SUMMARY OF RATE CORRECTIONS FOR ELECTRONICS RELATED EFFECTS

- Beam Current Scans :
  correction efficiency for all data sets.
- Wells Plot :
  correction effect on false detector asymmetry due to charge asymmetry
- Detailed comparison : WP vs BCS
- Conclusion

Beam Current Scan Analysis in e+π

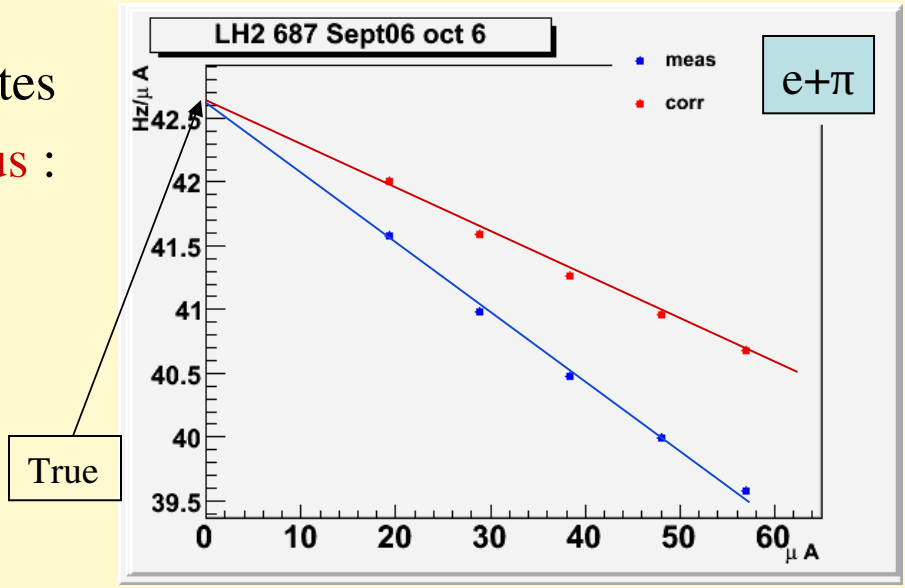
- Global dead time correction corrects for beam current dependant effects in the electronics :
  - Dead time and multi-hits of the CEDxFPD coincidence electronics
  - Randoms CEDxFPD coincidences

  (and Matrix contamination due to Čerenkov dead time and randoms.)

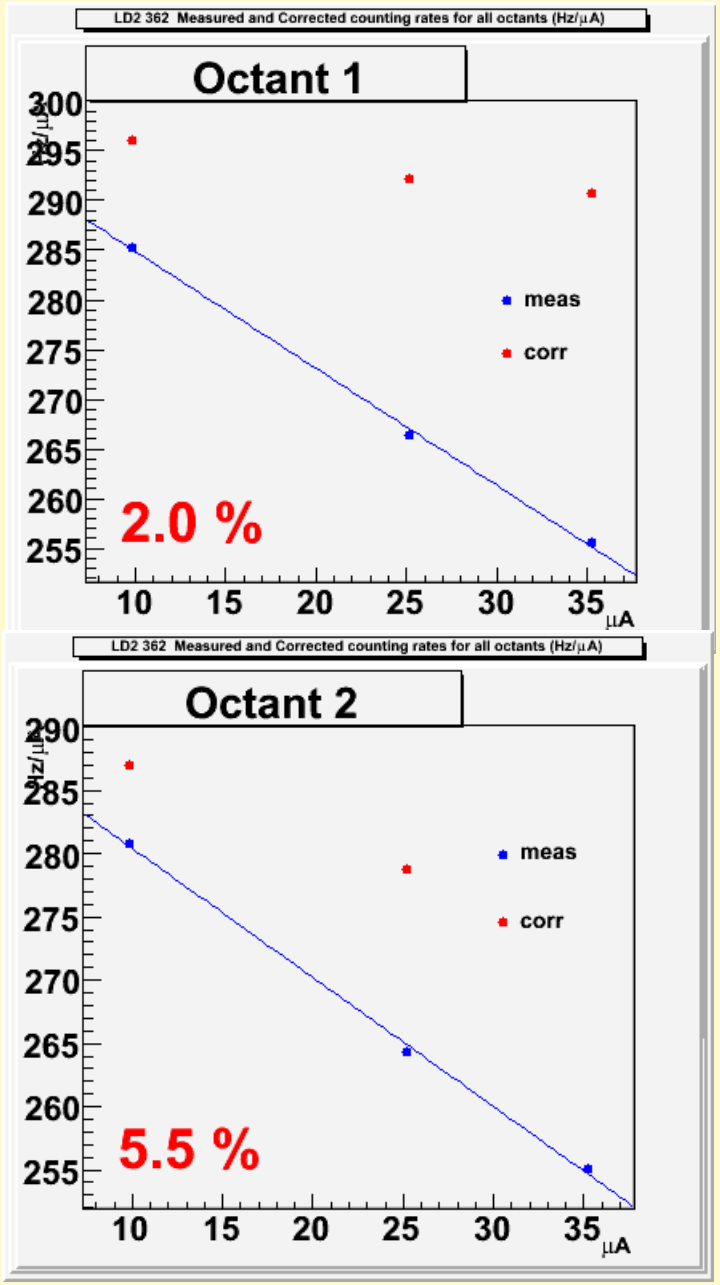
- In e+π beam current scan analysis, contamination effects are cancelled

- Correction efficiency is measured on the dependence of measured and corrected rates versus the beam current in the elastic locus :

