Status of the polarimeters at HERA

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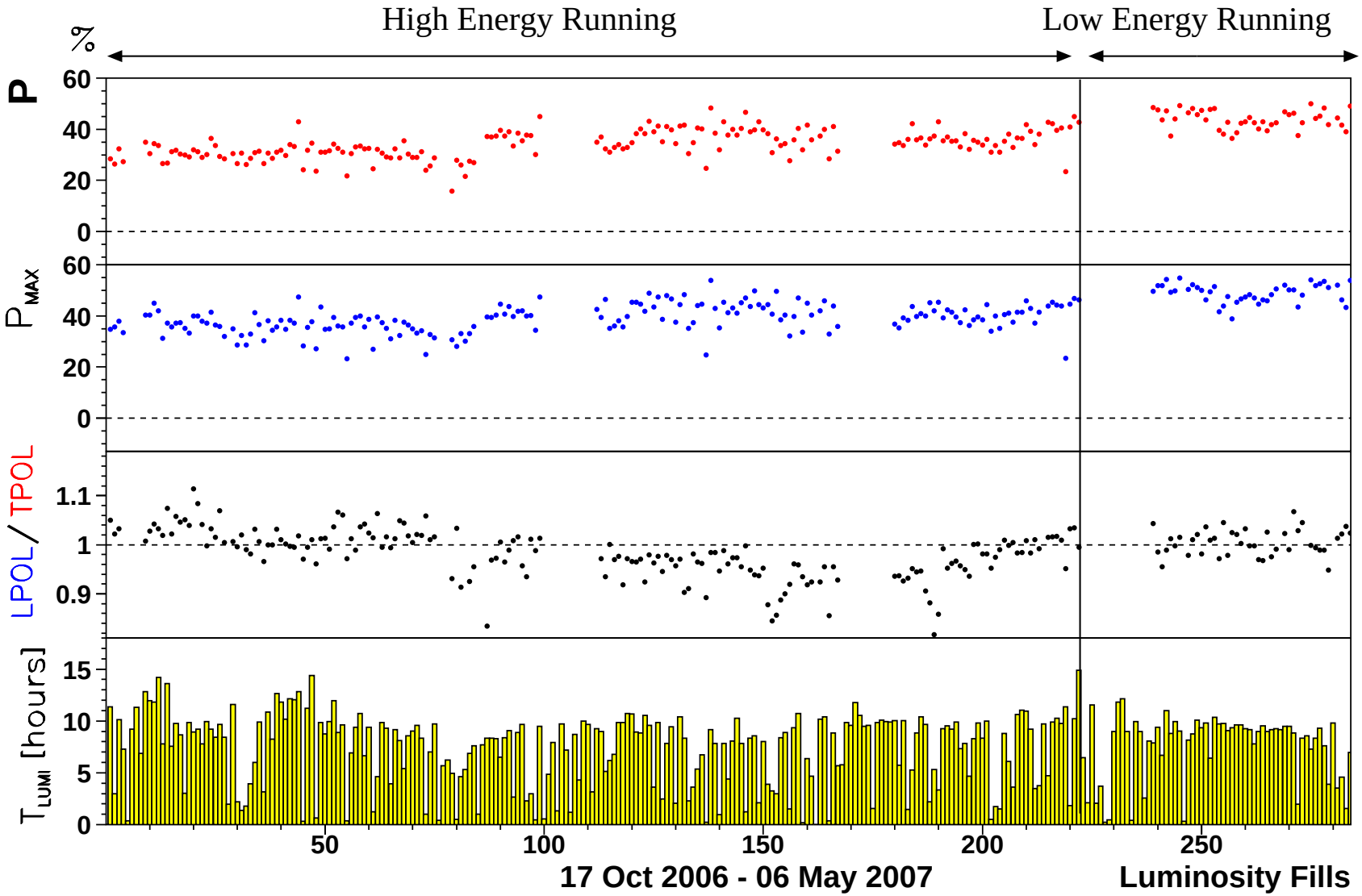
on behalf of POL2000

