TPOL IP

Position of the Interaction Point
Laser – HERA electron beam

Facts Known and Unknown
in the current Discussion

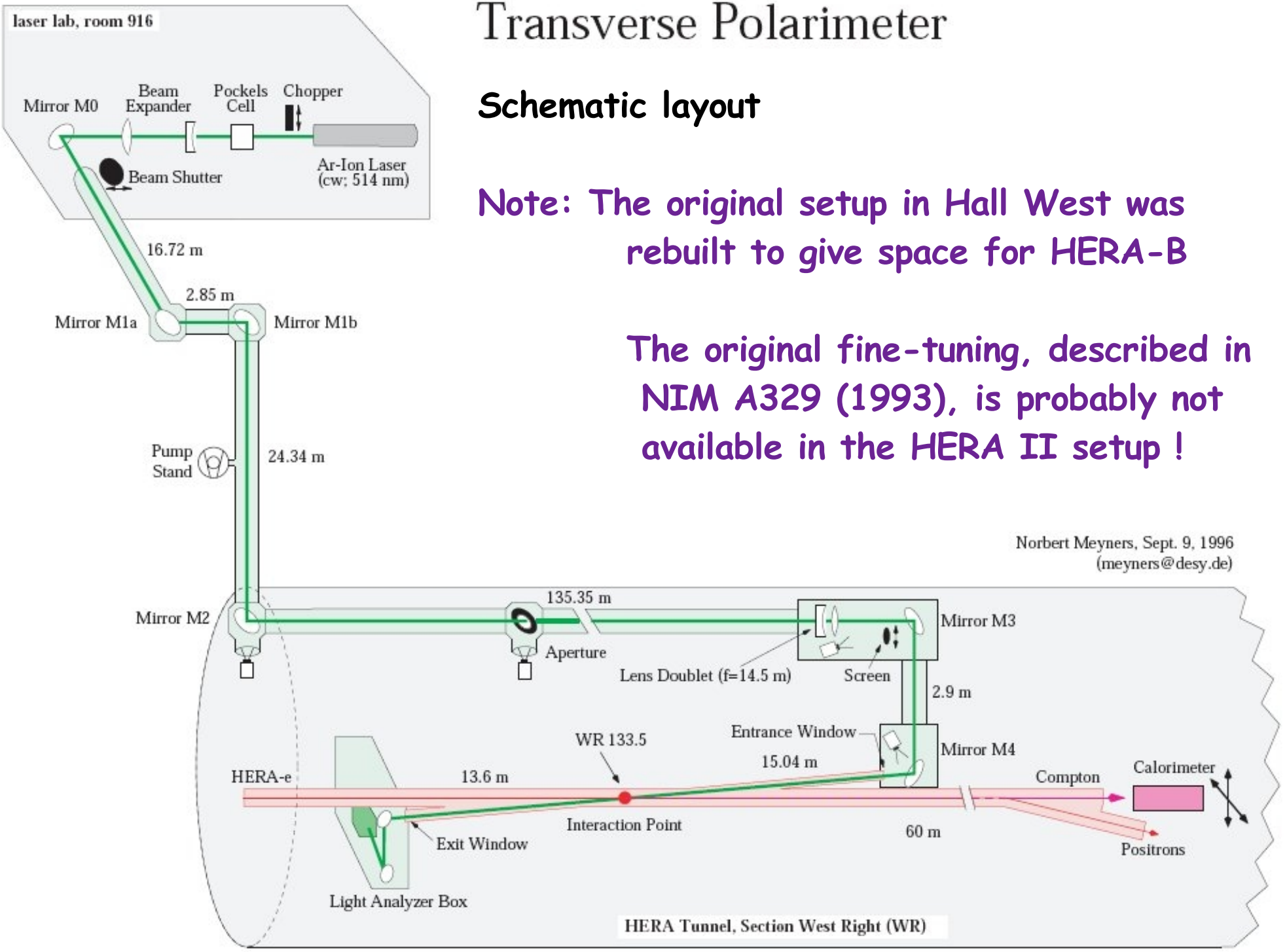
J. Olsson Polarisation Task Force Meeting 11.02.2009

Transverse Polarimeter

Schematic layout

Note: The original setup in Hall West was rebuilt to give space for HERA-B

The original fine-tuning, described in NIM A329 (1993), is probably not available in the HERA II setup !



