HERA-e Polarisation after the Luminosity Upgrade

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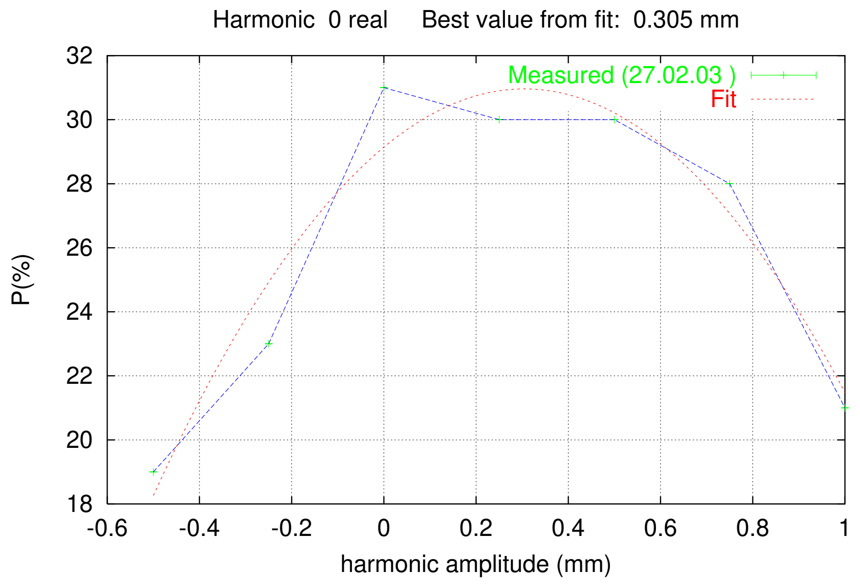
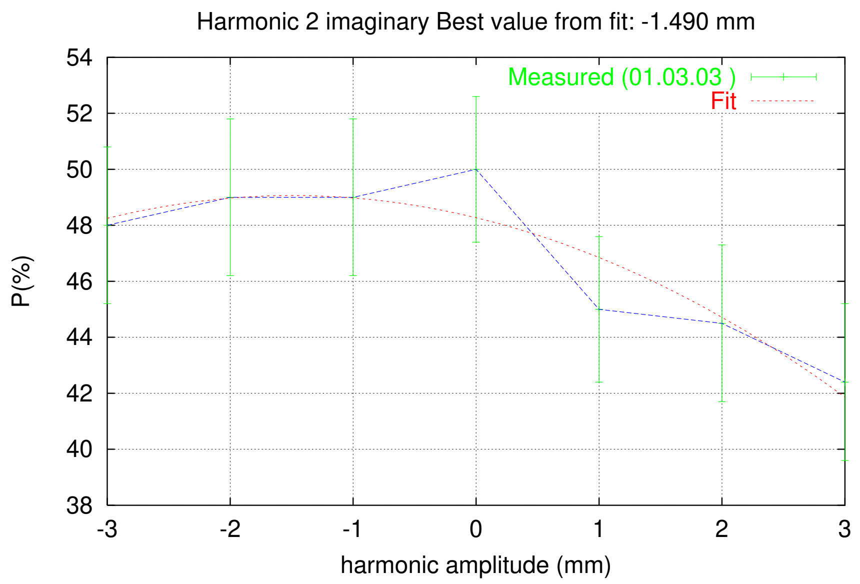
H1 meeting (19 February 2004)

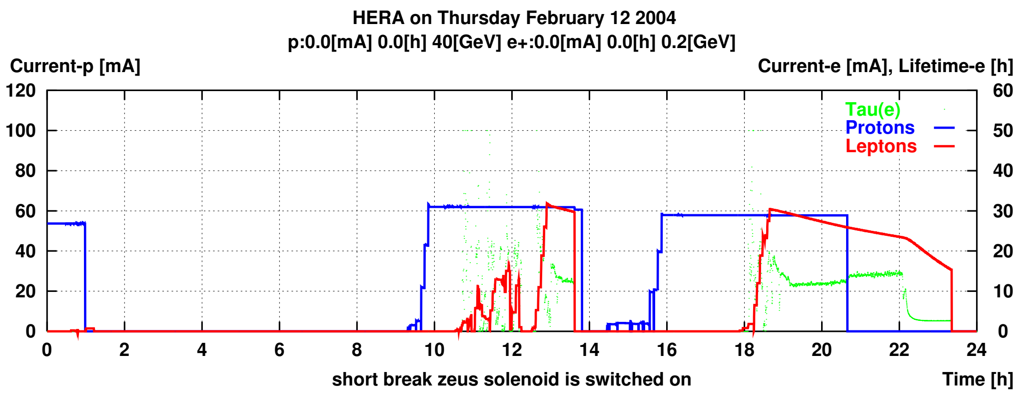
Contents:

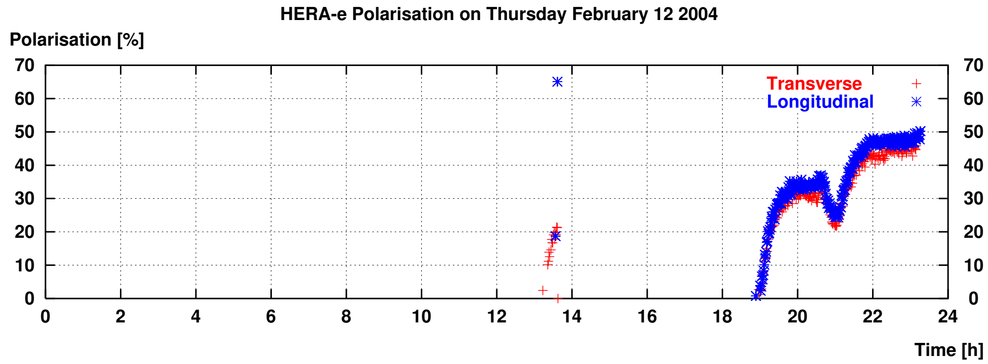
- Polarisation at Hera-e (overview)
- Impact of the luminosity upgrade on polarisation
- Status of polarisation operation in Hera-e

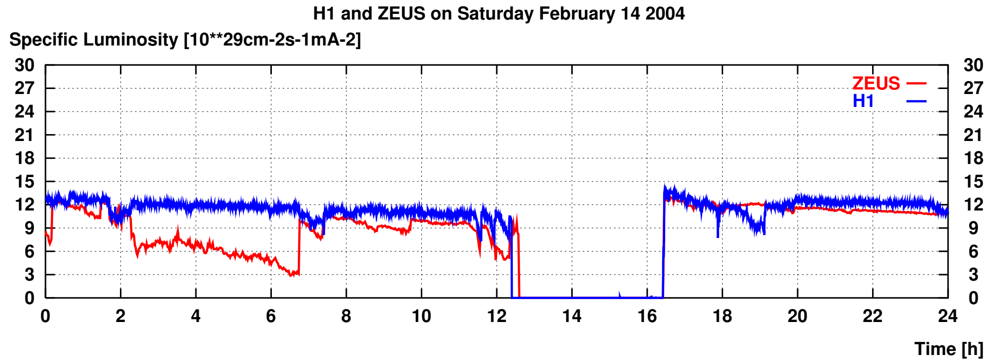

Harmonic 0 real Best value from fit: 0.305 mm
Measured (27.02.03)
Fit
P(%)
32
30
28
26
24
22
20
18
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
harmonic amplitude (mm)

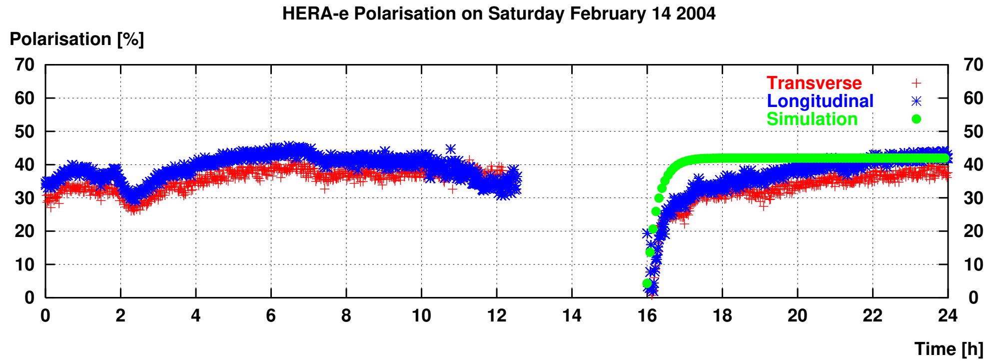

Harmonic 2 imaginary Best value from fit: -1.490 mm
Measured (01.03.03)
Fit
P(%)
54
52
50
48
46
44
42
40
38
-3
-2
-1
0
1
2
3
harmonic amplitude (mm)

