Early Totem optics, 90 m

- **Motivation**
- **Integration in standard V6.500**
  - **7 TeV (early collision optics),** tune adjust, aperture
  - **what about injection and ramp ?**
- **Outlook : V6.501**

thanks for help from
Thys Risselada (database, integration), Riccardo de Mario (matching with Jacobian), Frank Schmidt (madx issues), Werner Herr, Massimo Giovannozzi, ...

Motivation

very high β* optics (1540 m Totem and 2540 m Atlas)
needs lower emittance, different integer tune, lower by 1 in y
- not for the first year(s) of LHC operation

Totem : request for early 90 m optics
idea is to "just un-squeeze" in normal running to β* = 90 m
in parallel to normal physics running in the other experiments
(for instance with Atlas at β* = 2 m)

this could allow Totem to calibrate σ_{tot} (needed for absolute $\mathcal{L}$) **and**

to start part of their physics program (diffractive physics)

Integration in standard V6.500

files and sample job in database /afs/cern.ch/eng/lhc/optics/V6.500

IP5_beta90.str, job.sample.90m.madx

with optional Qx trim using ir4

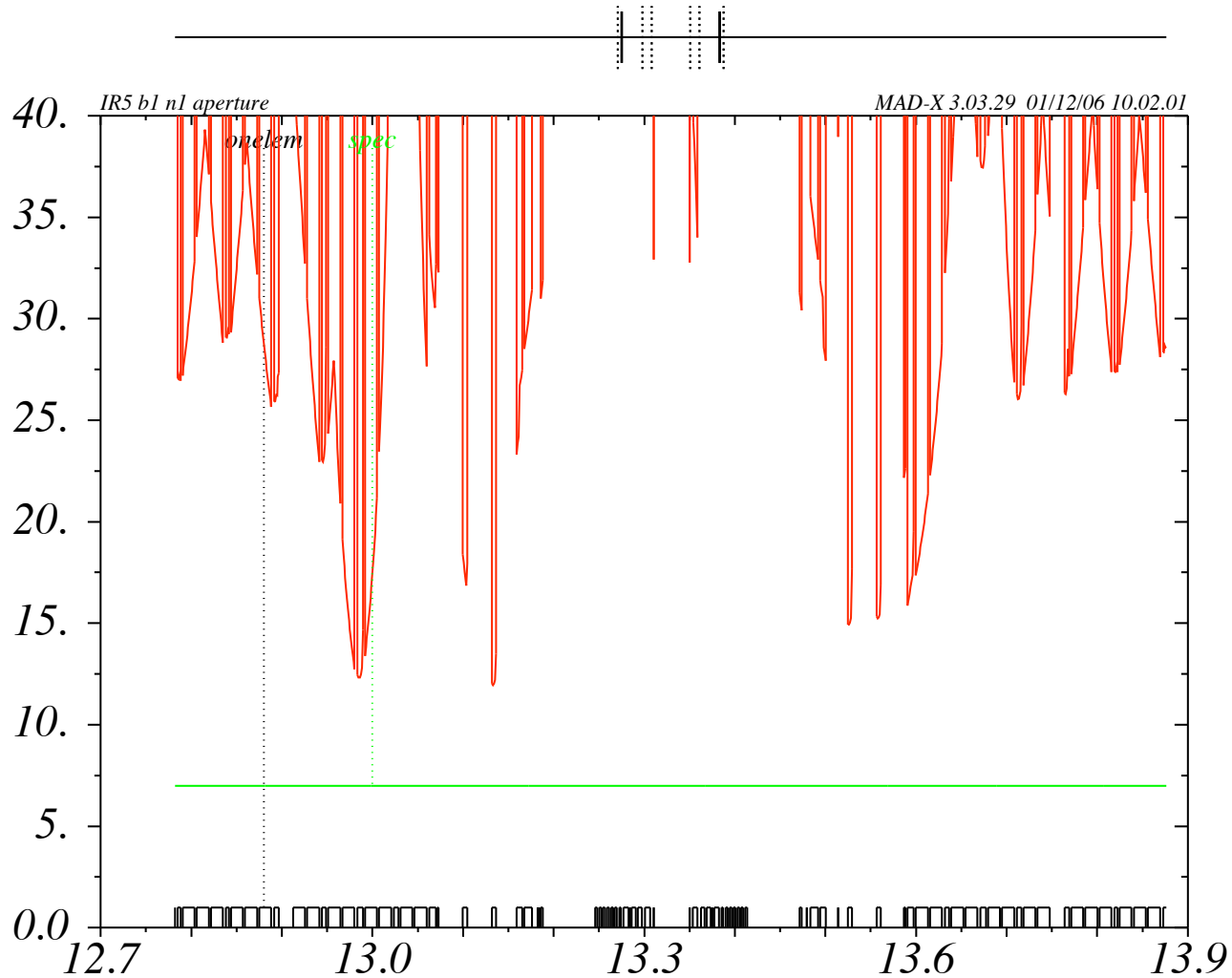
known issue : phase advance lower than in standard physics V6.500, Qx trim needed

