Alternative offline analysis:

first results for Jan–Mar 2004

- How does it work?
- First results
- Conclusions

How does it work?

Main idea: go from 2 dimensions (E,η) and multiple fits (L+R), (L-R) to three dimensions (E,η,s) and a single fit, where $s=L,R$ is the laser helicity.

Calorimeter response:

$$\frac{d^2\sigma}{dE_{\mathrm{true}}\,d\eta_{\mathrm{true}}} = \int \frac{d^2\sigma}{dE_{\mathrm{true}}d\phi}\frac{1}{\sqrt{2\pi}\sigma_y}\exp[-\frac{(y(\eta_{\mathrm{true}})-r(E_{\mathrm{true}})\sin\phi)^2}{2\sigma_y^2}]\frac{dy}{d\eta_{\mathrm{true}}}d\phi$$

$$\frac{d^2\sigma}{dE\,d\eta} = \int\int \frac{d^2\sigma}{dE_{\mathrm{true}}\,d\eta_{\mathrm{true}}}\frac{1}{2\pi\sigma_\eta\sigma_E}\exp[-\frac{(\eta_{\mathrm{true}}-\eta)^2}{2\sigma_\eta^2(\eta_{\mathrm{true}},E_{\mathrm{true}})}-\frac{(E_{\mathrm{true}}-E)^2}{2\sigma_E^2(E_{\mathrm{true}})}]d\eta_{\mathrm{true}}\,dE_{\mathrm{true}}$$

Fit function for χ^2 minimisation with normalisation k_s, k_{off}:

$$\chi^2 = \sum_{s=L,R}\sum_{E_i}\sum_{\eta_j}\frac{\left(N_{s,i,j}^{\mathrm{on}}-(1-k_{\mathrm{off}})N_{s,i,j}^{\mathrm{off}}-k_s\frac{d^2\sigma}{dE\,d\eta}\right)^2}{\sigma_{s,i,j}^2}$$

Fit parameters

Fit uses 4 parameter $\eta - y$ transformation

$$y(\eta) = p_0 \log \frac{1+\eta}{1-\eta} + p_1 (\log \frac{1+\eta}{1-\eta})^3 + (p_2 * \log \frac{1+\eta}{1-\eta})^5 + p_3 (\log \frac{1+\eta}{1-\eta})^7$$

Energy resolution two parameters a, b

$$\sigma_E(E_{\mathrm{true}}) = \sqrt{a^2 E_{\mathrm{true}} + b^2 E_{\mathrm{true}}^2}$$

Asymmetric Eta resolution: new parameter f_{skew}

$$\sigma_\eta(\eta_{\mathrm{true}}, E_{\mathrm{true}}) = a \sqrt{\frac{1-\eta^2}{E_{\mathrm{true}}}} \left(1 \pm f_{\mathrm{skew}} \sqrt{\sqrt{|\eta|} E_{\mathrm{true}}}\right)$$

Calibration f_E, f_η, E_{offs}, beam offset y_0, beam size σ_y.

Transverse beam polarisation $S_3^L\, P_y$, $S_3^R\, P_y$,

Longitudinal beam polarisation $S_3^L\, P_z$, $S_3^R\, P_z$.

Linear light polarisation S_1^L, S_1^R.

Distance interaction point to calorimeter d_0.

Fit parameters for test runs:

Strategy:

Obtain “best” $\eta - y$ transformation from one single fill, with fixed $d_0 = 65$ meter.