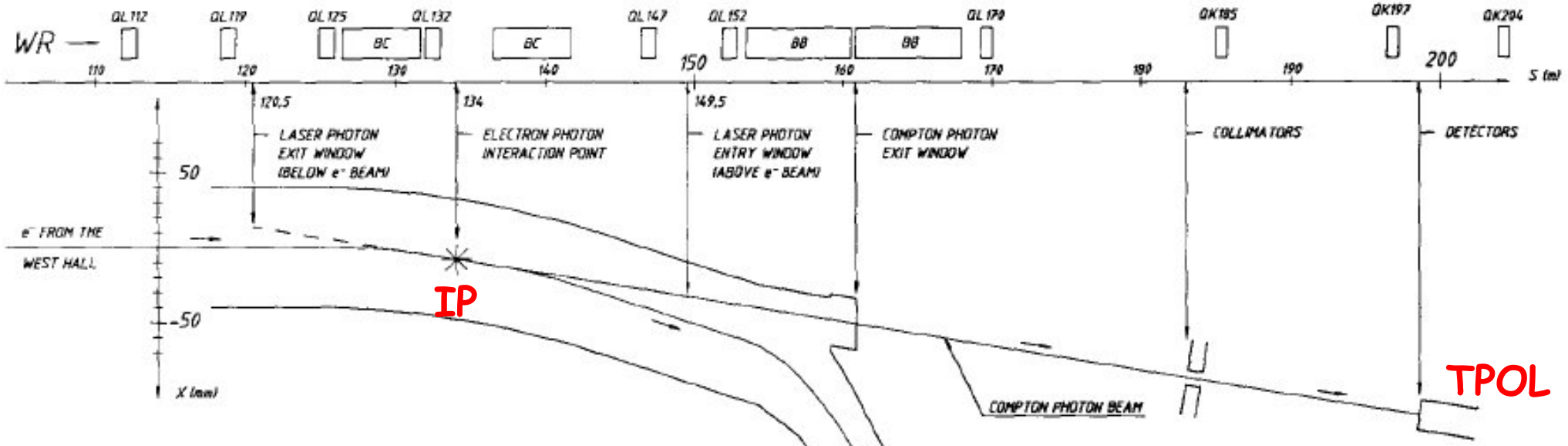


Fig.10 in NIM A329 (1993)

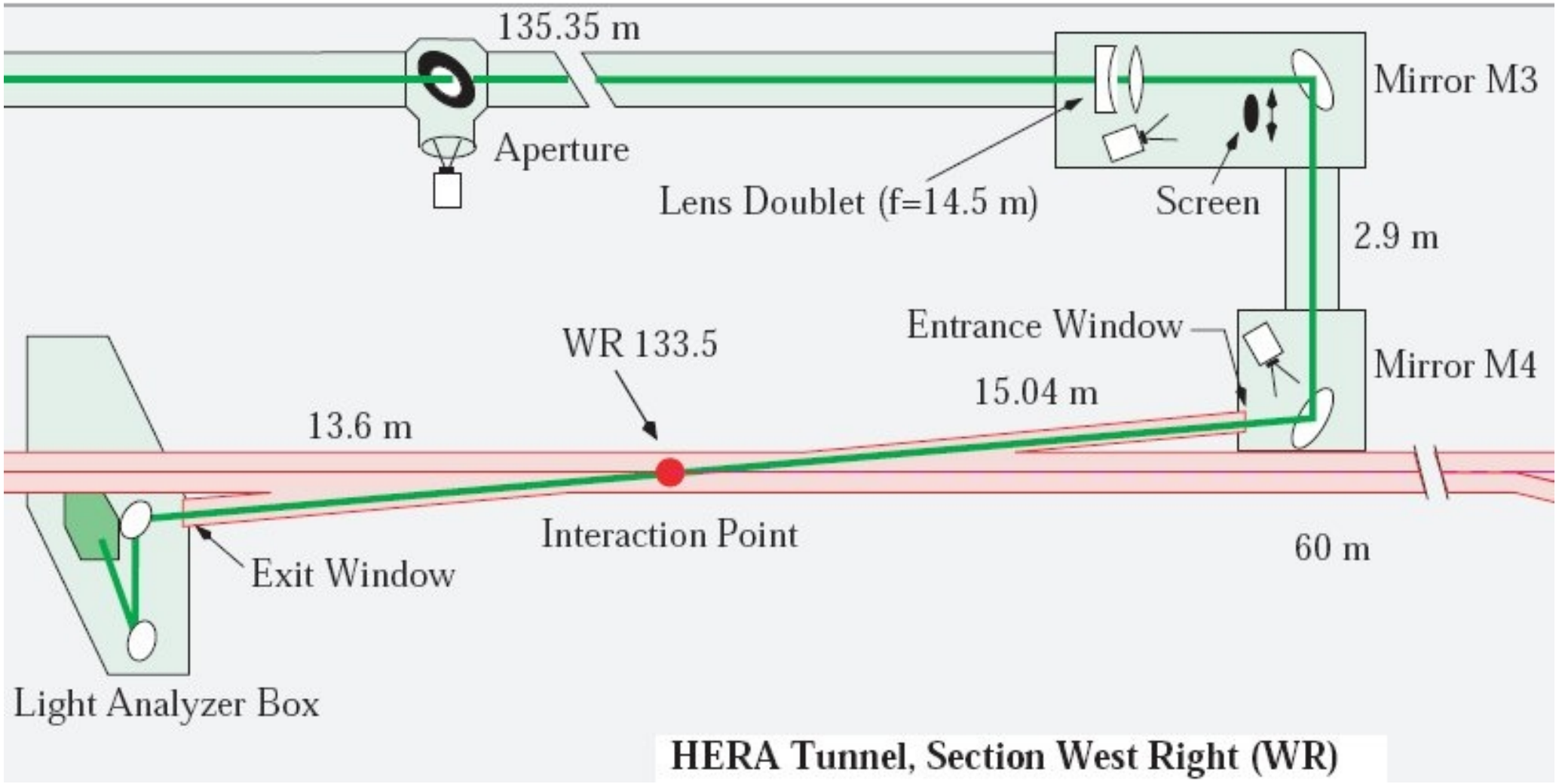
* Straight section (West) of 4.9 m, limited by the weak dipoles "BC"

