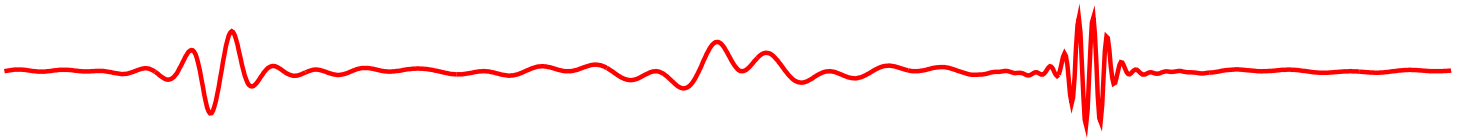
Optics measurements during the ramp and IR non-linear corrections



B. Dalena, M. Giovannozzi, Y.I. Levinsen, M.J. McAteer, E.H. Maclean, R. Miyamoto, T.H.B. Persson, S. Redaelli, P. Skowronski, R. Tomás and S. White

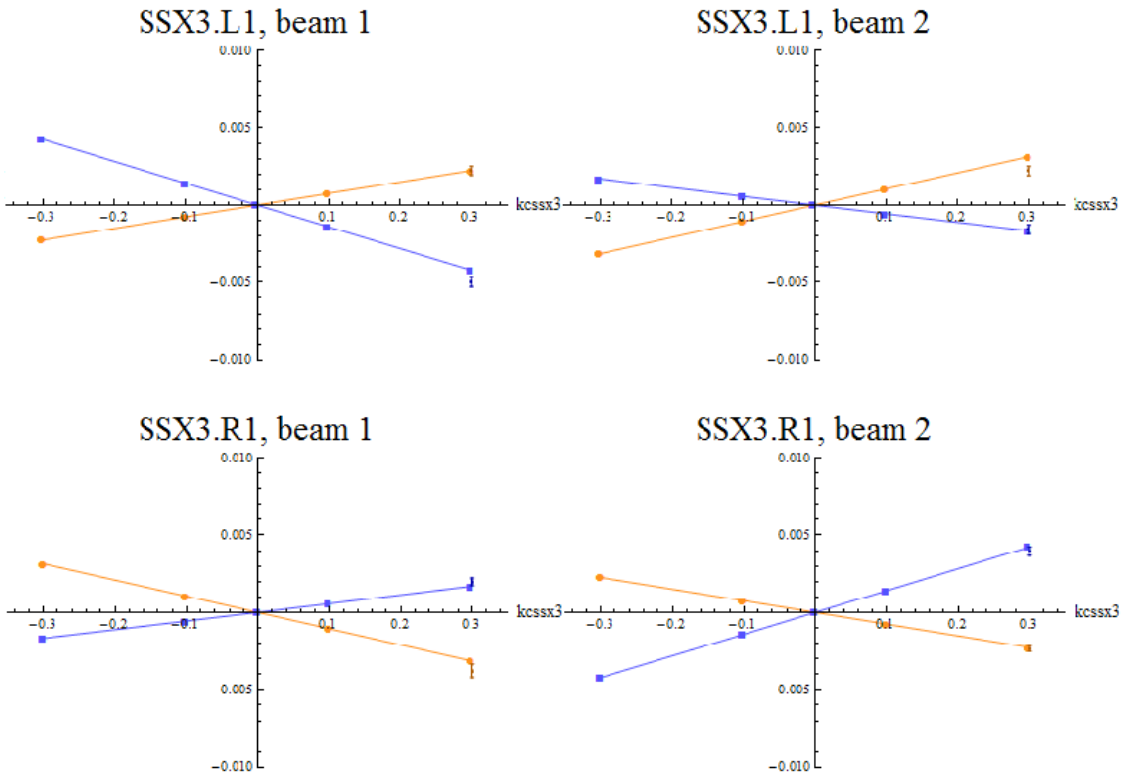
Thanks to A. Macpherson, M. Pojer and M. Solfaroli

October 2012

Contents

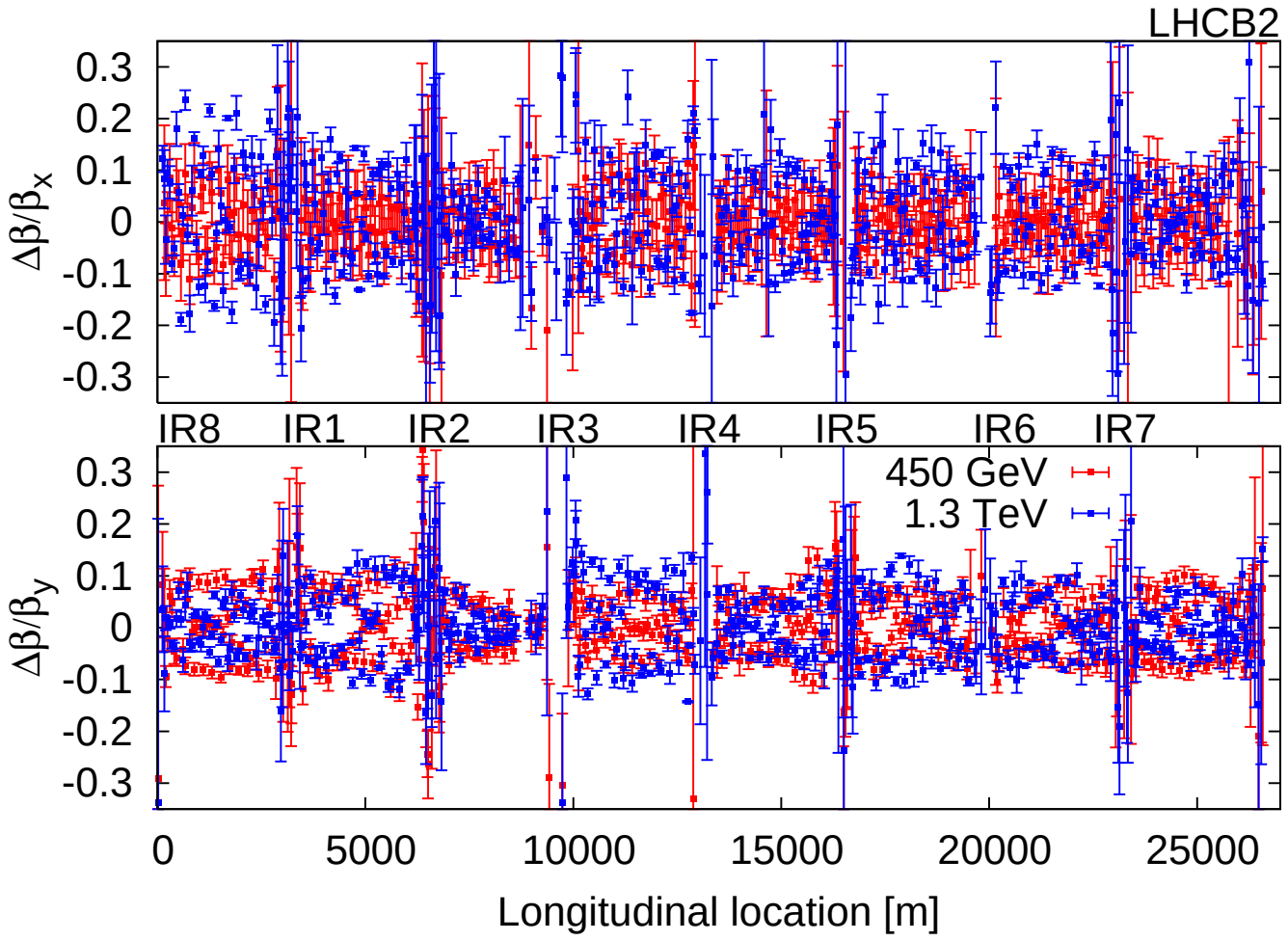
- IR skew sextupole polarity check
- β-beating during the ramp
- Chromatic coupling correction at β^*=0.6 m
- IR non-linear correction at β^*=0.6 m
- Amplitude detuning at β^*=0.6 m