Polarisation at Hera-e





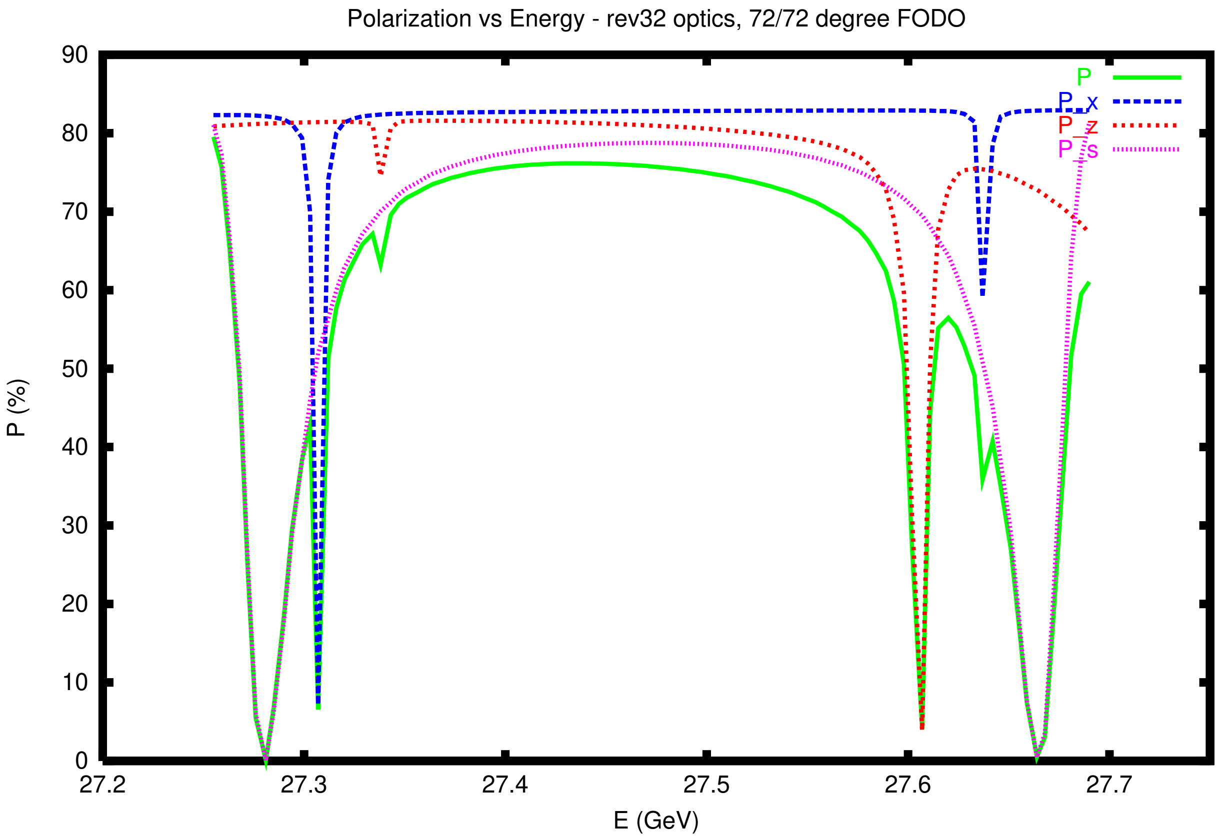




3 Rotator pairs optics - $72^o/72^o$ FODO -ideal machine

(SLIM)

