Status of the HERA polarimeters

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ZEUS collaboration meeting

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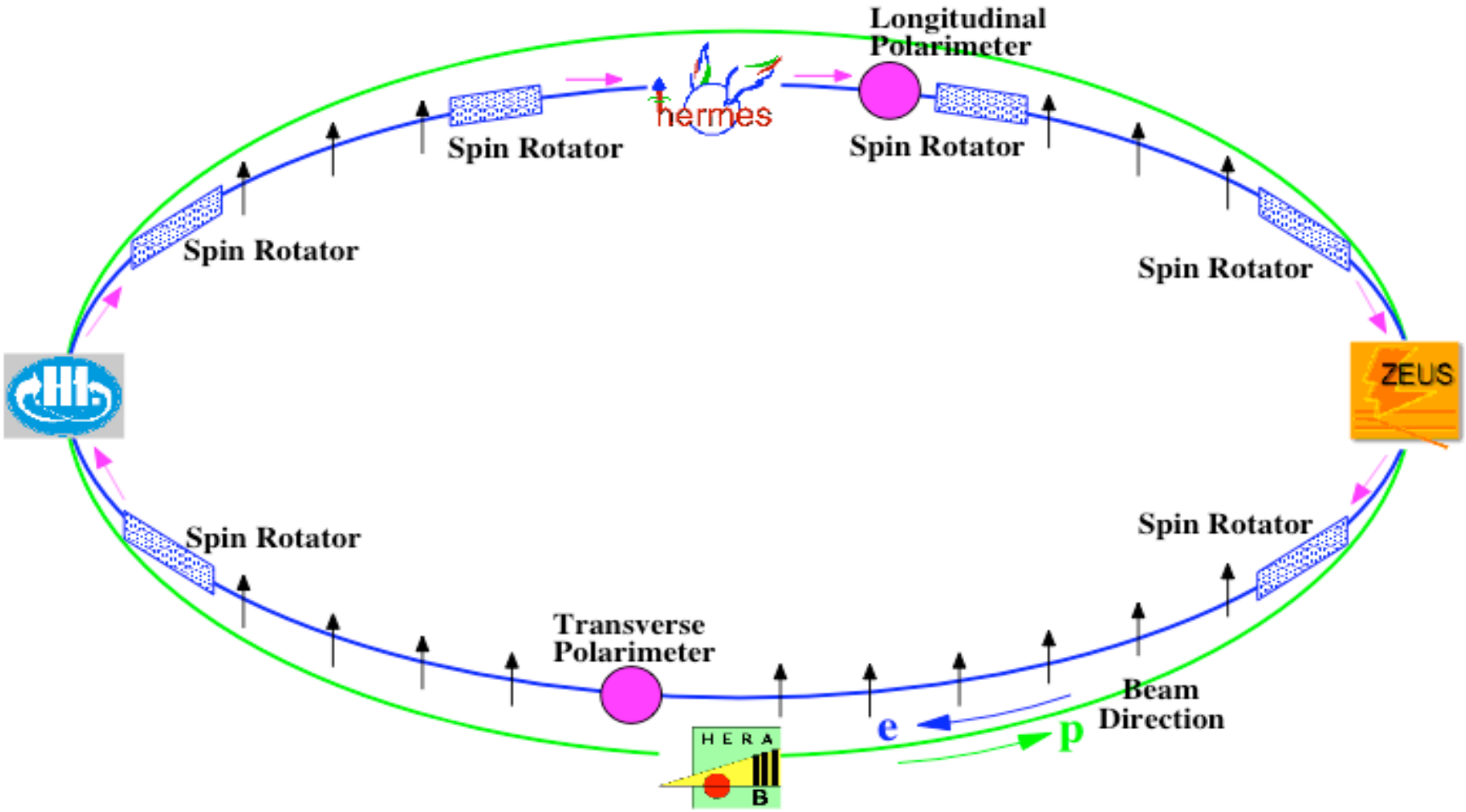
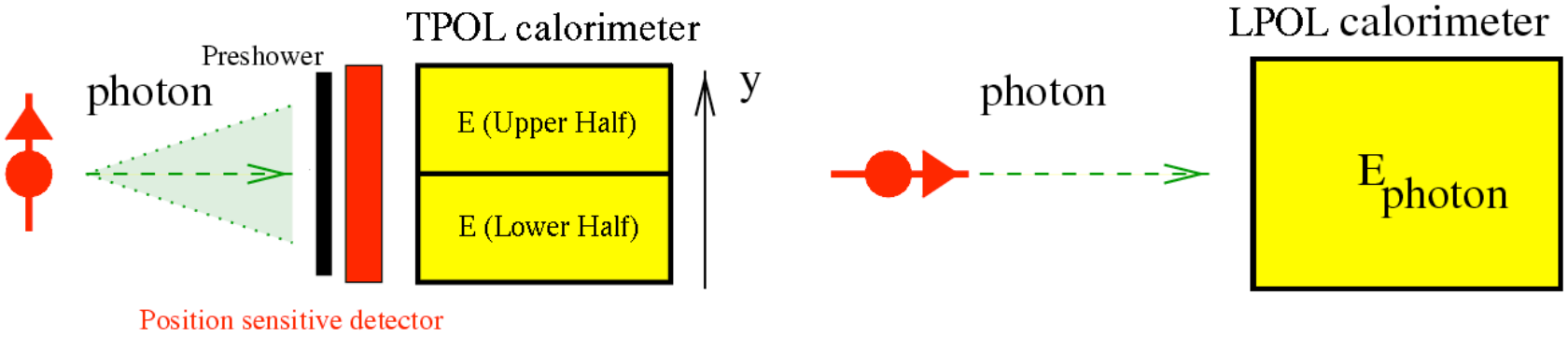
Outline