IR skew sextupole polarity check



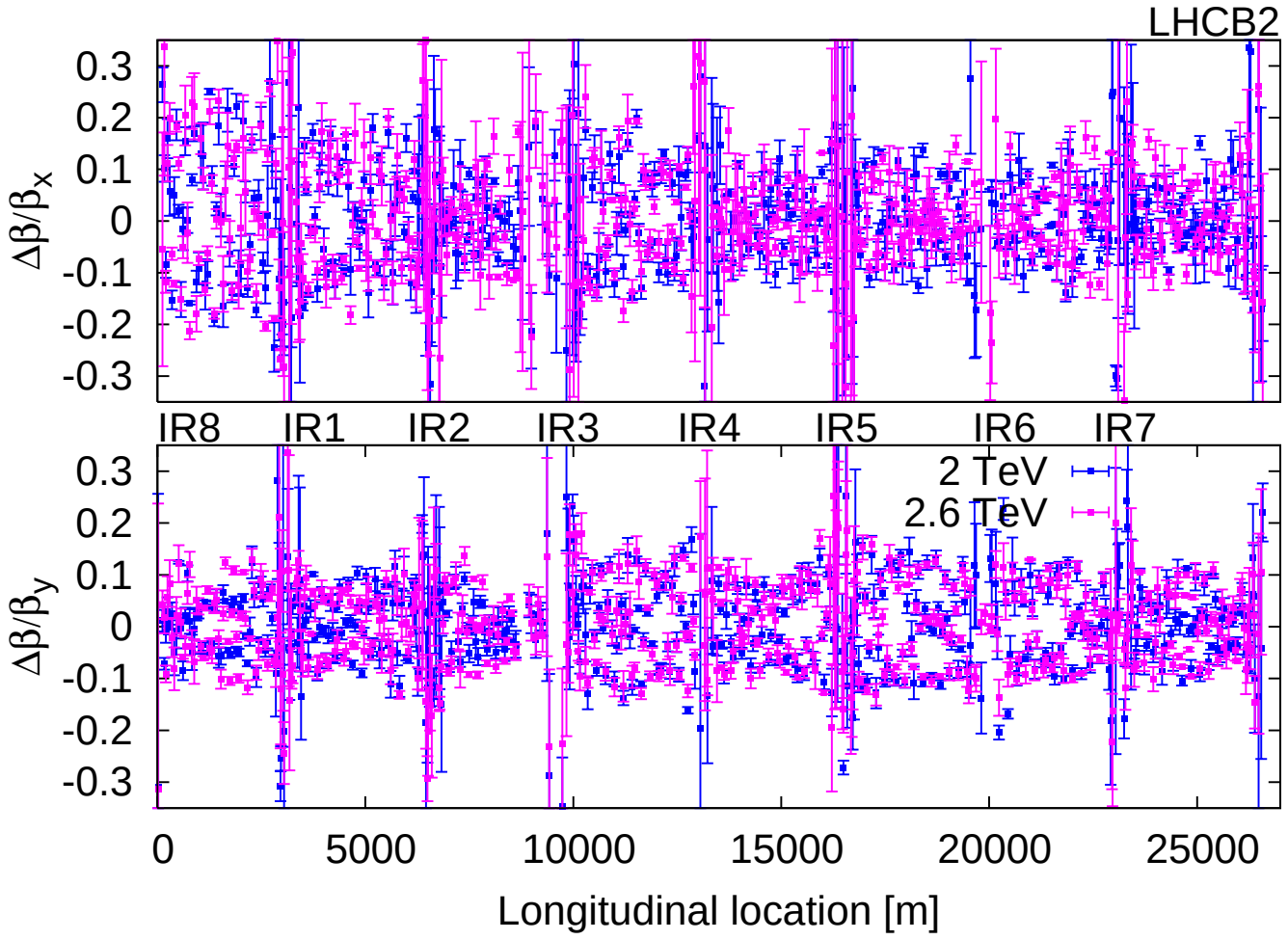
IR skew and normal sextupoles agree with MAD polarities and strengths (note that arc skew sextupoles do not).

β-beating during the ramp I



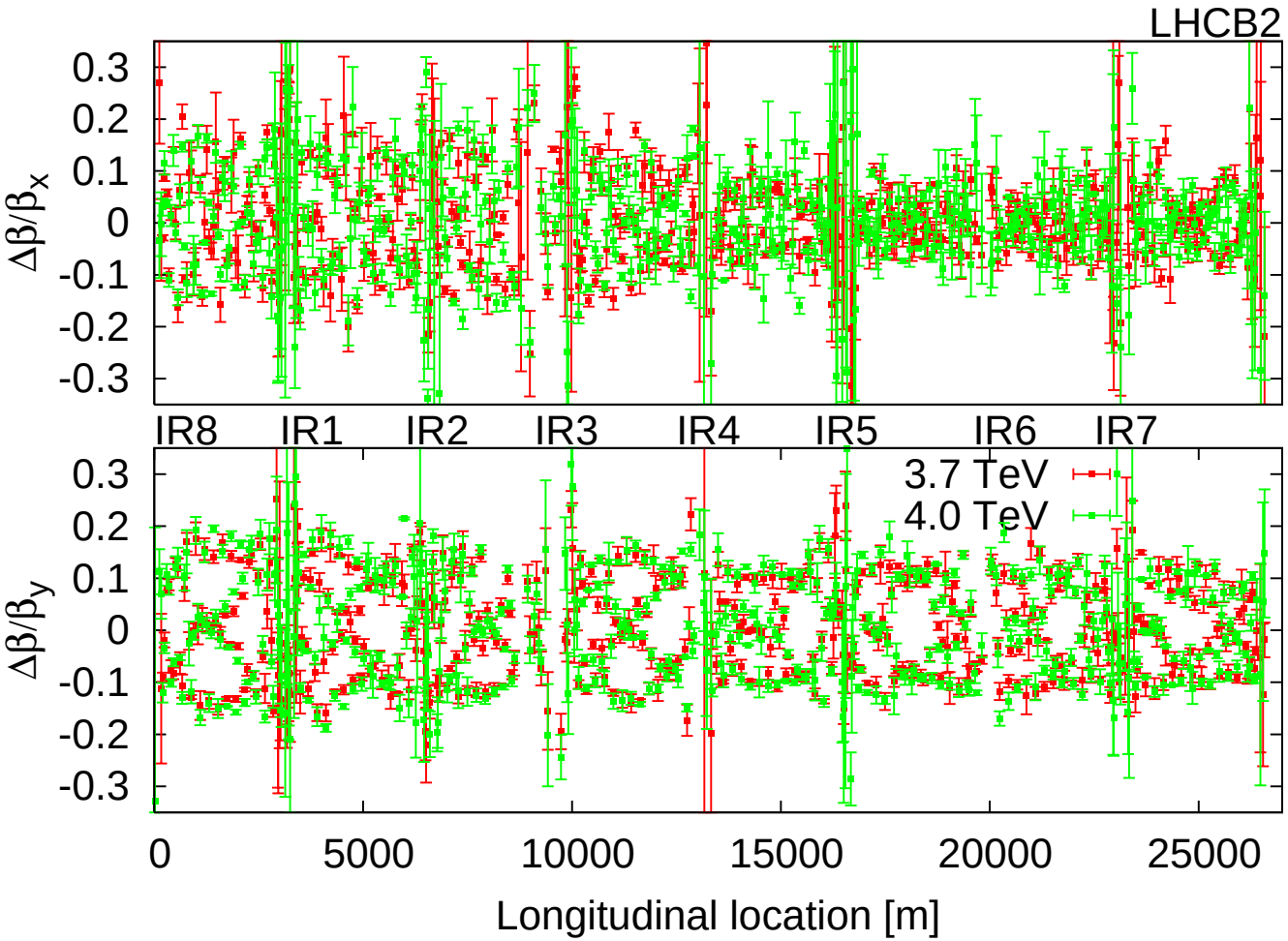
$\pm 10\%$ change in β-beating from inj to 1.3 TeV.

β-beating during the ramp II



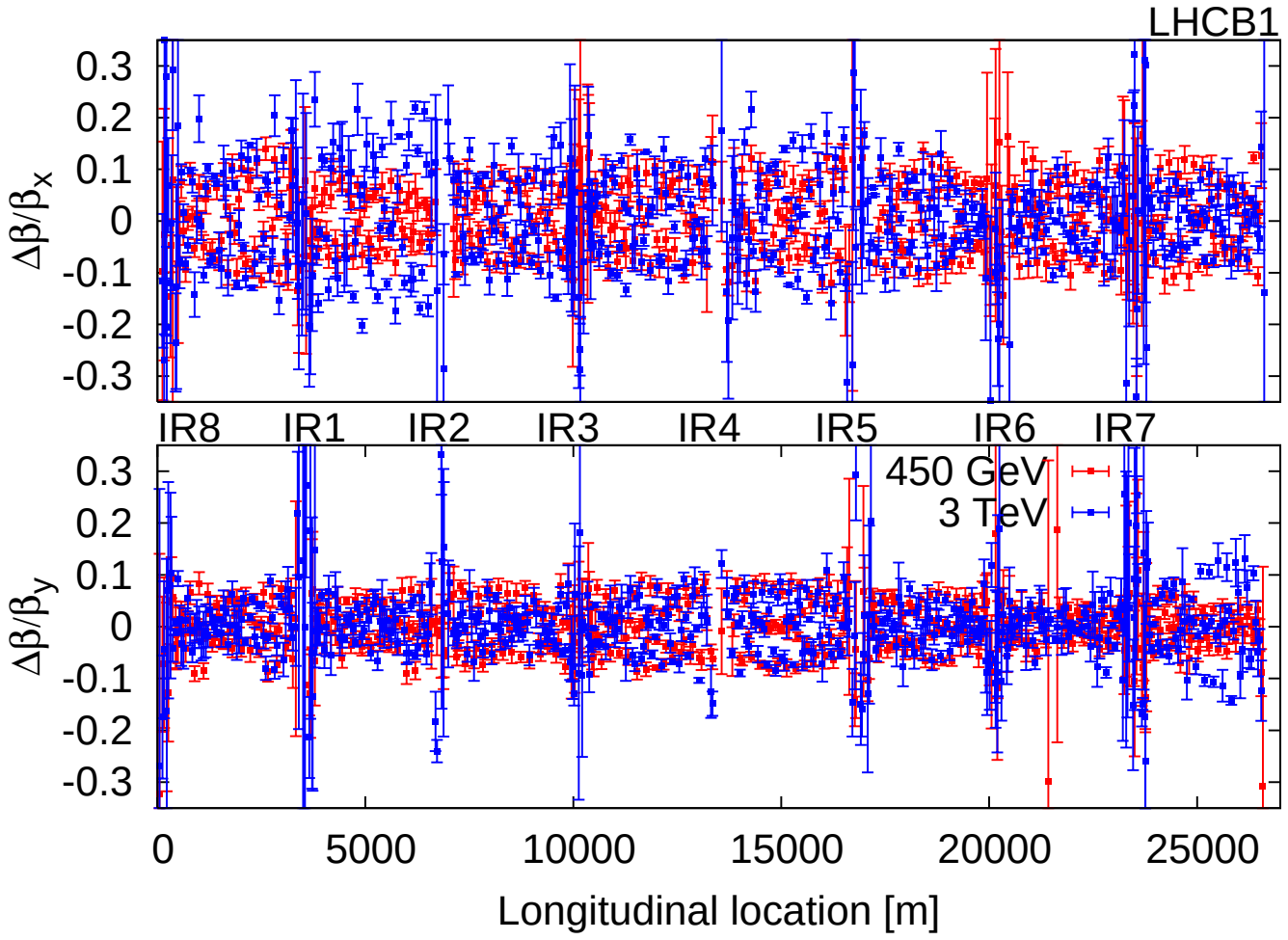
Small change in β-beating from to 1.3 TeV.