$$DT_{\mathrm{Re}sidual} = \frac{True - Corrected}{True}$$

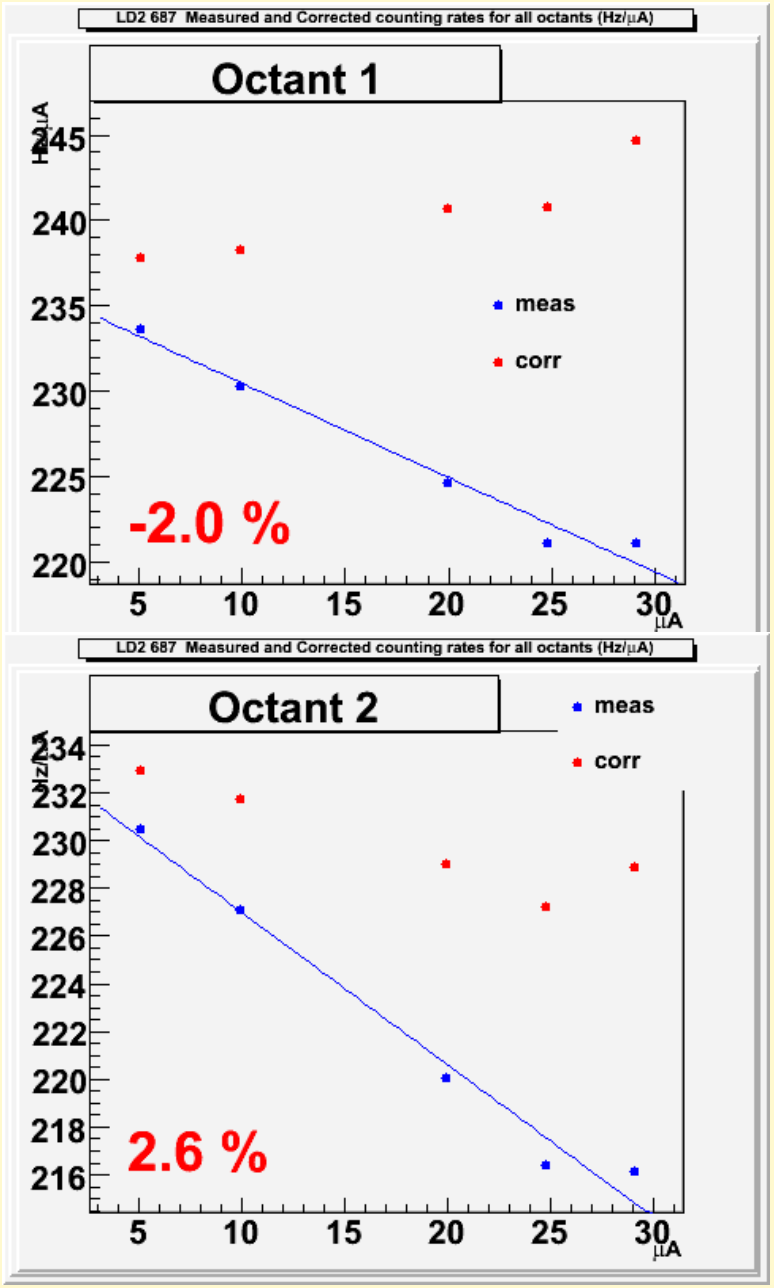


Beam Current Scan : Elastic locus, e+π LD2 362 MeV Jan.07



- I_{nom} = 35 μA
- Corrected rates
  Measured rates
- Measured rates dependence is negative : dead time effect is predominant
- NA : corrected slope ~ 0
  → dead time well accounted for
- Fr : Singles DT not corrected
  → larger residual DT : 5.5%
- Low residual correction

Beam Current Scan : Elastic locus, e+π LD2 687 MeV Nov.06



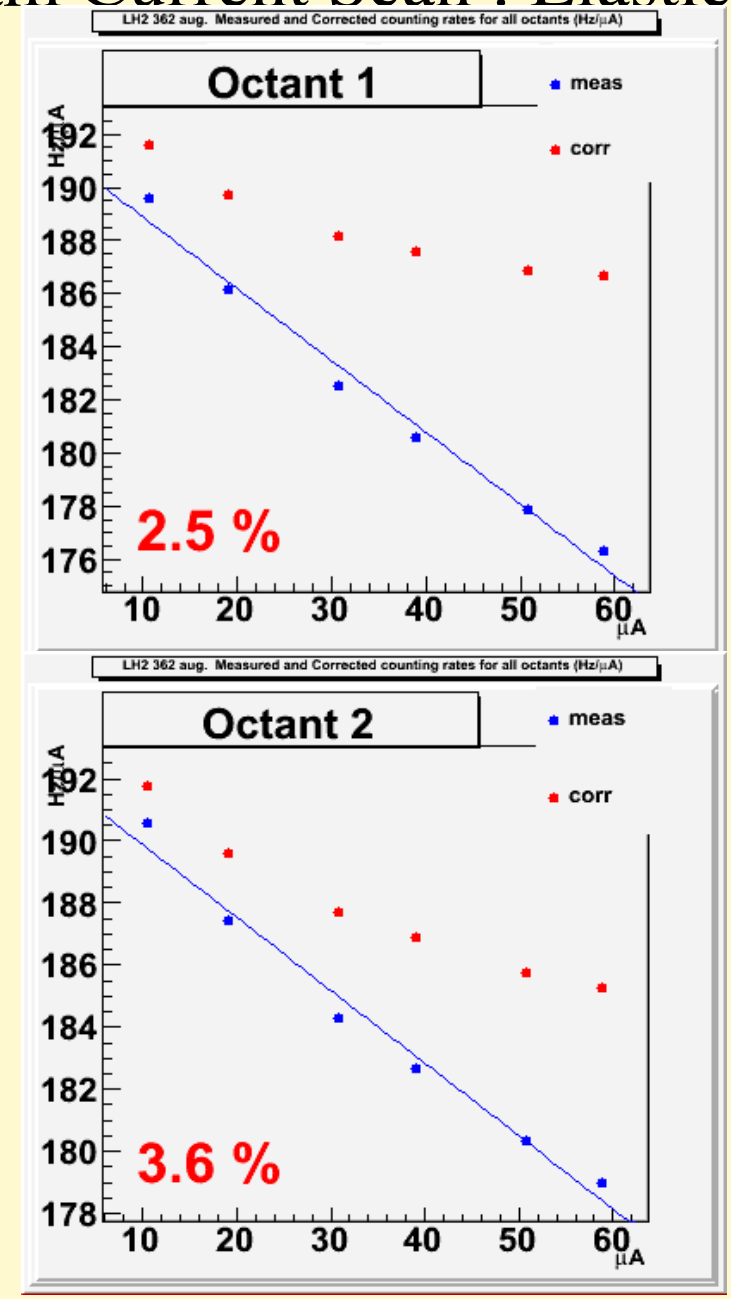
- I_{nom} = 20 μA
- Measured rates : DT predominant effect
- NA : residual 2% of random
  → $DT_{residual} < 0$, and corrected slope > 0
- Fr : residual 2.6% of DT
  → $DT_{residual} > 0$, and corrected slope < 0

