

# TPOL Offline analysis review talk



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TPOL analysis meeting  
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# OUTLINE

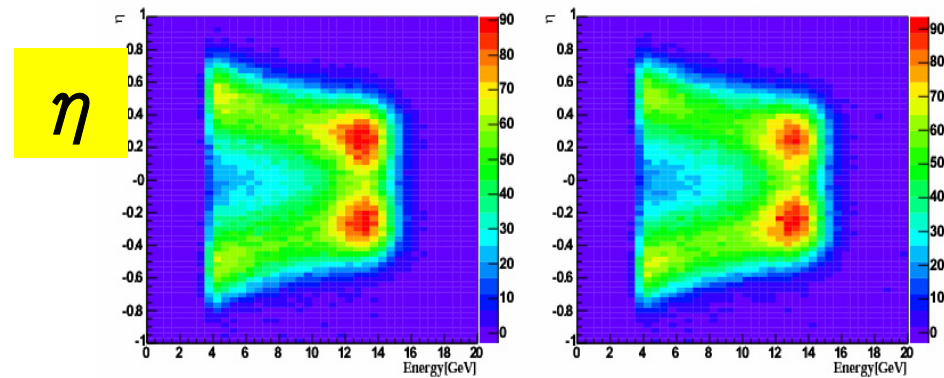
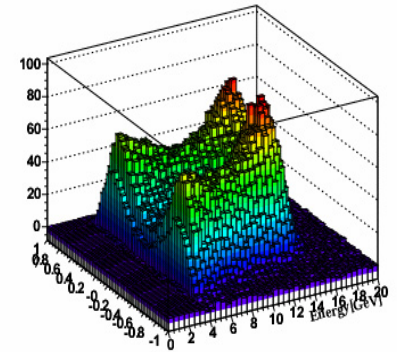
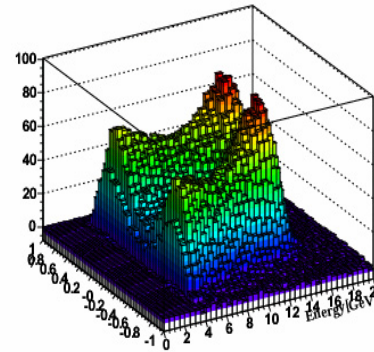
- The multi parameter fitting method.
- Study on the  $\eta$  range dependence.
- Final parameter set
- Some results with all data (03.Oct~04.Dec)
  - LPOL/TPOL ratio
  - Polarisation from laser left & right
  - Focus dependence
- Systematic study
- Summary

# The fitting method

- Fit to 2D  $(E, \eta)$  Compton cross section.
- Fitting parameters...
  - CAL related
    - Distance
    - Resolution
    - Skew-factor ( $\eta$  resolution)
    - Miscalibration etc...
  - Beam related
    - Beam offset
    - Beam size
    - Laser linear component ( $\Delta S1$ ) etc...