β-beating during the ramp III



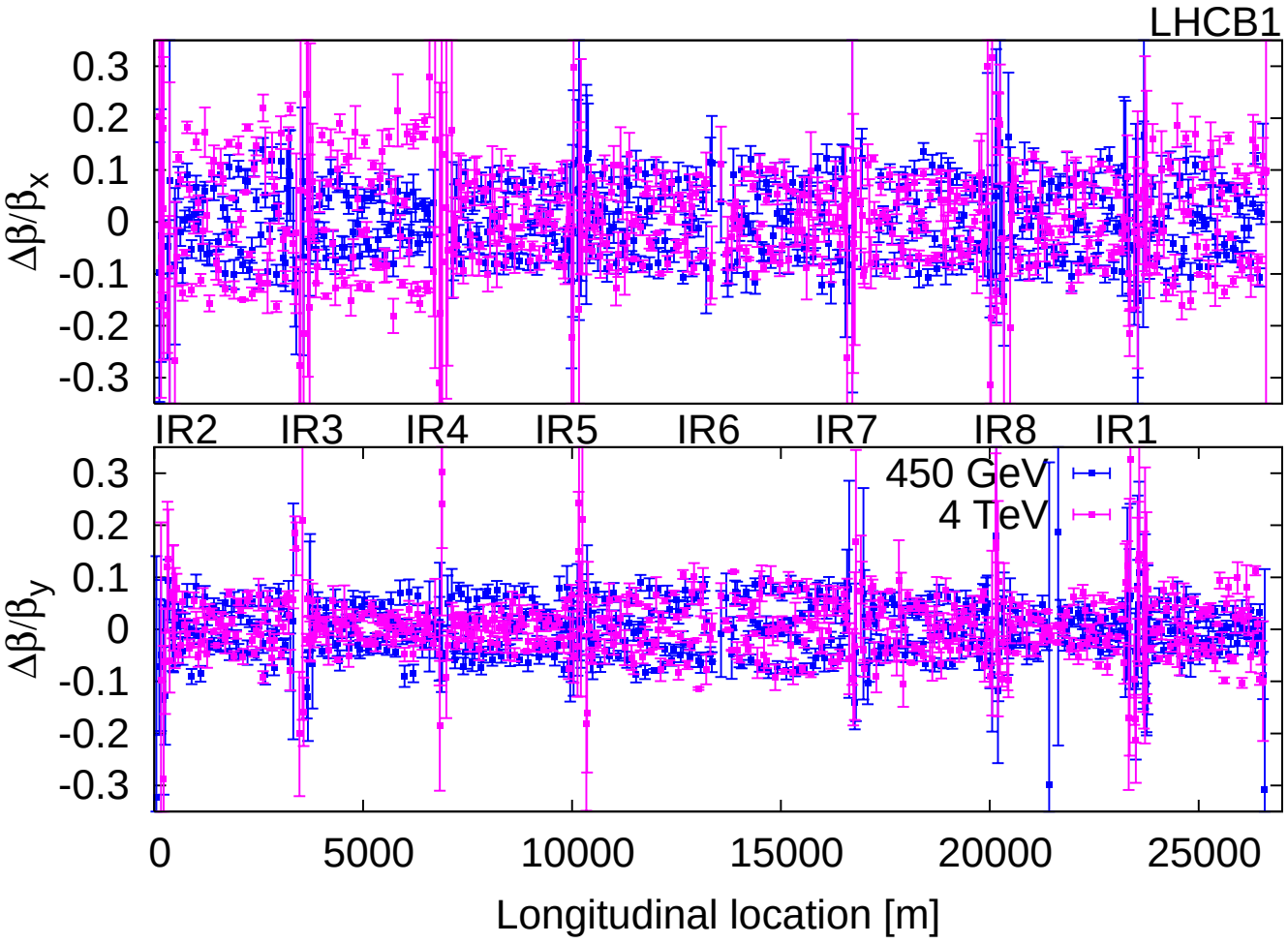
Small change in β-beating from 3.7 to 4 TeV.

β-beating during the ramp IV



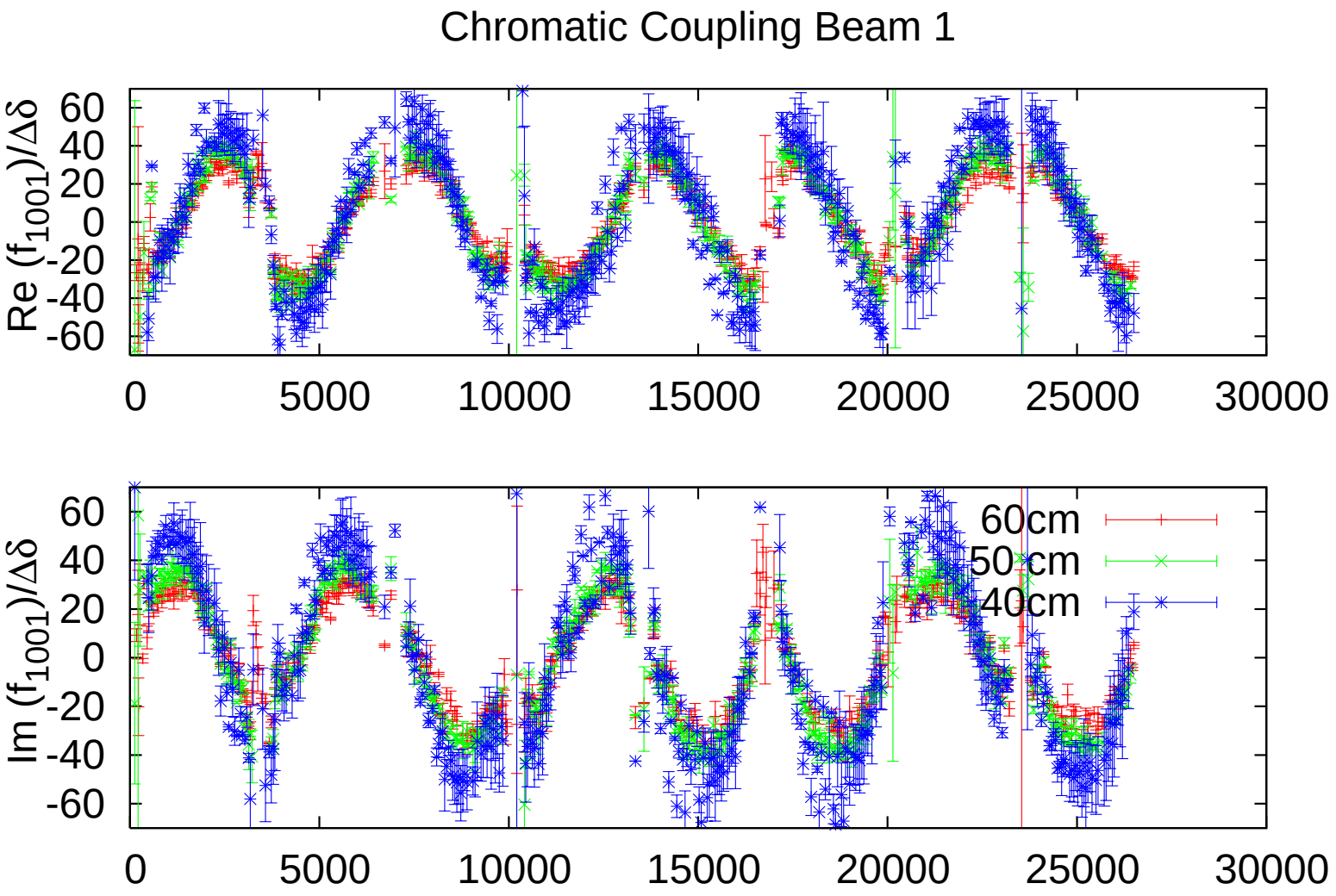
± 10% change in β-beating from inj to 1.3 TeV.