  → 5.5% of residual DT (LD2 362)
  - 2.0% of residual rdm (LD2 687 NA)
  ~2.6% of total residual correction

(☞ rough calculation since NA and FR randoms may differ)

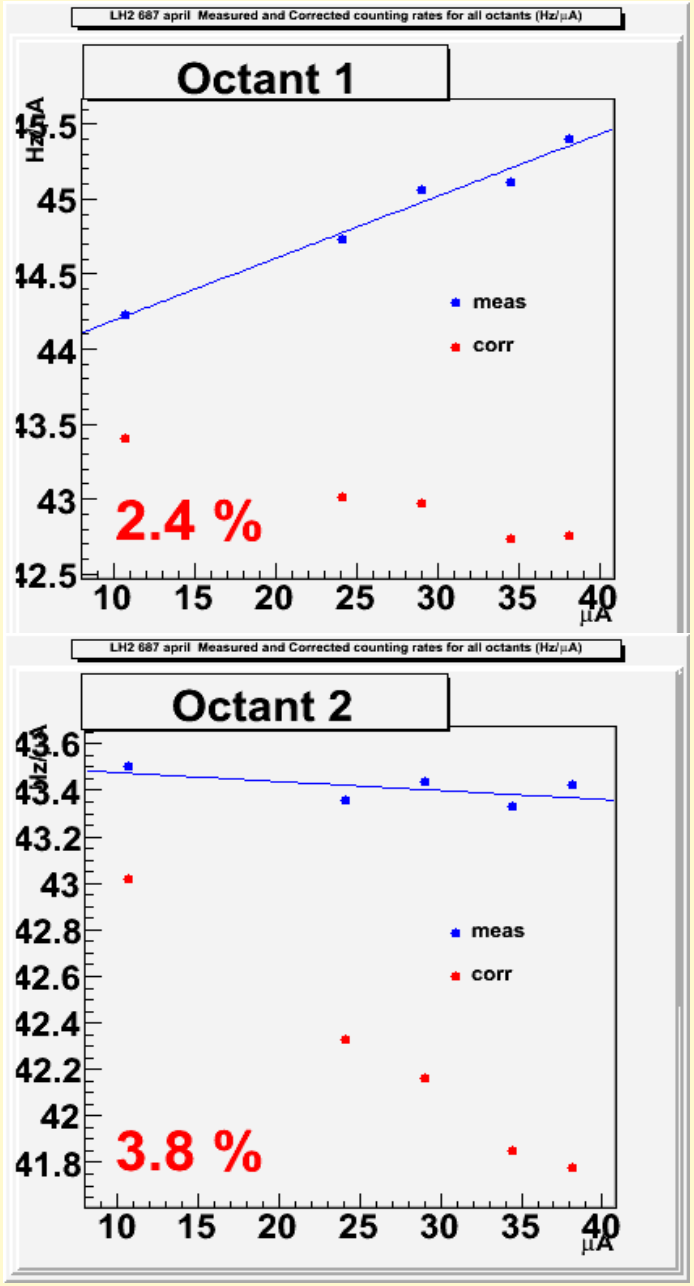
- Low residual correction

Beam Current Scan : Elastic locus, e+π LH2 362 MeV Aug.06



- I_{nom} = 60 μA
- Measured : DT effect is predominant
- Corrected :
  - Residual non linearity due to randoms
  - Residual correction = DT
- Residual correction < 5%

Beam Current Scan : Elastic locus, e+π LH2 687 MeV Ap.06



- I_{nom} = 38 μA

- FPD front-back coincidence not used
- NA measured : positive slope

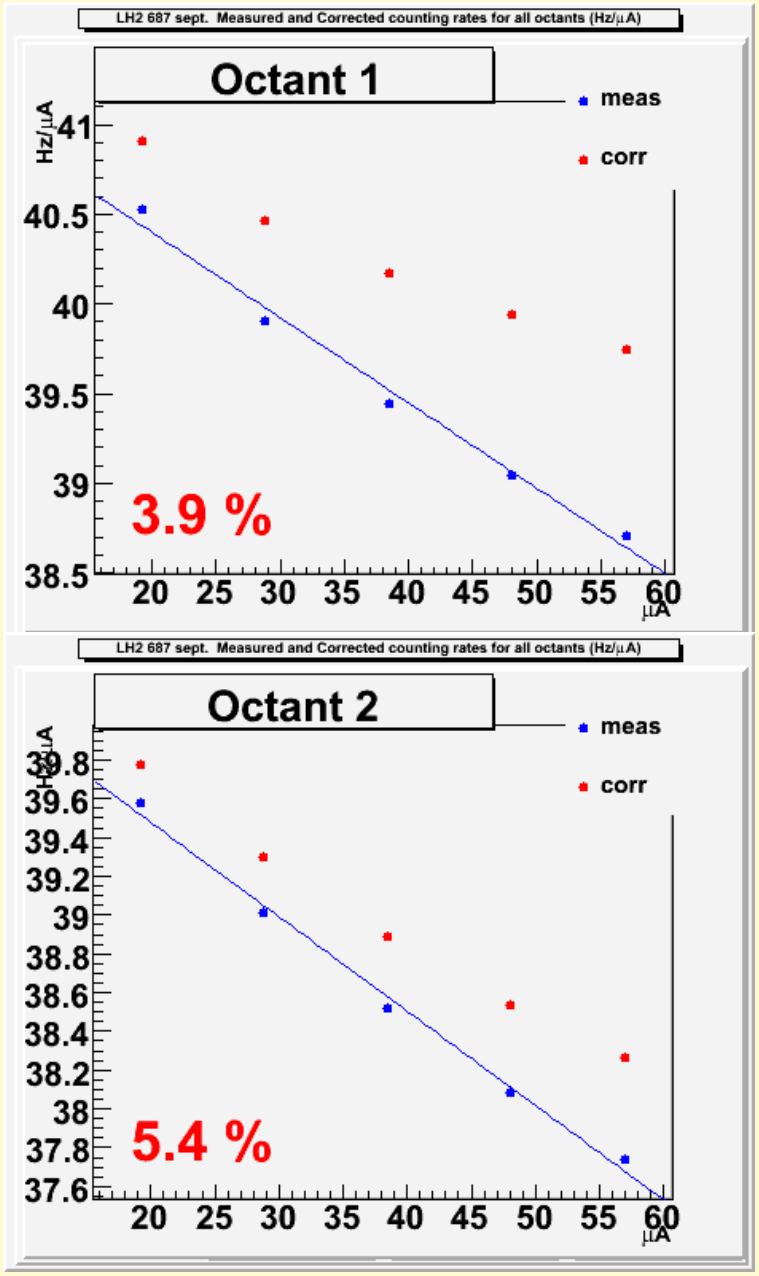
  ➔ CEDxFPD rdms is the predominant effect
- Fr measured : flat slope