Laser=LEFT

Laser=RIGHT

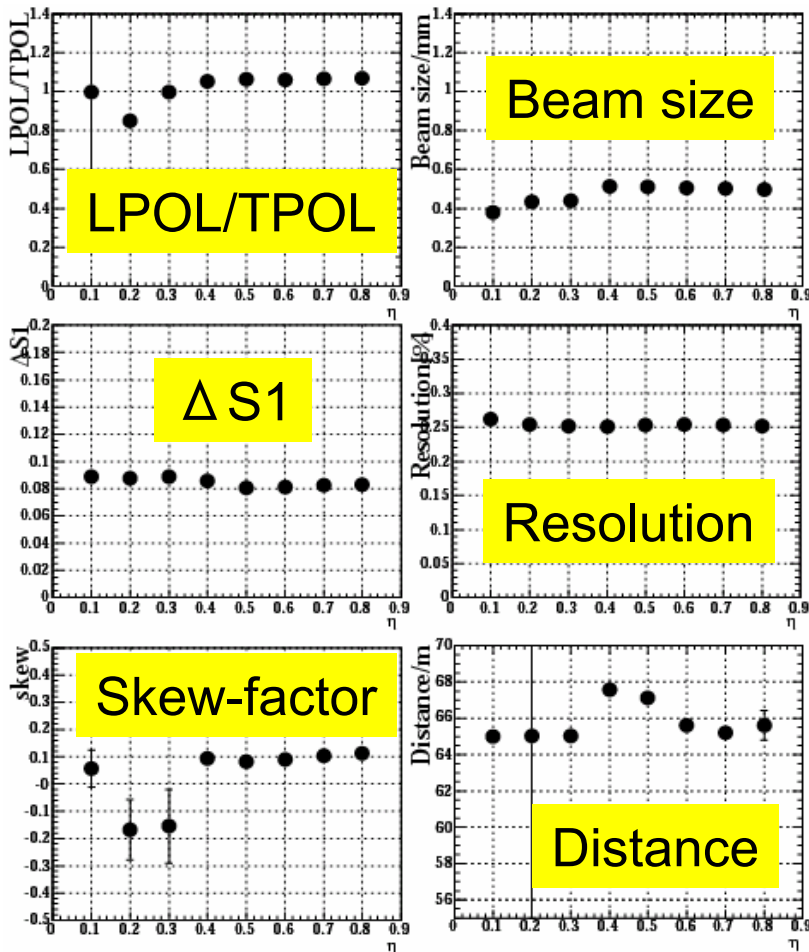


$\eta$

Energy

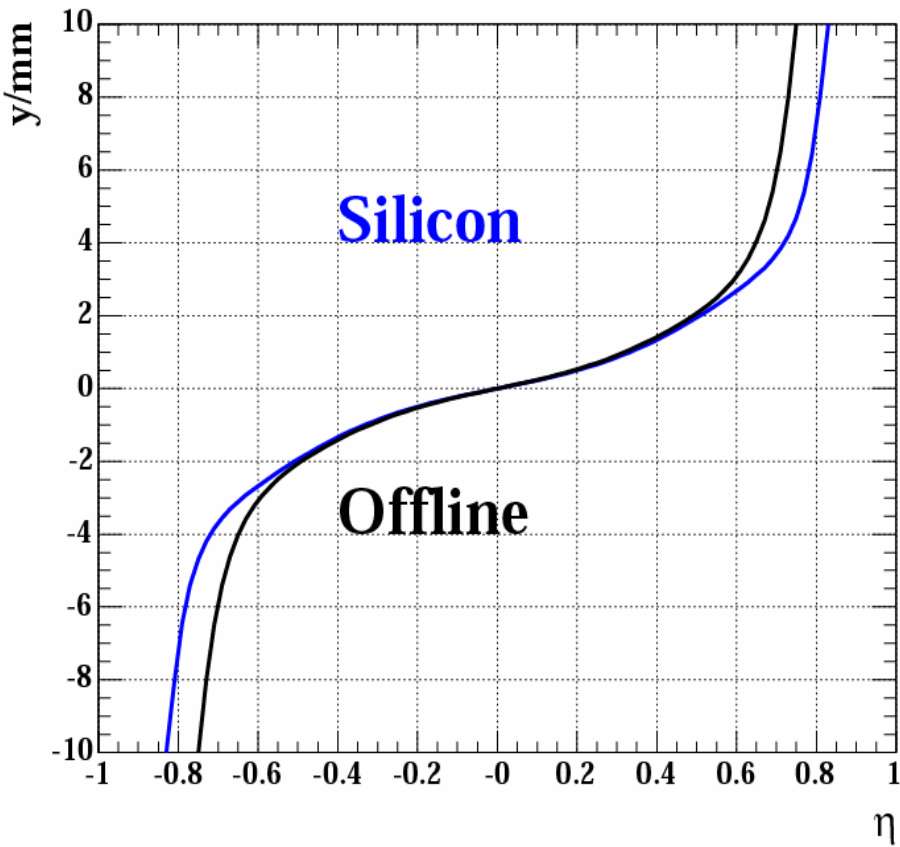
# Fit stability

## All parameters free



- Fitting range.
  - +/-0.1~+/-0.8, with 0.1 step
- Some parameters (LPOL/TPOL, beam size, etc) are almost stable in high  $\eta$  region.
  - check the  $\eta - y$  curve which the fitting method returns.

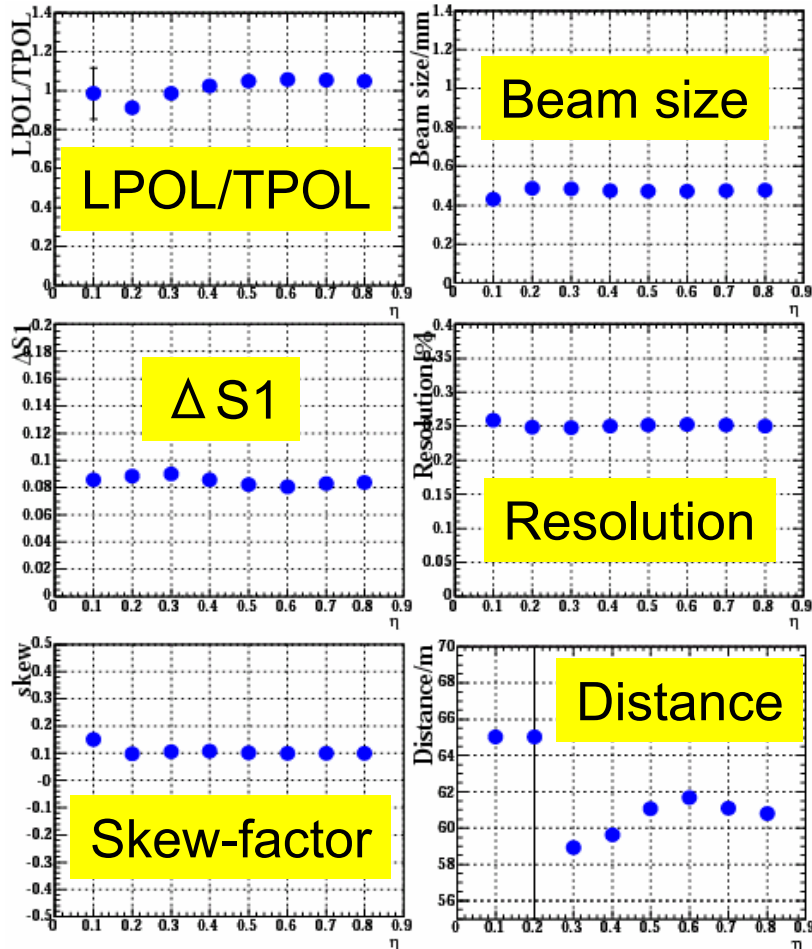
# $\eta - \gamma$ curve



- The method can not reproduce  $\eta - \gamma$  curve.  
→ fixed to the curve parameters with the silicon measurement.

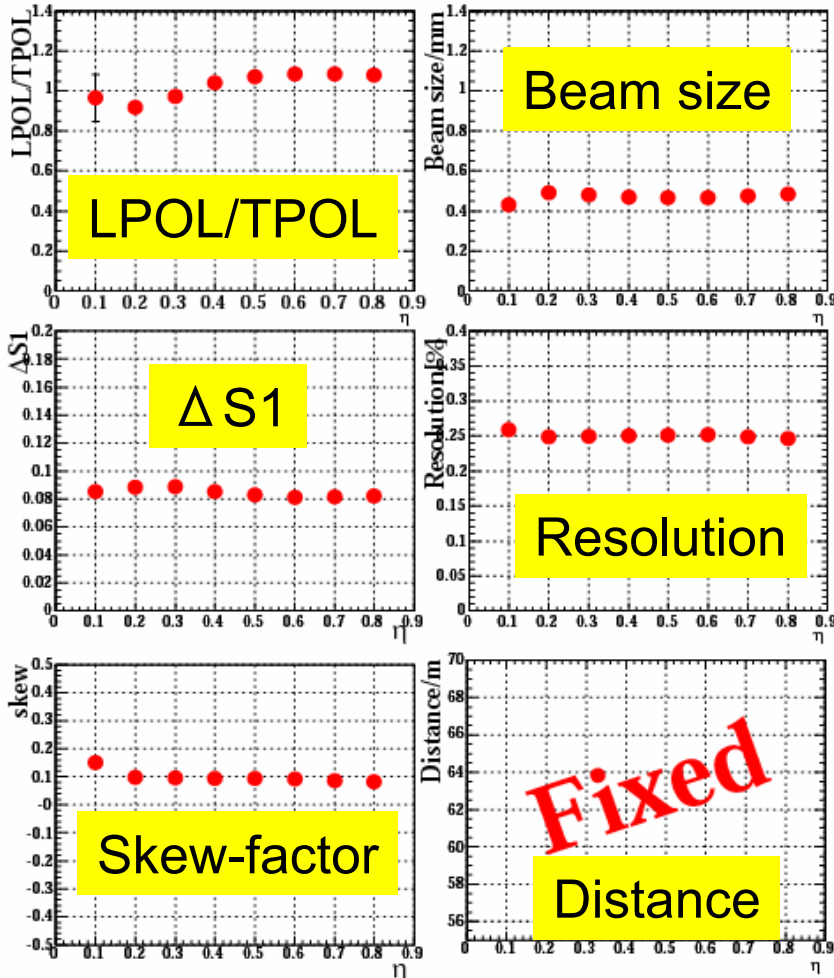
# Fit stability

## $\eta$ - $\gamma$ parameters fix



- The distance is not stable against  $\eta$ , though other parameters are almost stable.  
→ distance fixed to 65m.