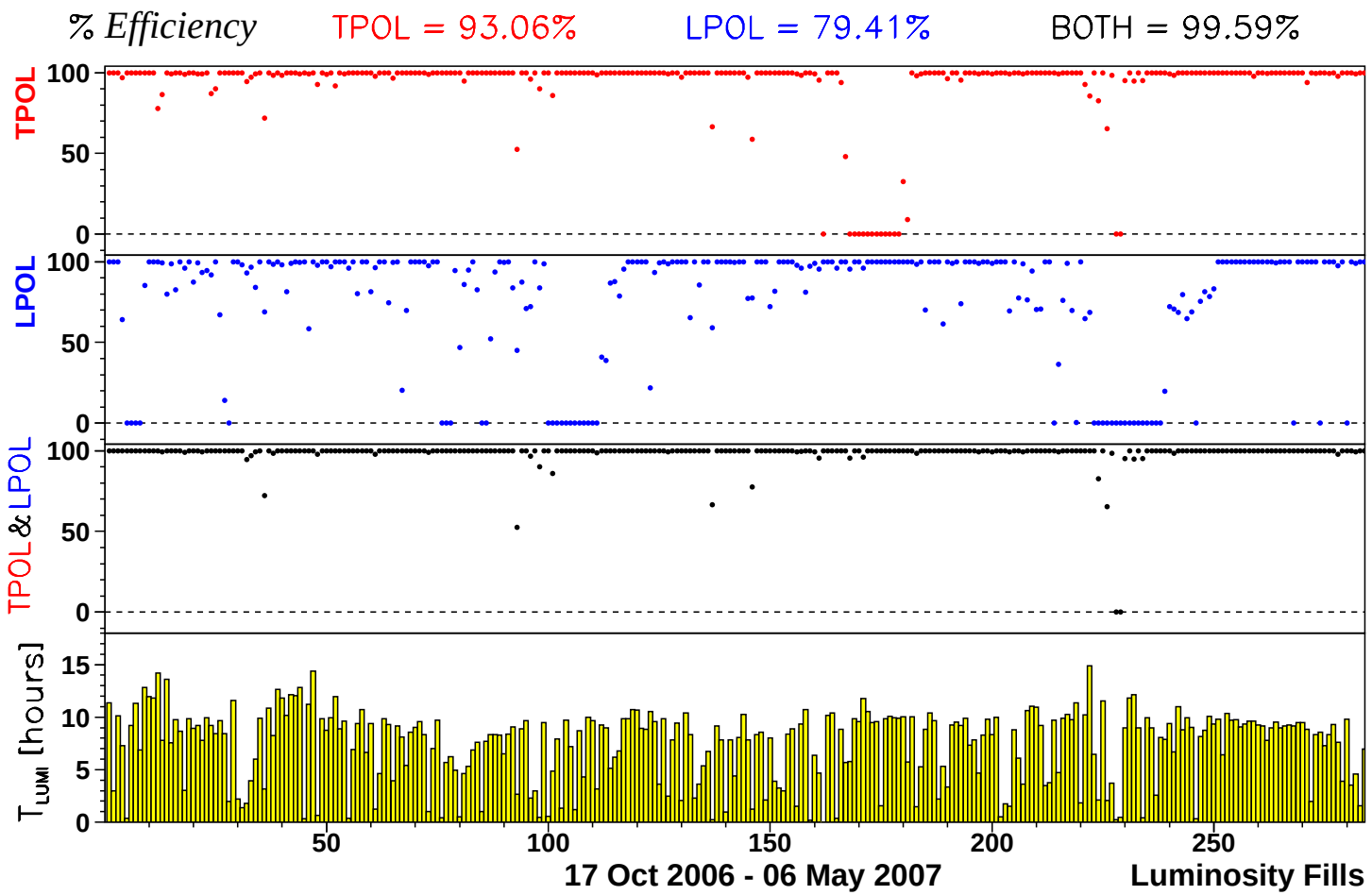
63rd Meeting of the DESY PRC, DESY
May 10–11 , 2007

Polarization in 2006



Since High Energy → Low Energy Run: higher polarization

Polarization in 2006-2007: online efficiency



TPOL

- 93.06%

LPOL

- 79.41%

Combined

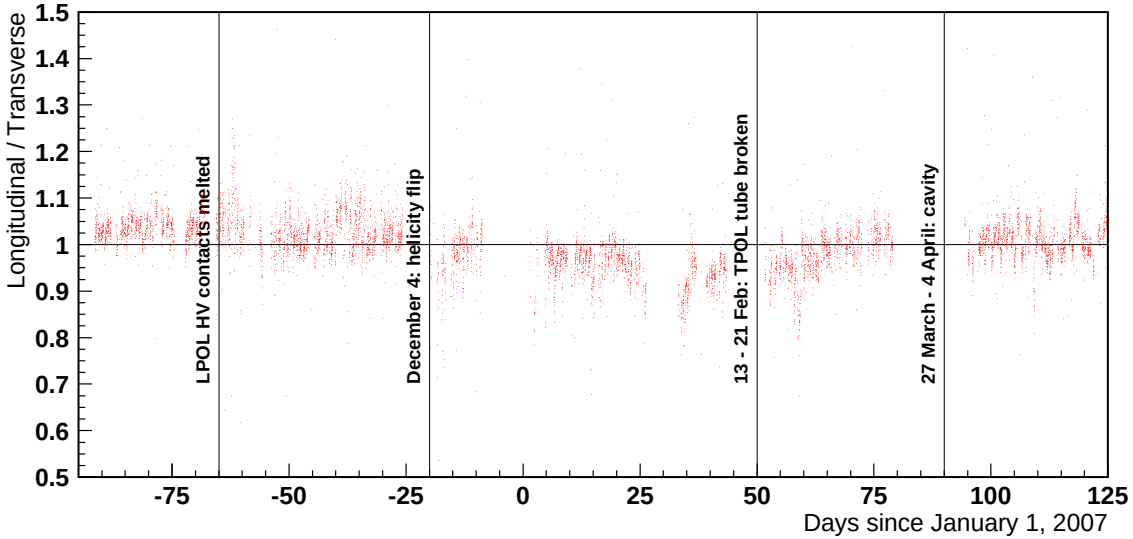
- 99.59%

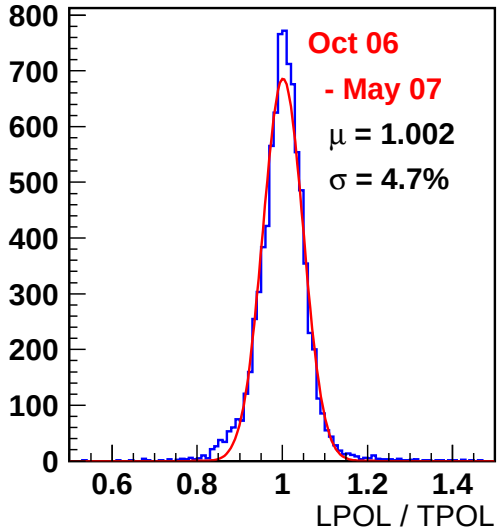
LPOL, in the recent past, mainly affected by cavity polarimeter datataking

TPOL and LPOL continue to deliver high efficiency measurements

LPOL/TPOL ratio and main causes of data loss

- 27 Dec – 03 Jan: LPOL (Calo table movement problems)
- 13 Feb – 21 Feb: TPOL Laser broken tubes
- 27 Mar – 04 Apr: LPOL (Cavity operation)