  ➔ rdm and DT are balancing each other (same order)

- DT is the residual effect on corrected rates
- Fr residual > NA residual due to single DT

- Still, residual effect is < 5%

Beam Current Scan : Elastic locus, e+π LH2 687 MeV Sept.07



- I_{nom} = 60 μA

- Measured rates dominated by DT effect
- Residual effect is still DT, with values < 5.5%

Beam Current Scan Analysis

- Residual global DT in % for all octants :

Octant	1	3	5	7	2	4	6	8
LD2 362	2.0	3.1	3.8	4.0	5.5	6.2	6.1	5.5
LD2 687	-2.0	-1.8	0.7	2.4	2.6	3.1	3.4	-0.8
LH2 362	2.5	3.0	2.3	3.0	3.6	3.9	3.7	4.5
LH2 687 Ap.06	2.4	5.4	6.9	8.2	3.8	4.2	3.4	3.2
LH2 687 Sept.06	3.9	3.9	4.4	3.9	5.4	5.6	5.2	5.3

Beam Current Scan Analysis Summary

- April06 : FPDs' front and back were not in coincidence
  ⇨ data dominated by CEDxFPD randoms

- Residual dead time correction < 8% on all data sets, all octants.
  (8.2% oct7 LH2 687 Apr.06)

- Residual DT globally > 0
  ⇨ True > Corrected : residual DT effect
  ⇨ Rdm effect seems to be well accounted for.

- Global DT correction is done based on our understanding of the electronics.
  Residual DT may be due to a lower estimation of the MH_{12} or Single DT

Wells Plot Analysis

- Wells Plot : A_{det} vs A_Q

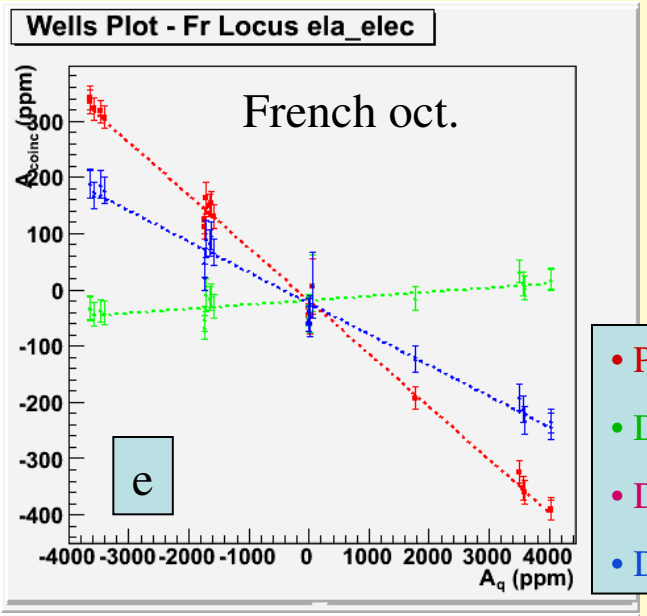
- Wells Plot analysis is a tool to measure the accuracy of rate corrections.

  ⇨ wells plot slopes should be reduced after rate corrections

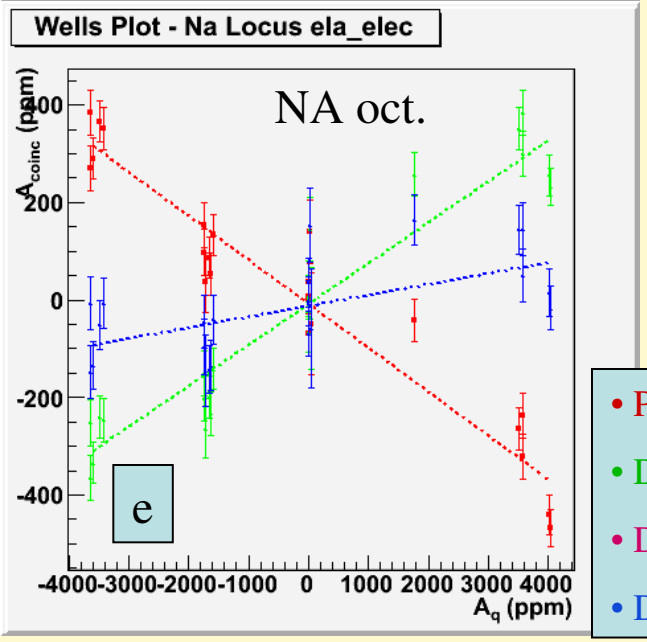
- To see each DT correction contribution, WP are generated with :
  - Pass1_2
  - Pass1_3 DT only
  - Pass1_3 DT + contamination
  - Pass1_3 DT + contamination + randoms

  for e, π and e+π on the elastic locus.

Wells Plot : LD2 362 MeV Jan.07



- Pass1_2
- DT_v1 : DT only
- DT + contam
- DT+ contam + rdm



- Pass1_2
- DT_v1 : DT only
- DT + contam
- DT+ contam + rdm

- Random mode runs : info. on e only
- No random subtraction on e : pink = blue

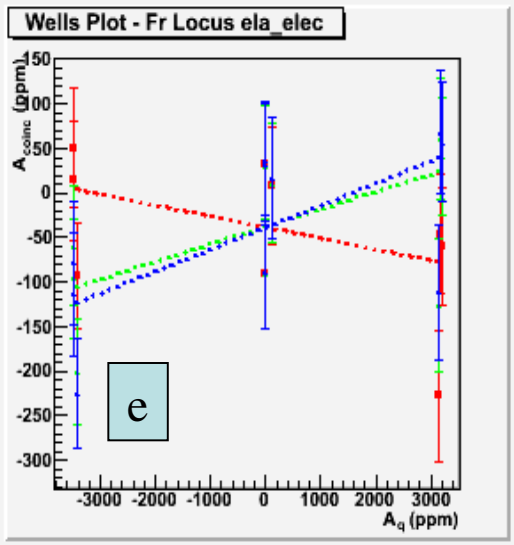
- DT correction : increases the rates, and so decreases the slope (Fr Single DT not corrected).
- Contamination : subtracts pions, and so increases the slope.

