Update on H2 TB2007 data analysis

Outline

- Beam cleaning conditions
- Particle Identification
  - Pion / Proton+Kaon
  - Pion / Proton / Kaon
- Time of Flight calibration
- Verification of particle identities with Fit
- Fraction of pi / pr/ k in beam
- Conclusion and Outlook

CaloTaskForce Meeting , October 3, 2008

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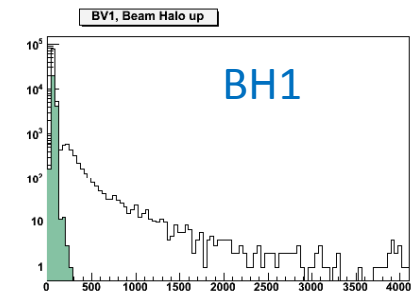
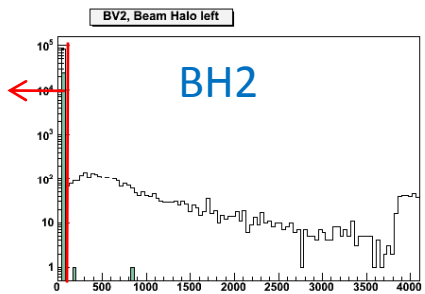
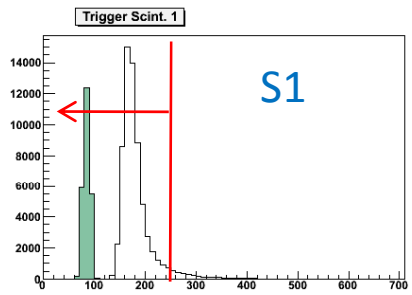
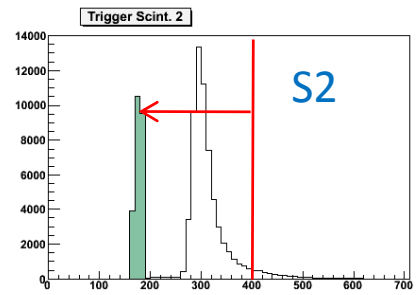
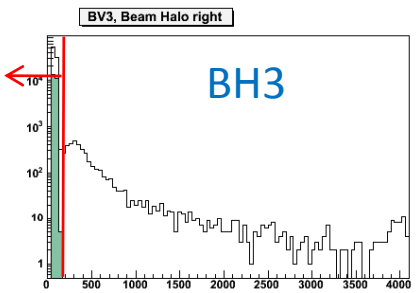
Various beam cleanings used for Particle Id

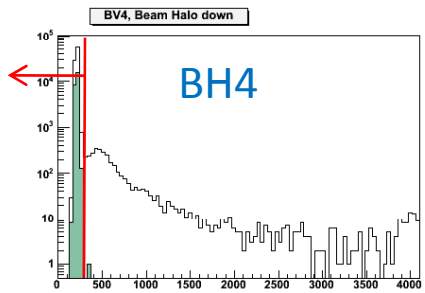


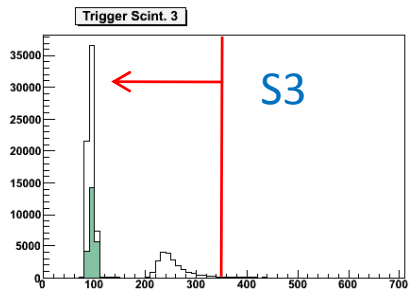


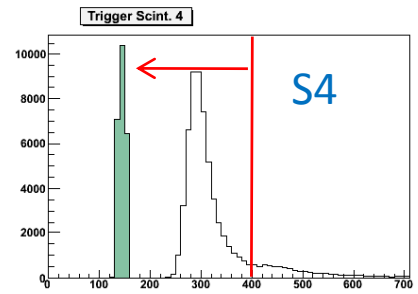












Definitions used :

tagged : if(S1>250 || S2>400 || S3>350 || S4>400 || BH2>80 || BH3>120 || BH4>280)

muon : if((! tagged) AND (VMB>400 || VMF>400))

