Polarization in HERA-e with Mirror Tunes (...so far !)

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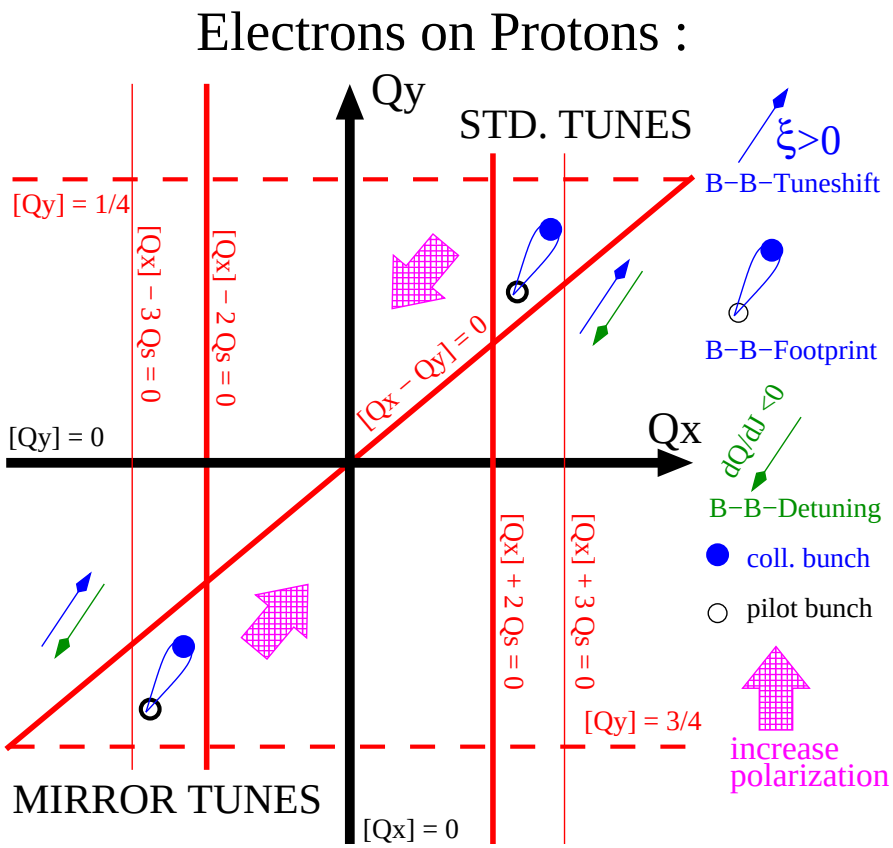
- Why mirror tunes ?
- Status
- Preliminary conclusions

* : D.P.Barber, M.Vogt; special thanks to E.Gianfelice (FNAL)

Why Mirror Tunes ?

- Polarization is generally better closer to the integer
- e^-/p collisions :
  $\xi > 0 \Rightarrow$colliding bunches have higher tunes
- standard tunes :
  = close **above** integer
  $\Rightarrow$ $P_{\text{pilots}} > P_{\text{coll.}}$
- mirror tunes :
  = close **below** integer
  $\Rightarrow$ $P_{\text{coll.}} > P_{\text{pilots}}$