* Nominal IP (at 65 m from TPOL calo) in the middle of this straight section

* Visible electron line from the TPOL detector: 4.9 +- 1.2 m, total of 7.3m

* Quadropole QL132 about 1m after first BC dipole

==> IP varies in "free" drift between -1.45m and +2.45m around nominal IP



Laser beam focused 14.5 m behind lens

Distance to IP is ~18 m from Mirror M3 (is this really true ?)

M3 can rotate both horizontally and vertically

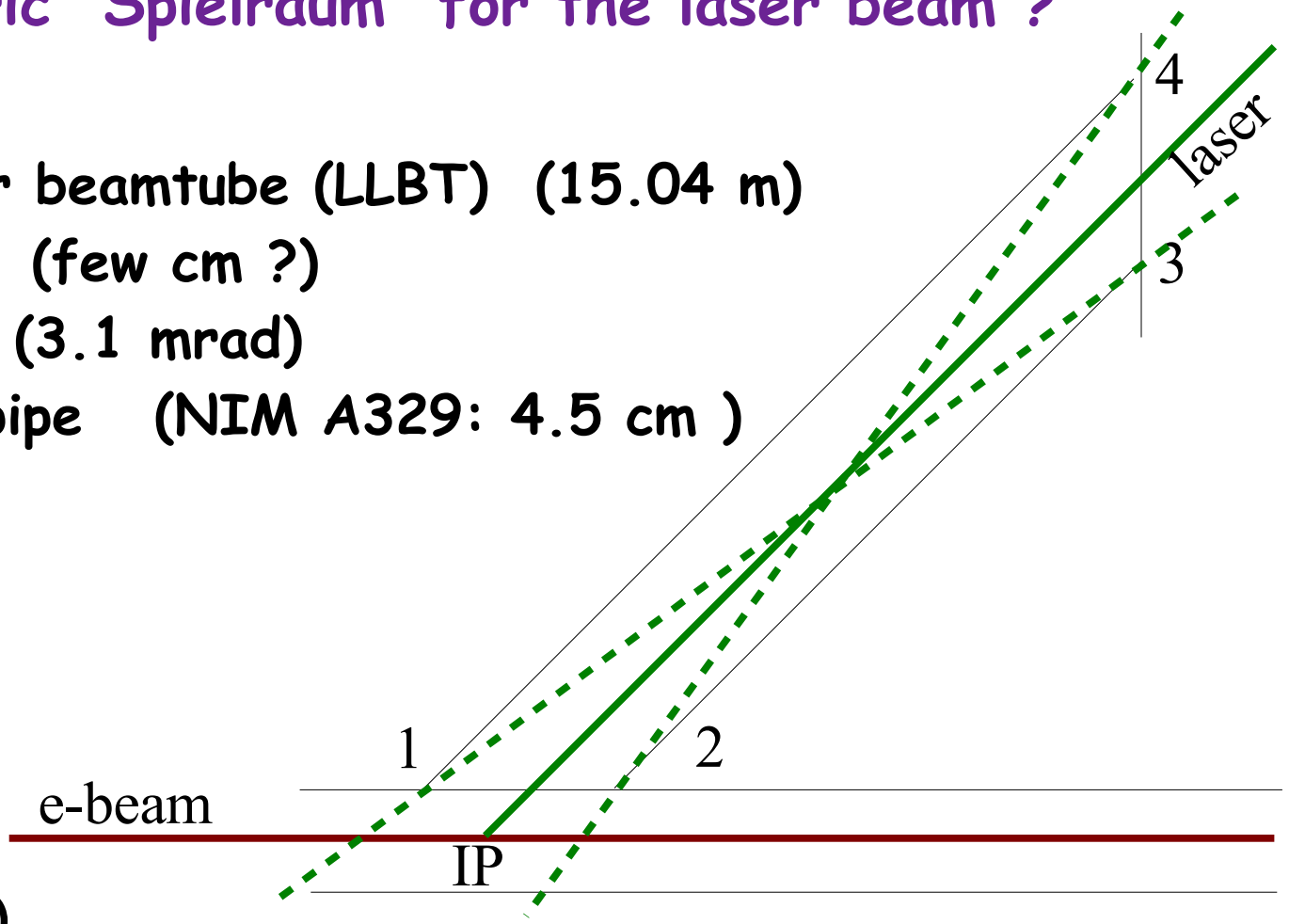
Angle of Laser beam incidence 3.1 mrad (NIM A329: error of 0.2 mrad)

Horizontal rotation of M3 determines z-coordinate of IP

What is the geometric "Spielraum" for the laser beam ?