Phase advance over ir5, (range = s.ds.l5 / e.ds.r5)

Qx	Qy	comment
2.618 2.633	2.644 2.649	injection physics
2.550 0.083	2.649 0.000	90 m trim

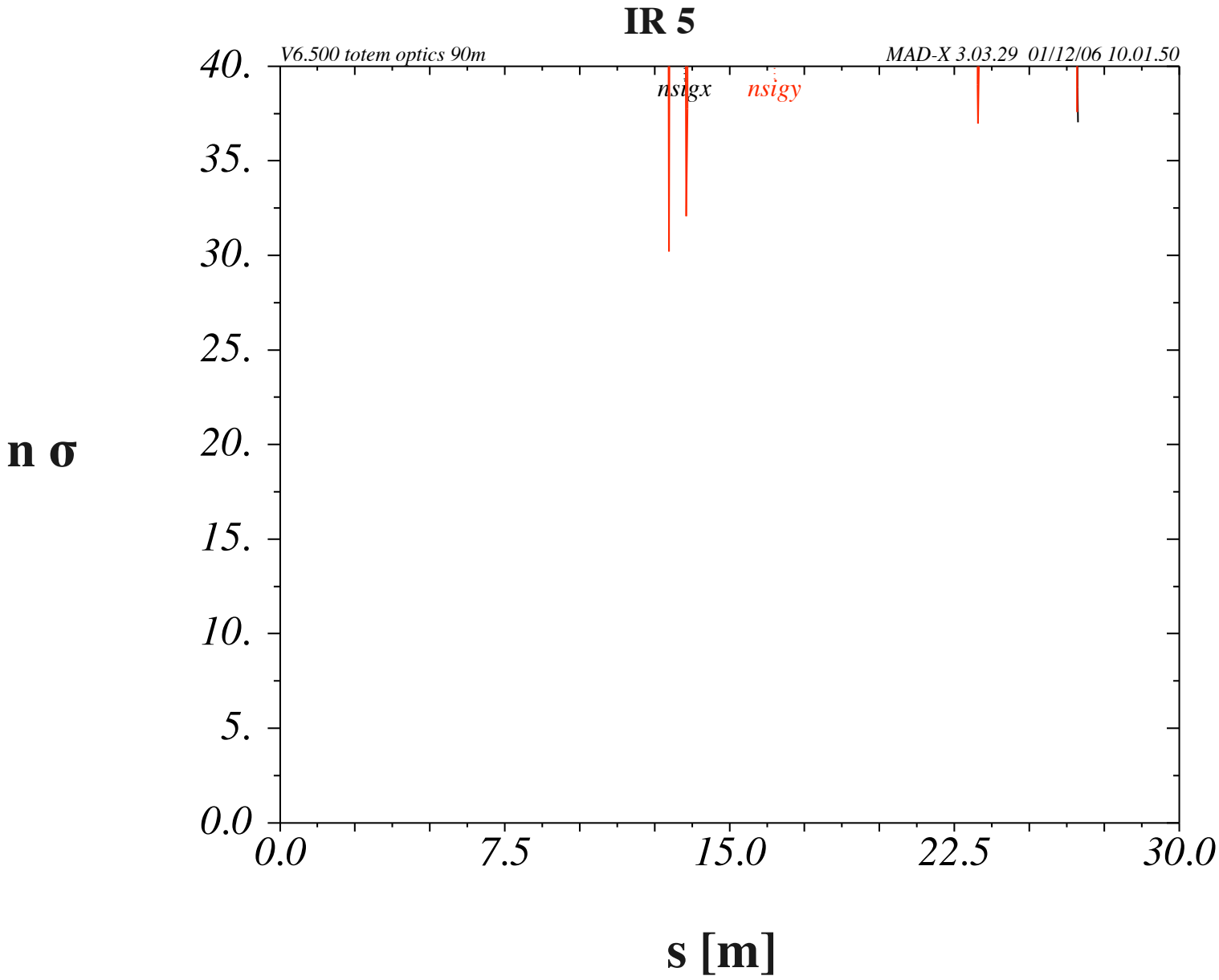
Aperture

in IR5 with the 90m early Totem optics



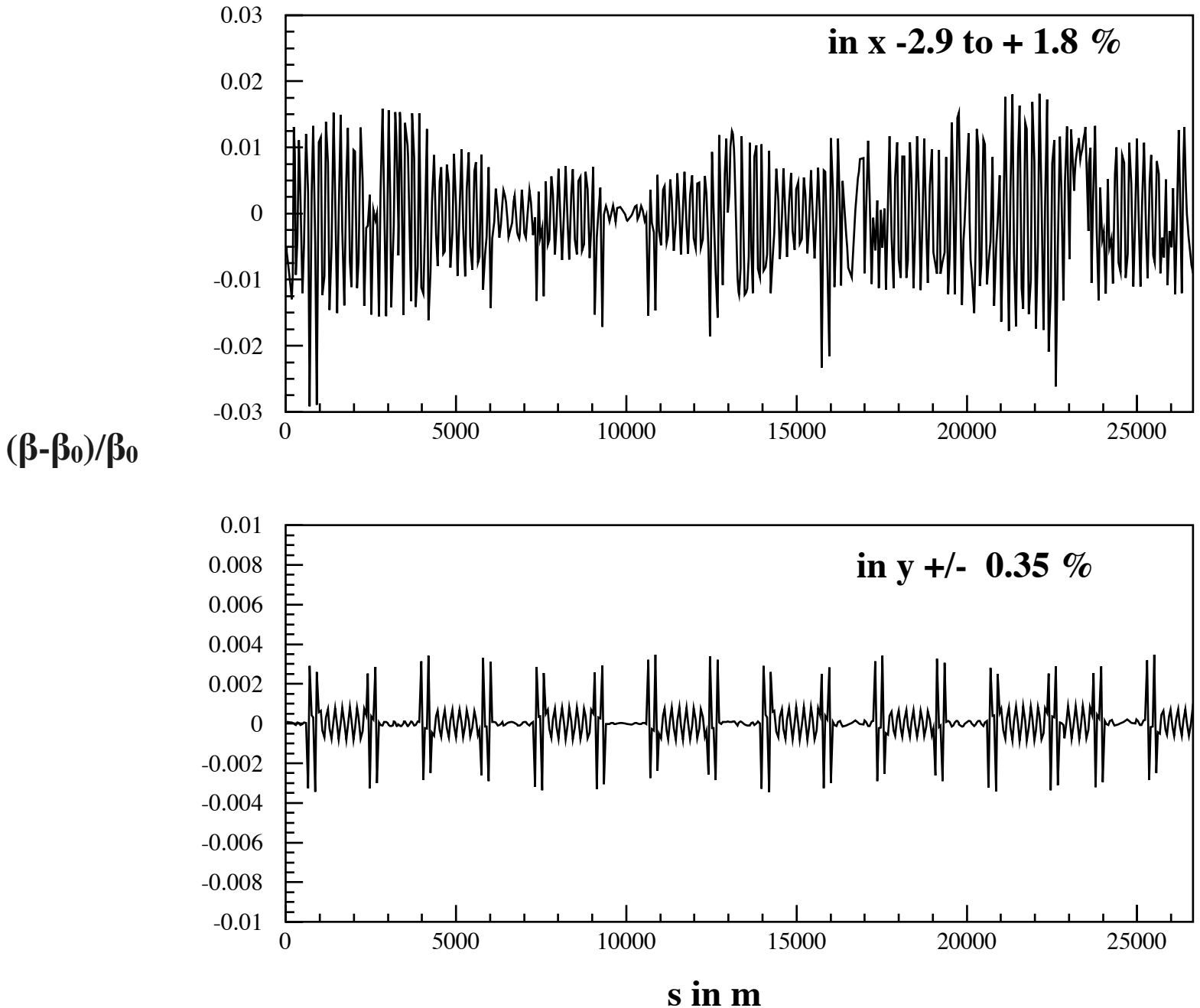
raw (no tolerances) aperture around the ring