β-beating during the ramp V



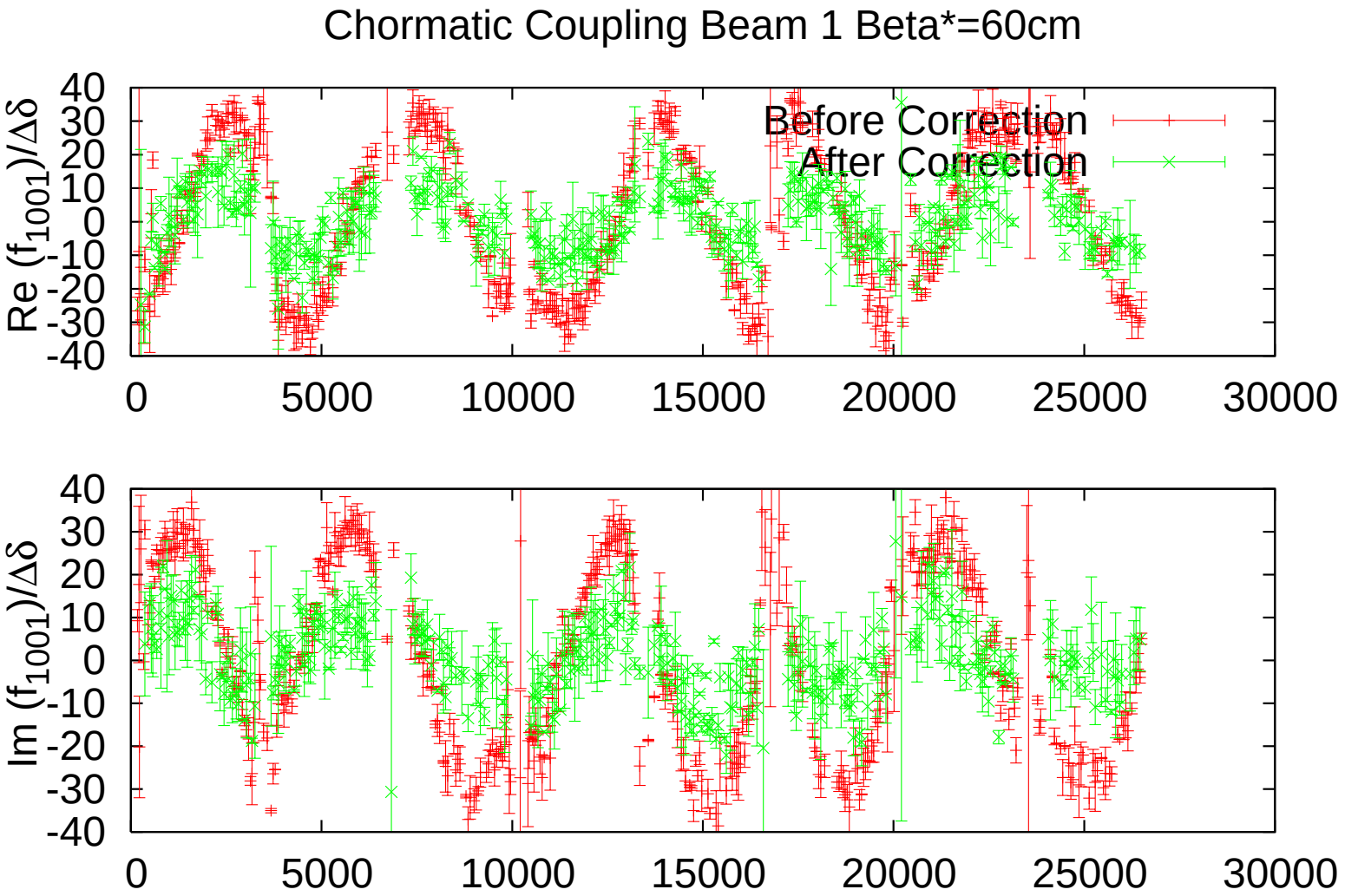
Small change in β-beating from 3 TeV to 4 TeV.

Chromatic coupling Vs β^*



At β^*=0.4 m a dp/p=0.001 gives $\Delta\Delta Q_{\min}$=0.0024.

Chromatic coupling correction at β^*=0.6 m



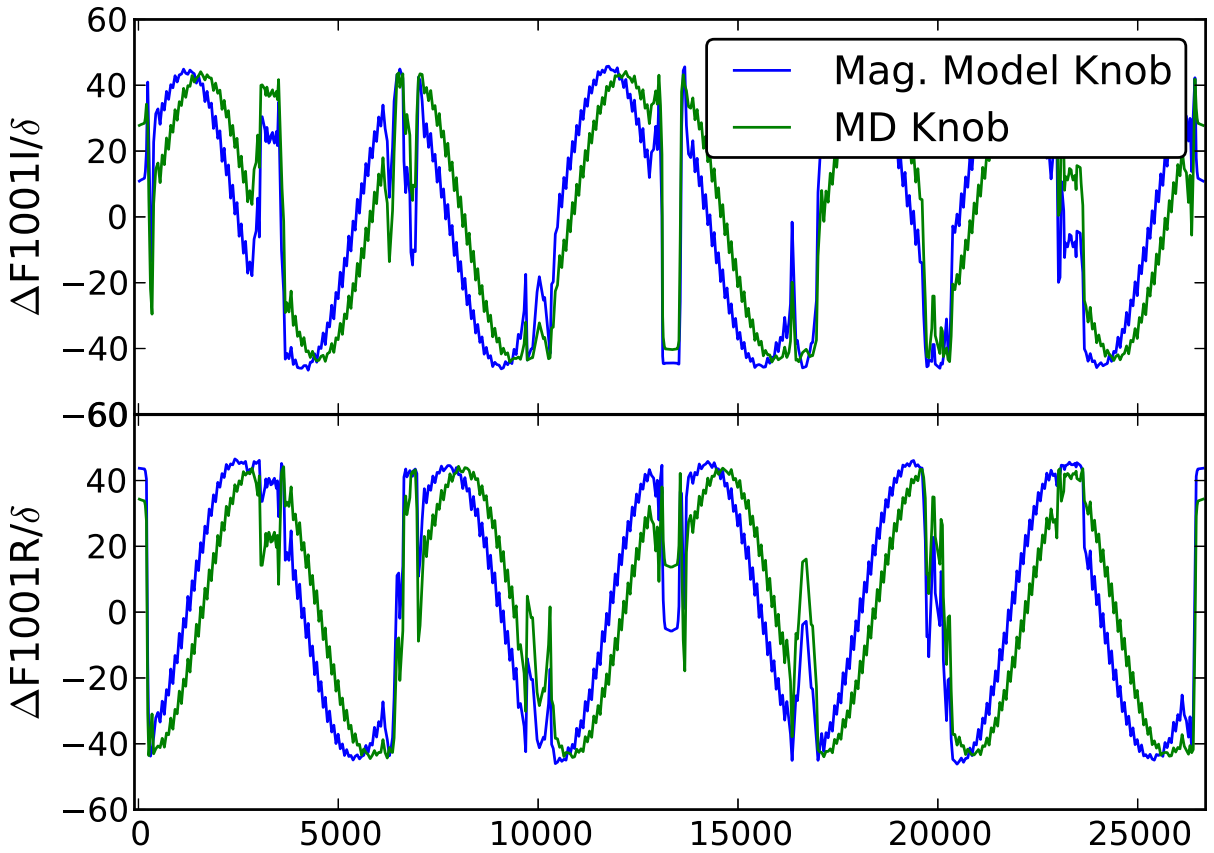
Chromatic coupling: Model Vs Exp

	Beam 1		Beam 2	
	Model	Exp	Model	Exp
KSS.a12	-0.0523	-0.0076	-0.0544	-0.0105
KSS.a23	-0.0335	0.0088	-0.0365	0.0101
KSS.a34	-0.0325	0.0028	-0.0313	0.0003
KSS.a45	-0.0313	-0.0049	-0.0239	-0.0069
KSS.a56	-0.0021	-0.0003	-0.0039	0.0024
KSS.a67	-0.0068	-0.0078	-0.0022	-0.0098
KSS.a78	-0.0356	-0.0058	-0.0335	-0.0070
KSS.a81	-0.0152	0.0000	-0.0182	0.0099

Model considerably stronger, but would it work?