Assumed defined by

* Length of last laser beamtube (LLBT) (15.04 m)
* Diameter of LLBT (few cm ?)
* Angle of incidence (3.1 mrad)
* Radius of e-beam pipe (NIM A329: 4.5 cm)



Simple calculation
(for LLBT diameter 2cm)

gives variation between -11m and +8m around IP

angles of incidence between 2 and 4.8 mrad (!)

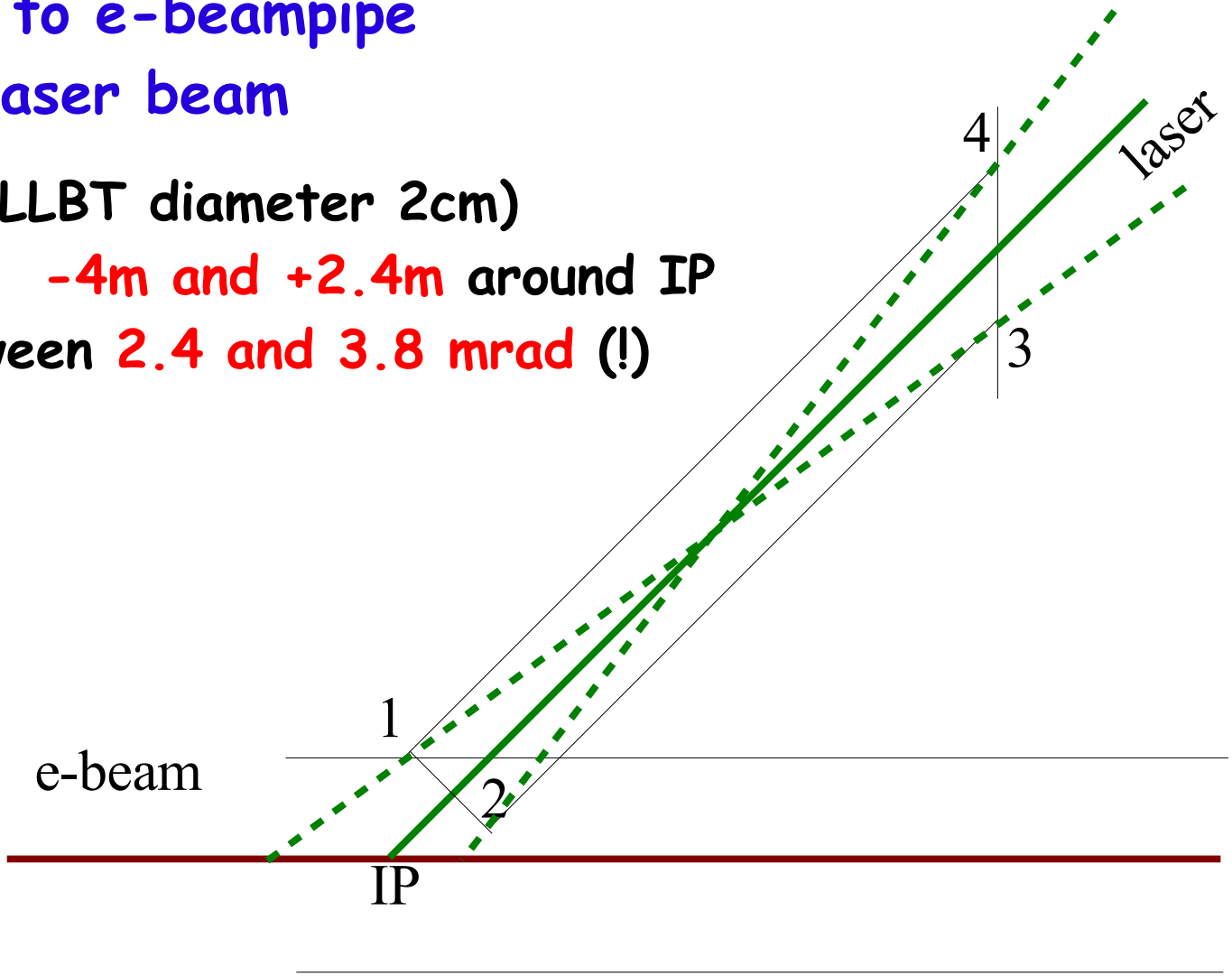
Clearly, this is nonsense.