V6.500 ecol.str + 90 m in IR5

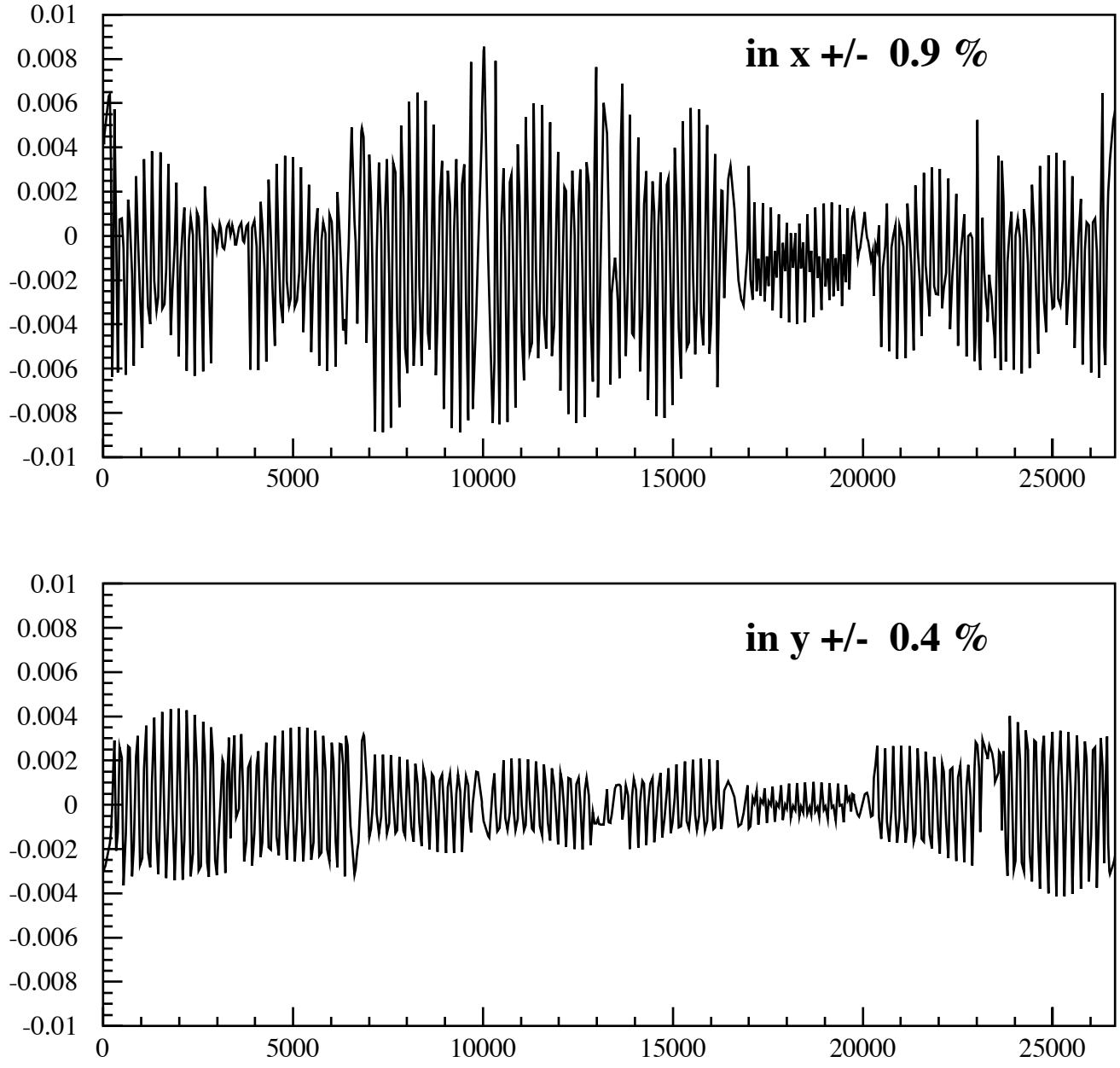


90 m totem optics. ΔQx = 0.083 using