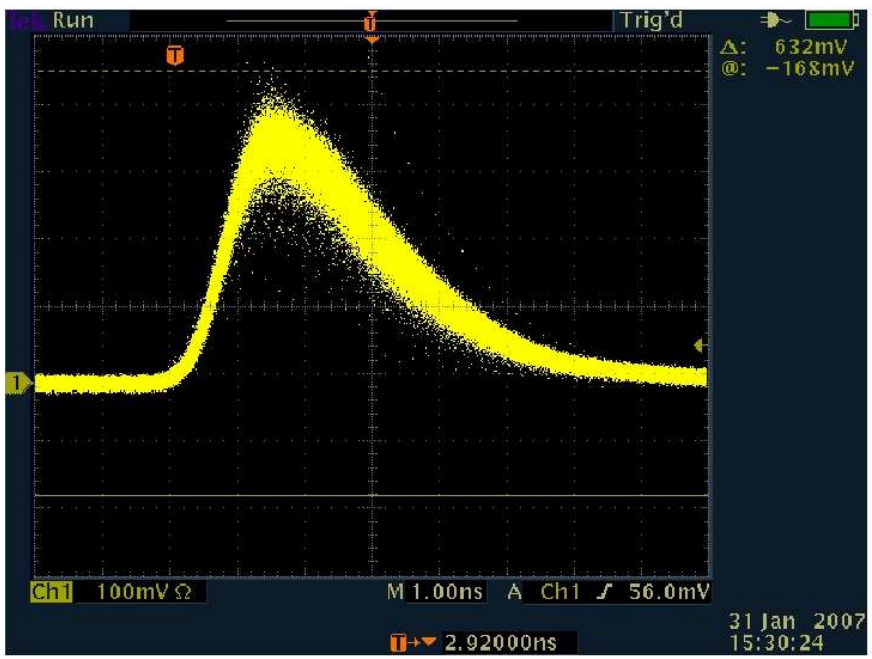
- No long periods with strong disagreement LPOL and TPOL since October 2006, but single instances of deviations from unity
- Thorough offline analysis of both LPOL and TPOL data still ongoing

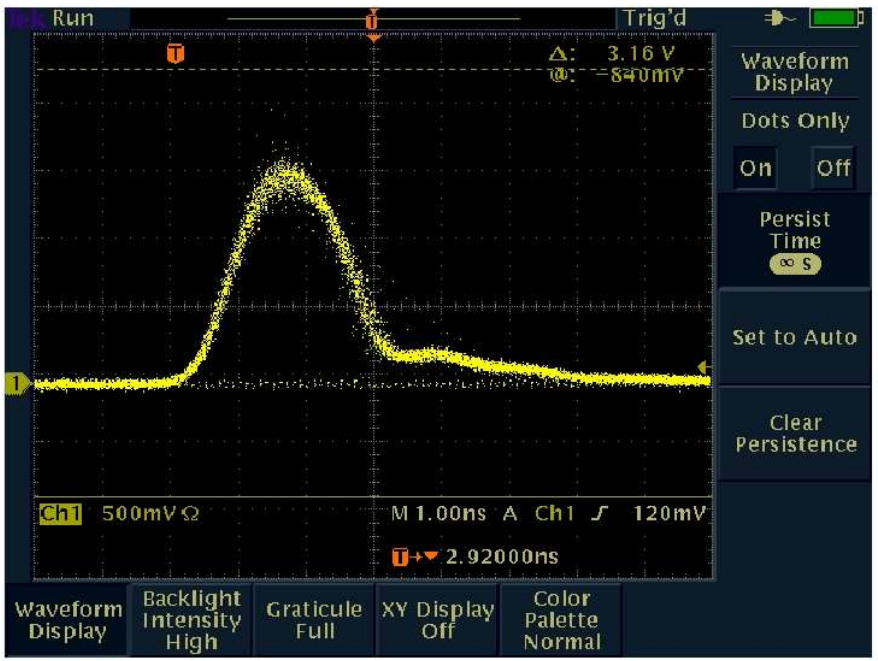
LPOL systematic studies

Continuous monitoring of hardware and systematics

- Laser polarization stable and symmetric for L and R
- Pockell cell high voltage does not contribute to systematics
- Laser intensity, PMT high voltage do not affect measurement