Window 1-2 cannot be parallel to e-beampipe under pipe angle of 3.1 mrad

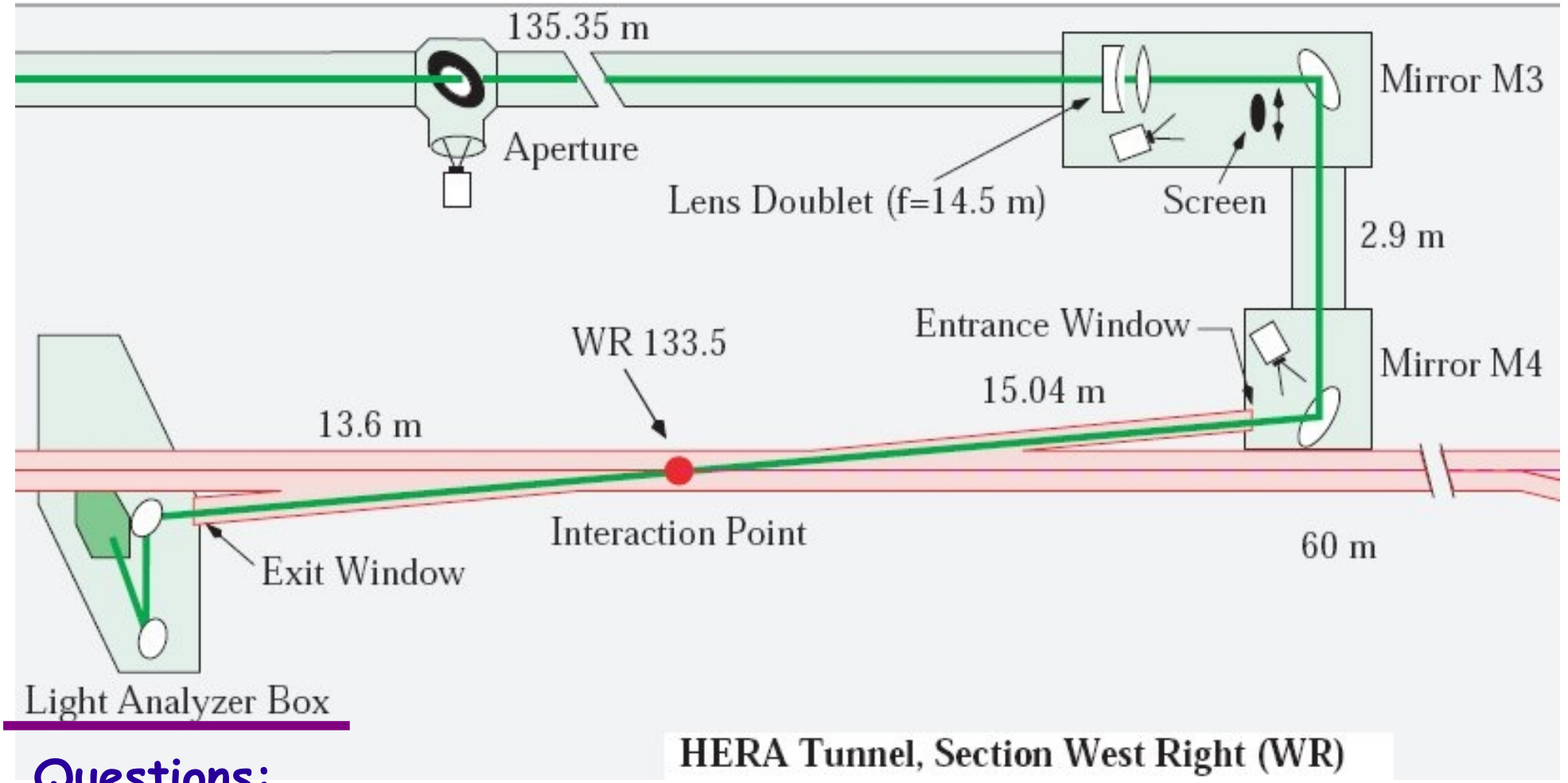
Try another approach:

Entrance Window to e-beampipe perpendicular to laser beam

Simple calculation (for LLBT diameter 2cm)
gives variation between -4m and +2.4m around IP
angles of incidence between 2.4 and 3.8 mrad (!)



Clearly, for correct calculation, the exact inner geometry of LLBT and its connection to the e-beampipe have to be known!



Questions:

* Has the Laser beam been "fixed" by the Light Analyzer Box, during HERA II running ?
* What is the exact geometry of the Exit Window to this box ?
* Are there any records of monitoring with the Analyzer Box ?

Presumable a strong constraint on the IP variation possibilities !

Some Numbers from the NIM A329 (1993) paper (Barber et al.):
(Note: these numbers refer to the original Hall West setup !)

* The Crossing Angle is given as 3.1 mrad +- 0.2 mrad

* "The entrance and exit windows to the electron vacuum chamber are vertically offset ~45 mm from the electron beam and are nearly perpendicular to the beam direction"
(laser beam is meant!?)

* Between mirrors the laser beam runs in Al-pipe, 15cm diam.

* Mirrors are adjusted to within 2 microrad

* The matrix for transportation of the laser beam, from laser to IP, is nearly unity