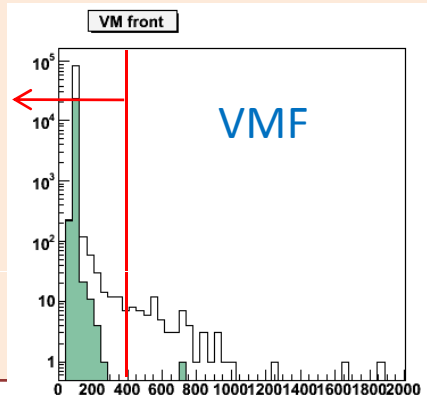
electron: if((! tagged) AND (! muon) AND CK2>100)

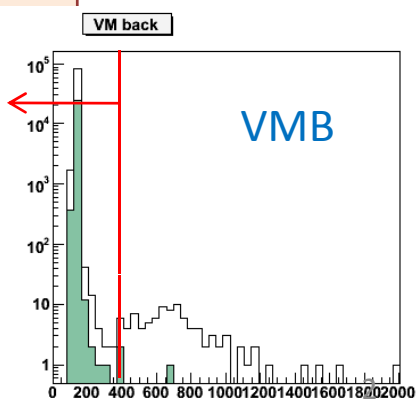
hadron : if((! tagged) AND (! muon) AND (CK2<100))

pions : if(hadron AND CK3>500) *

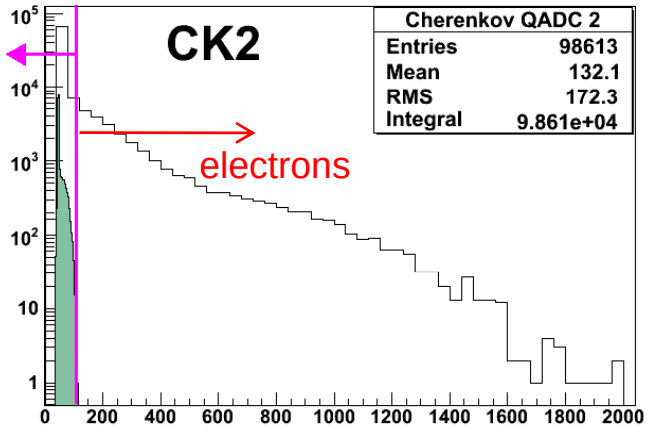
kaons + protons: if(hadron AND 100<CK3) *

*** These cuts vary from run to run (next slide)**

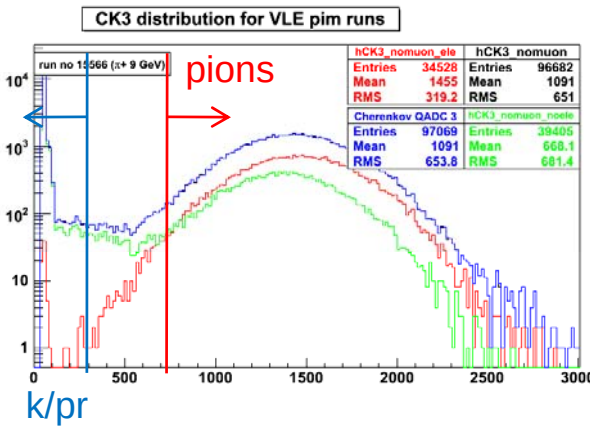




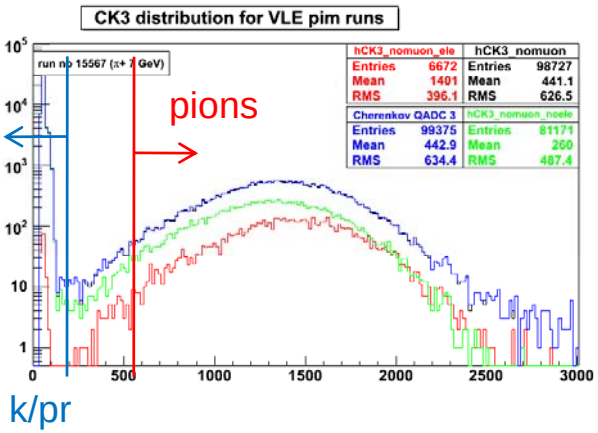
Particle Id determination from TB2007 data