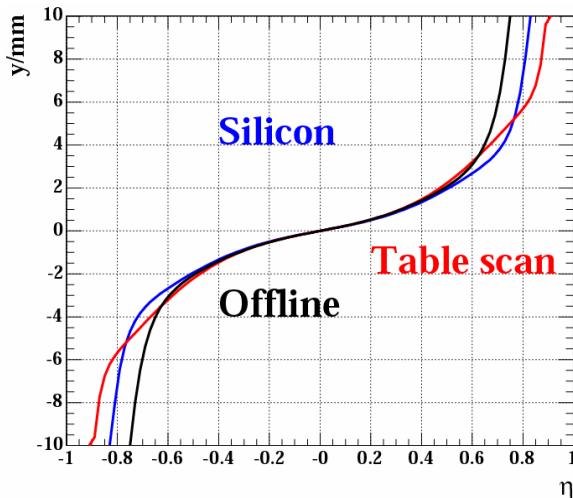
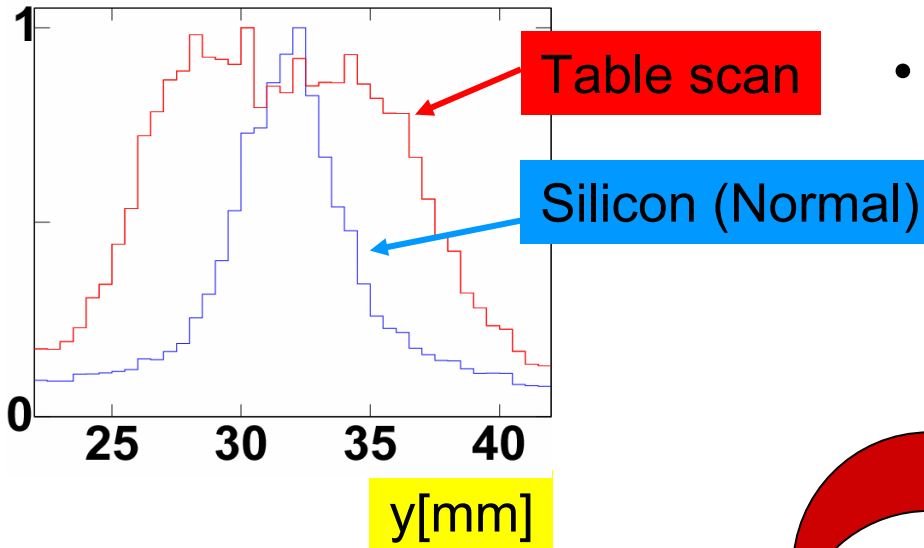
# Fit stability distance fixed to 65m



- After the distance is fixed, the method is almost stable, seems to be good.
- Which is best fitting range?

→ compare  $\eta$ -y curve from **Table scan** with **Normal**.

# Table scan



- Motivation

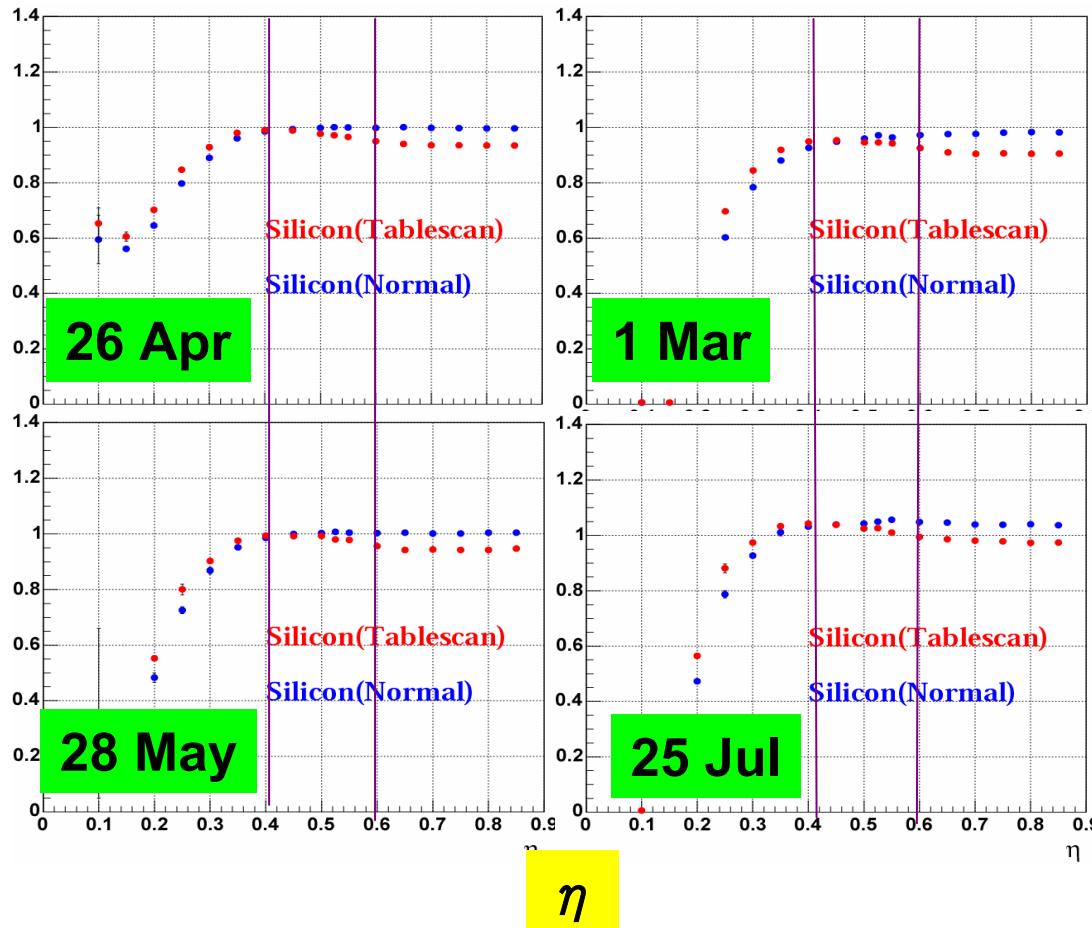
- To increase statistics at large  $\eta$  ( $y$ ).

- To reduce background which may cause bias in deriving  $\eta - y$ .