- The HERA polarimeters
- The polarisation measurement
- Electron beam polarisation
- Polarimeter performance
- LPOL/TPOL discrepancy
- TPOL offline analysis
- LPOL cavity and fibre calorimeter
- Summary and conclusions

HERA


Longitudinal
Polarimeter
hermes
Spin Rotator
Spin Rotator
Spin Rotator
Spin Rotator
ZEUS
Spin Rotator
Spin Rotator
Transverse
Polarimeter
HERA
B
e
p
Beam
Direction

Polarisation measurement

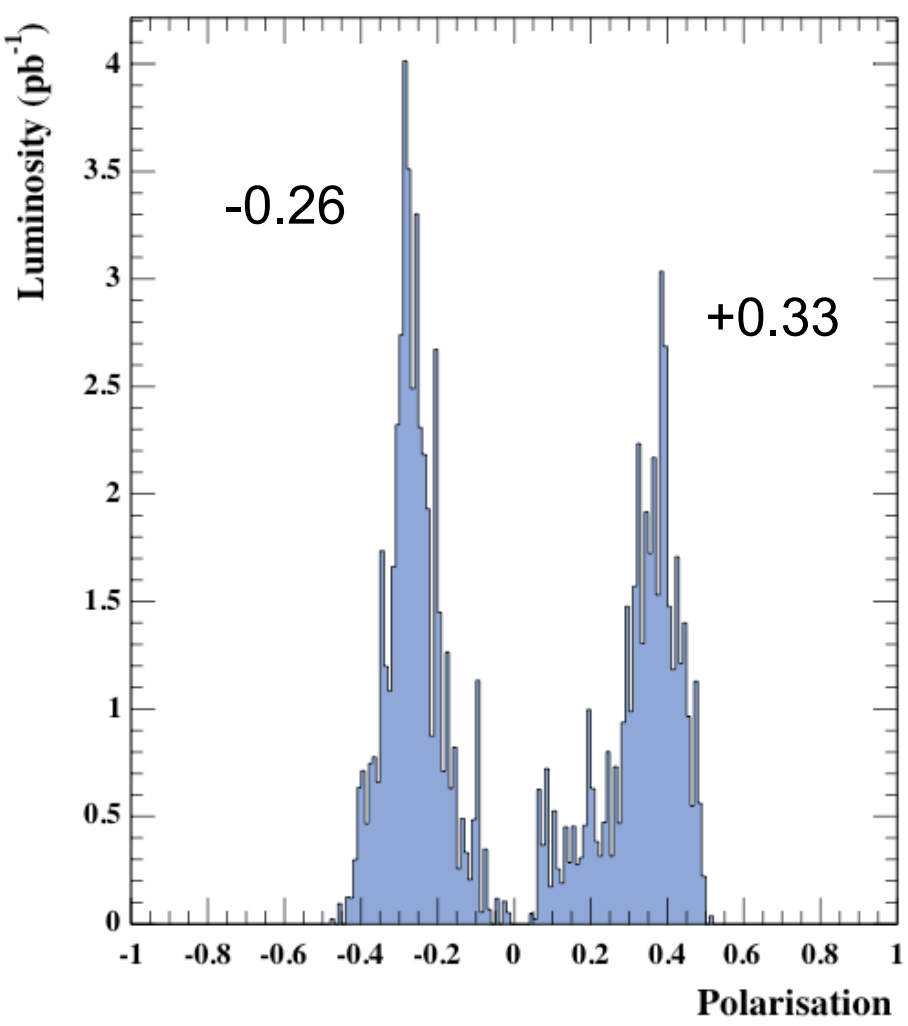


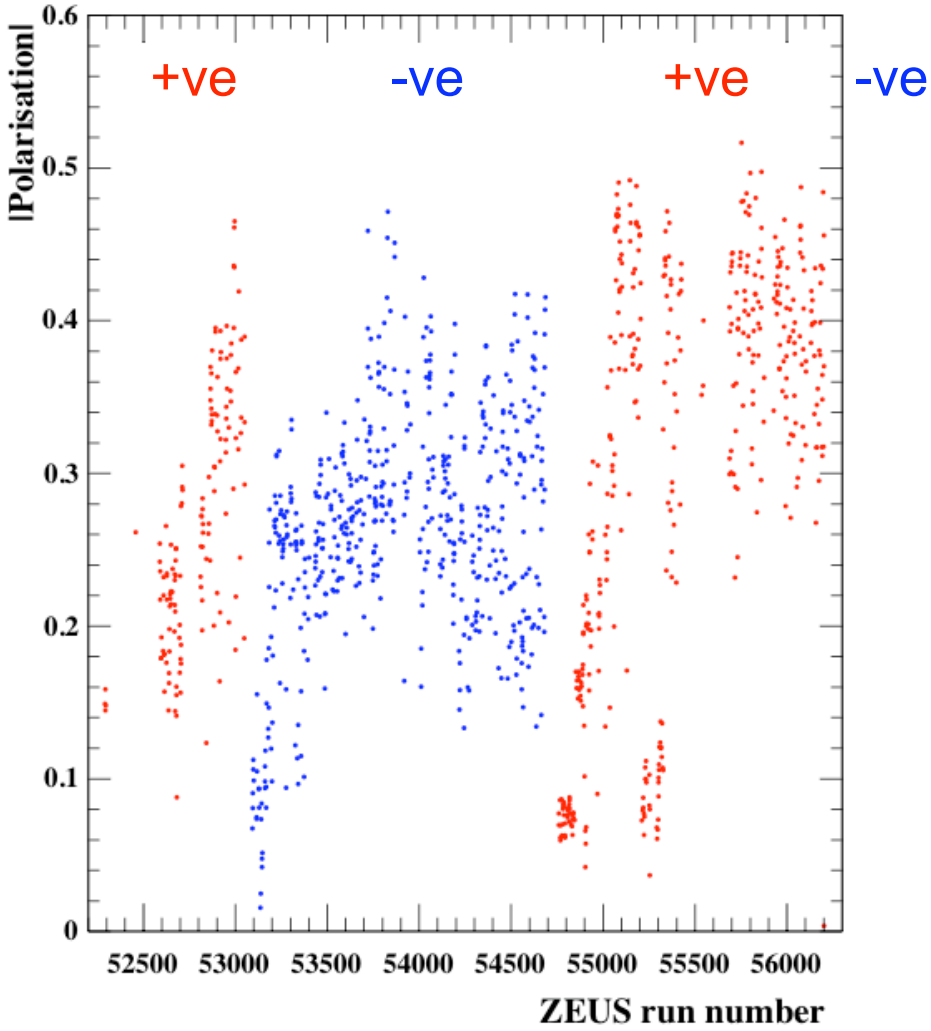
- Both polarimeters use Compton scattering of a circularly polarised laser off the electron beam to measure its polarisation
- TPOL measures asymmetry in vertical position and energy between LH and RH polarised laser to extract polarisation

$$\eta = \frac{E_{up} - E_{down}}{E_{up} + E_{down}} \qquad P_Y = \frac{1}{2}\Pi(\bar{\eta_R} - \bar{\eta_L})$$