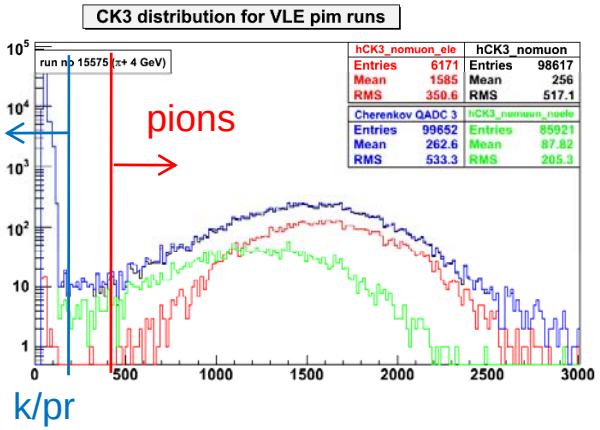
- CK2 is used for removing electrons.
- CK3 is used to distinguish pions from proton+kaon.
- Further Kaon/Proton separation was done using TOF information.



9 GeV pi+

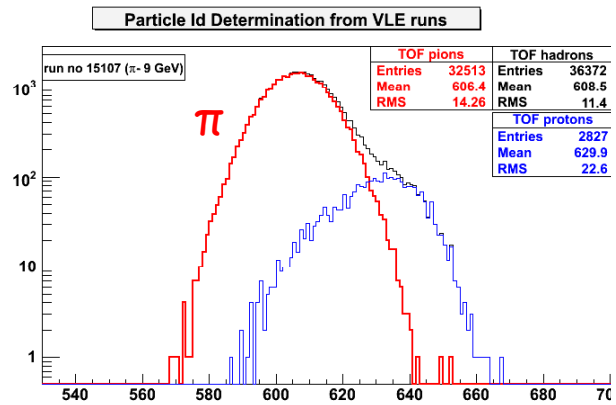


6 GeV pi+

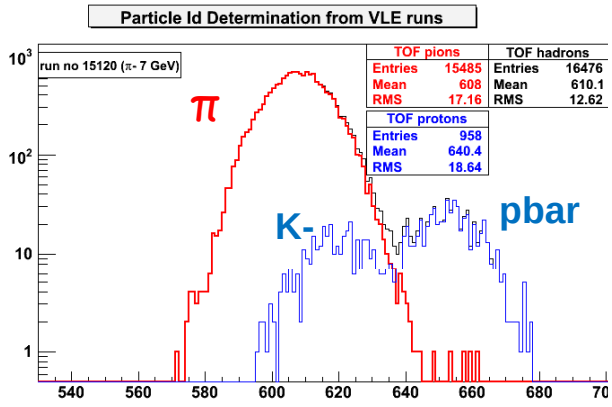


4 GeV pi+

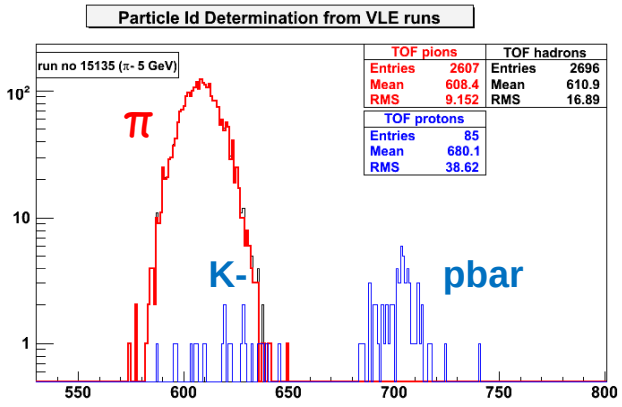
Particle Id determination (using CK3) : Pion Vs Proton+Kaon