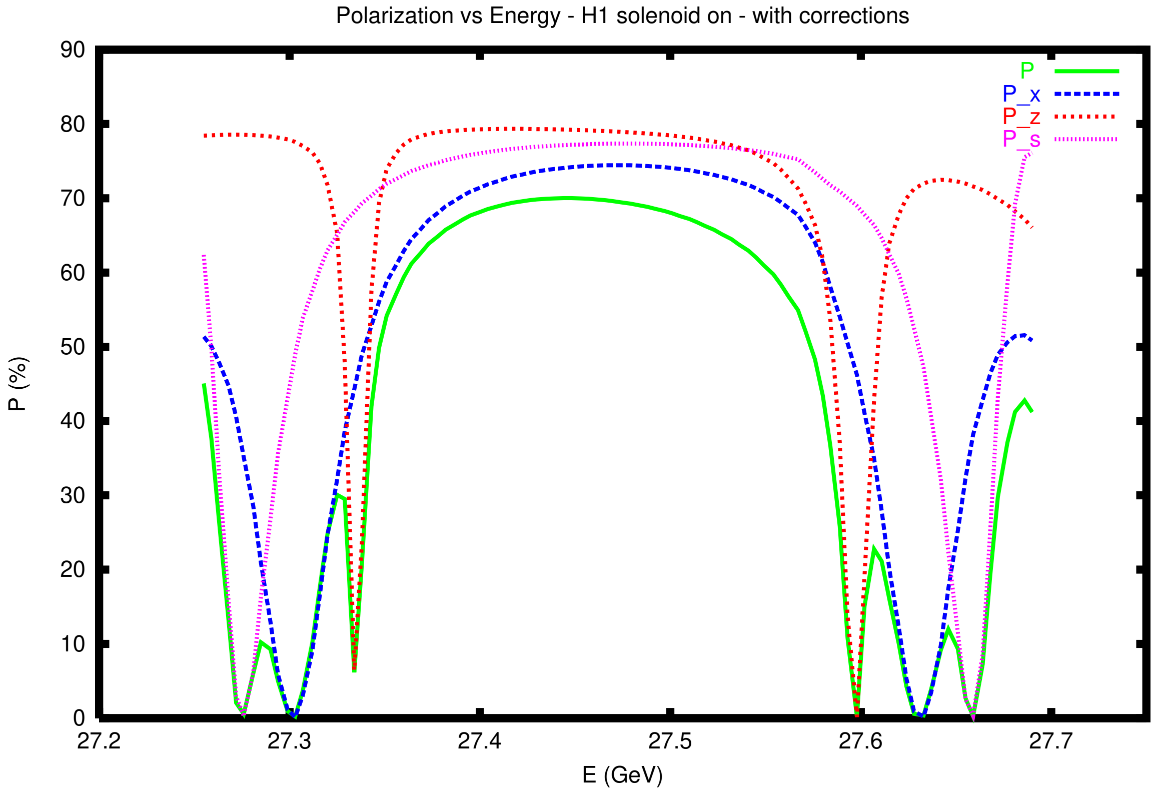
$P_{ST} = 83.3\%$



Polarisation vs Energy with H1 solenoid

“Sandwich Model”, with corrections

- local closed orbit correction
- coupling correction
- $\hat{n}_0$ correction (by “special” rotator settings)



Expected polarisation in presence of random errors (linear calculations)

After closed orbit correction (average on 6 seeds)

x_{rms}(mm)	z_{rms}(mm)	$\delta\hat{n}_0$(mrad)	$P(\%)$	$P_x(\%)$ $P_z(\%)$ $P_s(\%)$
0.76±0.06	0.81±0.14	35.6±11.1	12.3±11.8	73.5±4.1 72.5±4.4 11.3±11.9

...and with in addition the "harmonic bumps" (average on the same 6 seeds)

$\delta\hat{n}_0$ (mrad)	$P(\%)$	$P_x(\%)$ $P_z(\%)$ $P_s(\%)$
16.9±3.7	67.5±4.8	71.5±4.1 70.8±5.3 67.6±5.8

Expected polarisation with in addition the solenoids (no beam-beam)

After closed orbit correction (average on 8 seeds)

x_{rms}(mm)	z_{rms}(mm)	$\delta\hat{n}_0$(mrad)	$P_{lin}(\%)$	$P_x(\%)$ $P_z(\%)$ $P_s(\%)$
0.86±0.16	0.78±0.15	32.9± 7.6	10.3± 5.5	66.6±4.4 74.2±3.1 10.8±6.2