Test fit for colliding/non colliding bunches with:

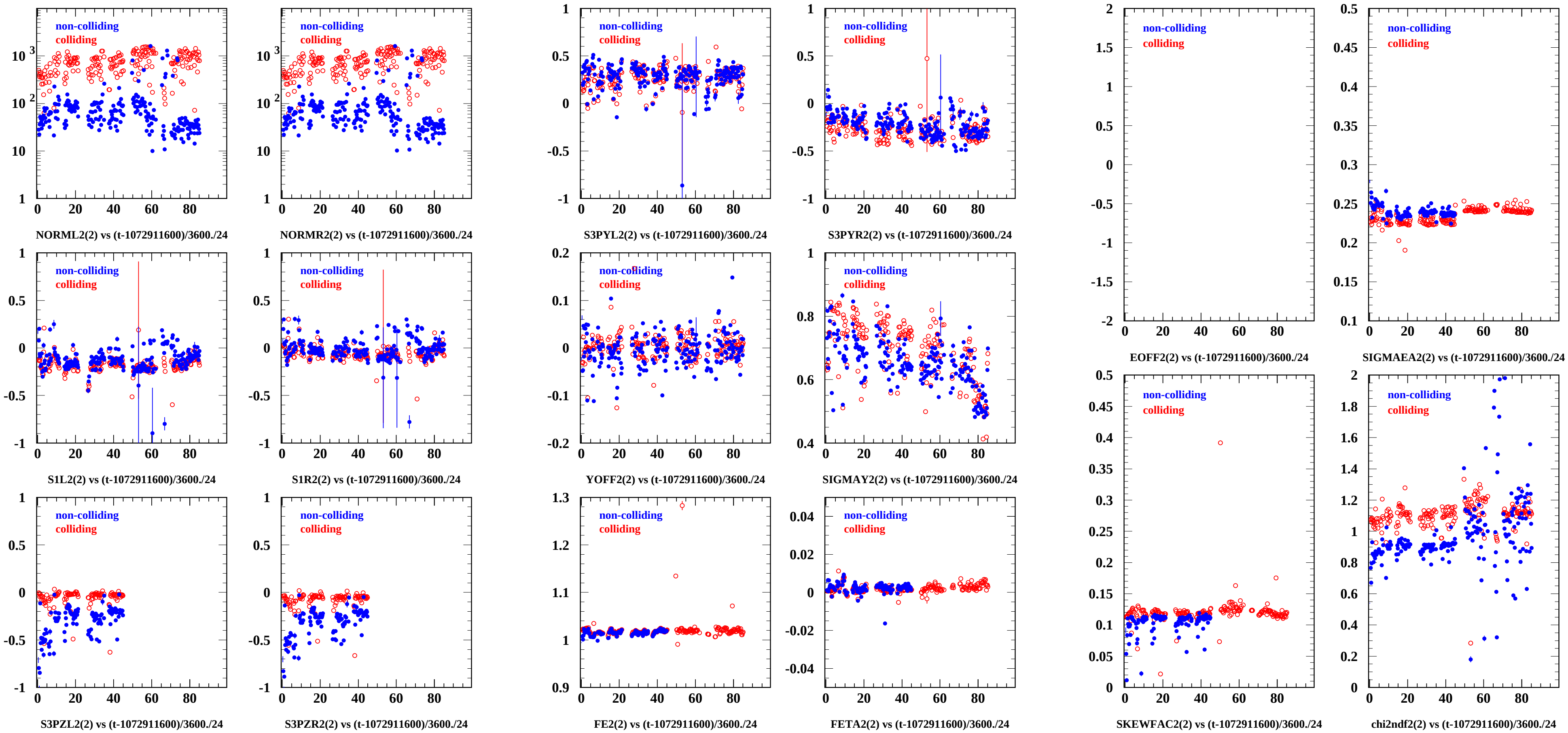
- large number of free parameters
- small number of free parameters

Fit results (1):

