Effect of Deadtime + random Cerenkov on asymmetries

C. Furget, collaboration meeting, 05/24/07

- From Doug's simplified formula

$$A_m = A_{s+b} - \left(\tilde{s}+\tilde{b}\right) I\tau_d \left(A_{s+b}+A_I\right) - \frac{\tilde{r}_1\tilde{r}_2\ I\tau_r}{\left(\tilde{s}+\tilde{b}\right)+\tilde{r}_1\tilde{r}_2\ I\tau_r}\left(A_{s+b}-A_I-A_{r1}-A_{r2}\right)$$

$$\text{where} \quad A_{s+b} = \left(1-f\right)A_s + f\,A_b$$

$$y_{m,\pm} = y_{c,\pm}\left(1-y_{c,\pm}\tau_d\right)$$

$$y_{c,\pm} = I_\pm\left(\tilde{s}_\pm+\tilde{b}_\pm\right)+r_{1,\pm}r_{2,\pm}\tau_r$$

$$\text{with} \quad r_{i,\pm} = I_\pm\tilde{r}_{i,\pm}$$

r_1 : Cerenkov
r_2 : CED-FPD coinc.

- Same using different notation

$$A_{meas} = A_{coinc} - A_{sys}\begin{cases} DT\times\left(A_{coinc}+A_I\right) \\ f_{rand}\times\left(A_{coinc}-A_I-A_\pi-A_{CER}\right)\end{cases}$$

$$\text{where} \quad A_{coinc} = \left(1-f_{back}\right)A_{el} + f_{back}\,A_{back}$$

→ Asymmetry from signal + background

→ Systematic asymmetry due to deadtime

→ Systematic asymmetry due to pion contamination (CER ⊗ CED-FPD coinc.)

Deadtime + random effects on the asymmetry

- To be more precise …

$$A_{sys} \begin{cases} A_{meas} = A_{coinc} \\ \quad - DT\left(A_{coinc} + A_{I}\right) \\ \quad - f_{rand}\left(A_{coinc} - A_{I} - A_{\pi} - A_{CER}\right) \end{cases}$$

$$where \quad A_{coinc} = \left(1 - f_{back}\right) A_{el} + f_{back}\, A_{back}$$

→ The deadtime should be decomposed in several contributions because it is due to coincidences, single MT and single CFDs

$$-DT\left(A_{coinc} + A_{I}\right) \quad \Rightarrow \quad - DT_{coinc}\left(A_{ALL\ coinc} + A_{I}\right) - DT_{MT}\left(A_{MT} + A_{I}\right) - DT_{CFD}\left(A_{CFD} + A_{I}\right)$$

→ The deadtime on one cell (i,j) is due to the whole coincidences (electron+pion)

→ In practice it is difficult to separate all contributions

- Questions :
  - ✓ How small can we reduce systematic asymmetries by performing deadtime & random corrections ?
  - ✓ Can we have a rough estimate of systematic asymmetries right now ?

Very rough estimate of systematic asymmetry

(for LD2 at 362 MeV and 35 μA)

- Before deadtime and random corrections

$$A_{sys}\begin{cases} A_{meas}\left(elastic\right) = A_{coinc} \\ \quad - DT \times \left(A_{coinc} + A_{I}\right) \\ \quad - f_{rand} \times \left(A_{coinc} - A_{I} - A_{\pi} - A_{CER}\right) \end{cases}$$

$$where \quad A_{coinc} = \left(1 - f_{back}\right) A_{el} + f_{back}\, A_{back}$$

$$A_{coinc} = -15\ ppm$$

$$-15\% \times -10\ ppm\ ?$$

$$-15\%\ ?? \times -15\ ppm$$

$$\Rightarrow \quad A_{sys} \,/\, A_{meas} \approx 25\ \%$$

- After 1st-step deadtime and random corrections

$$A_{sys}\begin{cases} A_{meas}\left(elastic\right) = A_{coinc} \\ \quad - DT_{residual} \times \left(A_{\sin gle} + A_{I}\right) \\ \quad - f_{residual\,,random} \times \left(A_{coinc} - A_{I} - A_{\pi} - A_{CER}\right) \end{cases}$$

$$A_{m} = -15\ ppm$$

$$-3\% \times -5\ ppm\ ? \left(= A_{\sin gle\ CFD\ or\ MT}\right)$$

$$-5\%\ ?? \times -15\ ppm$$

$$\Rightarrow \quad A_{sys} \,/\, A_{meas} \approx 6\%$$

- ✓ Hypothesis : A_{I} , A_{π} *and* A_{CER} □ A_{s+b}
- ✓ DT deduced from Philippe's study. In DT term, $A_{coinc} < A_{elastic}$
- ✓ Residual deadtime is supposed to come from single CFD and MT only
- ✓ f_{rand} obtained from Herbert's studies

Current Status

- Deadtime contribution to A_{sys}
  - ✓ 1st-step deadtime corrections are required to minimize systematic asymmetries
  - ✓ Is the 2nd-step corrections required ? The gain could be small.
  - ✓ Calculate several contributions (coinc, single MT and CFD) to A_{sys} ?
- Contribution of pion contamination to A_{sys} (Random CER ⊗ CED-FPD coinc.)
  - ✓ Main contribution to A_{sys}, which should depends on different settings (energy, target)
  - ✓ Several inputs need to be cross-checked (f_{rand}) and/or measured (A_{π}, A_{cer} …)
- Others contributions to be included ???
  - ✓ Random CED ⊗ FPD in electron and pion matrix
  - ✓ Background subtraction within each cell (not discussed here) could remain the main contribution to A_{sys}
  - ✓ …

Fraction of events in electron matrix, elastic region
(35 uA 362 MeV beam, LD2 target):

		fraction January	fraction February
A+F+G:	Aero * CED * FPD	84. -86. /78%	79. -83. /73%
B:	Aero . CED * FPD	12. -15. /20%	13. -18. /23%
C:	Aero * CED . FPD	1.3- 2.0 %	1.4- 3.1 %
D:	Aero * FPD . CED	0.4- 0.8 %	0.6- 1.6 %
E:	Aero . CED . FPD	0.4- 0.9 %	0.4- 1.9 %
B+C+D+E	randoms	14. -16. /22%	17. -21. /27%

values are ranges for octants 1-4,6-8; after "/" are for octant 5

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ASSOCIATED ISSUES:

- multiple hit losses
- dead time losses

Herbert, 03/01/07

Raw Blinded asymmetry Summary

	LH2 687 MeV Asym (ppm)	LH2 362 MeV Asym (ppm)	LD2 687 MeV Asym (ppm)	LD2 362 MeV Asym (ppm)	
Elastic electron Rand corr.	-39.7(1.7)	-10.59(0.7)	-43.83(2.9) -46.8(3.8)	-14.9 (0.7) -15.7(0.9)	
Inelastic Elec. Rand corr.	-21.7(1.9)	-2.76(2.3)	-18.53(2.7) -22.7(4.6)	-3.9(1.9) -6.2(3.9)	
Elastic pion	-12.2(2.4) ppm	-10.7(1.7)ppm	-6.7(2.9) ppm	-5.4 (1.2)	
Inelastic pion	-3.3(1.7) ppm	0.83(3.1)ppm	-1.9(1.5) ppm	-1.6(1.3)	
Elastic Rand.	Not available	Not available	-14.07(7.6)	-14.6(1.9)	
Inelastic Rand.	Not available	Not available	-0.75(4.2)	-3.95(2.8)	

Fatiha, 03/01/07