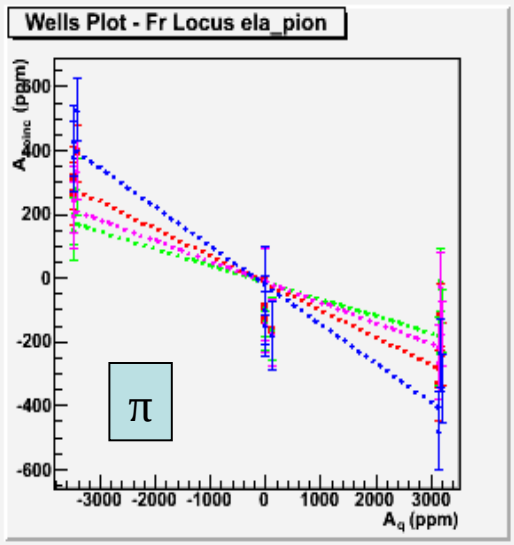
- Slopes :

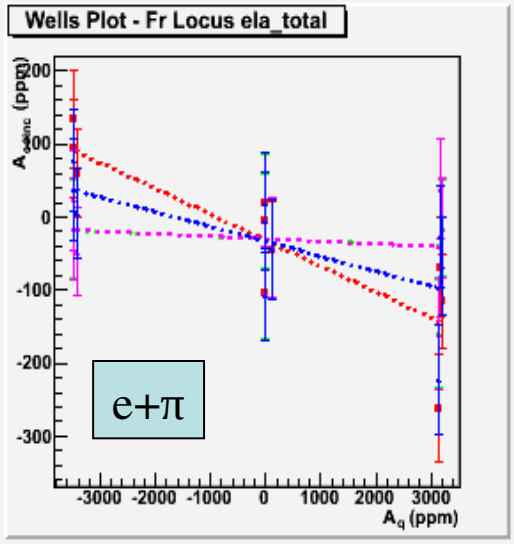
	Pass1_2	Final
Fr e	-0.094	-0.055
NA e	-0.090	0.022

False asymmetry for A_Q = 1 ppm

Wells Plot : LH2 687 MeV Sept.06







- Pass1_2
- DT_v1 : DT only
- DT + contam
- DT+ contam + rdm

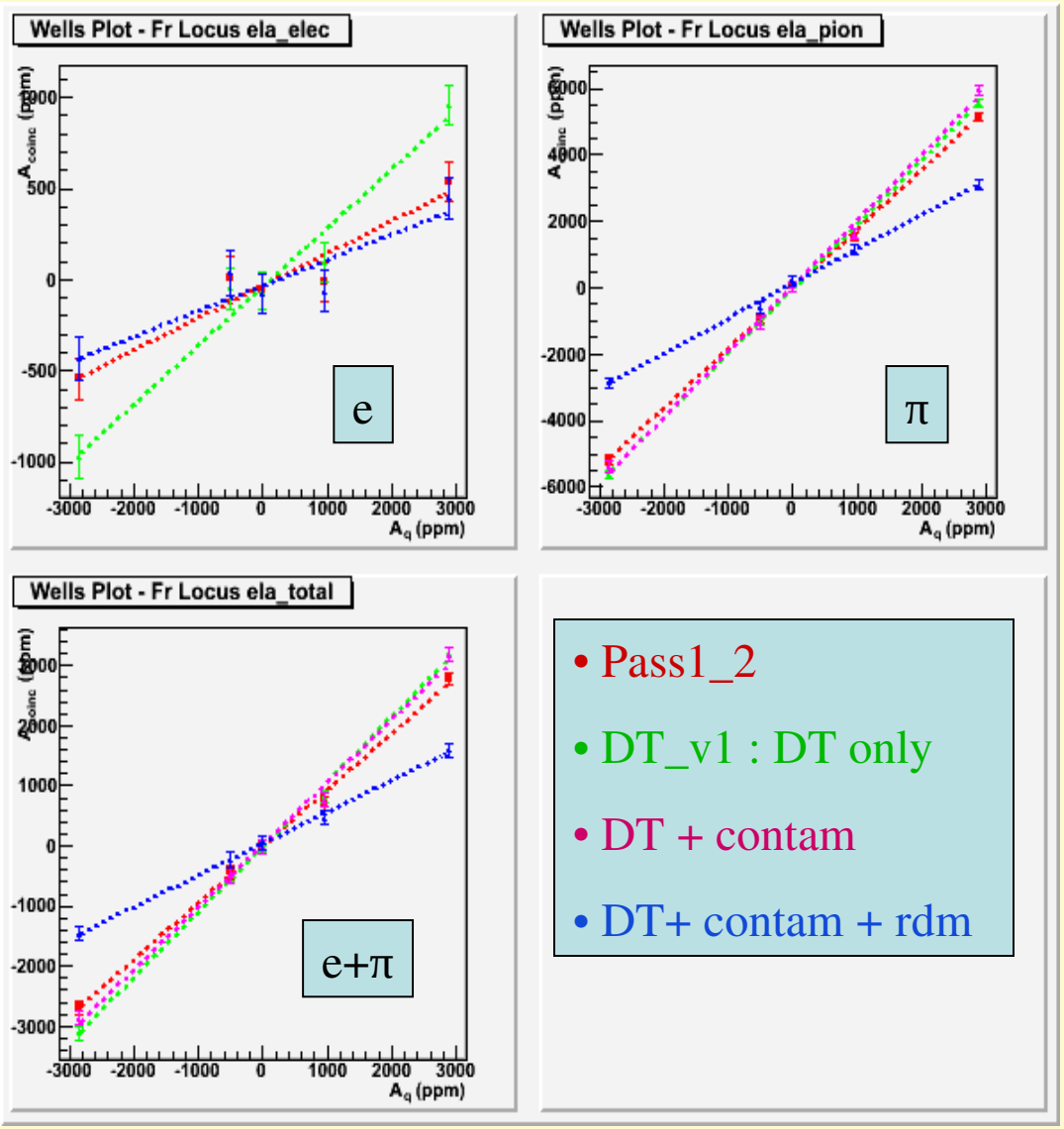
- e : no rdm corr. ➔ pink = blue
- e+π : no contam. effect ➔ green =pink
- On π :
  - DT increases the rates : reduction of the slope from red to green (Single DT not corrected)
  - Contamination is small and increases the slope from green to pink
  - Random subtraction is the dominant contribution, is 2 times larger than DT and increases the slope from pink to blue
- Slopes :