Laser Nd:YAG rod and reflector has been exchanged due to aging





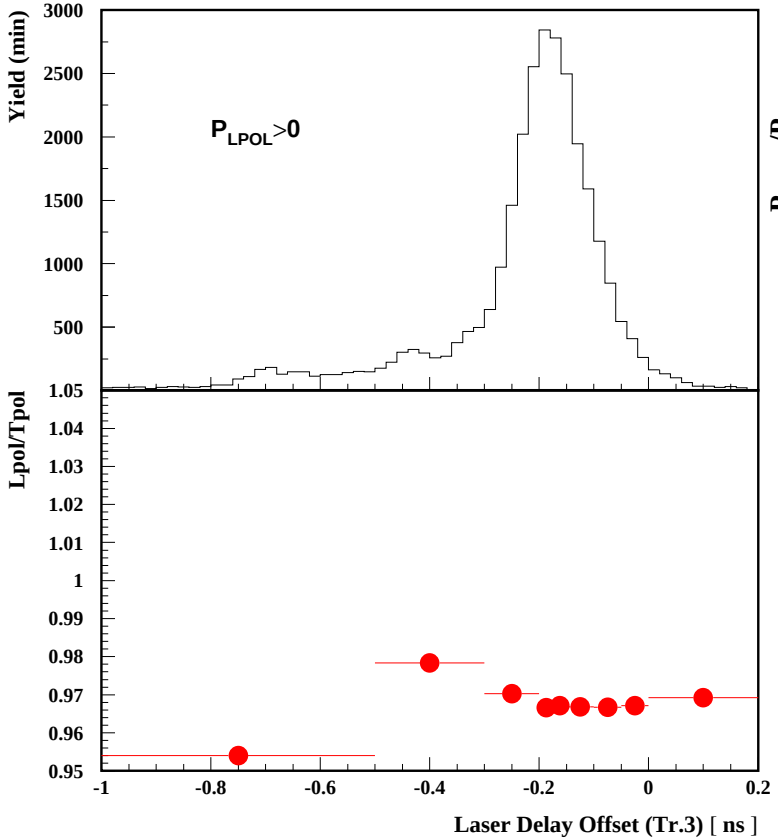
by A.Airapetian

LPOL system is stable again

Laser pulse shape

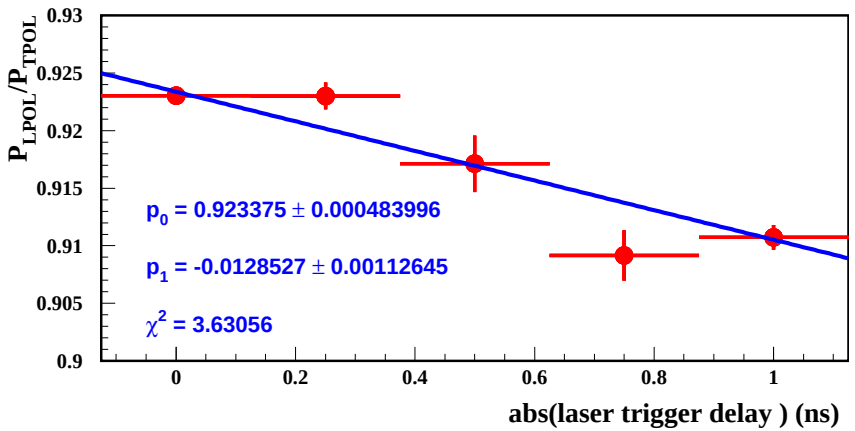
- How much the laser shape difference affects measurement
  - ☞ **Some preliminary results for 2007 data . . .**

Effects of fitted laser pulse shape:



$\approx 2\%$ consistent with reported analysis:

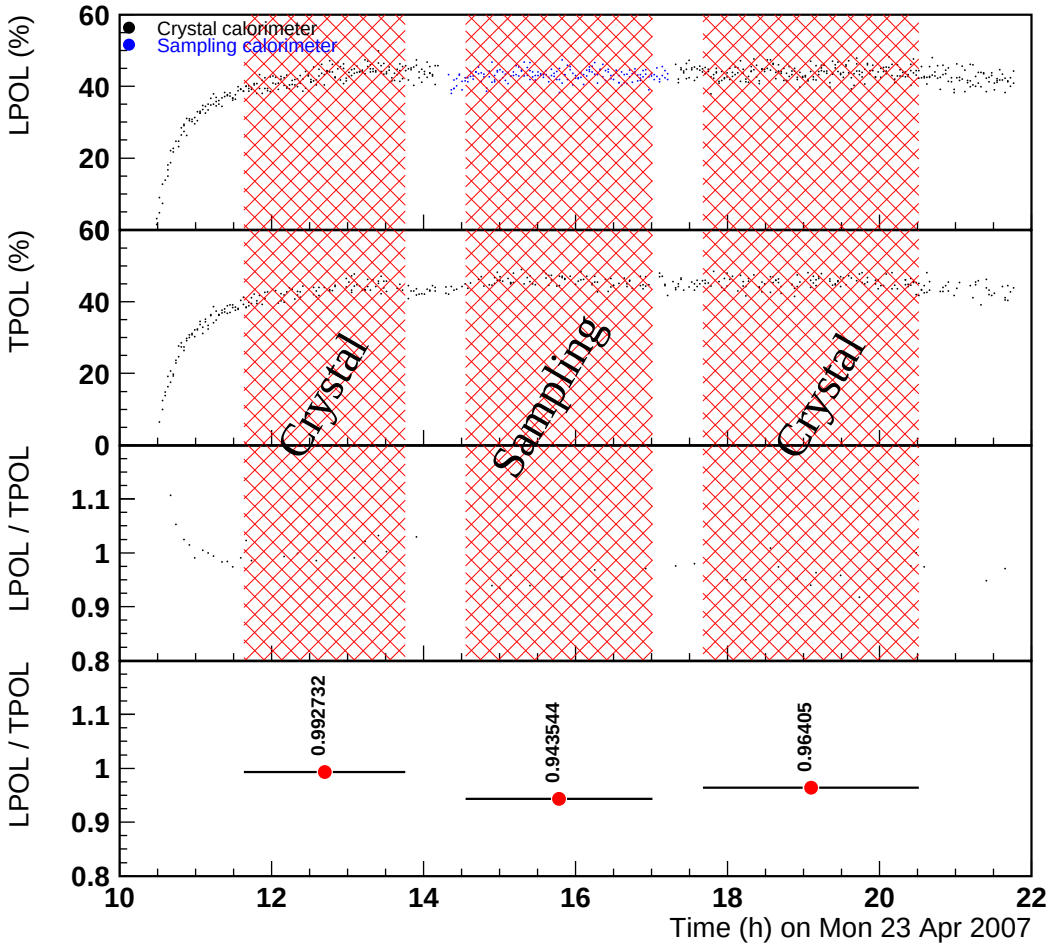
HERMES-IR-05-047



by R.Fabbri

LPOL sampling calorimeter (systematic check)

- Calorimeter used for cavity project
- Cross check for LPOL crystal calorimeter (used to be performed almost weekly)



by W.Deconinck

Comparison

- Sampling calorimeter
- A small step at first interface, more studies are needed (repeat the measurement once per week)
- Within few percent of crystal calorimeter