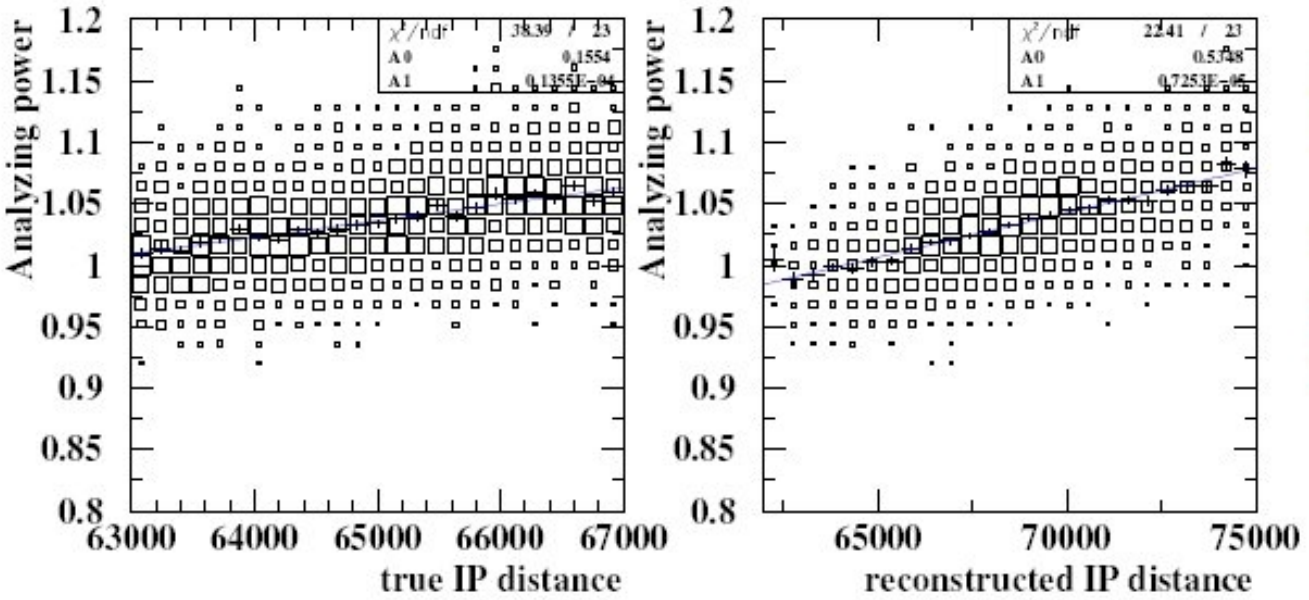
* The measured size of the laser beam at IP is 0.6 mm sigma

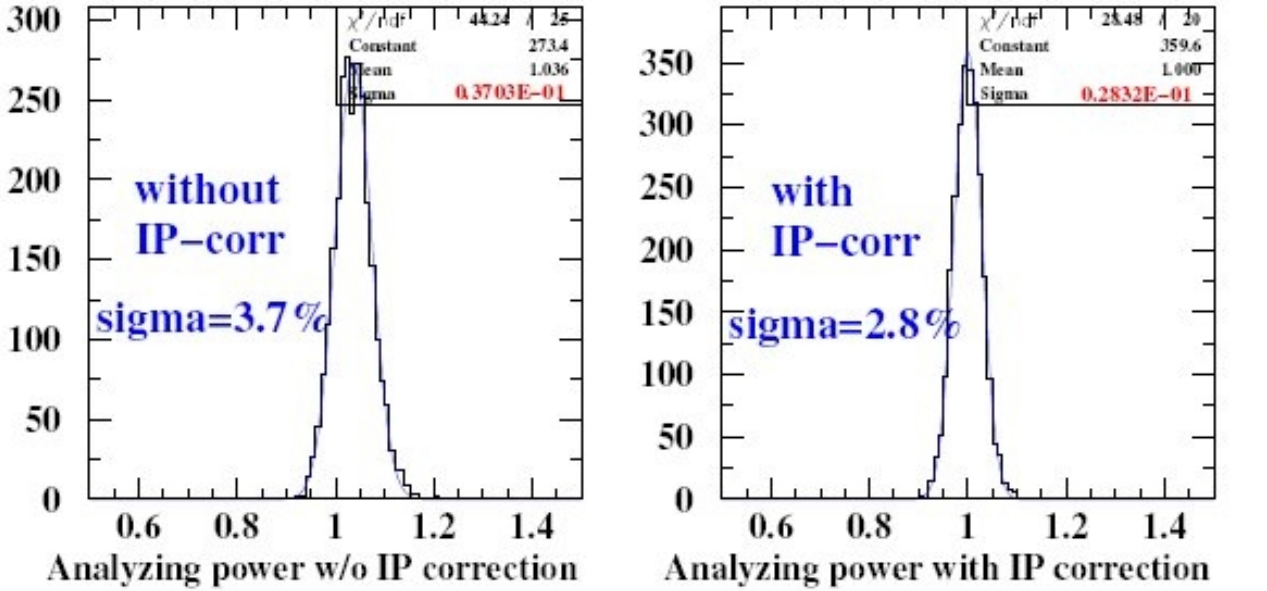
What about previous studies of the IP position and its influence on the Polarisation Measurement ??