trim quads kqtd, kqtf

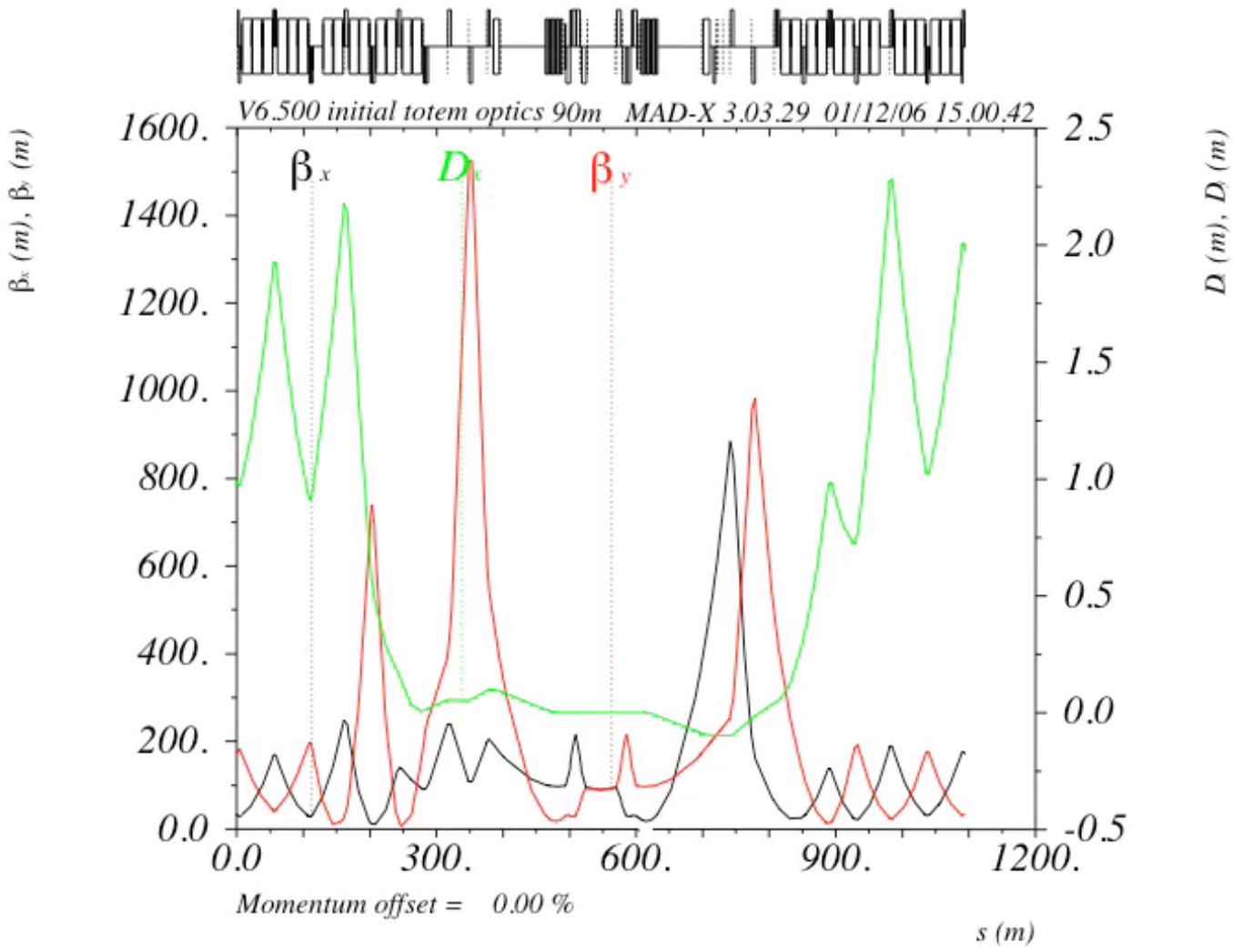
similar for both beams, shown here for beam 1