TPOL systematic studies

Analyzing power variations $=$ main uncertainty in TPOL system

- Distance between calorimeter and interaction point
- Transformation energy asymmetry (η) to vertical position (y)
- Absolute scale of analyzing power

Attempts to calibrate $\eta \rightarrow y$ transformation differently

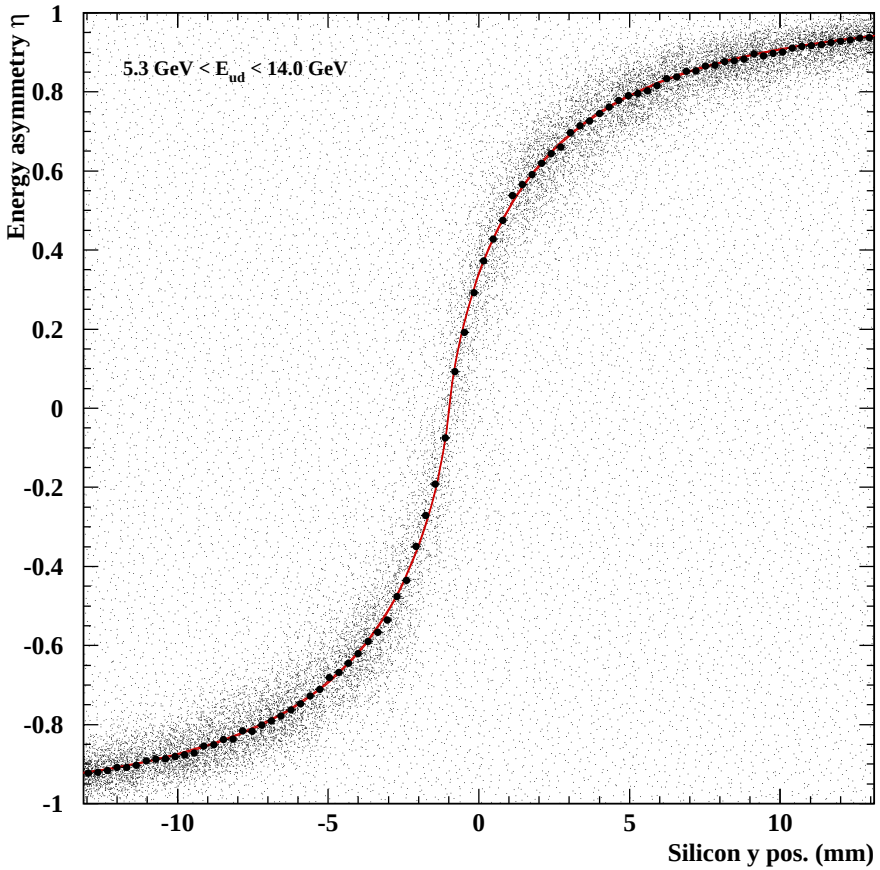
- Silicon detector in front of TPOL calorimeter
- Rise time measurements (no real improvement since last PRC)
- Tune GEANT MC to fully describe: apparatus, shower development and DAQ
- Offline analysis, stand-alone multi-parameter fit of (E ,η) distributions

Re-evaluation of systematic uncertainty in progress

TPOL: Silicon detector for η/y transformation

Determine transformation energy asymmetry η to position y, direct measurement of both η and y

- Red band: correlated systematic uncertainty (very accurate!)
- Agreement with Monte Carlo
- Reproducible between e^+ and e^-



New results: wider y range in data and narrower band w.r.t previous PRC meeting

Work in progress by Blanka Sobloher

Cavity polarimeter

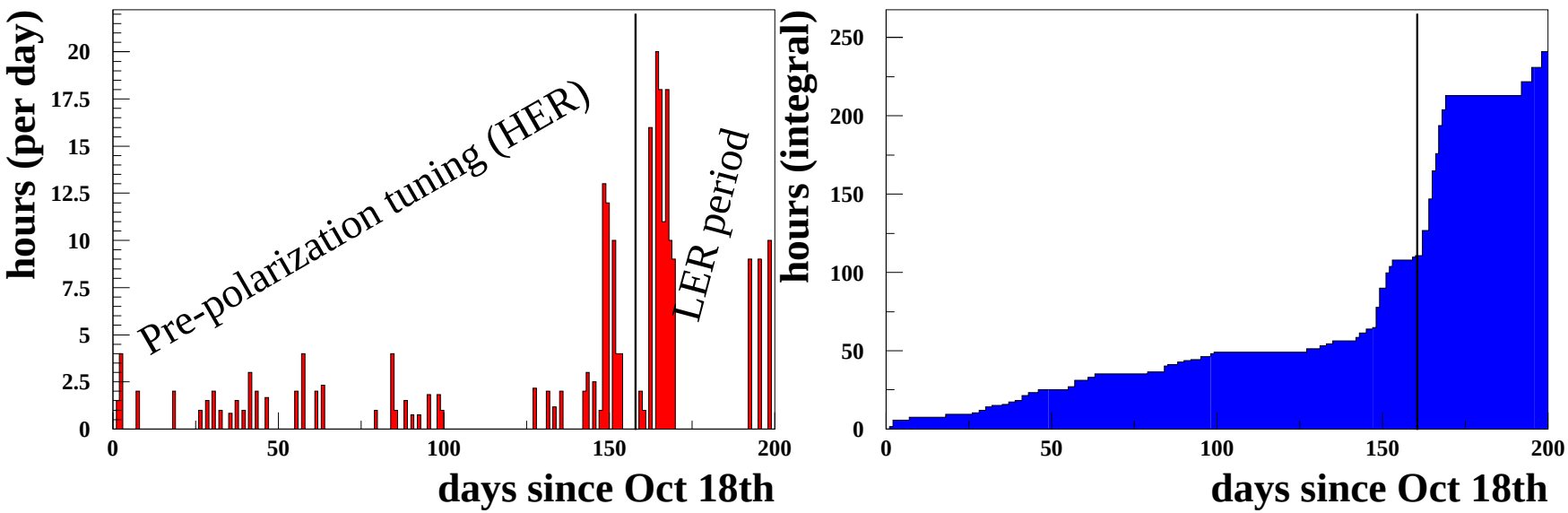
Hardware working fine now

- Using LPOL sampling calorimeter
- No problems finding beam or locking cavity
- No sign of aging of calorimeter so far