Go back to old talks by Stefan Schmitt:

Study: effect of IP distance

S. Schmitt 14.05.2007





TOY MC study: vary IP distance from 63 m to 65 m

AP depends on IP distance

It is possible to reconstruct the IP distance from the lowest energy bin

distip = RMS(eta)*dy/deta *sqrt(2) /sin(theta(<E>))

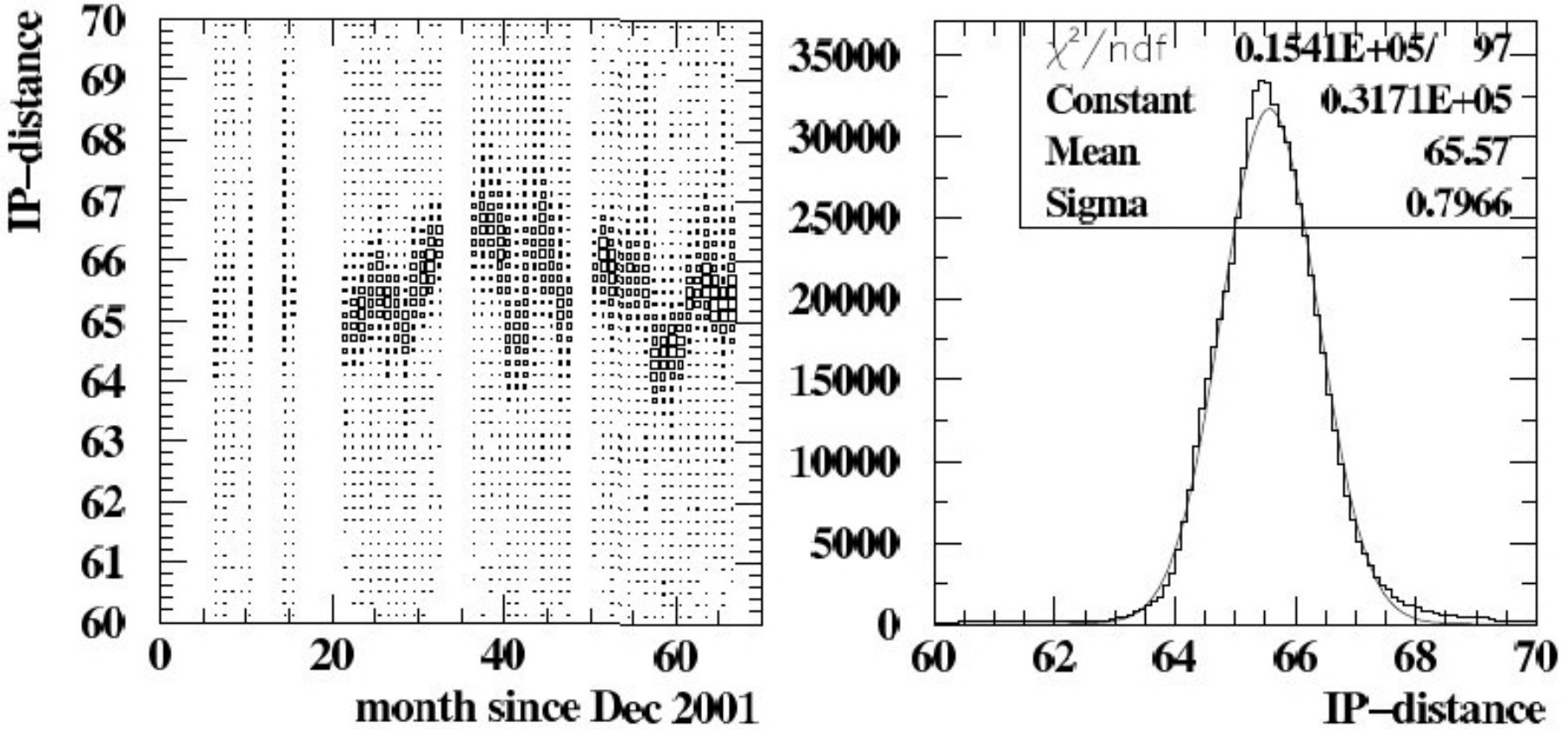
Predicted IP correction:

AP = AP0/(1+(IP−IPnom)/138m)

IP–distance for the HERA II data: width is 0.8 meter

S.Schmitt 03.07.2007

Time–dependent structures visible: correct pol measurements?