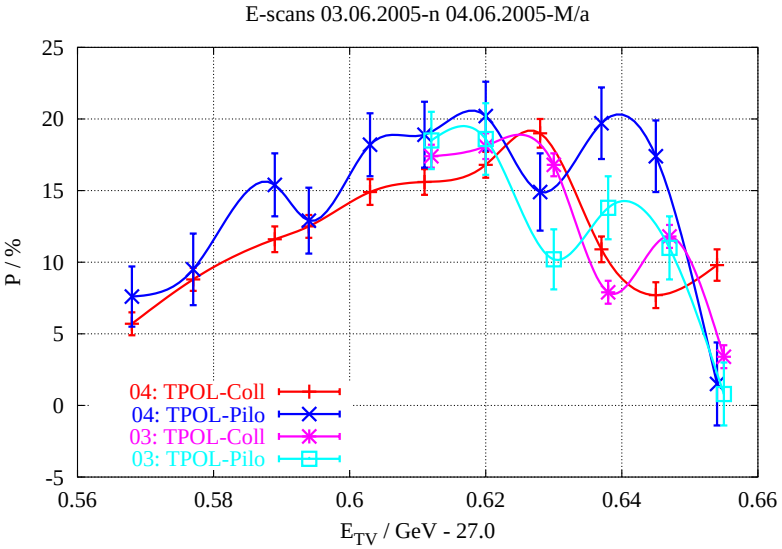


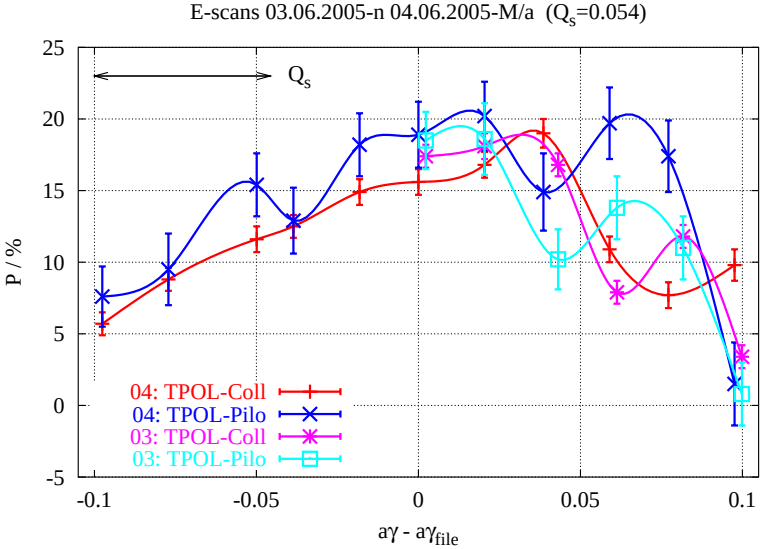
Set Up

- new optics & (certain) bumps
- rotators **flipped at the same time**
- technical set up (HTC, . . .)
- establish injection & ramp
- first lumi
- (inj/ramp/lumi)–files,. . .
- in lumi file :
- correct chromaticity
- correct coupling w/o ExpSol's
- correct coupling w ZEUS
- correct coupling w ZEUS & H1

- Lumi Optimization :
- IR-orbits, angles, backgrounds, . . .
- $\Delta\mu_x^{O/W}$, $\Delta\mu_y^{O/W}$
  $\rightarrow$to compensate b-b-β-beat IP's
  $\rightarrow$affects spin match in W-straight !!!
- TiltBumps (ZEUS & H1)
- tunes
- . . .
- Polarization Optimization
  $\rightarrow$Standard procedure . . .