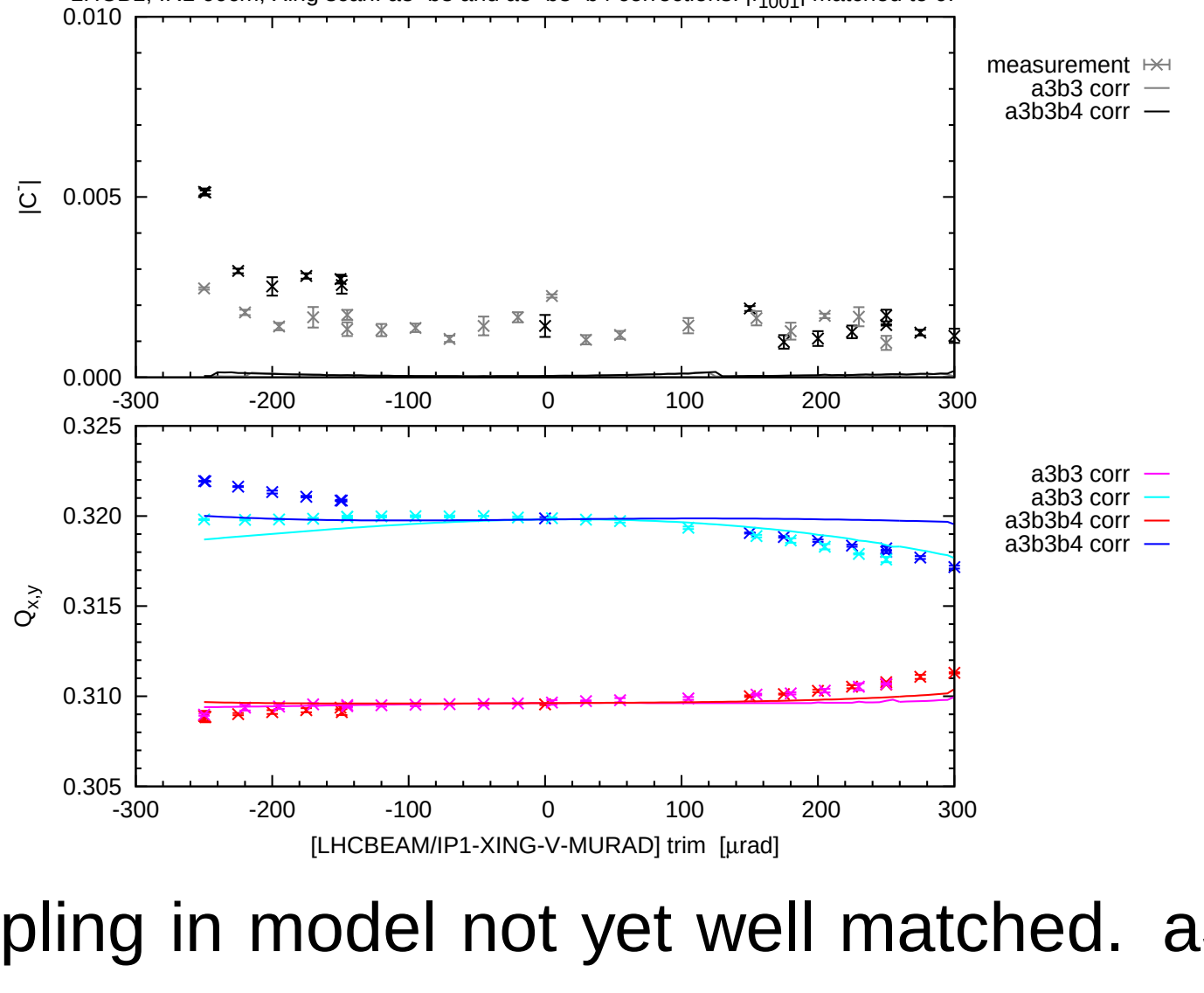
Chromatic coupling: Model Vs Exp

Beam 2



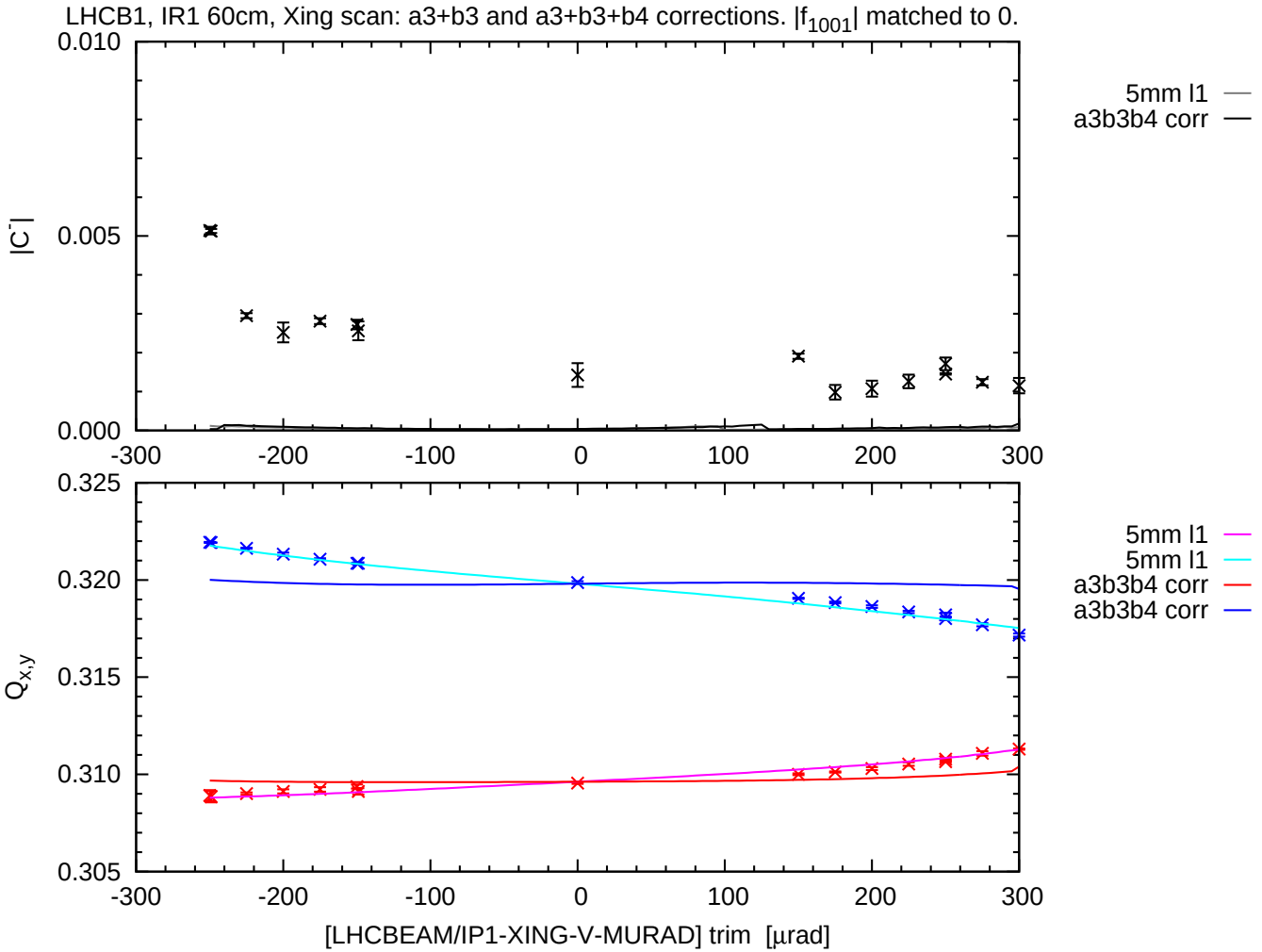
Yes.