...and with in addition the "harmonic bumps" (average on the same 8 seeds)

$\delta\hat{n}_0$ (mrad)	$P_{lin}(\%)$	$P_x(\%)$ $P_z(\%)$ $P_s(\%)$	$P_{nonlin}(\%)$
14.8±3.7	63.8±2.1	67.1±3.8 72.7±3.7 71.5±1.5	57.0±3.2

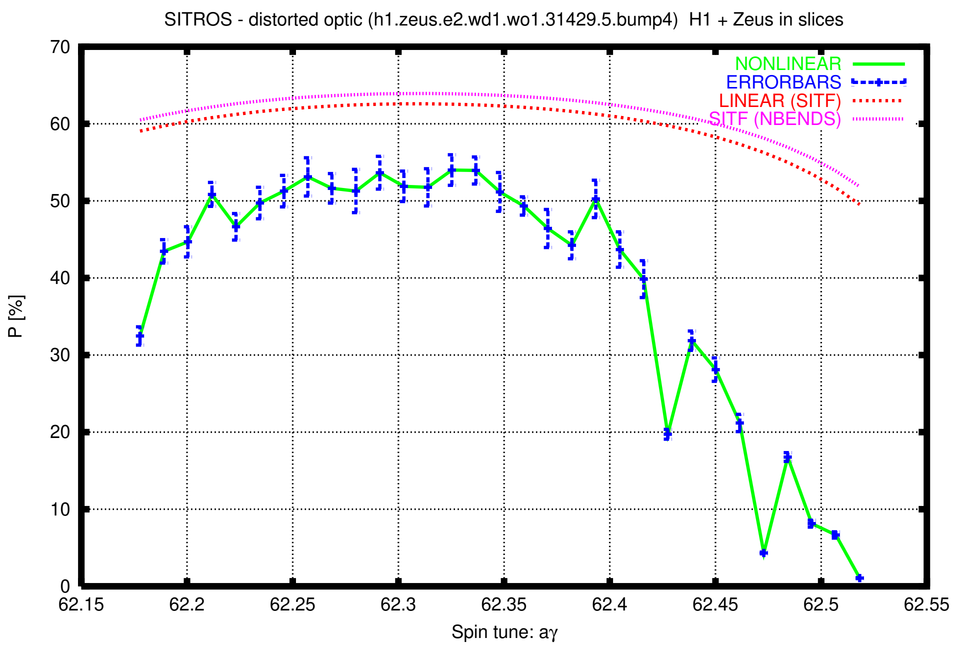
An example

seed	x z (mm)	ϵ_x ϵ_z nm $\times$ rad	$\delta\hat{n}_0$ (mrad)	P (%)	P_x P_z P_s (%)	$\delta\hat{n}_0$ (mrad)	P (%)	P_x P_z P_s (%)	# of corrected harmonic
51	1.0	29.8	39.8	5.6	71.7	22.7	56.5	74.4	4
	1.2	1.1			75.1			77.3	
					5.7			58.5	
51						20.0	65.1	71.4	8
								73.9	
								69.2	
51	0.7	29.1	34.7	7.4	74.7	17.8	65.6	75.7	4
	0.8	1.2			76.8			77.0	
					7.4			67.6	
51						14.0	72.3	69.4	8
								69.4	
								77.8	

SITROS

-non linear spin tracking-

example of a distorted machine with solenoids



- Energy plateau $\simeq$ 90 MeV

Current status and summary

- The design of the upgraded machine has been optimised for luminosity, but polarisation operation was expected to be more difficult. Even without considering beam-beam effects, the maximum reacheble polarisation is expected to be around 57%.
- Provided that the betatron tunes are set “correctly”, polarisation of about 40% is reached routinely. Due to the large run-to-run orbit excursions, this was not an obvious result; the orbit feed-back provides for the needed orbit stability.
- Increasing this level requires a finer tuning which is turning out to be almost impossible in the presence of beam-beam effects.
- There are indications of a blow-up of the e^+ emittance during collisions (but it could be also a beam-beam β-beat) This can further spoil the level of reacheble polarisation.