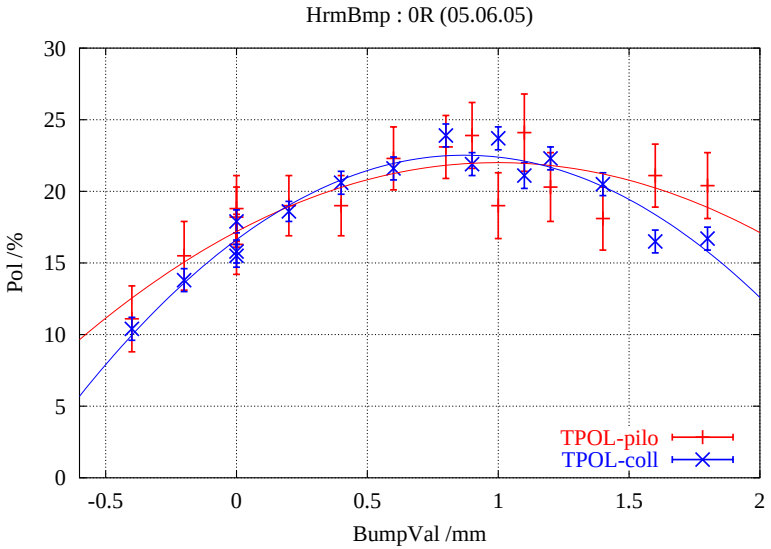
Energy Scan(s) / Coarse

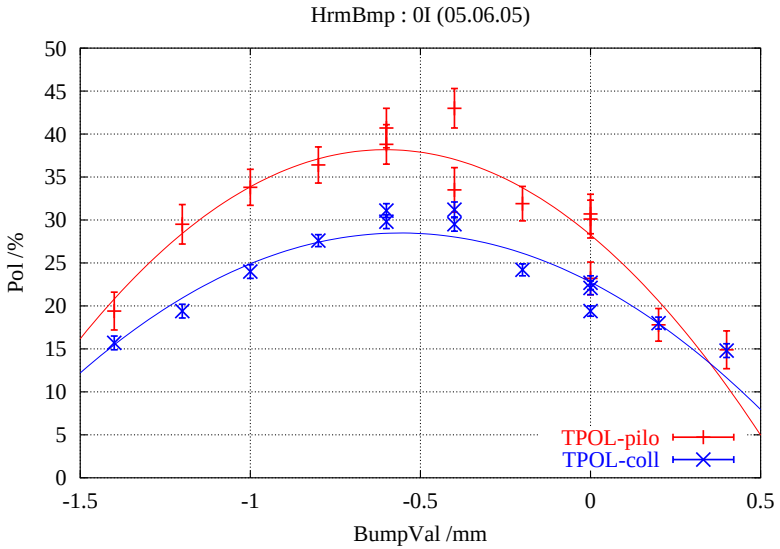




- shows theoretical energy not far off
- indicates theoretical energy slightly too low
- shows L/R–asymmetry. Not yet understood.

Status of Harmonic Bumps





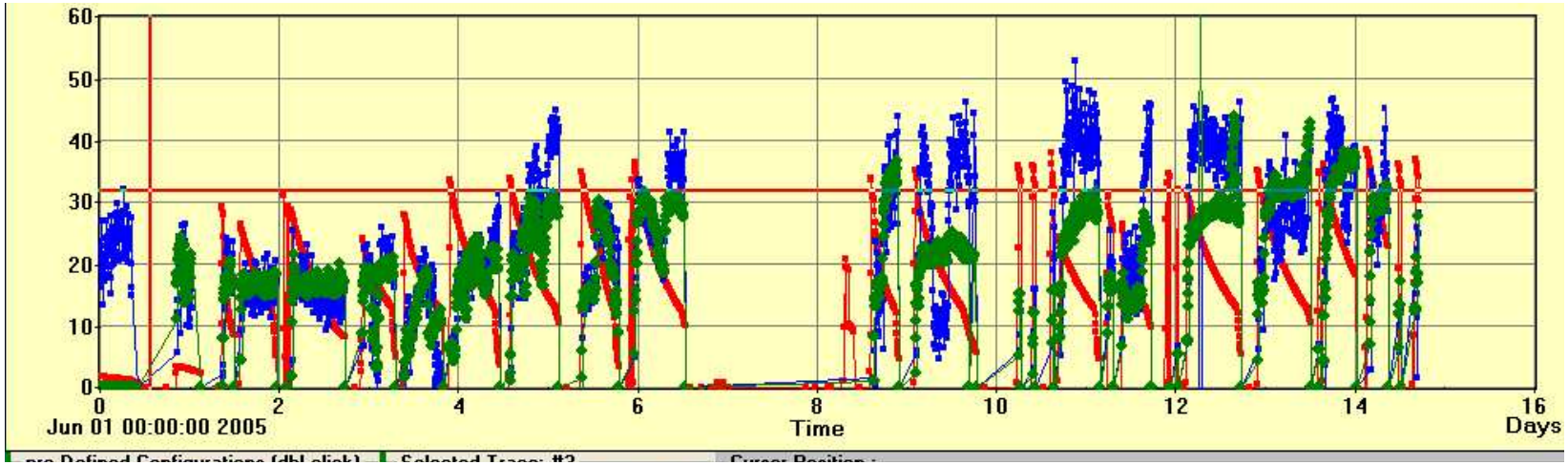
Bump	$-1R$	$-1I$	$0R$	$0I$	$+1R$	$+1I$	$+2R$	$+2I$
amplitude /mm	0.0	0.0	$+0.90$	-0.55	0.0	0.0	?.?	?.?