Fr	Pass1_2	Final
e	-0.012	0.024
π	-0.085	-0.122
e+π	-0.035	-0.02

⇨ Rdm seem to be overestimated

⇨ or DT underestimated

Wells Plot : LH2 687 MeV Apr.06



- π :
  - Very small effect of DT and contamination
  - Random effect is dominant
- Measured slope 10 times higher than in Sept.06
- Slopes :

Fr	Pass1_2	Final
e	0.177	0.14
π	1.79	1.04
e+π	0.94	0.52

Wells Plot vs Beam Current Scan Analysis

- Rates DT and rdm corrections are done by inverting :

$$y_{meas} = [y_{true}(1 - DT_{ced})(1 - DT_{fpd}) + y_{rdm}](1 - DT_{Trigg} - MH_{22})(1 - MH_{12})$$

- Detector false asymmetry related to A_Q :

$$A_{DT}^{false} = \left[f_{rand} - (1 - f_{rand}) \frac{DT_{ced}}{-DT_{ced}} \frac{DT_{fpd}}{-DT_{fpd}} \frac{DT_{Trigg} + MH_{22}}{1 - DT_{Trigg} - MH_{22}} - \frac{MH_{12}}{1 - MH_{12}} \right] A_Q$$

  - If $f_{rand} >> 1$, the effect of the singles DT on the asymmetry is largely reduced by the factor (1-frand)
  - DT terms are negative
  - Rdm term is positive

- For each Wells Plot, a global DT term is computed on the elastic locus as the weighed average over each cell of the cell value by the coincidence yield in the cell. Then a mean value over all runs and all Fr and NA octants is taken.

Wells Plot vs Beam Current Scan Analysis

French	April 2006			Sept 2006		
%	e	π	e+π	e	π	e+π
DT_{ced}	0.82	0.85	0.84	0.86	0.83	0.85
DT_{fpd}	0.88	0.88	0.88	0.77	0.75	0.76
DT_{Trig}	0.54	0.54	0.54	0.44	0.44	0.44
MH12	3.87	3.86	3.86	1.54	1.54	1.54
MH22	0.10	0.10	0.10	0.08	0.08	0.08
f_{rand}	0	50.2	24.3	0	3.97	1.26
DT*	-6.40	-5.54	-6	-3.73	-3.64	-3.70
A_Q	2873	2873	2873	3205	3205	3205
A_{DT}	-184	-159	-172	-119	-116	-118
A_{DT}(WP)	-410	-418	-408	-105	-100	-100
A_{th}/A_{meas}	45	38	42	113	116	118
A_{rand}	0	1436	698	0	127	40
A_{rand}(WP)	0	2859	1590	0	170	50
A_{th}/A_{meas}	-	50	44	-	75	80

NA	April 2006			Sept 2006		
%	e	π	e+π	e	π	e+π
DT_{ced}	-0.25	-0.24	-0.25	0.82	0.75	0.80
DT_{fpd}	-0.14	-0.14	-0.14	0.44	0.42	0.43
DT_{Trig}	0.36	0.36	0.36	0.47	0.47	0.47
MH12	7.3	7.34	7.33	3.45	3.52	3.47
MH22	0.16	0.16	0.16	0.21	0.21	0.21
f_{rand}	0	72.1	31.8	0	9.45	2.74
DT*	-8.04	-8.34	-8.17	-5.55	-5.42	-5.51
A_Q	2873	2873	2873	3205	3205	3205
A_{DT}	-230	-239	-234	-178	-173	-176
A_{DT}(WP)	-492	-474	-477	-210	-210	-210
A_{th}/A_{meas}	46	50	49	84	82	83
A_{rand}	0	2068	913	0	302	87.8
A_{rand}(WP)	0	3715	1997	0	380	110
A_{th}/A_{meas}	-	55	45	-	79	80

- A_{DT} and A_{rand} are false asymmetries obtained either via a calculation based on the DT macro or via a measurement on the Wells Plot (WP)

- Apr.06 : factor of 2 between the macro and the Wells Plot on A_{DT} and A_{rand} for Fr and NA.

  BUT beam current scan : underestimation of rdms of only ~ 5%

- Sept.06 : ✾ A_{DT} : ~ ±15% difference between the macro and the Wells Plot, Fr and NA

  ✾ A_{rand} : ~ 20-25% difference, Fr and NA

Conclusion

- Beam Current Scan Analysis :
  - DT corrections underestimated by ~ 5%
  - Random corrections underestimated by ~ 2%