- ◆ Back scatter from CAL
- ◆ Entering with angle due to pre-radiator

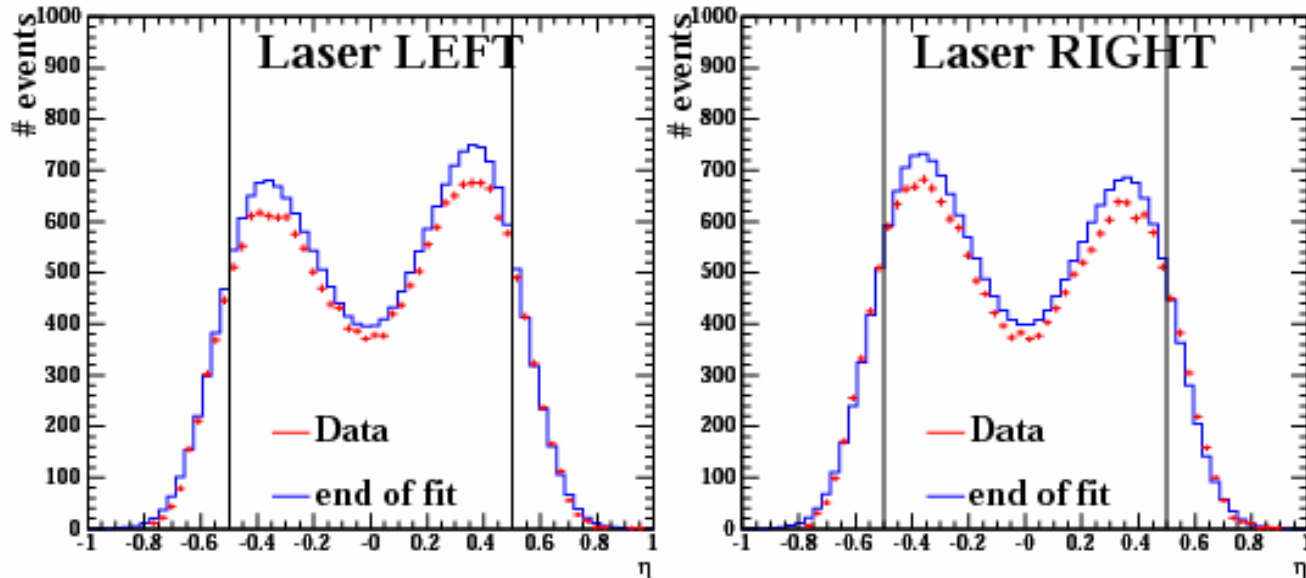


# Check $\eta$ range dependence



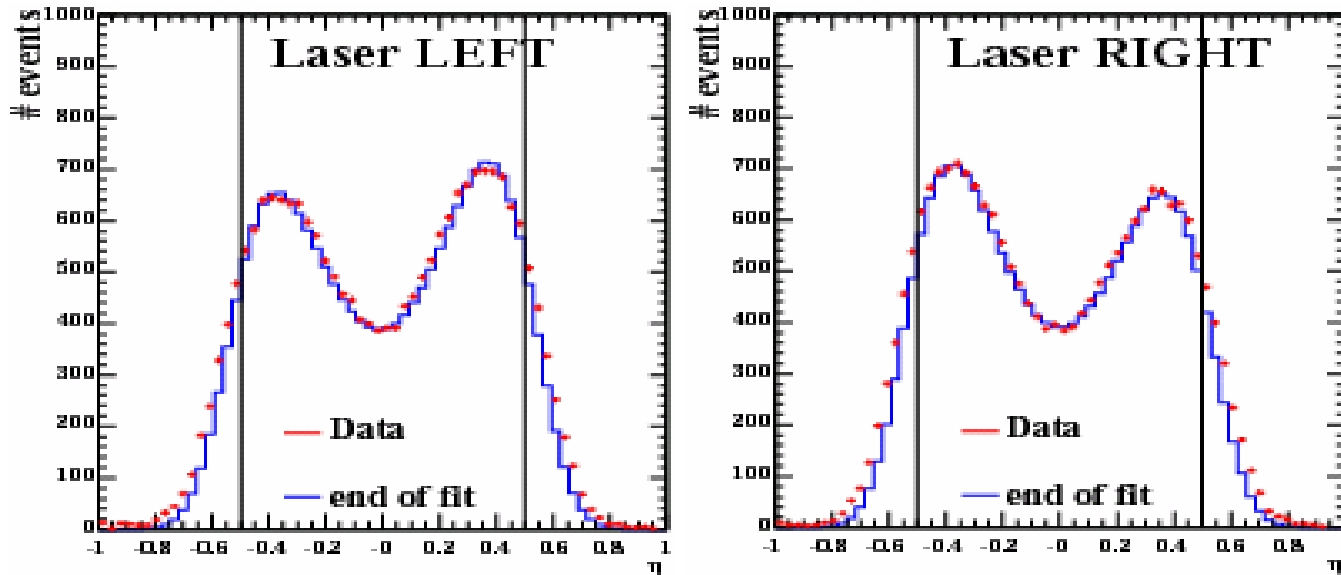
- High  $\eta$  region
  - Uncertainty due to background events and low statistics.
  - should be excluded.
- Low  $\eta$  region
  - Unstable
  - also excluded.
- Fitting region should be between  $\pm 0.4 \sim \pm 0.6$ .
- Selected  **$\pm 0.5$**

# Histogram check I



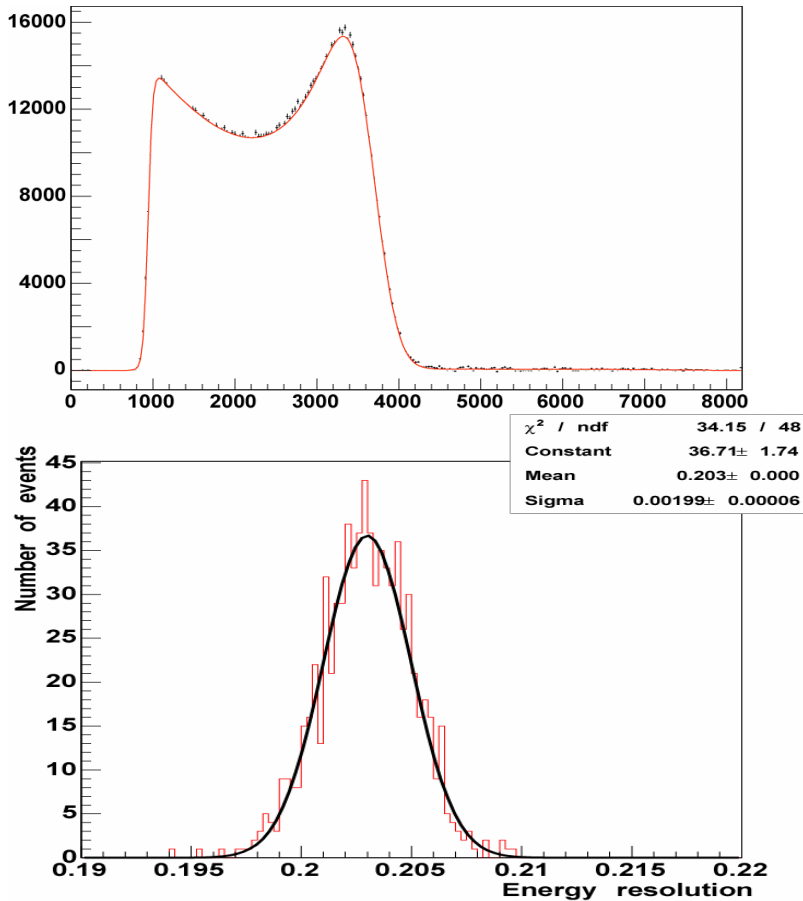
- Skew-factor and Energy resolution are free.
  - the fitting method can not reproduces data.
    - need to be fixed
    - which value?