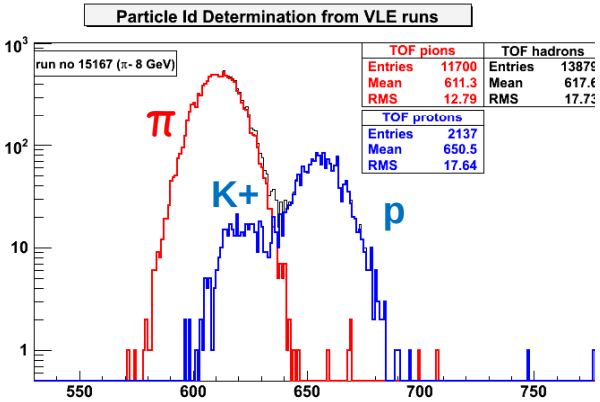
9 GeV pi-



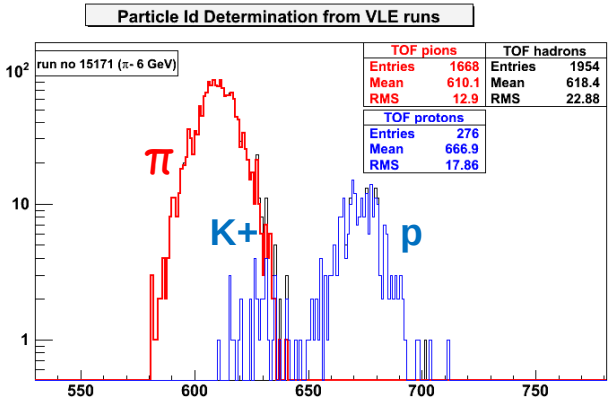
6 GeV pi-



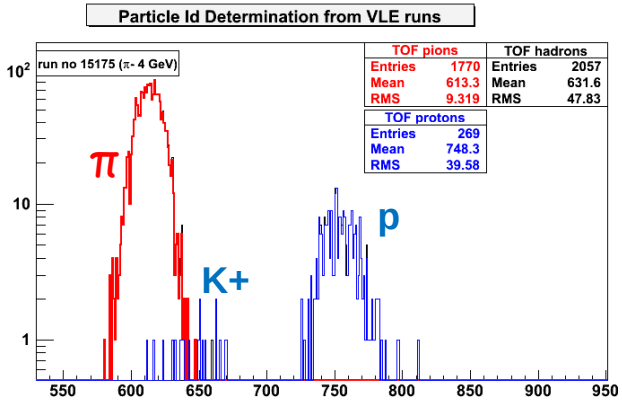
4 GeV pi-



7 GeV pi+



6 GeV pi+



4 GeV pi+

NB: Clearly **p** production is more than **pbar** production. Less than 6 GeV proton/pion separation Is better.

Peak positions of pion from negative and positive beams

	Pion peak positions in TDC counts (data)	
Beam momentum(GeV)	From pi- runs	From pi+ runs
2	621.4	629.4
3	612.8	-
4	610.9	614.0
5	608.8	-
6	608.8	610.2
7	608.0	611.0
8	606.7	-
9	606.4	610.9

- We see that the peak postions for pions from negative and positive beam runs vary by 3 TDC counts approximately. Hence there may be a possibility of an offset.

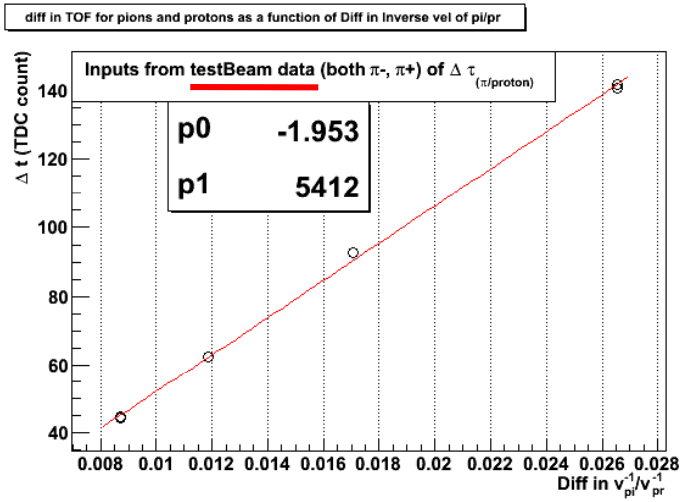
- But for the runs where we have clear separation between protons and pions, we see the difference Between the two peaks for positive/negative beam runs remains similar.