IR1 non-linear correction - Beam 1



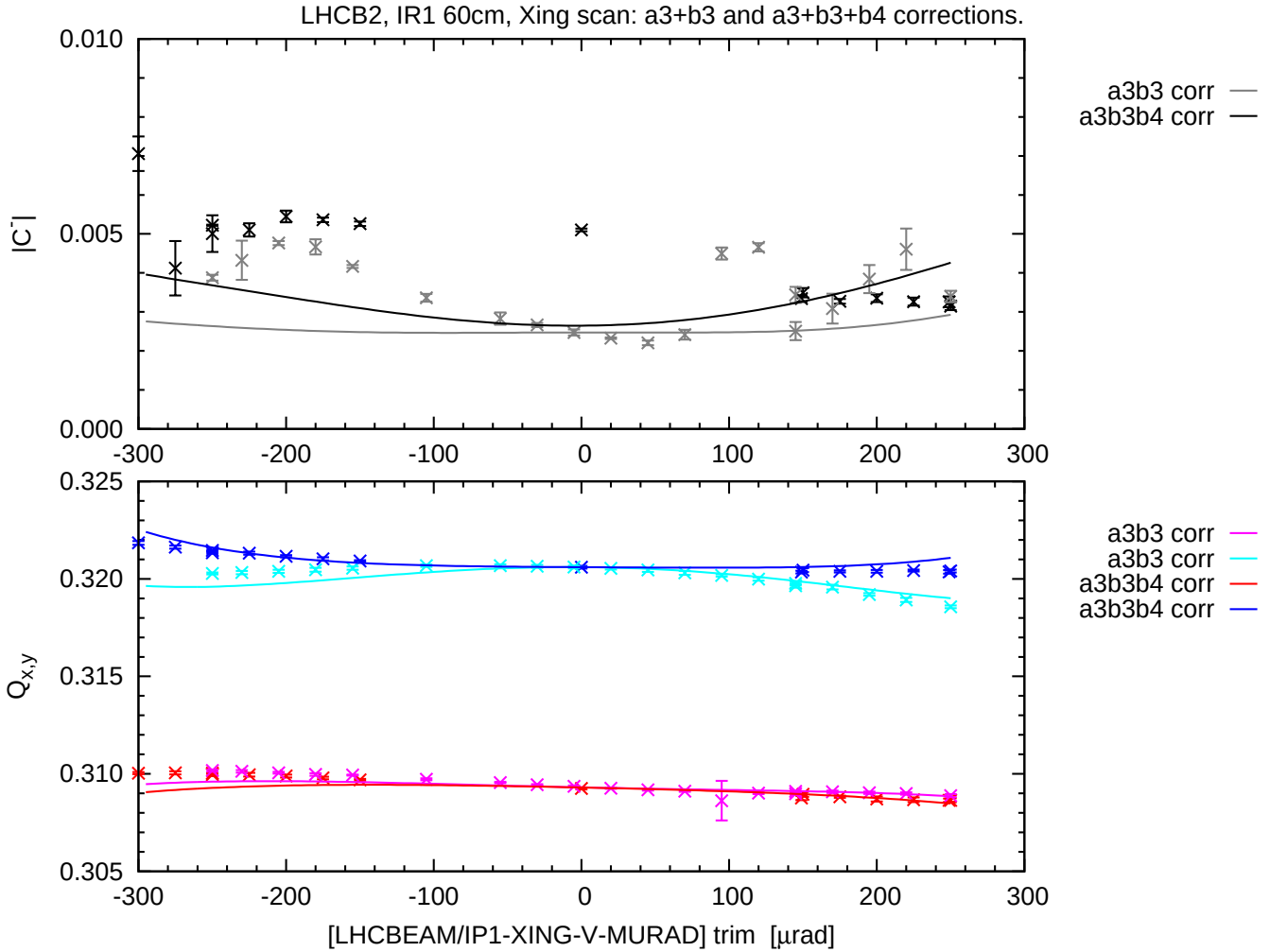
Coupling in model not yet well matched. a3 and b3 corrections OK, b4 not so nice.

5 mm misalignment in RCOX.L1?



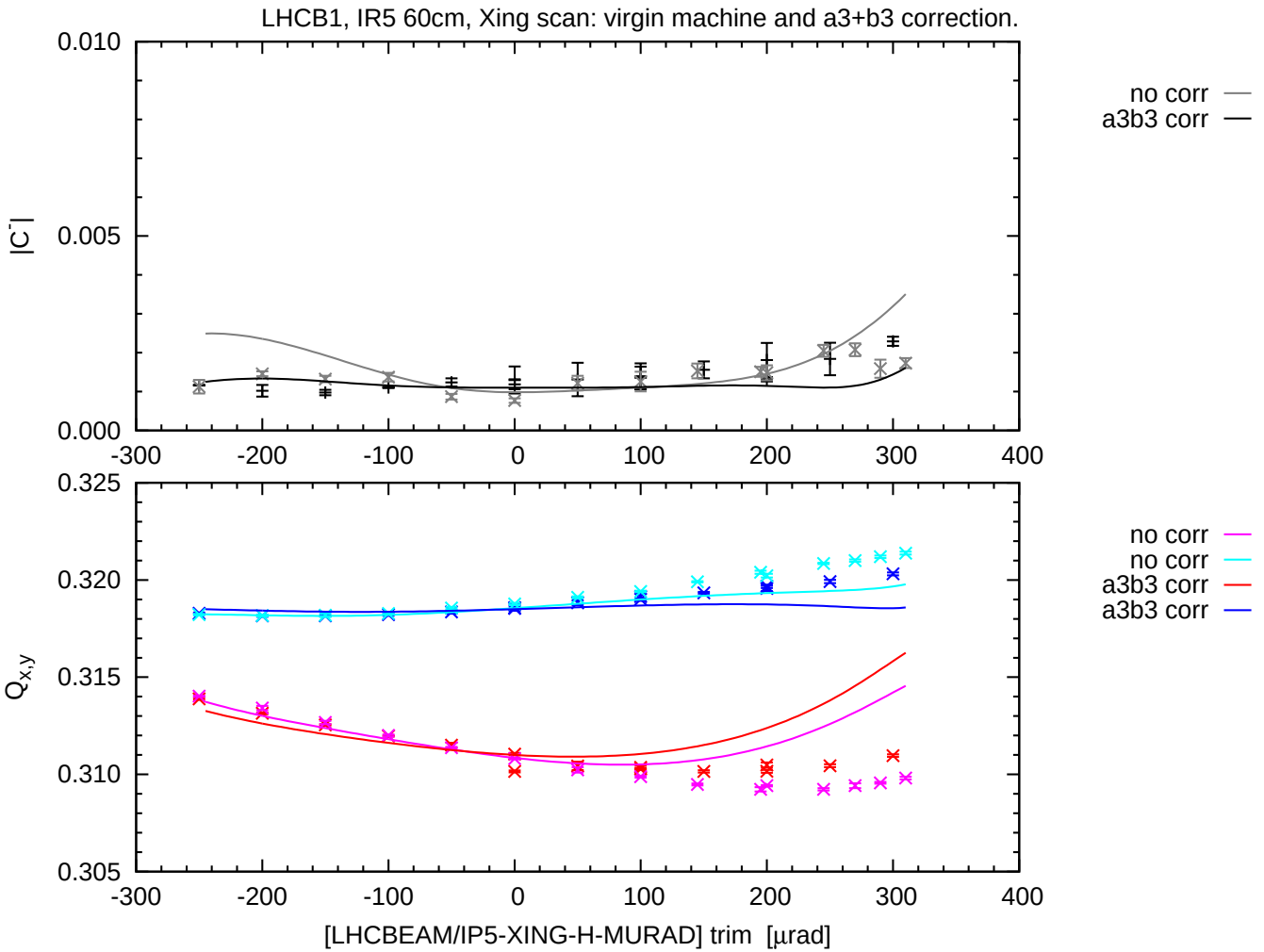
It seems very appealing!

IR1 non-linear correction - Beam 2



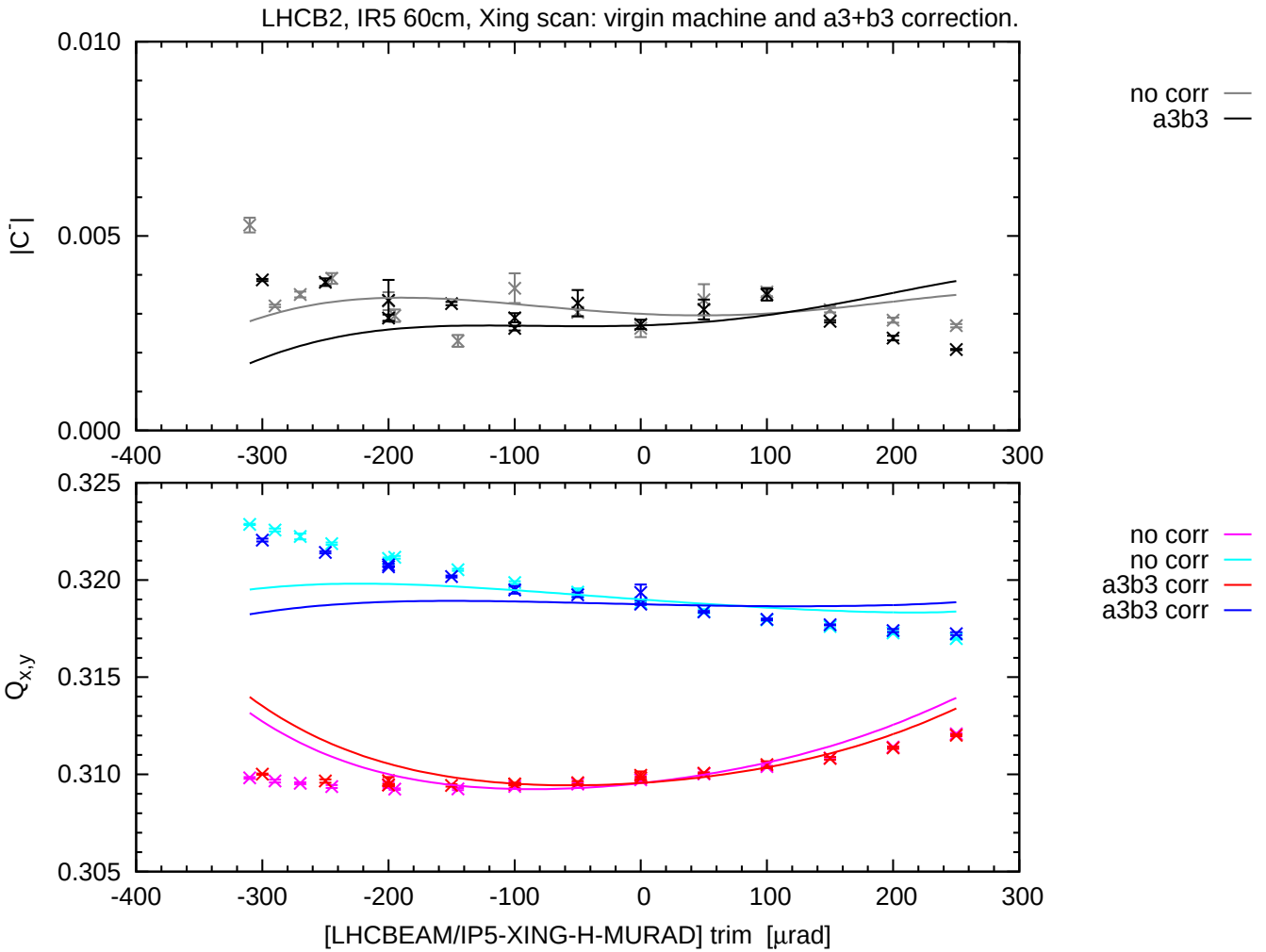
Very good corrections!