Except

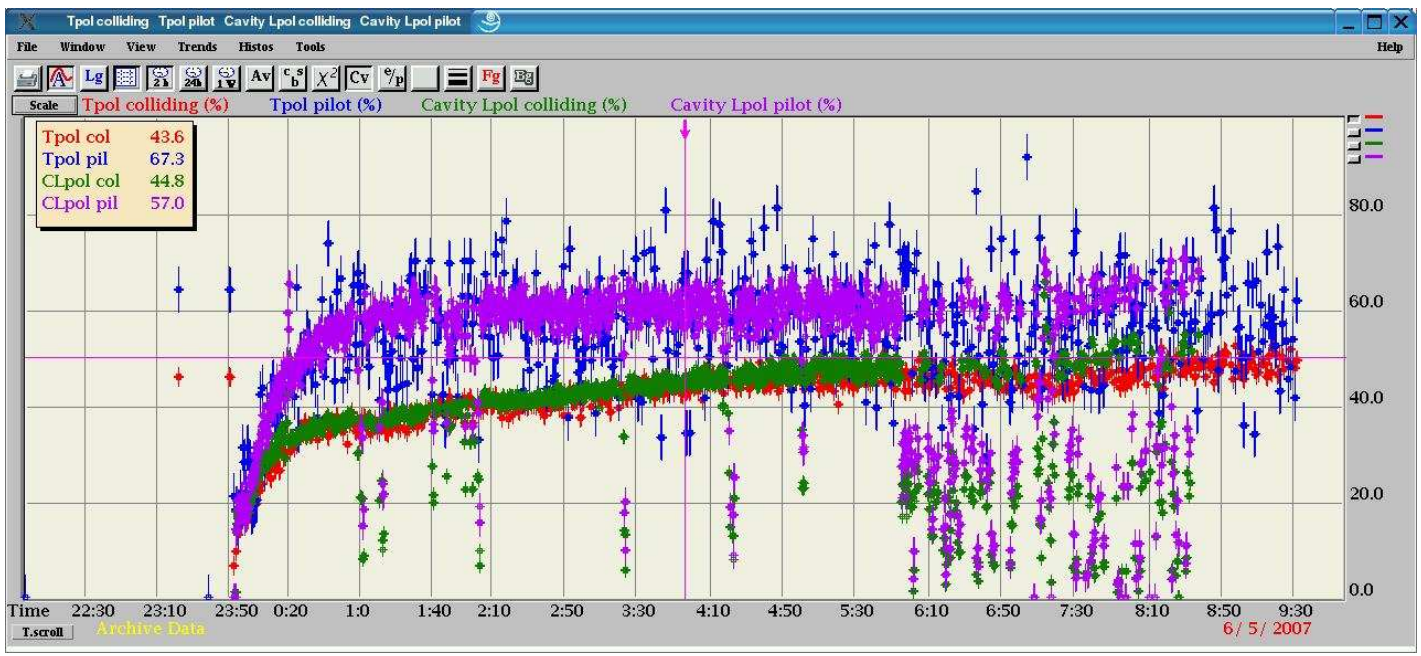
- Laser controller unit, two times repaired (10th Feb. and 5th Apr.), due to lacking of cooling (installed during May access)

Regular data taking



Cavity polarimeter: DAQ

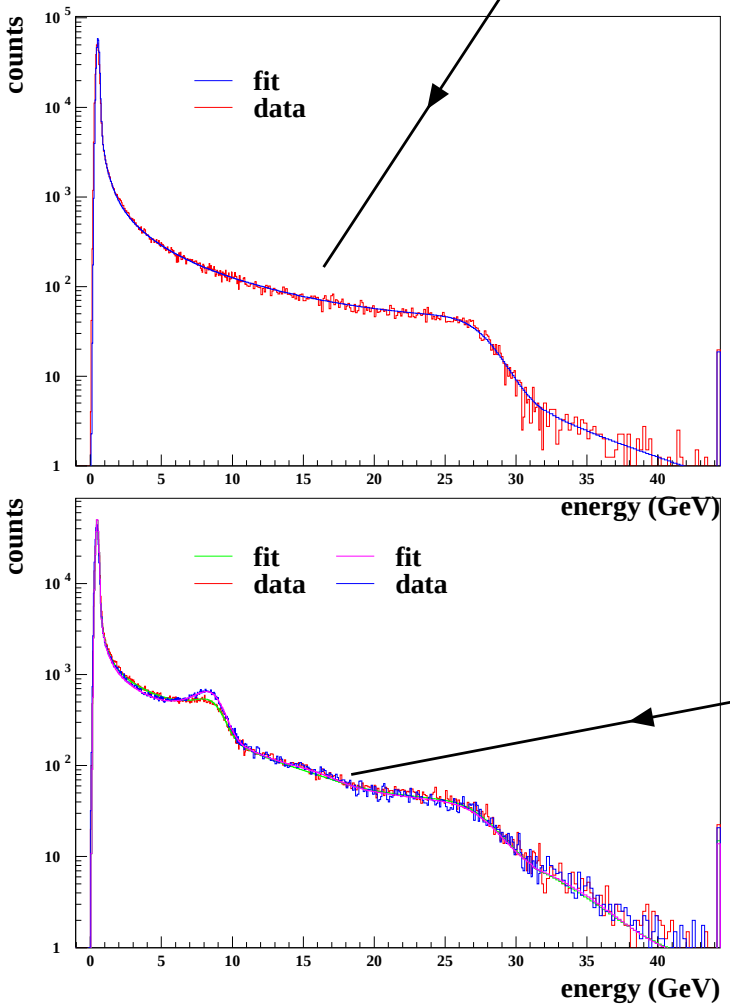
- new 32 bit histogramming
- HERA clock synchronization (48 ns flip)
- many improvements in the details of the fit → online fit possible
- online fit in place since mid Feb, (results sent to NETMEX, and H1-server)
- first offline results available within 24 hours time
- control of data taking: still under expert control to be safer