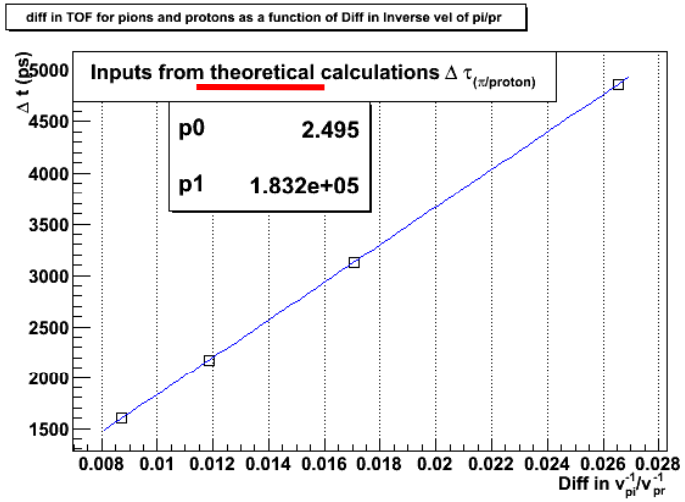
Calibration of TOF: TDC to pico seconds conversion

- We take the time differences (TDC counts) (dt) for proton and pion where we have clearly separated peaks. We also take the differences in inverse of velocities for proton/pion (dv).

$$d\tau = \frac{L}{v_\pi} - \frac{L}{v_{proton}} = L\left(\frac{1}{v_\pi} - \frac{1}{v_{proton}}\right) = L \times dv$$

The data points are taken from both pi- and pi+ runs.





From the plots we see

Ratio of the two slopes

Give us a factor : 33.8

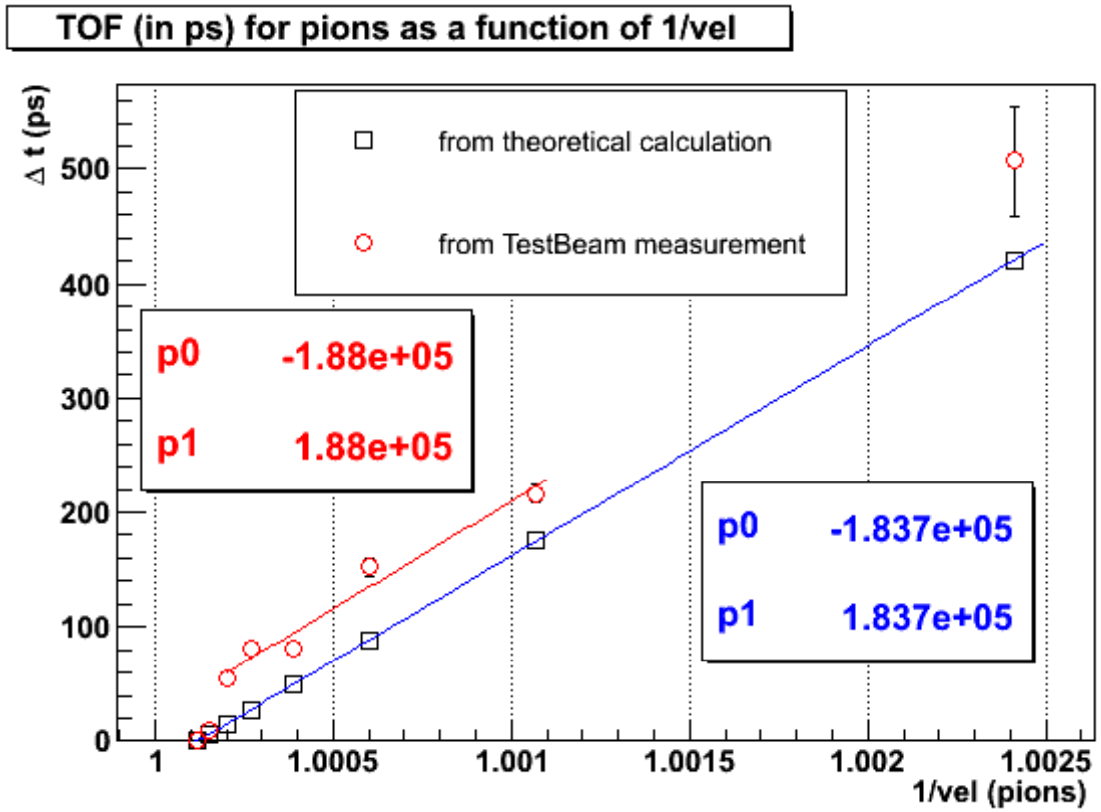
Hence the conversion:

1TDC count = 33.8 ps

Note: Repeating energy points show data taken from pi- and pi+ runs.

- Then we use that fit parameter to find the expected peak positions of proton and kaon using the pion peak position as a reference (for each run). Eg. $\tau_{proton} = \tau_\pi + p_0 + p_1 \times dv$

Calibration of TOF: mismatch between expected and data



Conversion used:
1TDC = 33.8 ps.

We plot time of flights of pion for different momenta as calculated and from data as a function of inverse of pion velocities.

We see an offset in data from theoretical calculations.

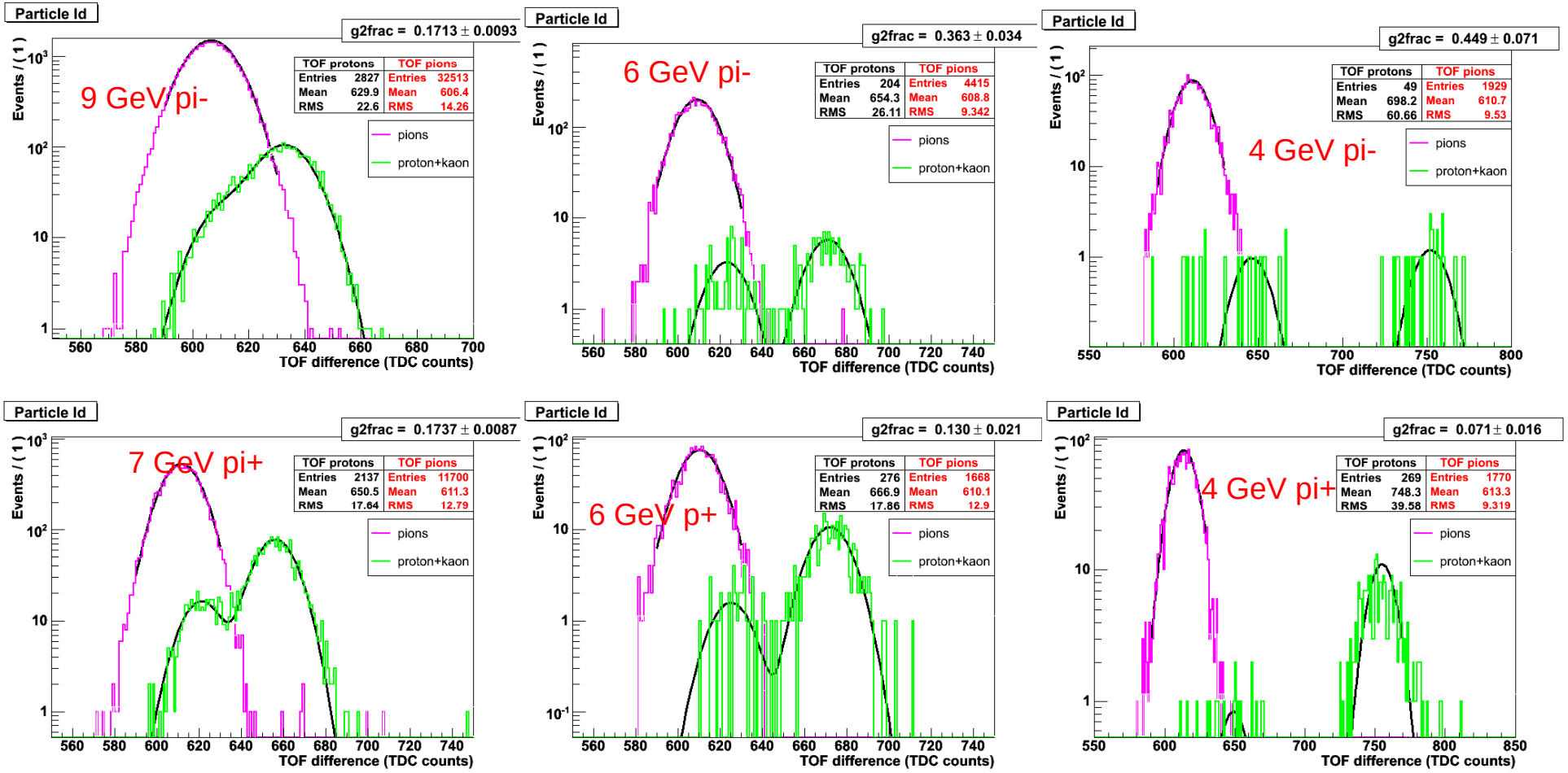
Expected proton/kaon peak positions

We use pion peak position as a reference and the fit from the dt/dv plot (slide 6) from data to estimate the other peak positions:

Beam mom(GeV)	Pion peaks	Kaon peaks	Proton peaks	Error*
2	621.4	768.4	1172.0	1.4
3	612.8	677.6	863.4	0.2
4	610.9	646.6	752.5	0.2
5	608.8	631.0	699.1	0.2
6	608.8	623.3	671.1	0.1
7	608.0	618.4	653.4	0.1
8	606.7	614.2	641.0	0.1
9	606.4	611.9	633.1	0.1

* Error estimated from the RMS/sqrt(N) from pion distribution function.

Fit with the expected peak positions for kaon/proton



The expected values match the data very well !

Fraction of pion/ kaon/proton

Beam)	No of hadr	No of Pion	No of (k+pbar)	%pion	%k	%pbar	# of k	# of pbar
2	303	51	248	-	-	-		
3	1636	1562	56	95	3.4	1.6	37	19