- all four first order bumps scanned
- two second order bumps scanned : rather flat / compatible with 0.0

Still to do (in terms of polarization tuning)

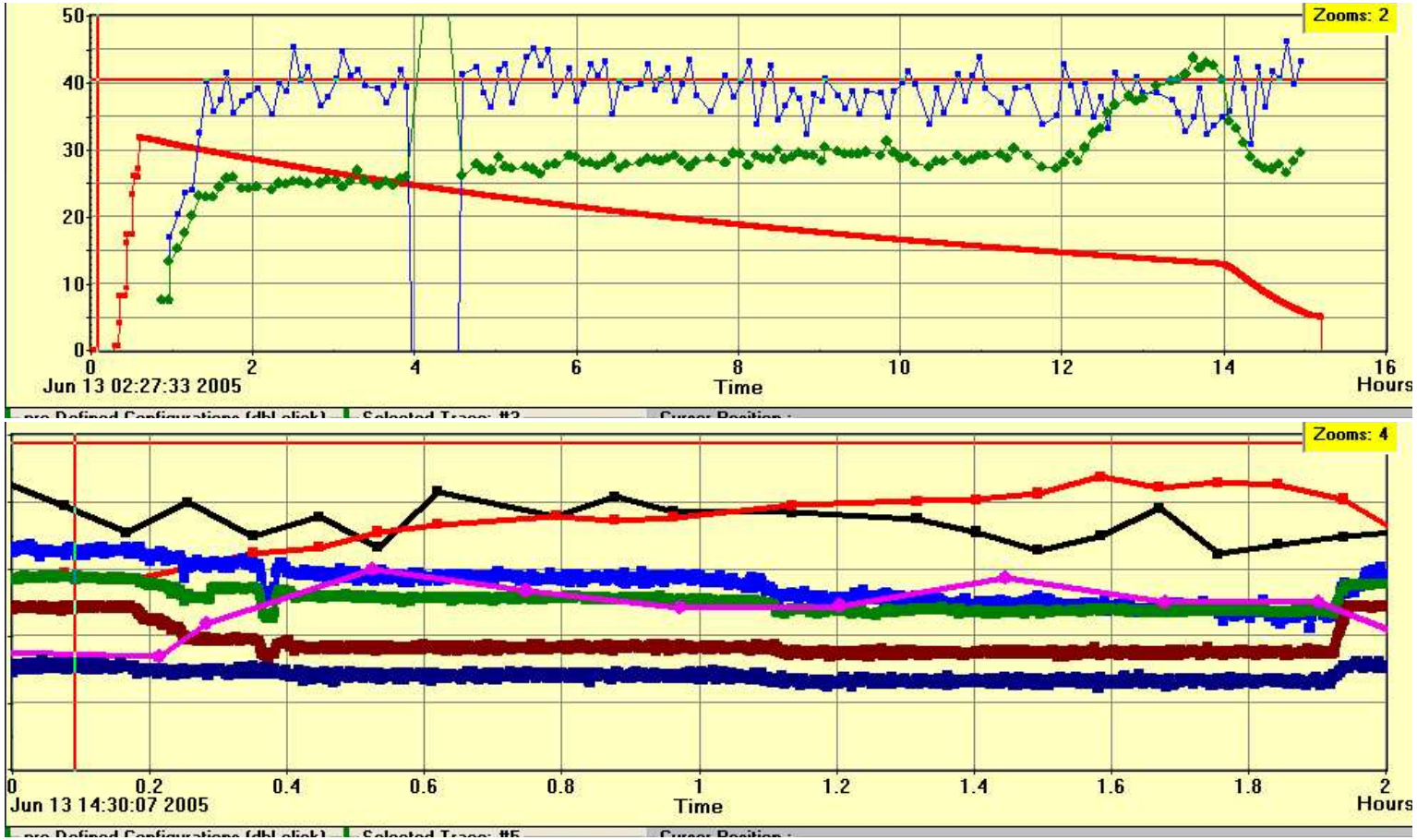
- 2-nd energy scan (**fine steps**)
- **systematic tune scan** :
  Q_x, Q_y : monitor $\mathcal{L}_s$ **and** P
  $\Leftarrow$**yet only "tune experiments" !** $\rightarrow$next couple of transparencies
- probably 2-nd iteration of bump scans
- . . . and then : find optimal tunes for $\mathcal{L}_s$ & P

Polarization June 2005



- I_e, TPOL-pilots-5min, TPOL-coll-5min

Highest Polarization : Push the Tunes !