- LPOL measures asymmetry just in energy between LH and RH polarised laser to extract polarisation

Electron beam polarisation

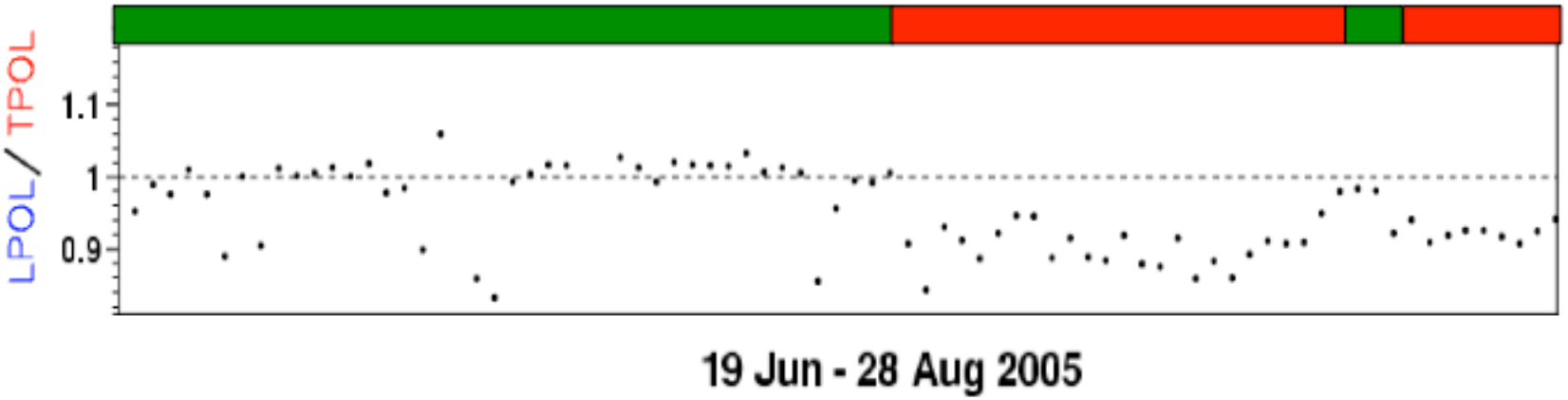




Polarimeter performance

- LPOL or TPOL efficiency > 99 %
- Generally smooth running for both polarimeters
- LPOL
  - systematic studies of crystal calorimeter
  - repaired sandwich calorimeter (radiation damage)
- TPOL
  - few problems with laser cooling over summer
  - replaced old laser tube and a broken discriminator
  - offline analysis studies
  - replaced silicon detector after x-plane was damaged
- Cavity LPOL
  - installation of new fibre calorimeter
  - commissioning ongoing - taking Bremsstrahlung spectra and hope to measure Comptons soon