IR5 non-linear correction - Beam 1



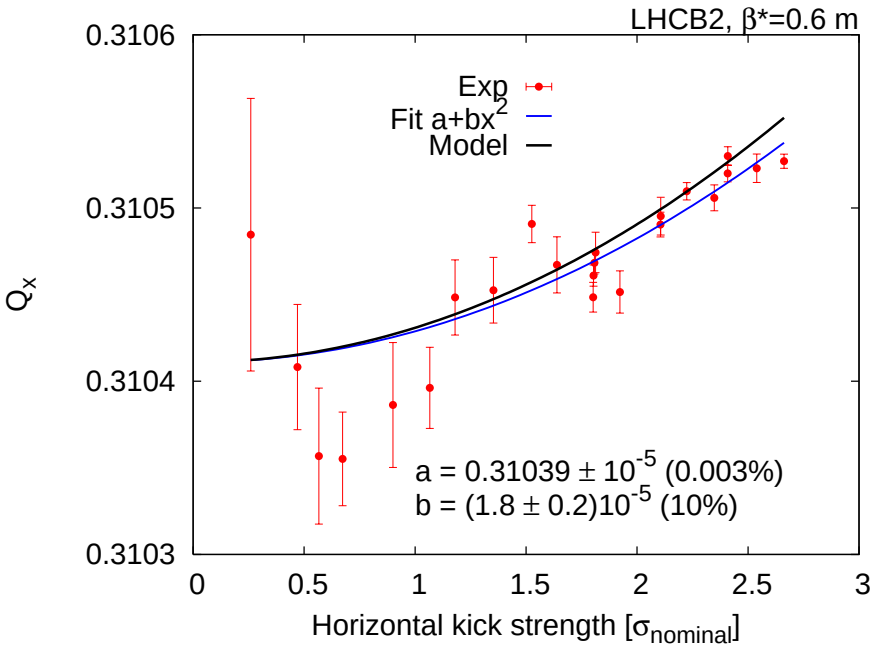
Significant deviations in IR5.

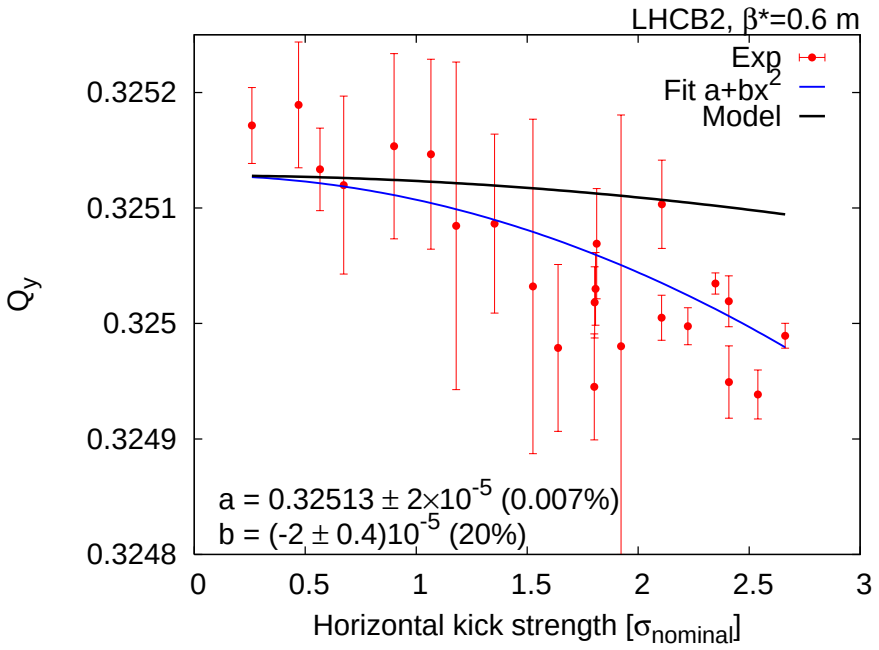
IR5 non-linear correction - Beam 2



Also for beam 2 $\longrightarrow$ need better corrections for IR5.

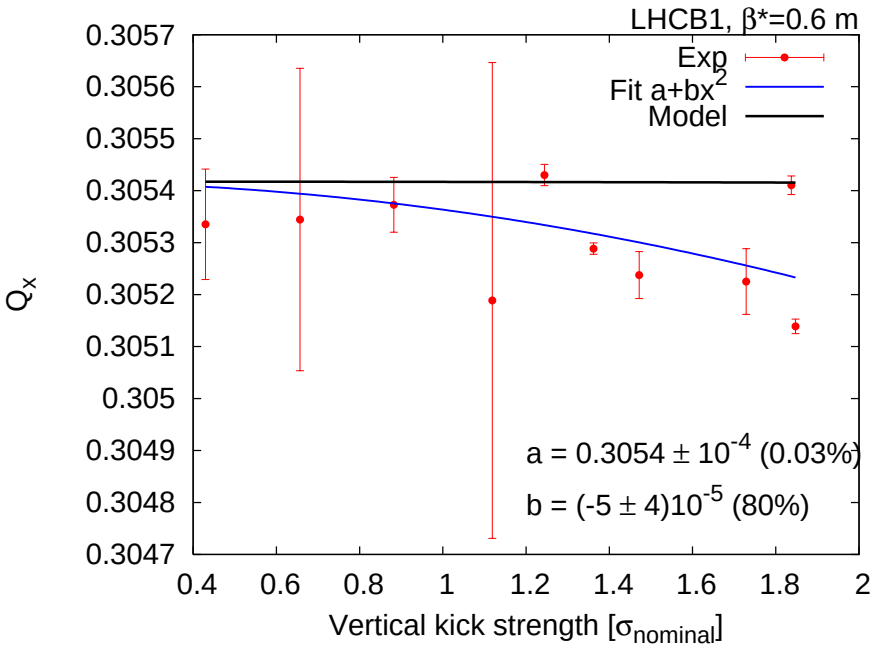
Amplitude detuning - Beam 2H

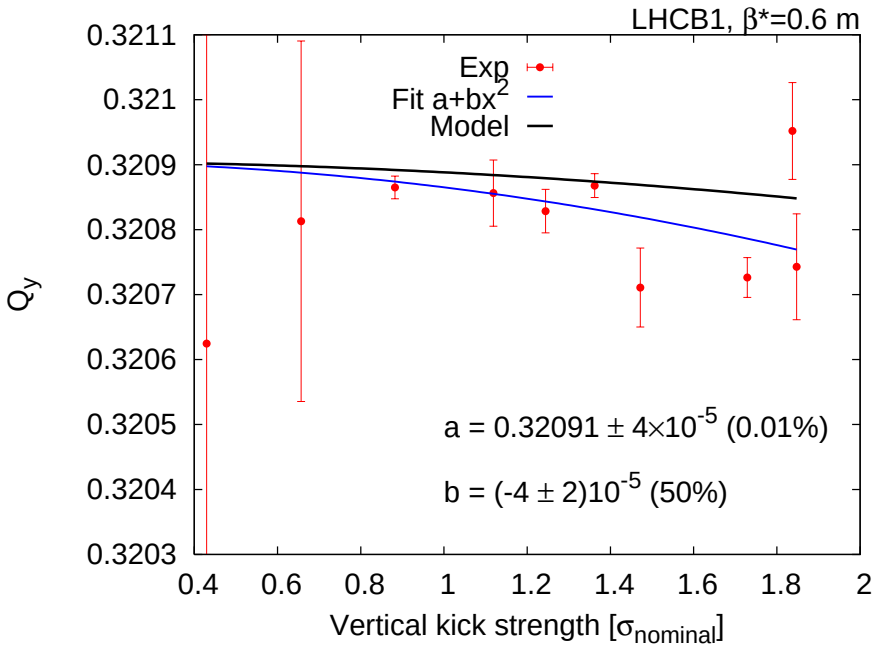




First direct measurement of amplitude detuning with AC dipoles! IR1 and IR5 corrections are in. In the model they cancel about 50% of the amplitude detuning. Natural amplitude detuning ≈ 100 Amps of MO.