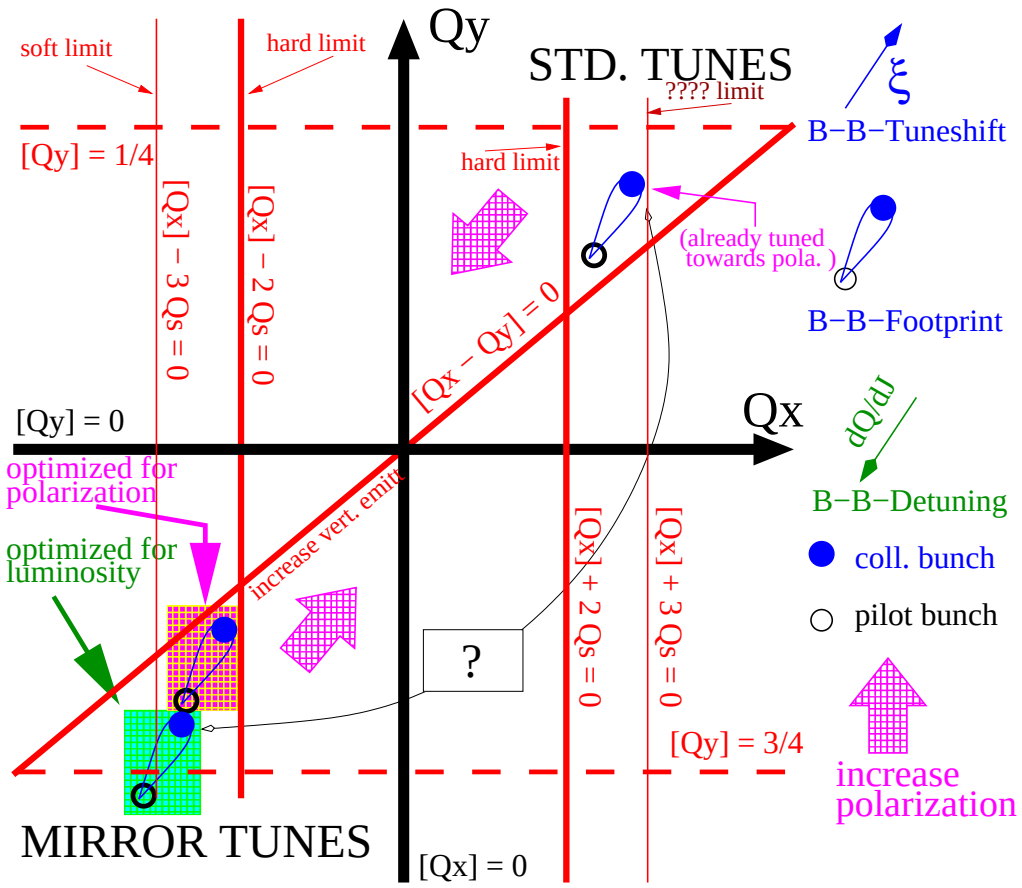


1. red: I_e, blue: TPOL-pilots-5min, green: TPOL-coll-5min
2. brown: f_y, dark-blue: f_x, black: TPOL-pilots-5min, red: TPOL-coll-5min, blue: $\mathcal{L}_s$-H1, green: $\mathcal{L}_s$-ZEUS, magenta: TPOL-ϵ_y-5min