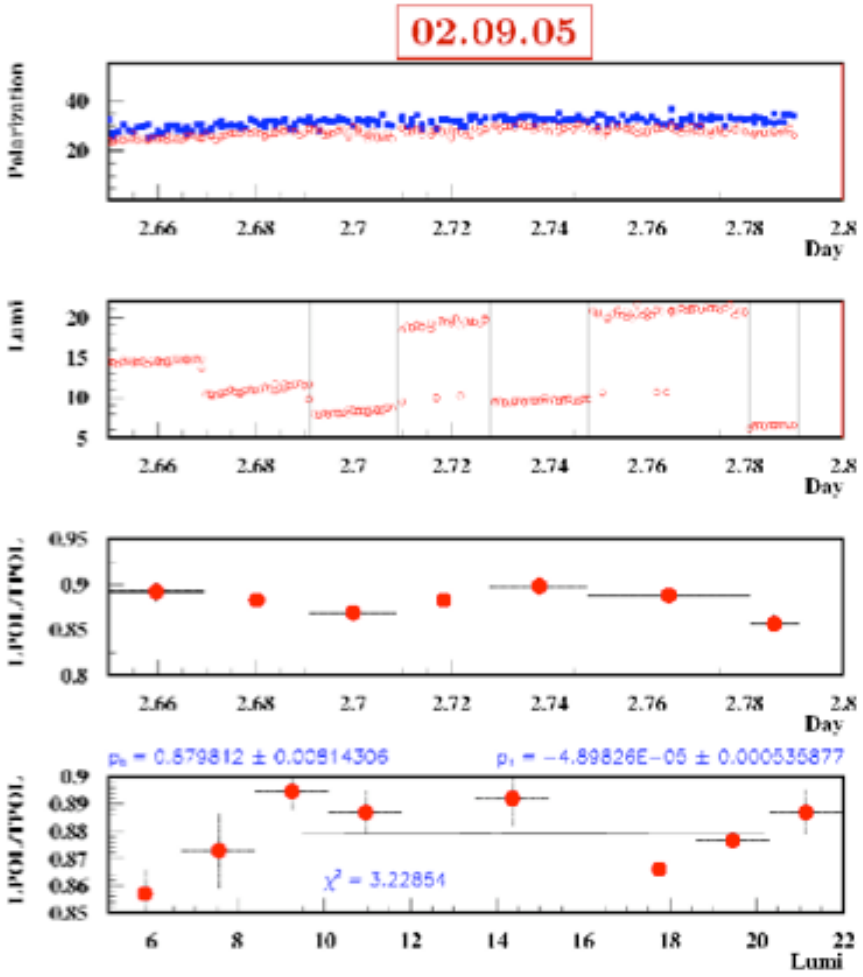
LPOL/TPOL discrepancy



- 2nd August LPOL/TPOL jumped from ~1.0 to ~0.9
- Many studies from LPOL and TPOL into cause of jump
- No clues for now about its cause
- Ratio now back to ~1.0, but studies are continuing to understand the cause of this discrepancy…