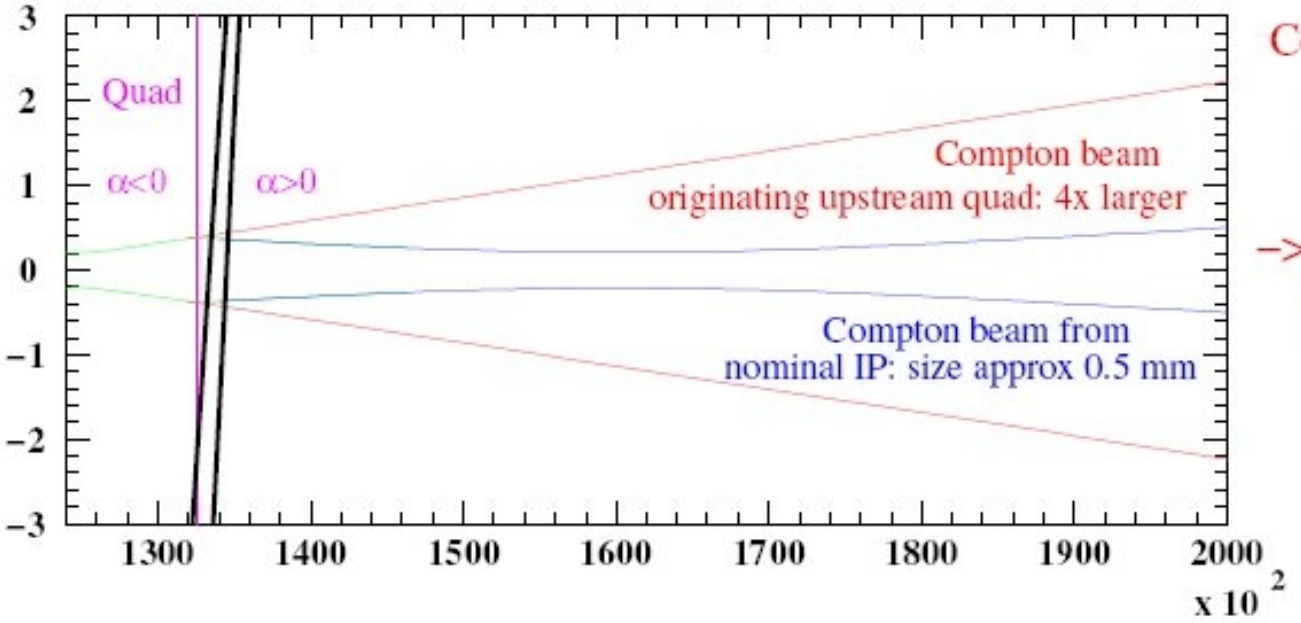
Estimate from toy Monte–Carlo tests: Polarisation change dP/P=1% per 1.4 m

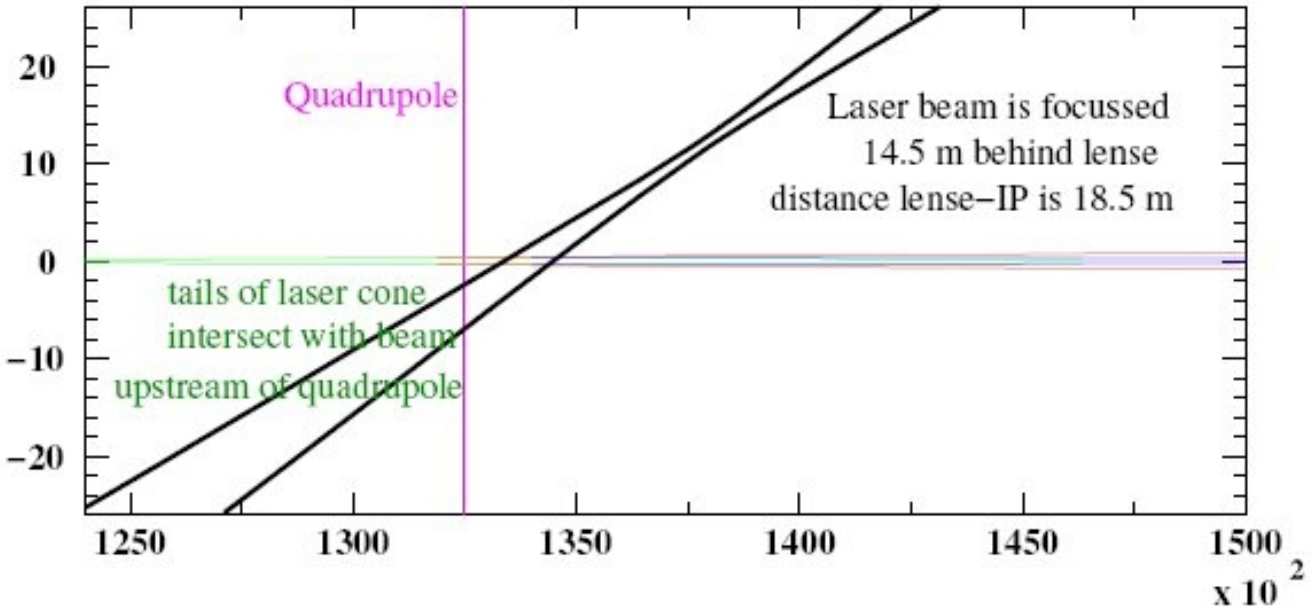
Should we implement the IP time dependence in the Monte Carlo ?

Note: the average (65.57 m) is not luminosity weighted !

Lepton beam and TPOL IP

S.Schmitt 30.01.2007





Conclusion: Compton beam has contribution from interactions downstream of Quadrupole

–> need double–Gaussian to describe Compton beam at calo

Core component:

- width σ_y
- offset $y_{\rm off}$
- normalisation $1 - f^2_{\rm tail}$

Secondary component:

- width $\sigma_y(1 + r^2_\sigma)$
- offset $y_{\rm off2}$
- normalisation $f^2_{\rm tail}$

SUMMARY:

Many Questions around the IP position, e.g. :

* What is the exact geometry available to the laser beam and e-beam?

* Has the laser beam been monitored with the Analyzer during the HERA II run ? Are there recorded data?

* Have the findings of Stefan Schmitt ever been used in corrections of the current TPOL values, used by the experiments?