Normalisation L,R — $S_3 P_y$ L,R

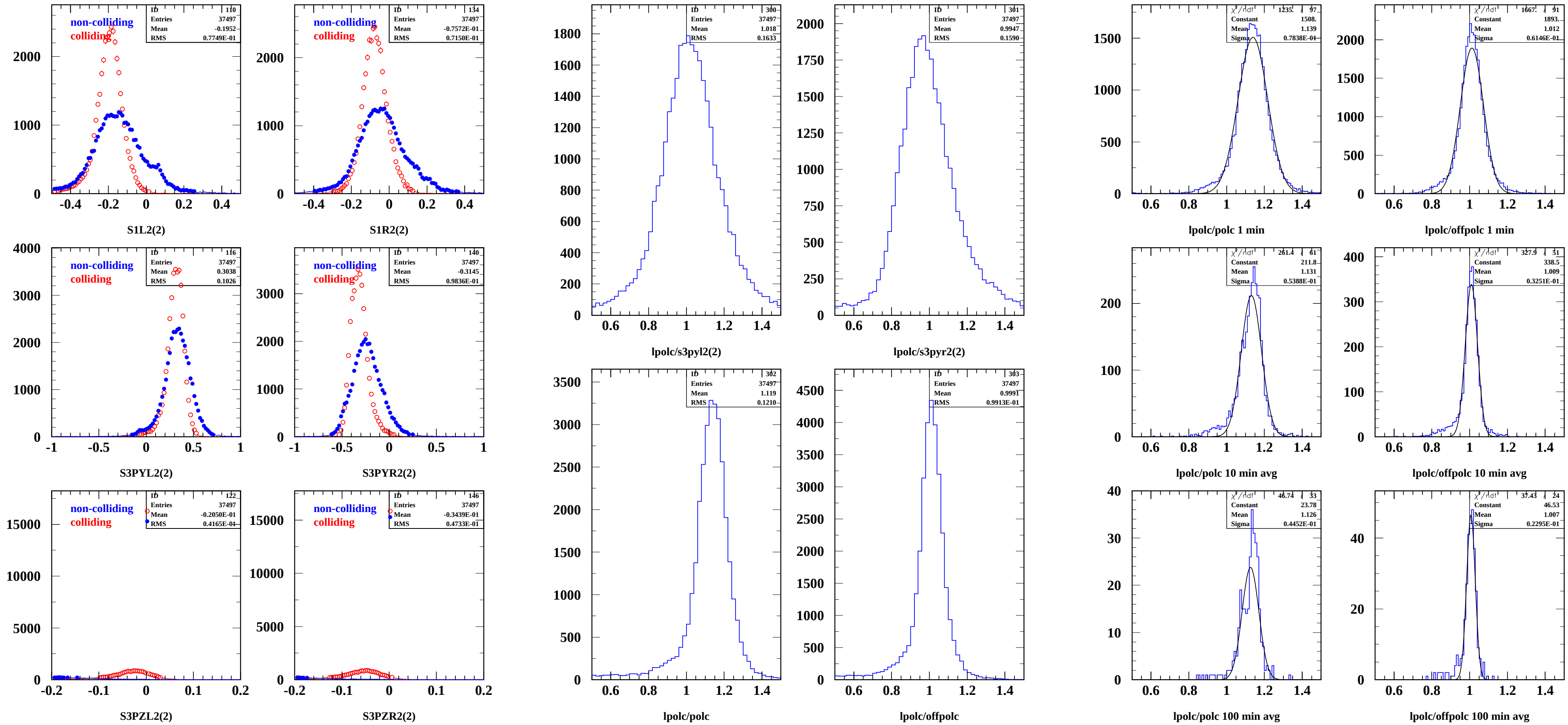
S_1 L,R — y-offset — beam size — Energy resol.

$S_3 P_z$ L,R — Energy cal. — η cal. — $f_{\rm skew}$ — χ^2



Fit results (2):

S_1 L,R			LPOL/TPOL 1 min
S_3P_y L,R	LPOL/S3PYL	LPOL/S3PYR	LPOL/TPOL 10 min
S_3P_z L,R	LPOL/online	LPOL/S3PY	LPOL/TPOL 100 min



Conclusions

- New fit seems to work
- Good stability against number of free parameters for colliding bunches
- Non colliding bunches: fix some parameters as obtained from colliding bunches
- Agreement with LPOL within 2%
- More work necessary to sort out all details

  Should start offline analysis of TPOL data in mass-production mode as soon as possible