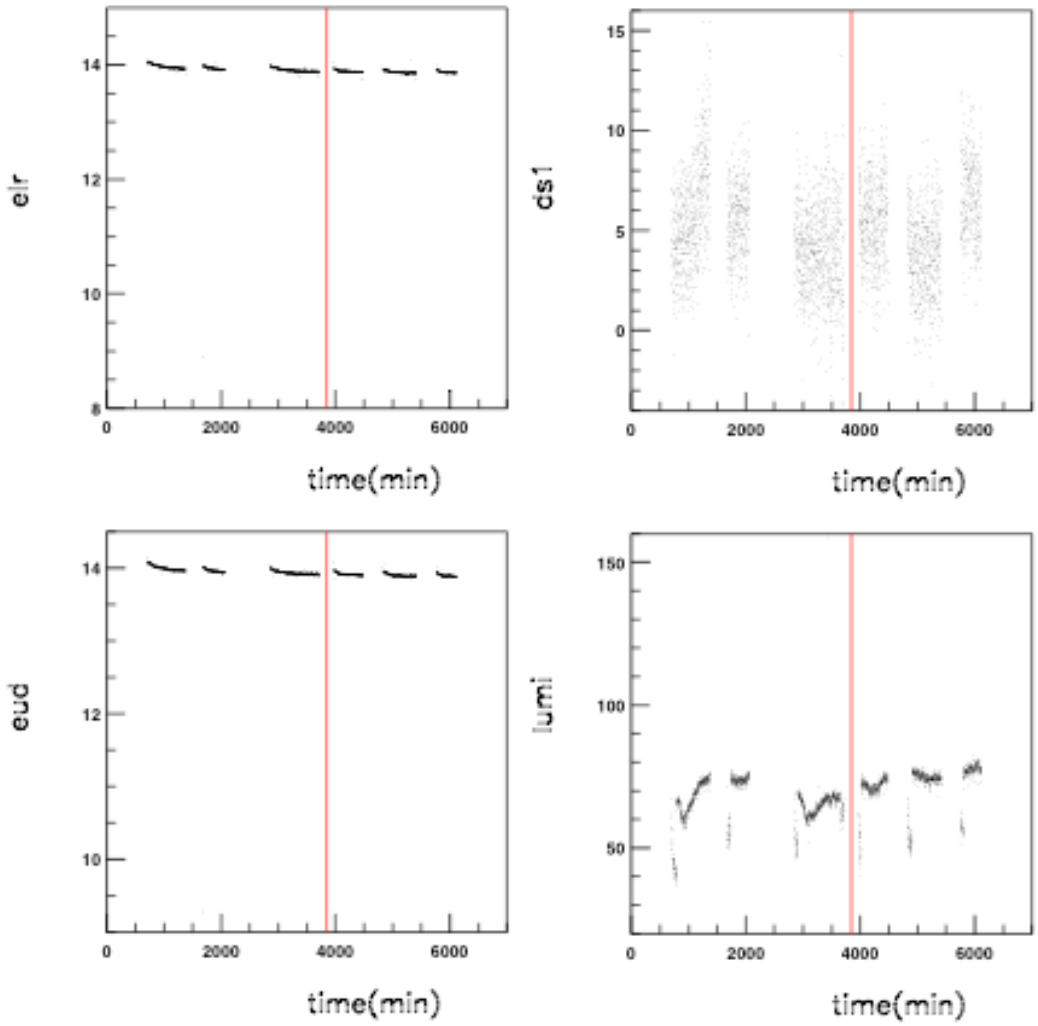
LPOL investigations

- Luminosity was found to be slightly low
  - Optics was checked and fixed and luminosity improved
- Checked calorimeter alignment and performance
- Radiation damage to sandwich calorimeter was discovered and repaired
- But still no clue to explain jump in ratio



TPOL investigations

- Stable running and calibration of TPOL
- Hardware and software all OK
- Plotted all possible observables for beam and TPOL over these dates
- No suspicious behaviour seen