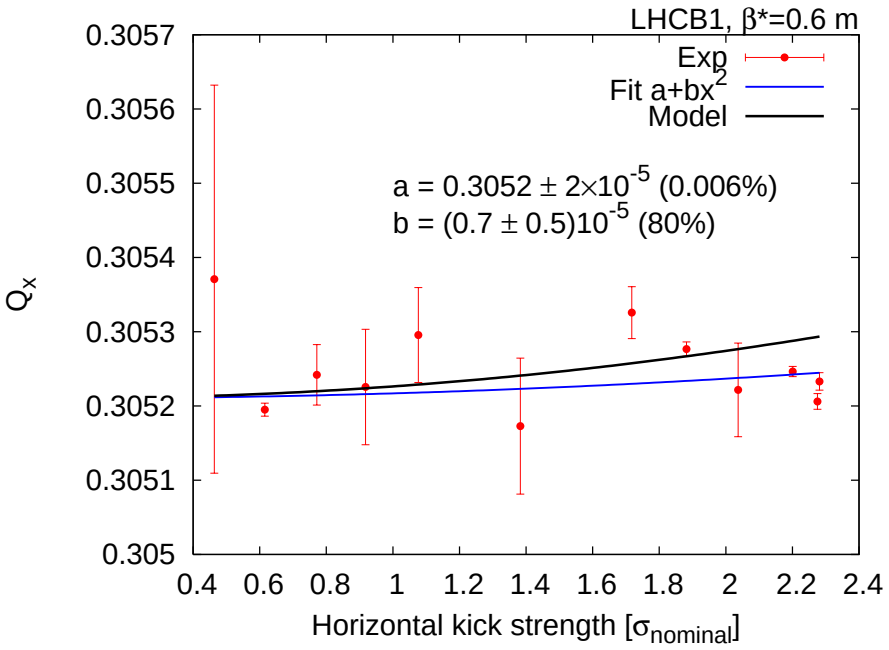
Amplitude detuning - Beam 1V

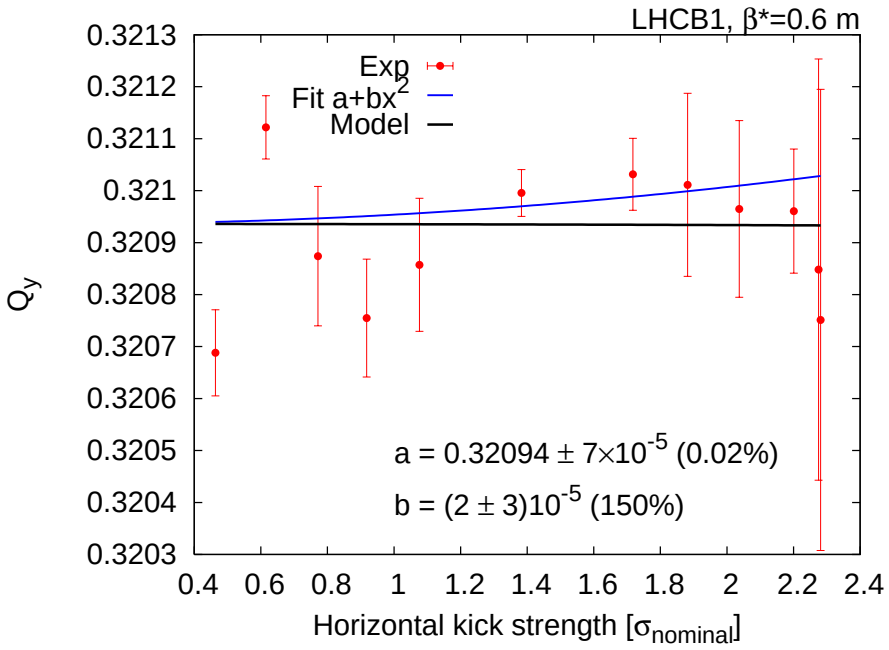




Lower excitation amplitude and poorer amplitude detuning measurement, yet consistent with model.

Amplitude detuning - Beam 1H



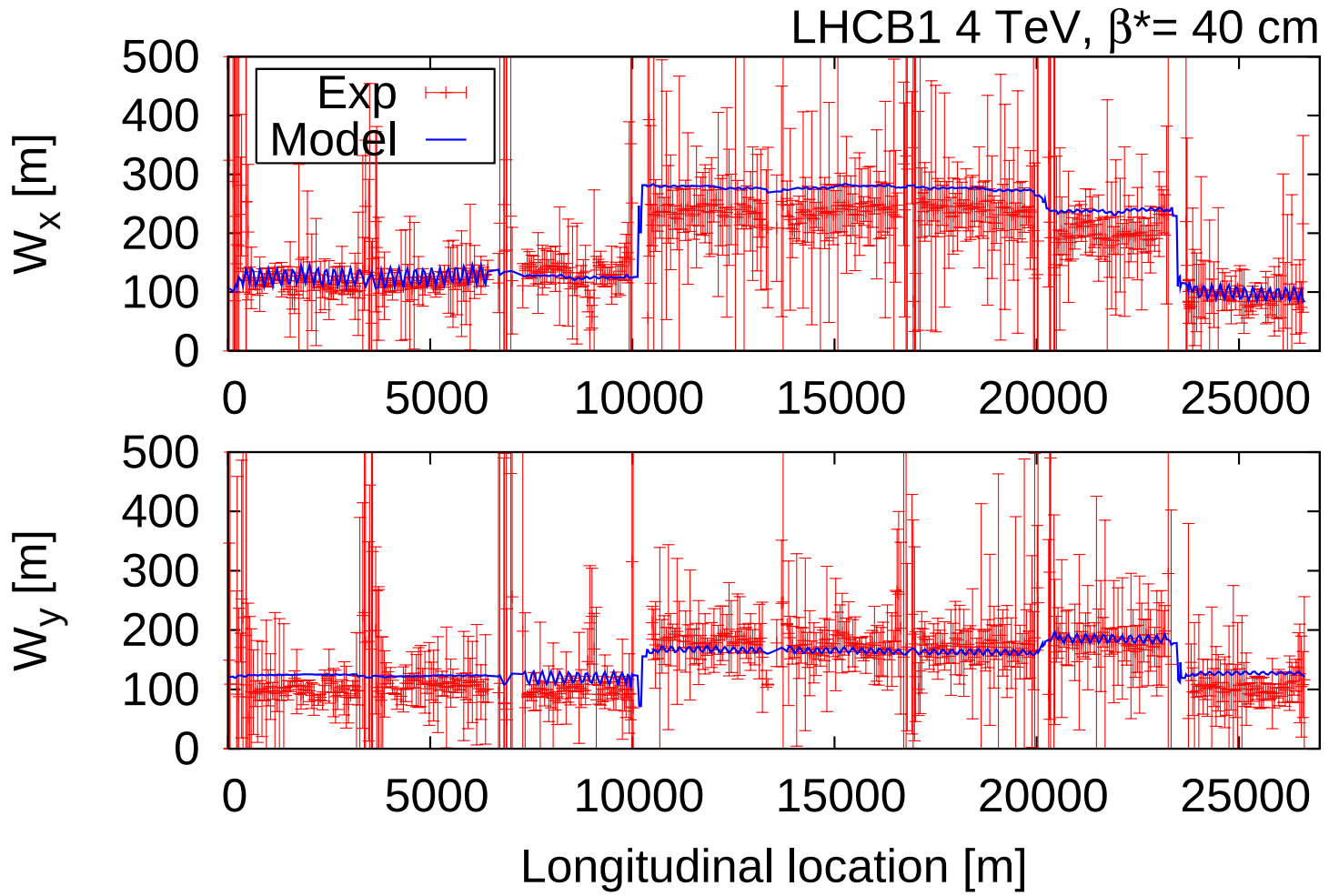


Beam 1 seems to have smaller amplitude detuning than Beam 2. Measurement still poor and consistent with model.

Summary

- Skew sextupoles change polarity convention between arc and IR
- Optics change by $\approx 10\%$ between 450 GeV and 1.3 TeV and then constant
- Stefano requests measurements along the squeeze
- First chromatic coupling correction
- IR1 non-linear corrections OK (RCOX.L1 misaligned by 5mm?).
- IR5 needs further studies.
- First direct measurement of amplitude detuning with AC dipoles. Natural detuning not negligible.
- N. Mounet requests measurement at flattop (combined with the MQY 1% error MD!).

Chromatic β at 40 cm



β-beating at 40 cm