43% achieved

$\mathcal{L}_s$ vs. P

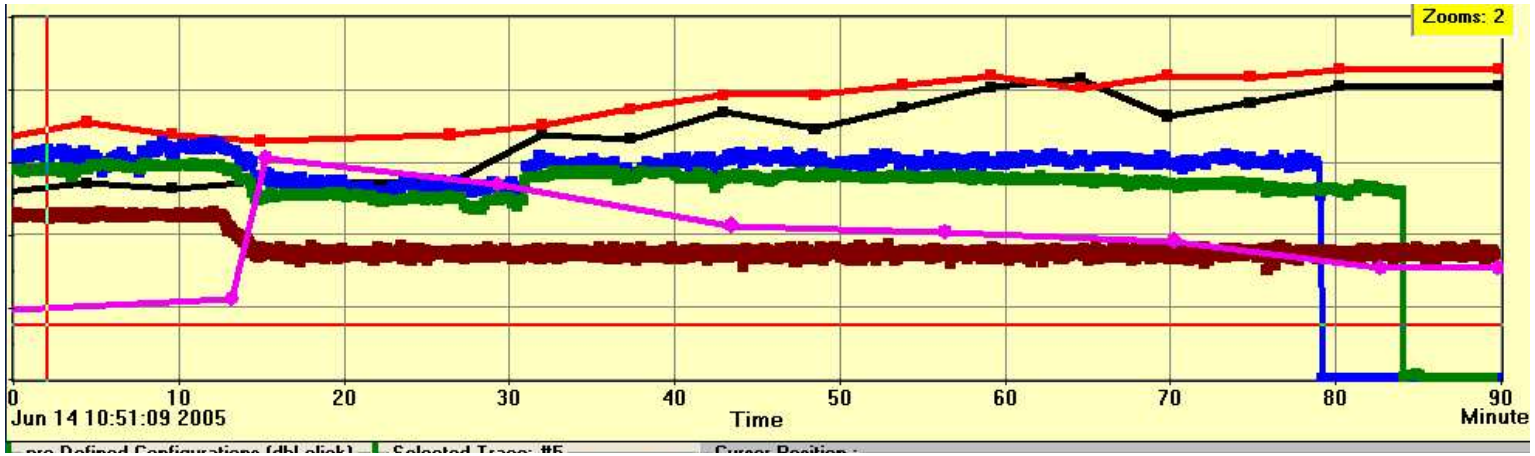
- high Q_x
  $\rightarrow$colliding bunches closer to 2-nd satellite
  $\rightarrow\epsilon^p$ grows ???
- high Q_y
  $\rightarrow$closer to coupling resonance
  $\rightarrow\epsilon_y^e$ grows !!!
- possible to compensate coupling ???
  $\rightarrow$**no** ϵ_y^e–growth at high Q_y ???
- 3-rd satellite seems no hard limit for pilots
- $\Rightarrow$mirror tunes possibly more flexible



Q_y towards Compensated Coupling Resonance

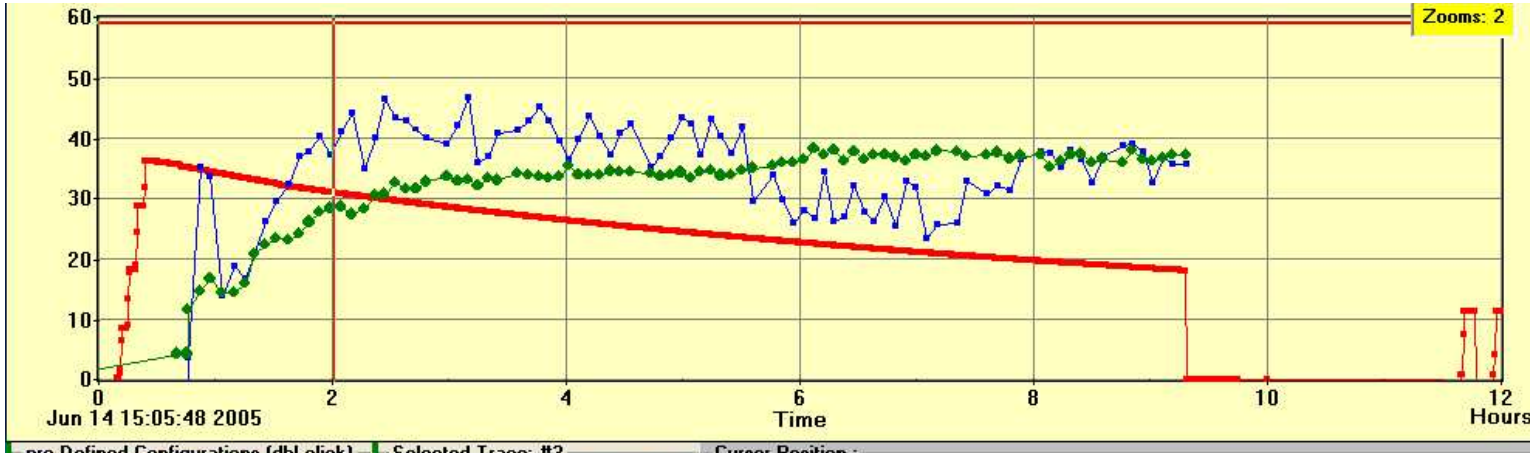
- red: I_e, blue: TPOL-pilots-5min, green: TPOL-coll-5min
- Experiment during HD-Run (14.06.2005 / ca. 11:00)