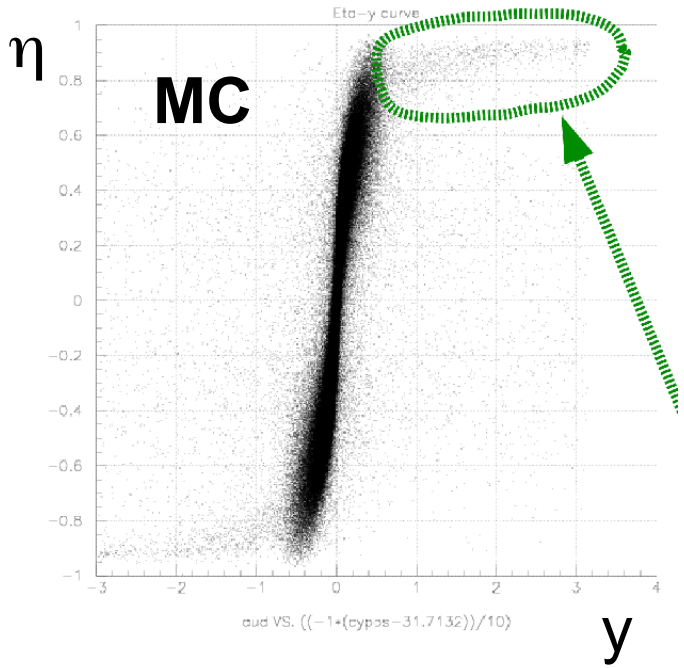
TPOL offline analysis - I

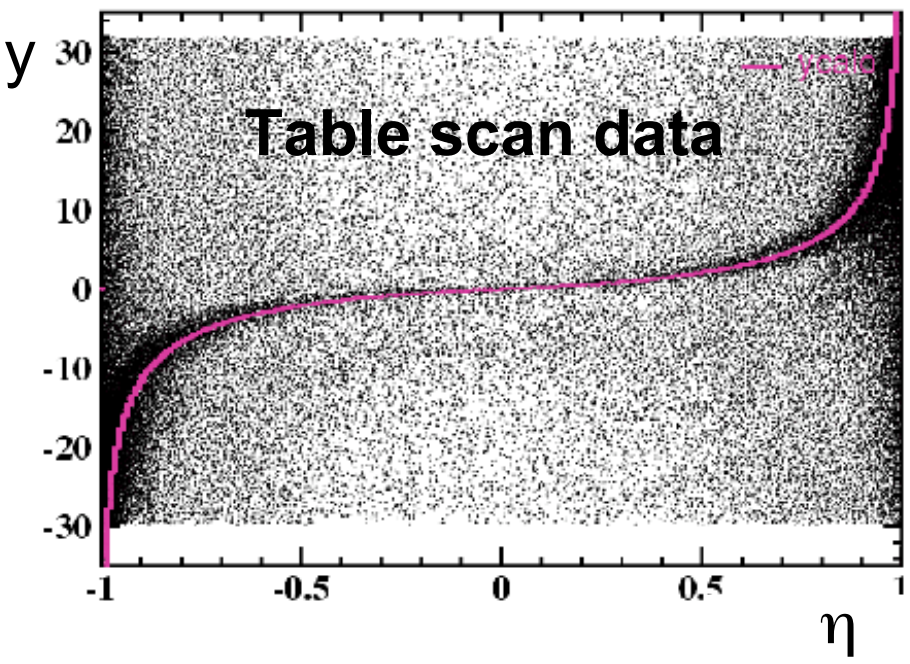
η-y curve	0.87 %
Fitting range	1.99 %
CAL calibration	1.97 %
Beam offset	0.02 %
IP-CAL distance	0.78 %
Energy resolution	1.16 %
Total	**3.25 %**

ZEUS note:
ZEUS-05-012

- Systematic error from TPOL online analysis is 3.5 %
- With a new offline analysis Osamu has estimated systematic error to be 3.25 % - want to decrease this!
- Main sources of error are η-y curve and CAL calibration
- Need more accurate description of η-y, especially at large η
- Less events in this area so need to take dedicated 'table scan' runs…

