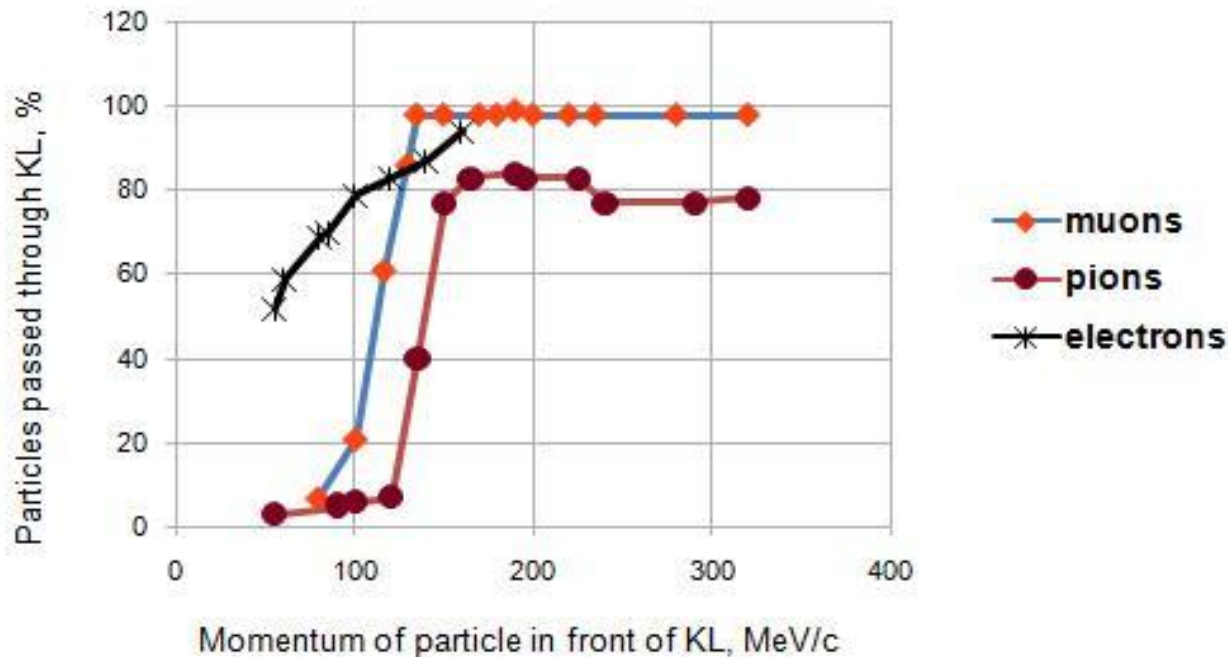


Table Data and Results

beam	electrons			muons					pions				
	P_{KL}^{in}	P_{KL}^{out}	%	TOF	P_{TOF}	P_{KL}^{in}	P_{KL}^{out}	%	TOF	P_{TOF}	P_{KL}^{in}	P_{KL}^{out}	%
200 π			67	10.0	140	130	90	86	12.0	125	100	Kill	6
210 π			66	9.7	155	135	100	98	11.2	140	120	Kill	7
230 π			72	9.3	180	170	140	98	10.4	170	150	100	77
250 π			80	9.1	195	180	150	98	10.0	185	165	125	83
270 π			78	8.9	215	200	180	98	9.5	215	195	165	83
290 π			89	8.8	230	220	195	98	9.3	240	225	195	84
300 π			86	8.8	230	220	195	98	9.3	240	225	195	81
200 e	55	Kill	52	10.9	110	80	Kill	7					
210 e	60	Kill	59	10.5	125	100	Kill	21	13.5	100	55	Kill	3
220 e	80	Kill	66	10.1	135	115	65	61	12.3	120	90	Kill	5
250 e	85	0	70	9.5	165	150	120	98	10.7	155	135	65	40
300 e	100	5	79	9.0	205	190	165	99	9.7	205	190	155	84
350 e	125	7	83	8.7	245	235	210	98	9.1	255	240	215	72
390 e	140	10	87	8.5	295	280	260	98	8.8	305	290	265	73
430 e	160	12	94	8.4	330	320	295	98	8.7	330	320	295	77

Graphics Results



- Almost all muons with $P \geq 135$ MeV/c at KL entrance will reach EMR.
- Almost all muons with $P \leq 80$ MeV/c at KL entrance will be killed in KL.
- $> 70\%$ of pions with $P \geq 150$ MeV/c will reach EMR.
- Almost all pions with $P \leq 120$ MeV/c at KL entrance will be killed in KL.
- 50-94% of electrons with $50 \leq P \leq 160$ MeV/c will reach EMR.
- There is a drop in the fraction of pions passing KL for $P > 240$ MeV/c. The reason is unknown, only known is that there is ~ 2 months difference between data taking

Conclusions

- ❖ KL is operational, stable from hardware and electronic point of view
- ❖ Software for reading, processing and analysing data is available
- ❖ Series of pion and electron runs with momenta between 200 MeV/c and 430 MeV/c are explored using data of TOF1-2, KL and TAG counters.
 - Results for electrons confirm BTF data from 2006 test:
 - 50% of 50 MeV/c
 - 94% of 160 MeV/crelease some energy in TAG counter.
 - Results for muons
 - Muons with $P \geq 135$ MeV/c at KL entrance will reach EMR.
 - Muons with $P \leq 80$ MeV/c at KL entrance will be killed in KL.
 - Results for pions:
 - >70% of pions with $P \geq 150$ MeV/c will reach EMR.
 - Pions with $P \leq 120$ MeV/c at KL entrance will be killed in KL.
- ❖ Still to come:
 - PID algorithm
 - attempt to extract time info from fADC
 - developing Monte Carlo simulation