# Histogram check II



- Finally,
  - skew-factor  $\rightarrow 0.0$ ,
  - energy resolution  $\rightarrow 20.3\%$ . See next slide

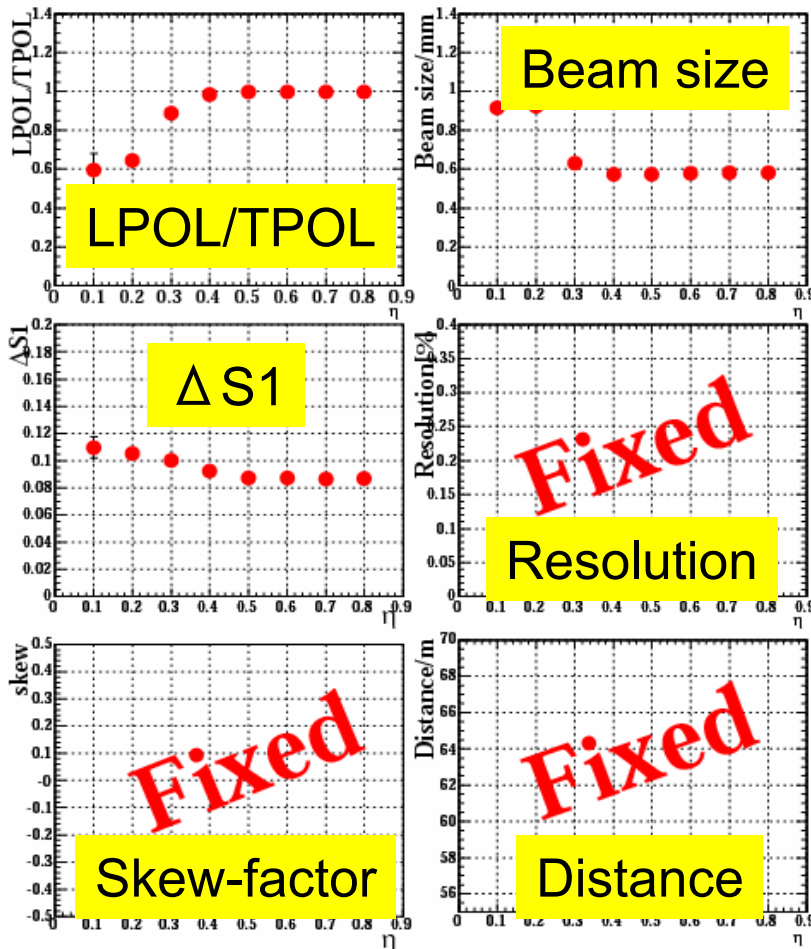
# Energy resolution



Date	$\sigma$
01.Mar	0.1918
07.Mar	0.1932
24.May	0.1988
11.Aug	0.1847

- 20.3% is consistent with Catherine's results.
- 23% at CERN beam test, will be included as a systematic error. (See later)

# $\eta$ range study with final parameters set



- $\eta$  range between +/- 0.4~+/-0.6 is almost stable.  
→ +/-0.5 is reasonable.
- Analyzed all data (Oct.03~Aug.04)  
See later...

# Final parameters set

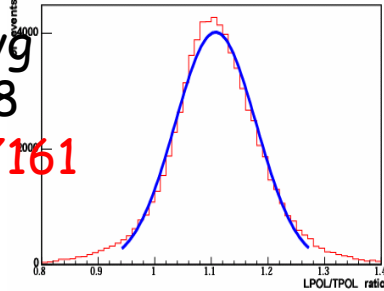
$\eta$ - $\gamma$ 4 parameters	Table scan
$\eta$ range	+/- 0.5
beam offset	free
distance	65m
beam size	free
CAL miscalibration	free
skew ( $\eta$ resolution)	0.0
CAL energy resolution	20.3%

# LPOL/TPOL ratio with all data

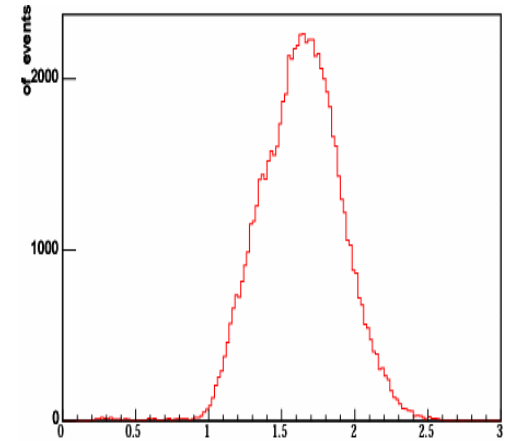
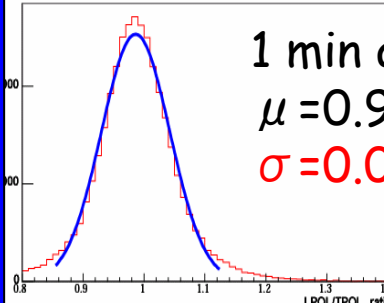
Online

Offline

1 min avg  
 $\mu = 1.108$   
 $\sigma = 0.07161$

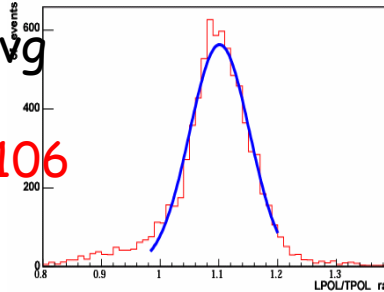


1 min avg  
 $\mu = 0.9914$   
 $\sigma = 0.06456$

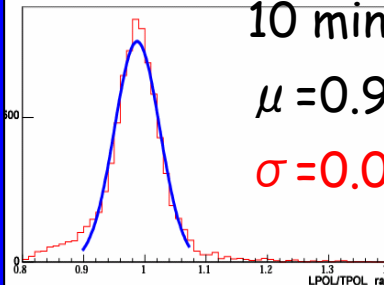


Chi2

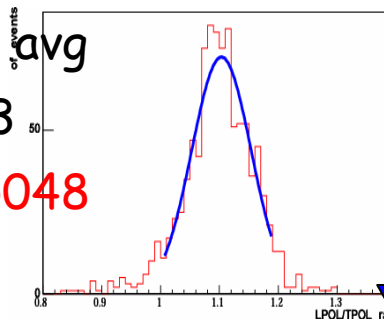
10 min avg  
 $\mu = 1.101$   
 $\sigma = 0.05106$



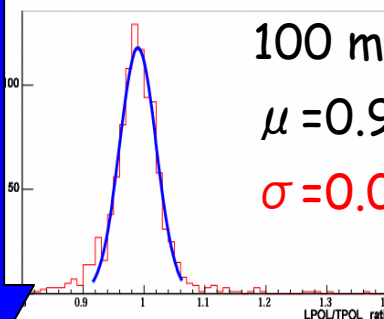
10 min avg  
 $\mu = 0.9969$   
 $\sigma = 0.047$