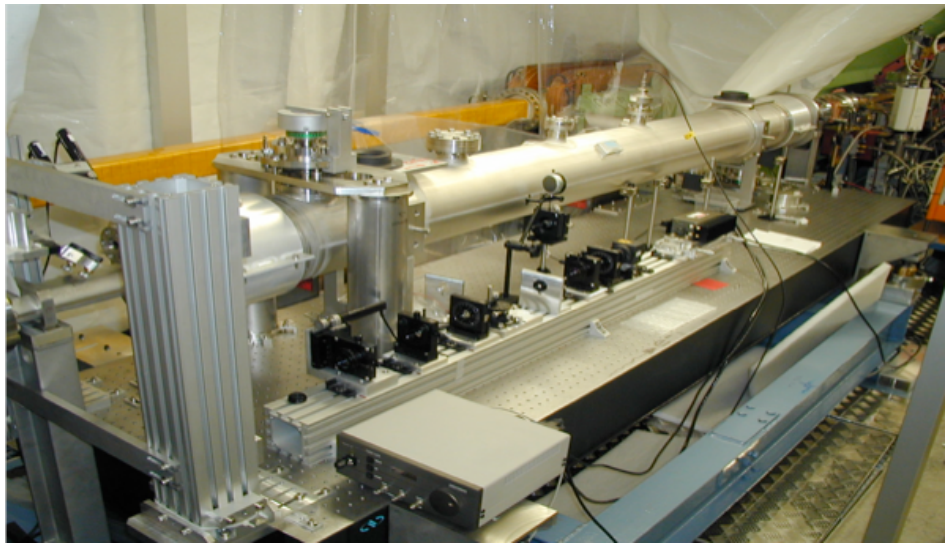
TPOL offline analysis - II





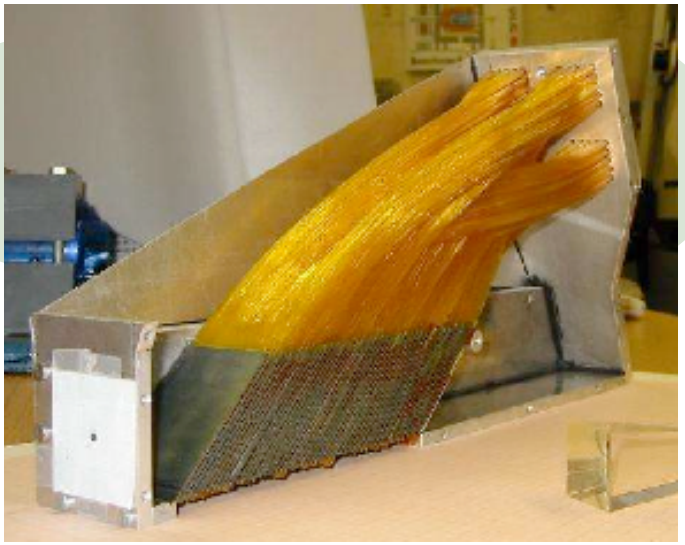
- MC studies show do indeed get events at high η
- New table scan data has increased statistics in this region considerably
- Now work ongoing to analyse this data, improve the η-y transformation and decrease the systematic error!

LPOL cavity

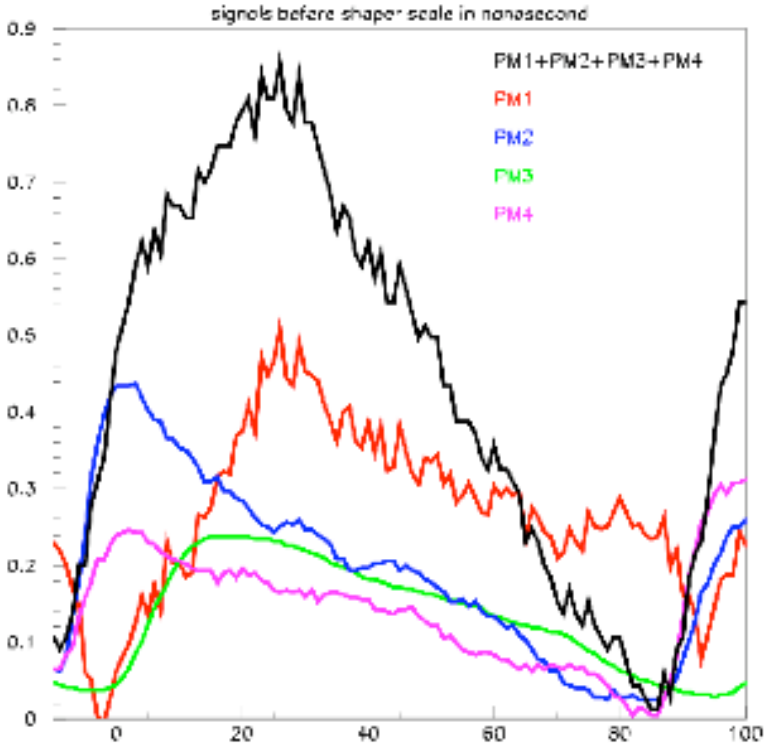


- Work performed to improve the locking of the cavity during beam
- The new fibre calorimeter has been installed
- The DAQ PC crashed and has been replaced with a new PC and all DAQ software has now been re-installed
- First attempts made to measure Compton spectrum
- Plan to test cavity and commission detector for extended time over several fills before November shutdown

Fibre calorimeter



- Finished building in June, followed by DESY test beam and then installation on 6th July
- Showed good linear response in test beam with low energy electrons
- Have installed attenuators to stop the signal saturating the driver board
- Have made first measurements with HERA beam
- Currently measuring and analysing bremsstrahlung spectra and will then take Compton spectra



Summary and conclusions

- Overall smooth and reliable performance of polarimeters, efficiency > 99 %
- However, the LPOL/TPOL 10 % discrepancy seen in August is still not understood - studies ongoing
- TPOL offline analysis now focussing efforts on getting a better η-y description at high η in order to reduce the systematic error
- LPOL cavity and new fibre calorimeter undergoing extensive tests before shutdown
- Now measuring bremsstrahlung spectra, hope to measure Compton spectra soon