same ΔQx = 0.083 required for b1, b2
use main quads to adjust tune kqd, kqf

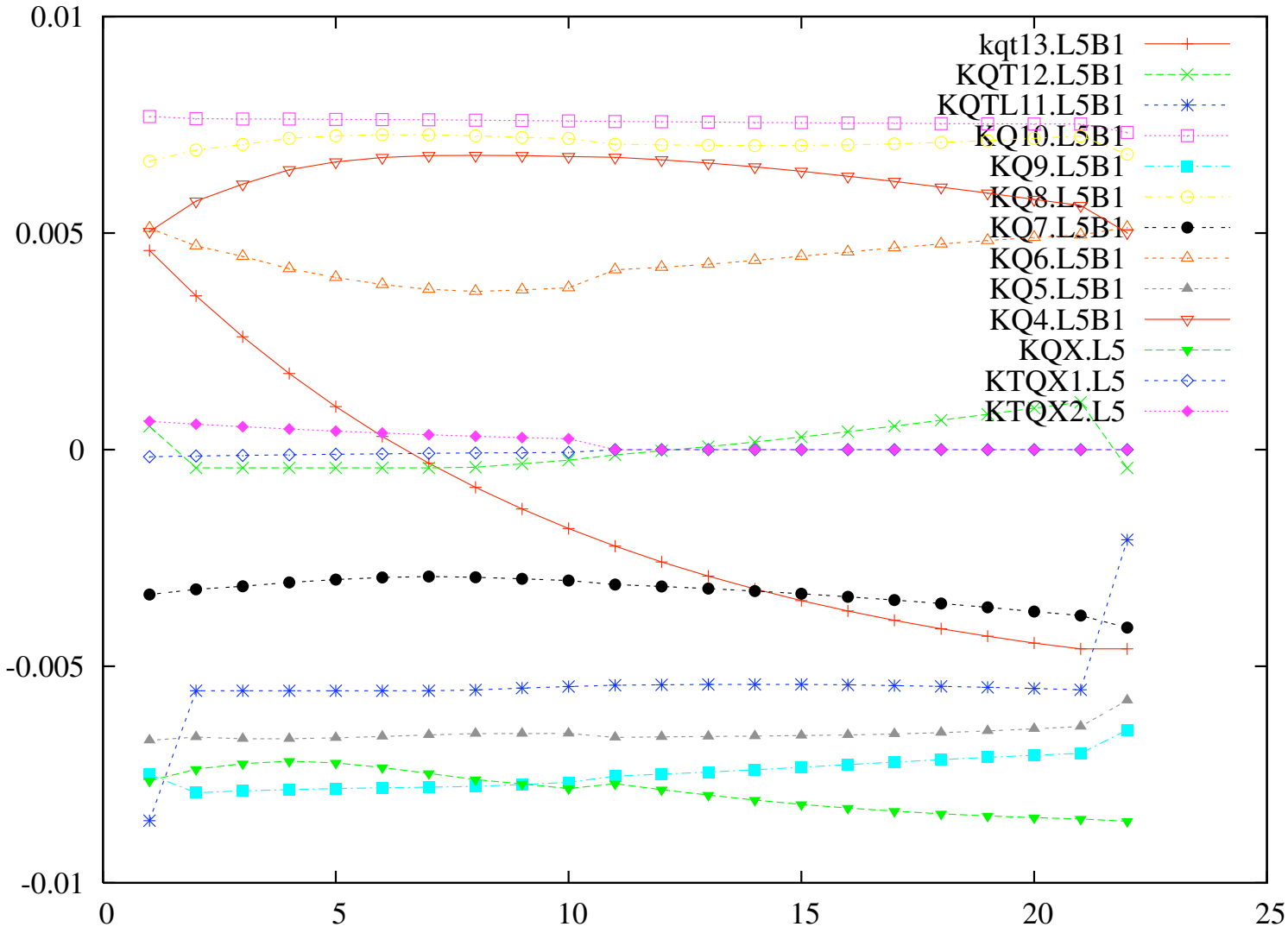


squeeze from 90 m to 11 m



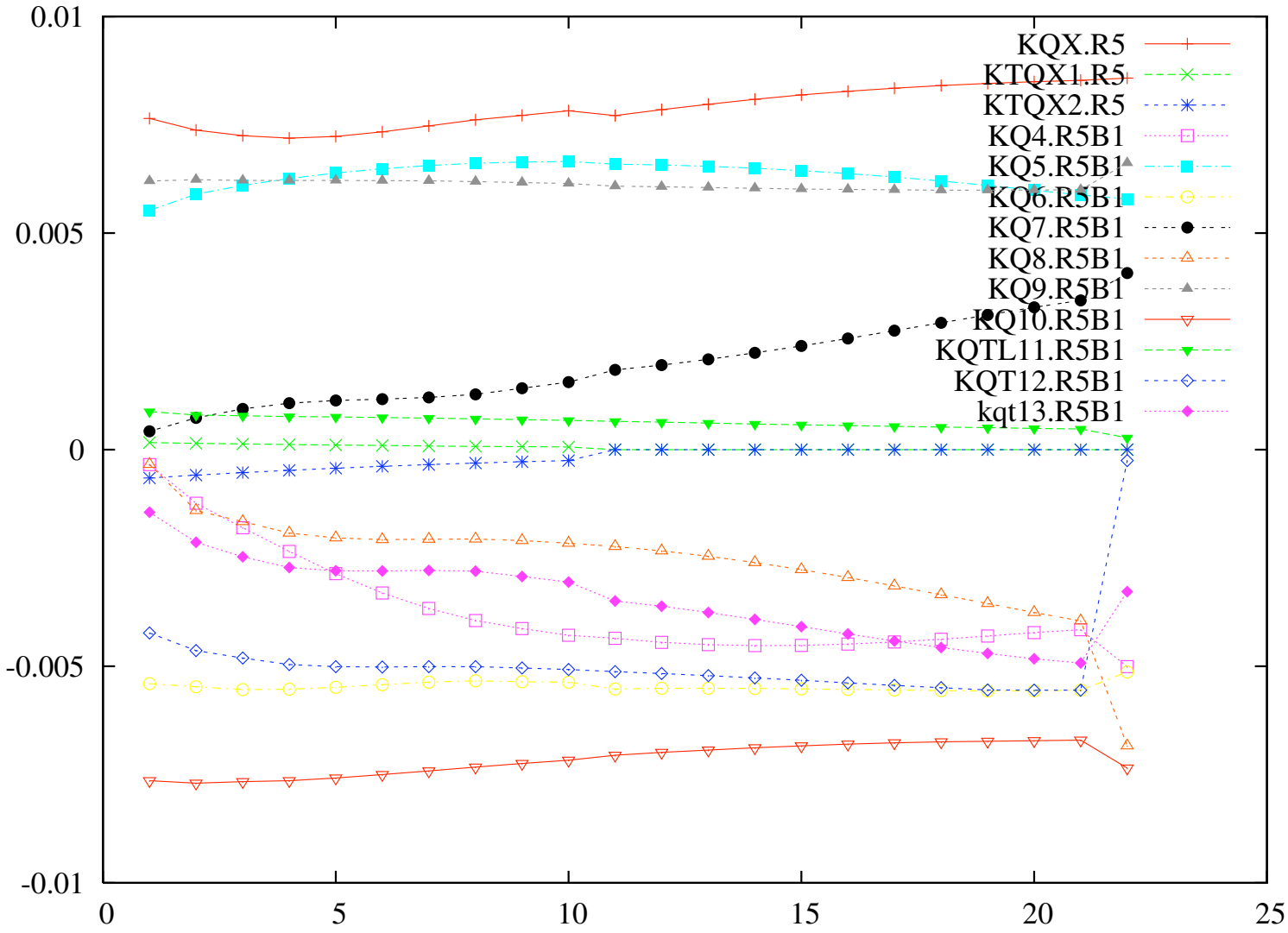
“squeeze” from 90 m to 11 m in ir5

in this case with with tune adjust from mux 2.550 = muy 2.649 to injection values of mux 2.618 = muy 2.644 as linear function of β. In 21 steps, each 10 % reduction in β. Last step is target strength.



Normalised strength, left side ir ip5.
21 steps, each 10 % reduction in β. Last step is target strength.

“squeeze” from 90 m to 11 m in ir5



Normalised strength, right side.

21 steps, each 10 % reduction in β. Last step is target strength.