100 min avg  
 $\mu = 1.103$   
 $\sigma = 0.05048$



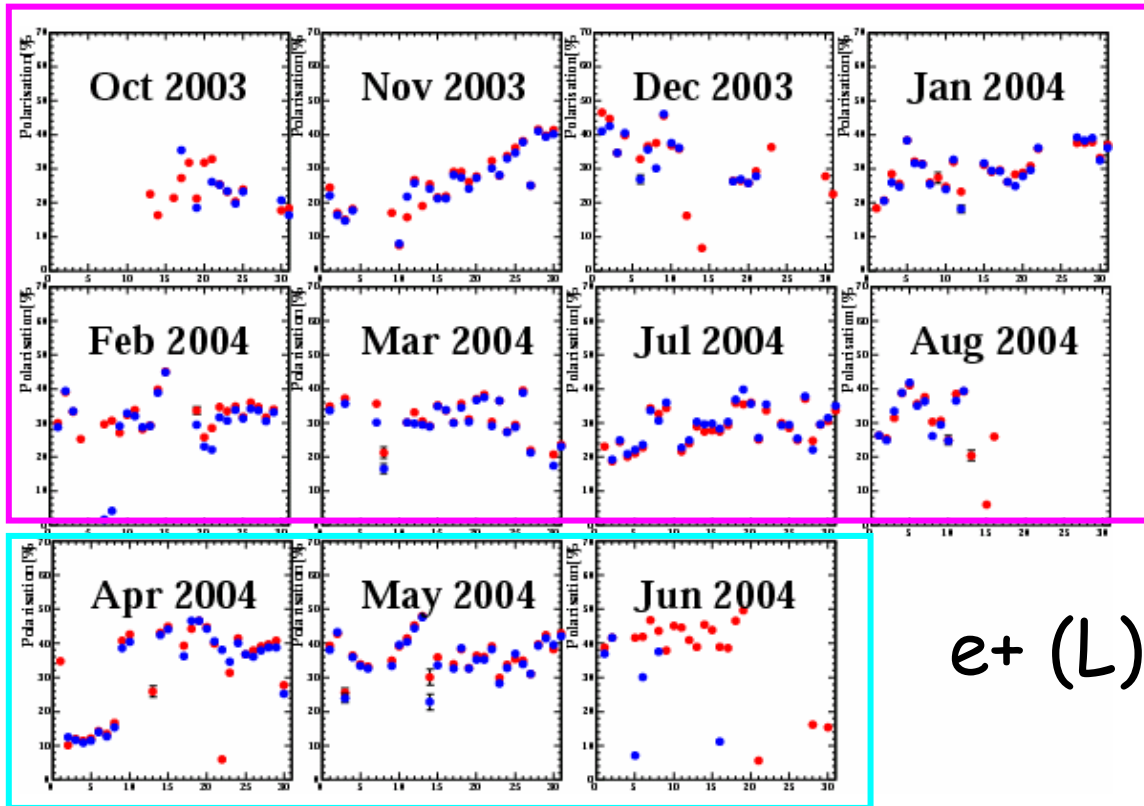
100 min avg  
 $\mu = 0.9979$   
 $\sigma = 0.0362$



With more averaging time.  
 $\rightarrow \sigma$  is getting smaller  
 Chi2  $\sim 1.6$

# Average HERA polarisation

Polarisation[%]



$e^+$  (R)

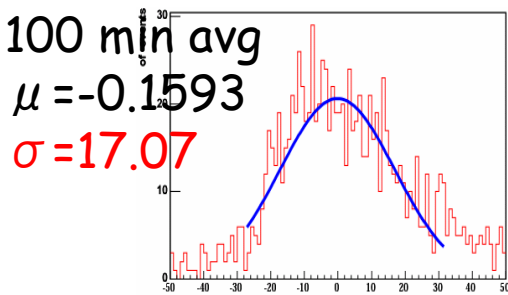
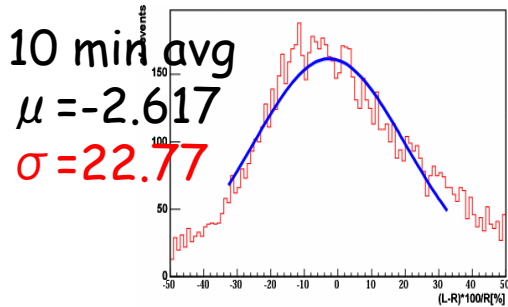
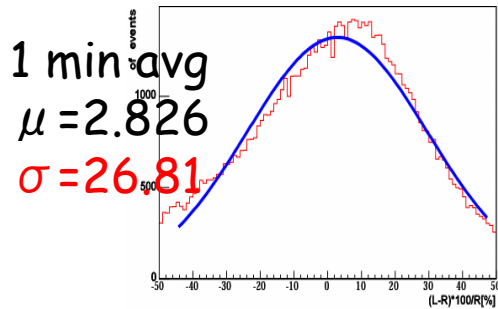
LPOL (online)  
TPOL (offline)

$e^+$  (L)

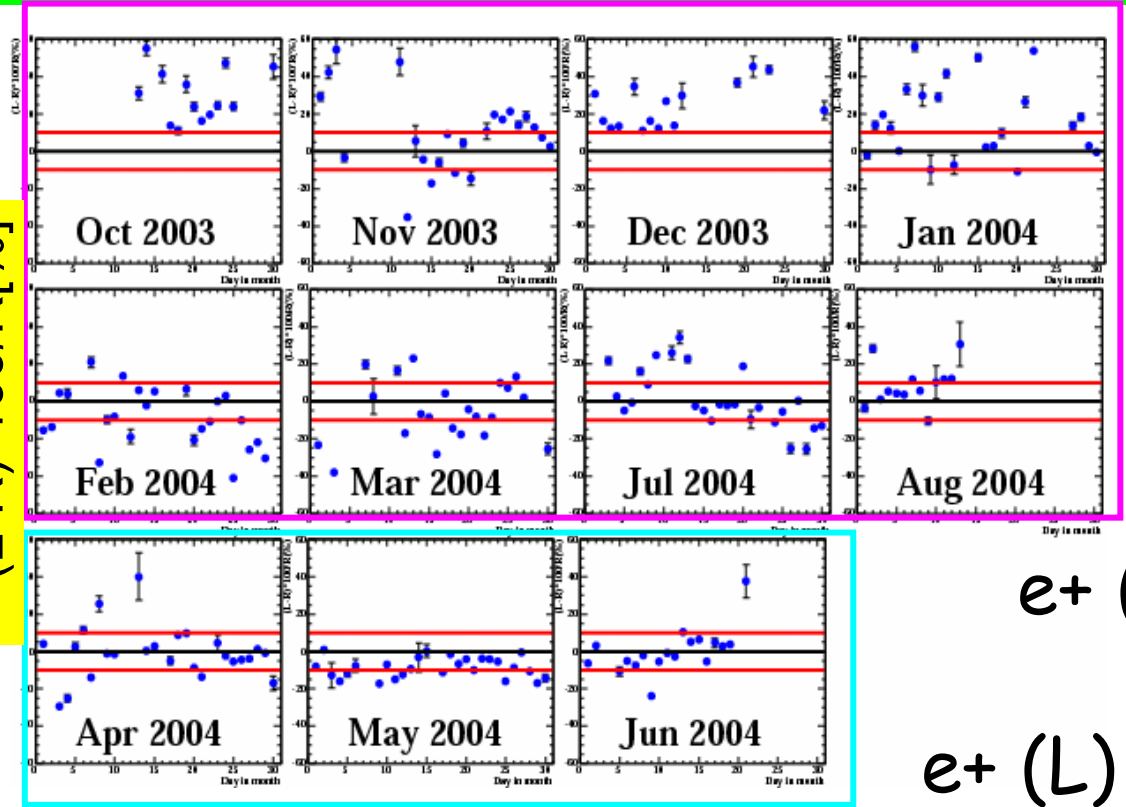
LPOL and TPOL agree with each other.