4	1988	1929	49	97	1.35	1.65	22	27
5	2696	2607	85	96	1.08	3.92	23	62
6	4627	4415	204	95	1.8	3.2	74	130
7	16476	15485	958	93	2.52	4.48	345	613
8	45279	41889	3273	92	3.2	4.8	1448	2173
9	36372	32513	2827	89	1.87	9.13	846	3320

Beam)	No of hadr	No of Pion	No of(k+p)	% pion	%k	%proton	# of k	# of proton
2	167	32	133	-	-	-		
4	2057	1770	269	86	.98	13.02	19	67
6	1954	1668	276	85	1.95	13.05	36	240
7	13879	11700	2137	84	2.72	13.28	363	1774
9	77187	51443	21975	67	3.63	29.37	2417	19548

Conclusions and Outlook

- We decide on the cuts on Cerenkov counters and Time Of Flight counters for good particle identification.

- We observe an offset between peaks positions of pions as measured from positive and negative beams.

- We attempt a rough calibration of the TOF counter and establish a relation between TDC count as actual time of flight in pico seconds.

- We take the difference in TOF between pion and proton for various runs in case of clear separation between the two and use that information to estimate the particle identification.

- In higher energies (9, 8 GeV) the separation between pion/kaon/proton is not very clear. For lower energies we see clear separation.

- We make an estimate of the fraction of different particles present in the beam as measured by the calorimeter.

- We shall use this information to find energy response and resolution for different particles.