Outlook V6.501

V6.501 (or V6.500 + newIRn.str) can be expected to facilitate the integration of the early totem 90 m optics.

V6.500 : ΔQx = 0.083 needed to get to nominal physics tunes with 90 m optics

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Qx adjusted with ir4
mu_x  2.1430 → 2.226
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LHCVERSION V6.500

	beam1		beam2	
	MU_X	MU_Y	MU_X	MU_Y
arcs	44.1040	40.6890	44.1040	40.6890
IR1	2.6330	2.6490	2.6330	2.6490
IR2	2.9740	2.7980	2.9910	2.8440
IR3	2.2480	1.9430	2.2494	2.0066
IR4	2.2260	1.8700	2.2260	1.8700
IR5	2.5500	2.6490	2.5500	2.6490
IR6	2.0150	1.7800	2.0150	1.7800
IR7	2.3770	1.9680	2.4826	2.0504
IR8	3.1830	2.9740	3.0590	2.7820
tune	64.3100	59.3200	64.3100	59.3200

V6.501
mux increased in various places : ir2, ir7
with a minor ΔQx = 0.0215 contribution from ir4
Improved tuning range for the 90 m option

LHCVERSION V6.501

	beam1		beam2	
	MU_X	MU_Y	MU_X	MU_Y
arcs	44.1040	40.6890	44.1040	40.6890
IR1	2.6330	2.6490	2.6330	2.6490
IR2	3.0098	2.8102	2.9908	2.8441
IR3	2.2050	1.9596	2.2088	1.9673
IR4	2.1645	1.9715	2.2567	1.8862
IR5	2.5500	2.6490	2.5500	2.6490
IR6	2.0150	1.7800	2.0150	1.7800
IR7	2.4500	1.9236	2.4894	2.0030
IR8	3.1786	2.8880	3.0622	2.8525
tune	64.3100	59.3200	64.3100	59.3200