# Polarisation with laser left & right



$(L-R)*100/R[\%]$



$e^+ (R)$

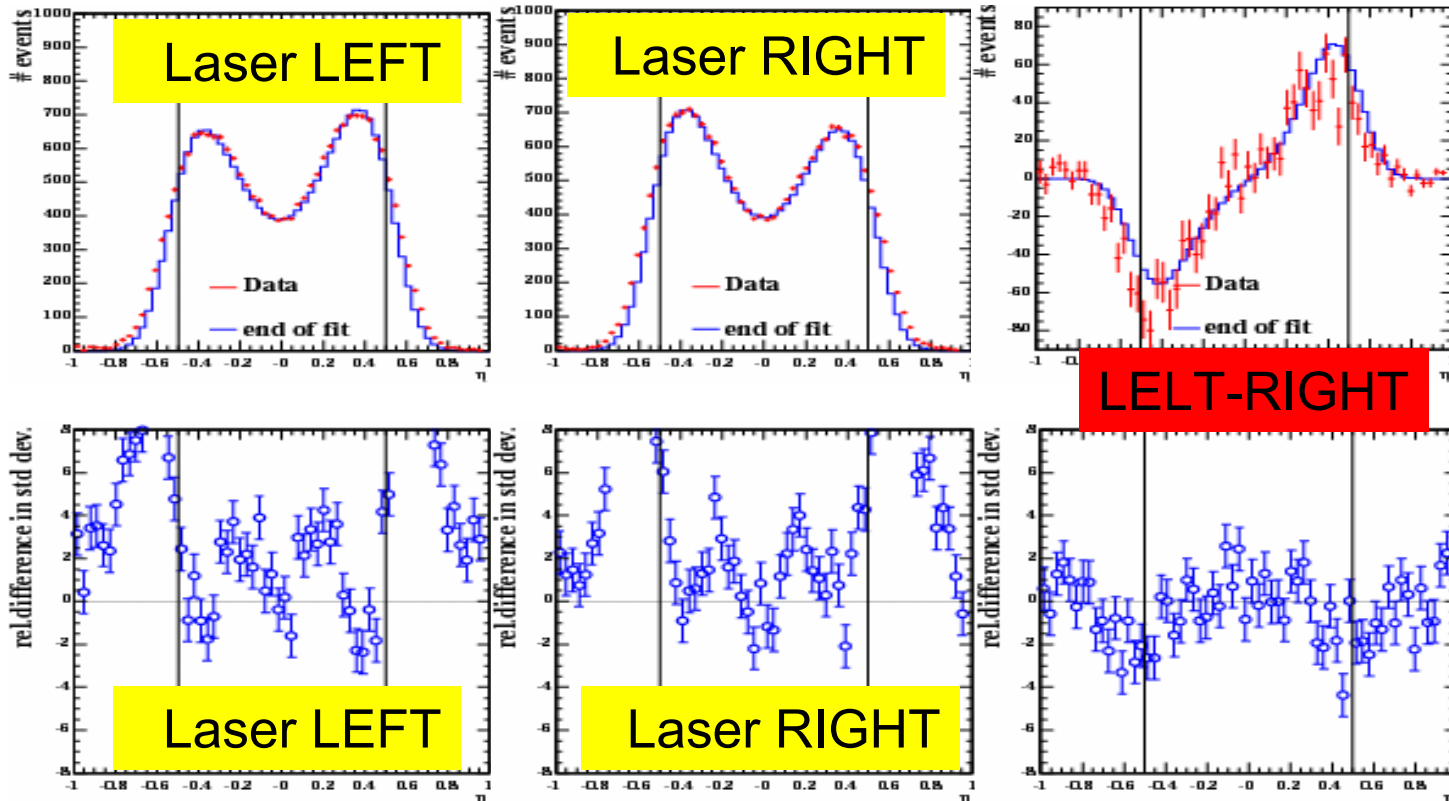
$e^+ (L)$

- The difference between Pol-left & Pol-right is small with more averaging time, but seems to have time dependence.

$(L-R)*100/R[\%]$

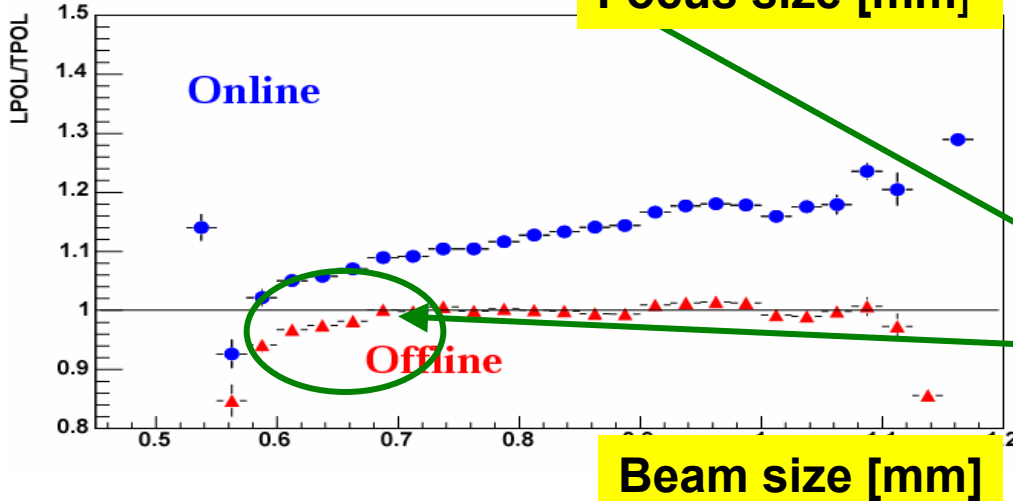
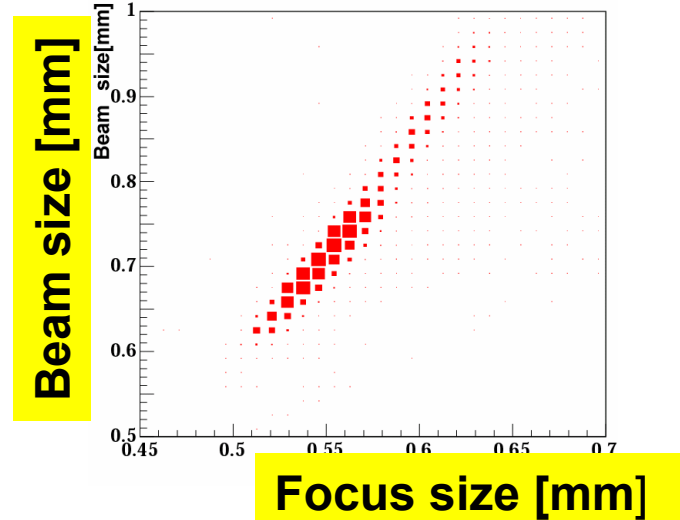
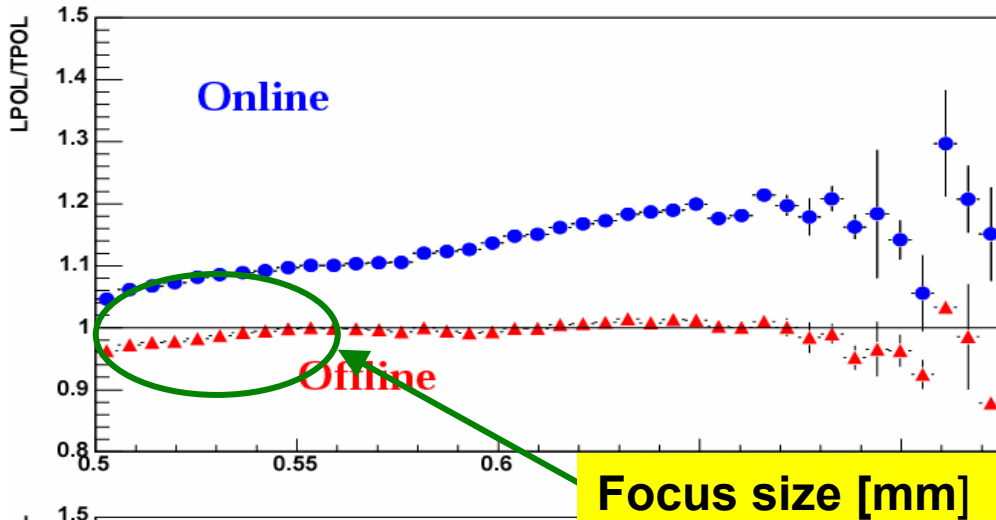
More averaging time