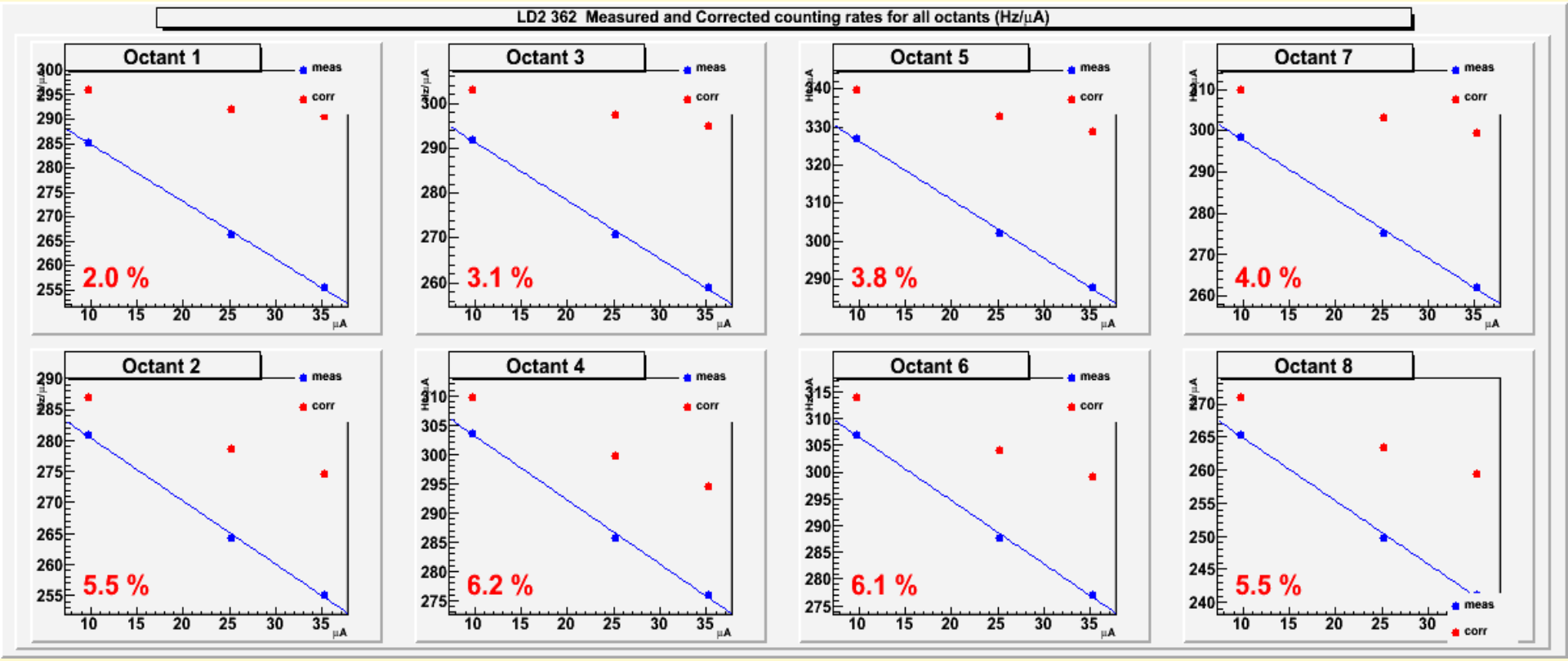
- Wells Plot Analysis :
  - Inconsistencies between Ap.06 Wells Plot and beam current scan results
  - Randoms generally higher than in beam current scans

- Perspective :
  - Reduce Wells Plot slope in e by introducing a random subtraction?

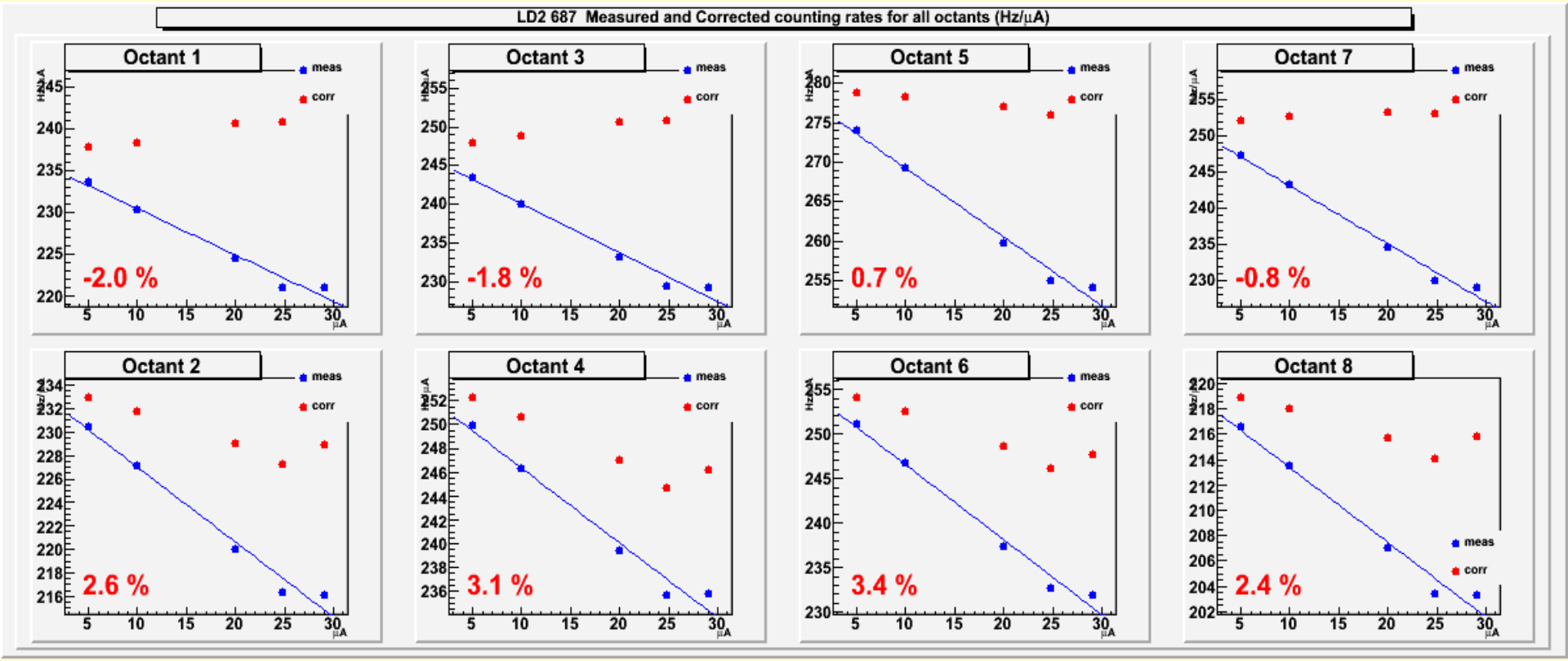
    ➥ introduction f_e : fraction of randoms associated with a Cerenkov signal
  - Need of linear regression to reduce the asymmetry due to A_Q ?
  - Evaluate $A_{singles}$, A_{trig}, A_{MT} and $A_{trigCer}$ to compute the total false asymmetry related to the global dead time correction