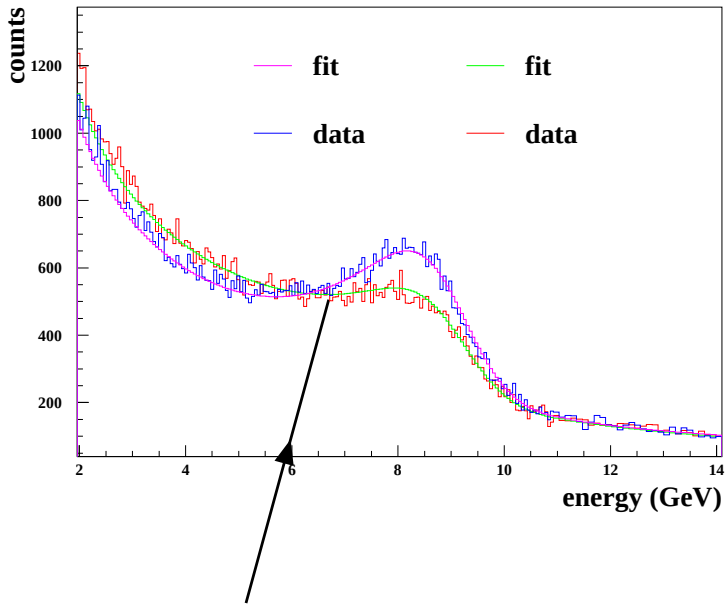
USED BY MACHINE GROUP TO TUNE POLARIZATION

Significant improvement on the analysis level

- data with fit, Bremsstrahlung only (laser off)



- zoom on Compton edge



- Bremsstrahlung and Compton components (laser on, superimposed L/R helicity states)

Nice agreement of fit and experimental data

Cavity polarimeter: systematic studies

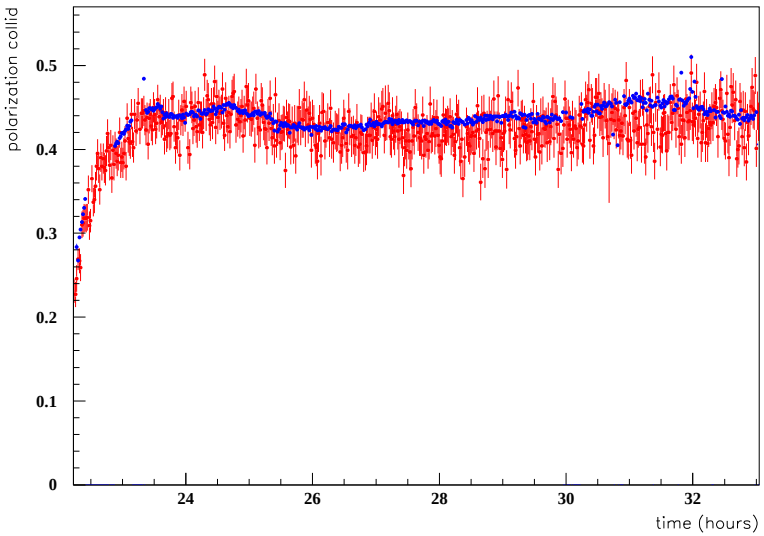
Systematic studies performed:

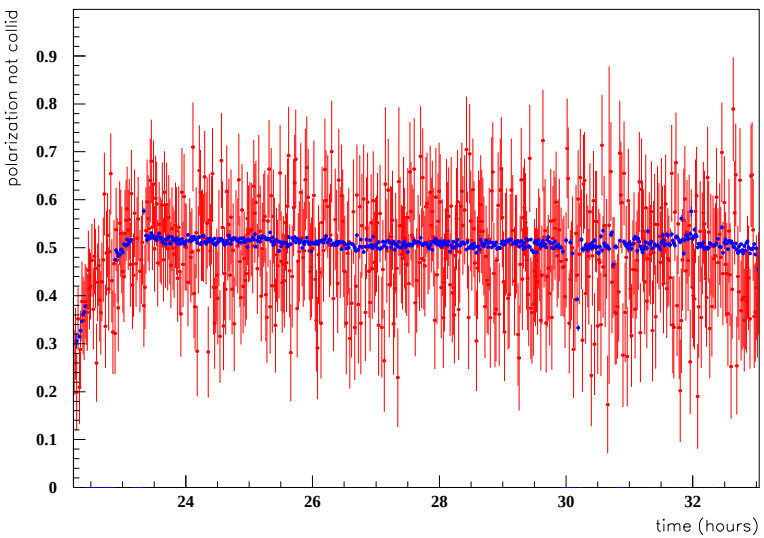
- L/R asymmetry of laser intensity: taken into account, resulting uncertainty is negligible (it depends on a tiny misalignment of the $\lambda/4$ plate used to switch laser beam polarisation state)
- Beam position and angle: uncertainty at per mille level
- Degree of laser circular polarization: uncertainty < 0.1 %
- Different detector models: uncertainty at per mille level
- Different blackbody radiation: uncertainty at per mille level
- Importance of accurate synchro/rad peak (need 10 MeV accuracy on peak position determination), now using a parabolic fit