# Histograms & pull / Laser LEFT, RIGHT, (LEFT-RIGHT)



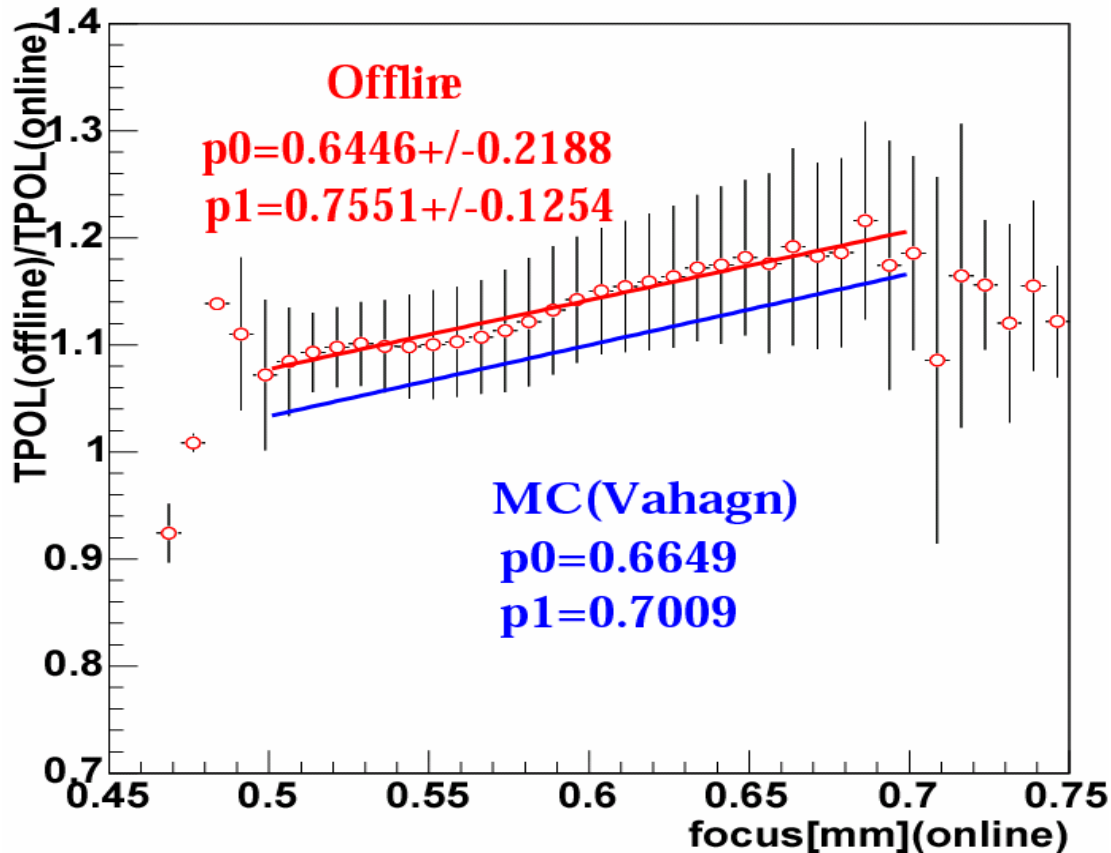
- There seems to exist some counter systematic uncertainties laser-left and laser-right.
- In extracting polarisation, used averaged histogram (L-R)  
→ seems to be ok.

# Focus dependence



The fitting method can almost absorb a focus/beam size dependence. Weak dependence are remained.

# Focus correction



The slope from the fitting method agree with Vahagn's results, but the offset does not.

# Systematic study

- $\eta - \gamma$  curve
  - Table scan, Normal
- $\eta$  range
  - (0.5 +/- 0.1)
- Distance
  - (65m +/- 1m)
- Beam offset
  - (free  $\rightarrow$  fixed to 0.0)
- CAL miscalibration
  - (Fe, Feta) free
    - $\rightarrow$  (1.0, 0.0) fixed
- Skew ( $\eta$  resolution)
  - 0.0  $\rightarrow$  free
- CAL energy resolution
  - 20.3%
    - $\rightarrow$  (+/- 1sigma of Compton edge)
    - $\rightarrow$  CERN test

# Systematic error

- $\eta$  - $y$  curve 1.27( $\pm$ 0.04)%
- $\eta$  range 2.07( $\pm$ 0.04)%
- Calibration of CAL 1.37( $\pm$ 0.04)%
- Beam offset 0.02( $\pm$ 0.04)%
- Distance IP to CAL -0.98( $\pm$ 0.04)%
- Energy resolution -0.13( $\pm$ 0.04)%
- Skew-factor 4.19( $\pm$ 0.04)%

5.12%

# Summary

- For working this fitting method, some fitting parameters should be fixed,
  - $\eta$  -  $y$  curve, Distance, Skew-factor, Energy resolution.
- The difference between Polarisation from laser-left/right is small with more averaging time but seems to have time dependence.
- There seems to exist some counter systematic uncertainties laser-left and laser-right
  - Not understood why this happens.
  - Seems to be ok with averaged left and right.
- Analyzing all data (03.Oct~04.Aug), the LPOL/TPOL ratio is close to 1 and with more averaging time, sigma is getting small.
- The fitting method can almost absorb the focus dependence which is seen clearly on the online analysis.
- The fitting method can reproduce the focus correction function which is estimated with MC by Vahagn.
- Systematic error is rather large ~5%