end

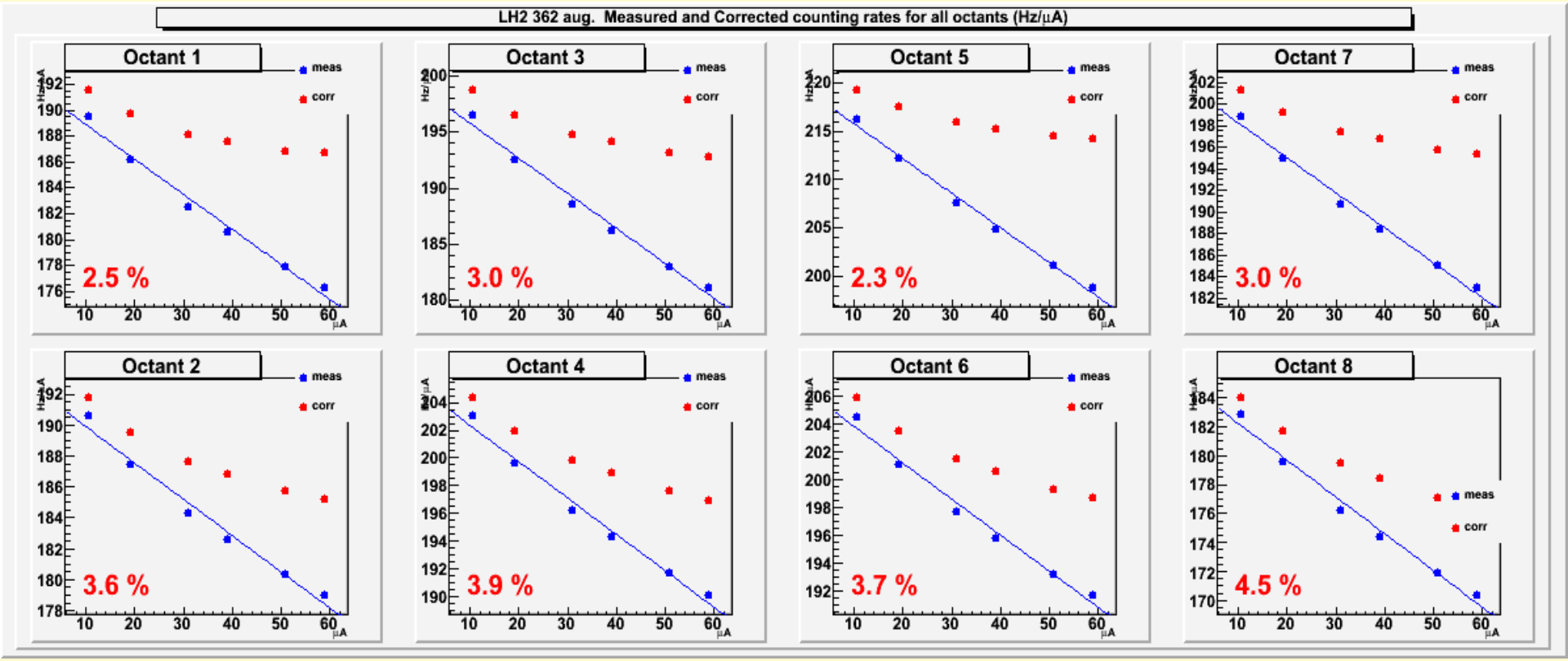
Beam Current Scan : Elastic e+π LD2 362 MeV



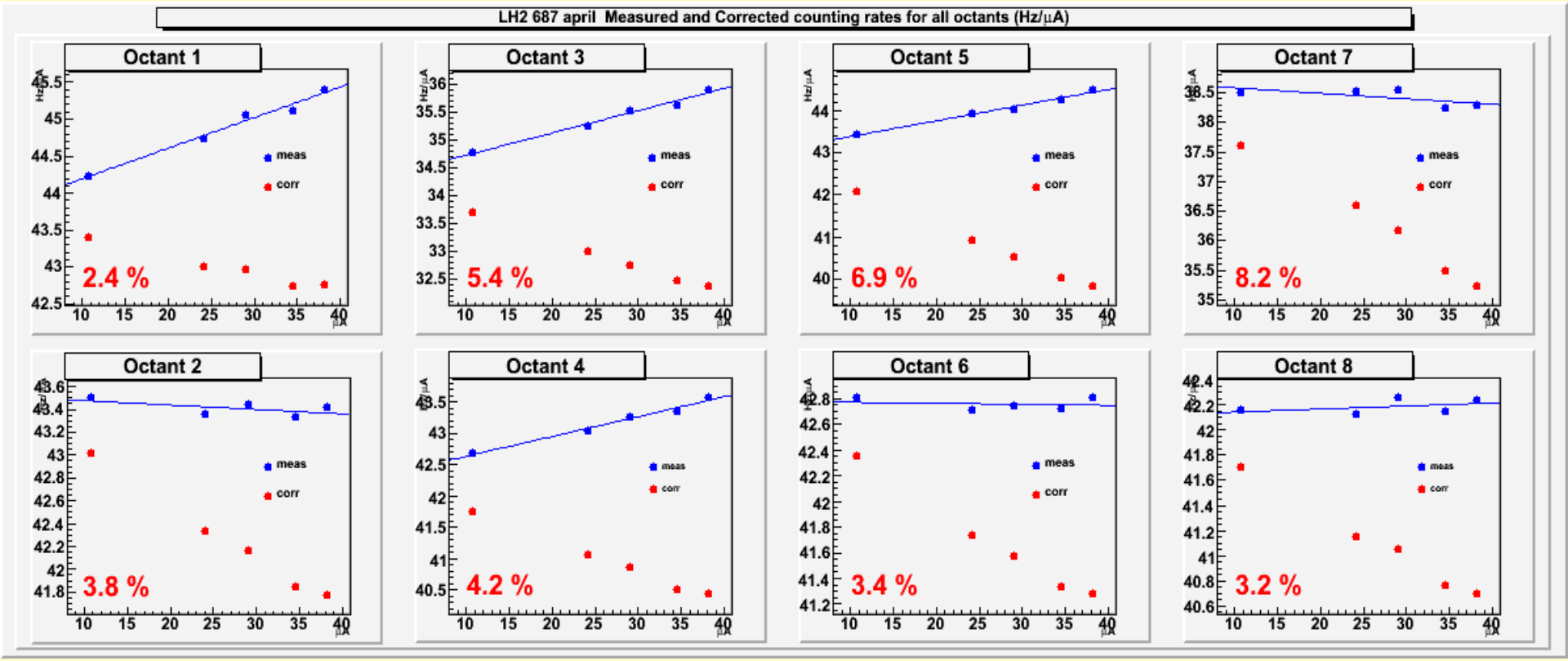
Beam Current Scan : Elastic e+π LD2 687 MeV



Beam Current Scan : Elastic e+π LH2 362 MeV



Beam Current Scan : Elastic e+π LH2 687 MeV Ap.06



Beam Current Scan : Elastic e+π LH2 687 MeV Sept.06