Statistical precision (10+10 s each measurement point)

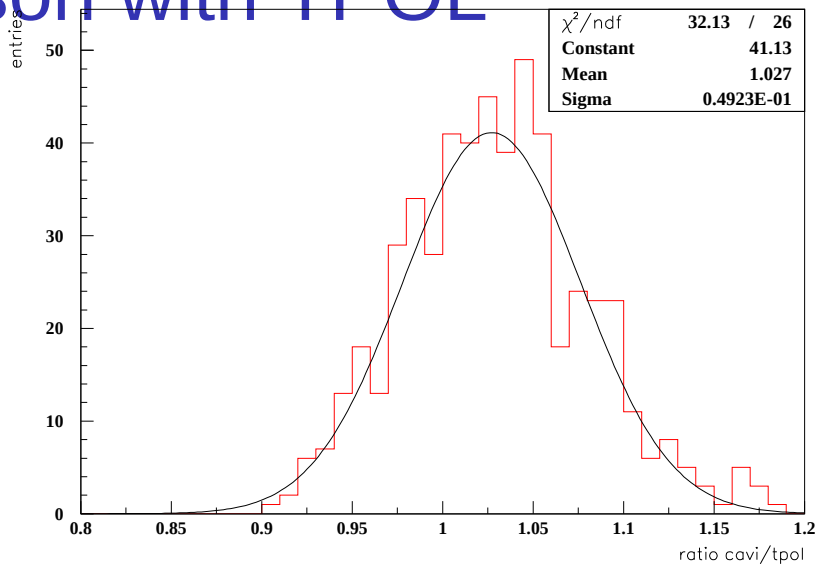
- $\approx$ 2.5% per bunch
- $\approx$ 0.3% for all bunches

Cavity polarimeter: comparison with TPOL





March 15, 2007



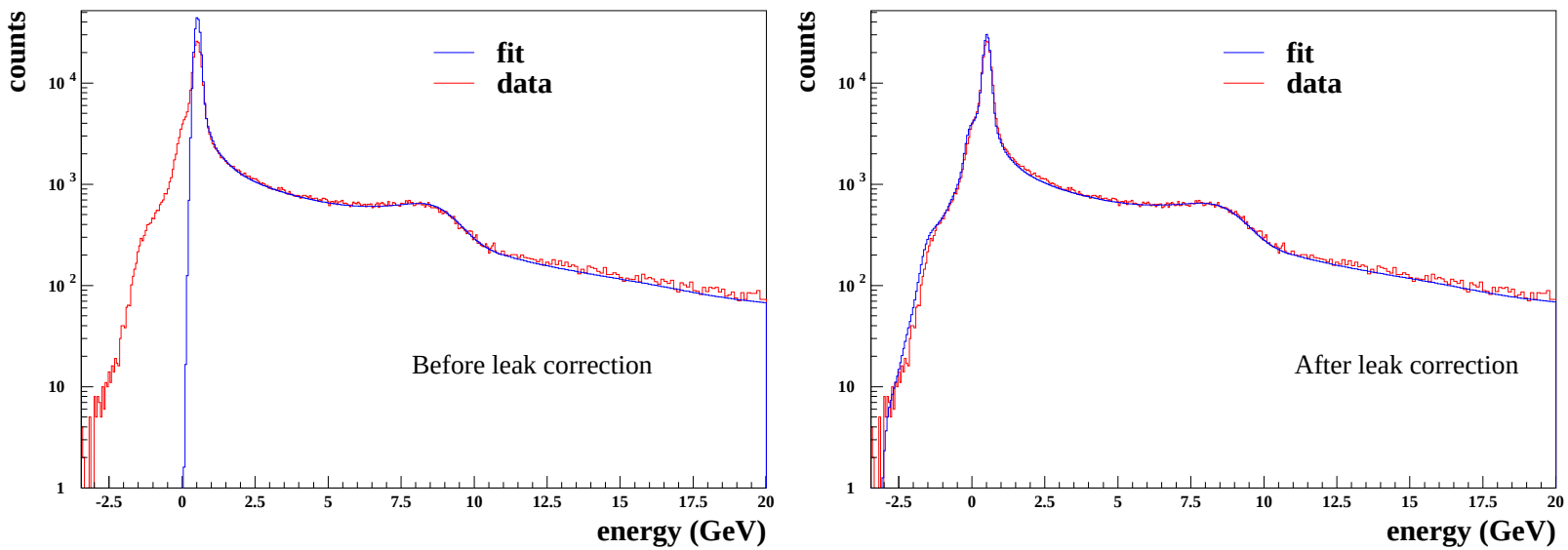
Comparison

- TPOL measurements
- Cavity measurements
- Higher statistical precision! (<0.2% error bars invisible, averaging cavity values over $\pm 30 sec$ each side of TPOL point)

Cavity polarimeter: future plans

Continue commissioning of the cavity polarimeter as a whole

- Finalize systematic studies with also some specific data-taking sessions:
  - Interleaving LPOL-Cavity
  - Table scan
  - Beam scan (already done once, it would be nice to repeat it)
- Bunch to bunch leak contribution, code ready, waiting to solve all other details



- More and more data have been taken, reprocessing of all sets with latest version of fit

Conclusions

- LPOL / TPOL ratio problem not reappeared
- Previous disagreement still not understood
- LPOL
  - Systematic uncertainty well under control (quoted: ± 2.0 %)
- TPOL
  - Progress in improved determination of analyzing power
  - Re-evaluation of systematic uncertainty underway (quoted: ± 3.5 %)
- no final systematic error on the measurement
- Cavity
  - Hardware “no problem”
  - Regular polarization measurements
  - Systematic studies need finalizing
  - More frequent and longer data taking since last PRC meeting, providing quite nice measurements