Q_y towards Compensated Coupling Resonance



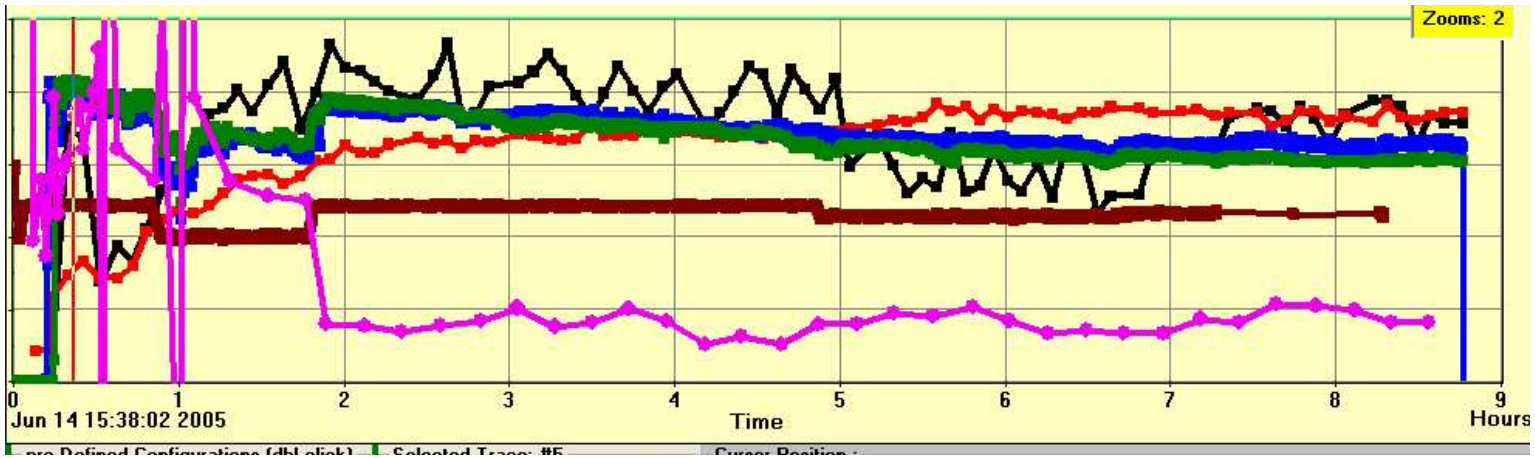
- brown: f_y, black: TPOL-pilots-5min, red: TPOL-coll-5min, blue: $\mathcal{L}_s$-H1, green: $\mathcal{L}_s$-ZEUS, magenta: TPOL-ϵ_y-5min
- push Q_y towards integer until $\mathcal{L}_s$ drops due to increased coupling
- compensate coupling ($\Re$ & $\Im$)
- $\mathcal{L}_s$ almost completely recovers

Optimum so far : $Q_x = 6.9$ kHz, $Q_y = 11.5$ kHz,



- red: I_e, blue: TPOL-pilots-5min, green: TPOL-coll-5min
- 14.06.2005 afternoon
- early run : try to redo HD-run experiment from morning
- mid-of-run : attempt to find acceptable tunes for $\mathcal{L}_s$ & $P_{\text{coll.}}$

Optimum so far : $Q_x = 6.9$ kHz, $Q_y = 11.5$ kHz,



- brown: f_y, black: TPOL-pilots-5min, red: TPOL-coll-5min, blue: $\mathcal{L}_s$-H1, green: $\mathcal{L}_s$-ZEUS, magenta: TPOL-ϵ_y-5min

1. Coupling compensation experiment could not be verified, probably because of noisy ϵ_y measurement
2. Later: $Q_x = 6.9$ kHz, $Q_y = 11.5$ kHz : no further $\mathcal{L}_s$ decay & $P_{\text{coll.}}$ almost 40%

My Preliminary Conclusion

- Polarization is not yet well-tuned enough to be compared with e^+/p–collisions at standard tunes nor with e^-/p–collisions at standard tunes
- Mirror tune working point appears rather flexible : $\mathcal{L}_s \leftrightarrow P_{\text{coll.}}$
- However, sofar no major breakthrough has yet been achieved
- It **might** turn out, that we don't gain much Polarization w/o loosing much Luminosity