High-β studies

Team

Jörg Wenninger, Stefano Redaelli, Matteo Camillocci, Laurette Ponce / setup, hypercycle

Rogelio Tomas, Tobias Persson, Piotr Skowronski, Ewen Maclean, Yngve Levinsen, Simon White
(Optics measurements and correction)

Sophie Cavalier, Pascal Hermes / optics systematics, ALFA, ALICE

Mirko Poger, Ghislain Roy, Alick Macpherson, Enrico Bravin / EICs

Short overview here (detailed MD Note in preparation)

18/06, Mon. night before the MD, (partial) recommissioning 90 m

21/06, Thu. morning, de-squeeze to 500 m flat machine, measure + correct optics

23/06, Sat. morning, separation on, remeasure 500 m, first (successful) attempt to 1000 m

done with probe beams

at very end started with 2 nominal bunches, ok to 90 m

2012 : "high luminosity" 90 m + highest β*

Commissioning + MD

Wk	Apr 14	15	16	17	May 18	19	20	21	June 22	23	24	25	26
Mo	2	Easter 9	16	23	30	7	14	21	Whit 28	4	11	90 m [12 h]	25
Tu					1st May								
We				TS1			VdM scans [48 h]						TS2
Th												MD1	
Fr	G. Friday												
Sa			MD									MD2	
Su													

Scrubbing run (date tbc)

Wk	July 27	28	29	30	Aug 31	32	33	34	35	Sep 36	37	38	39
Mo	2	9 Floating MD [48 h]	VdM scans [48 h]	23	30	6	13	20	27	3	10	17	24
Tu								500 m [24 h]	Floating MD [48 h]				
We		90 m [24 h]										TS3	
Th								500 m [24 h]		J. Genevois			
Fr	90 m [24 h]												MD
Sa													
Su													

90 m for physics

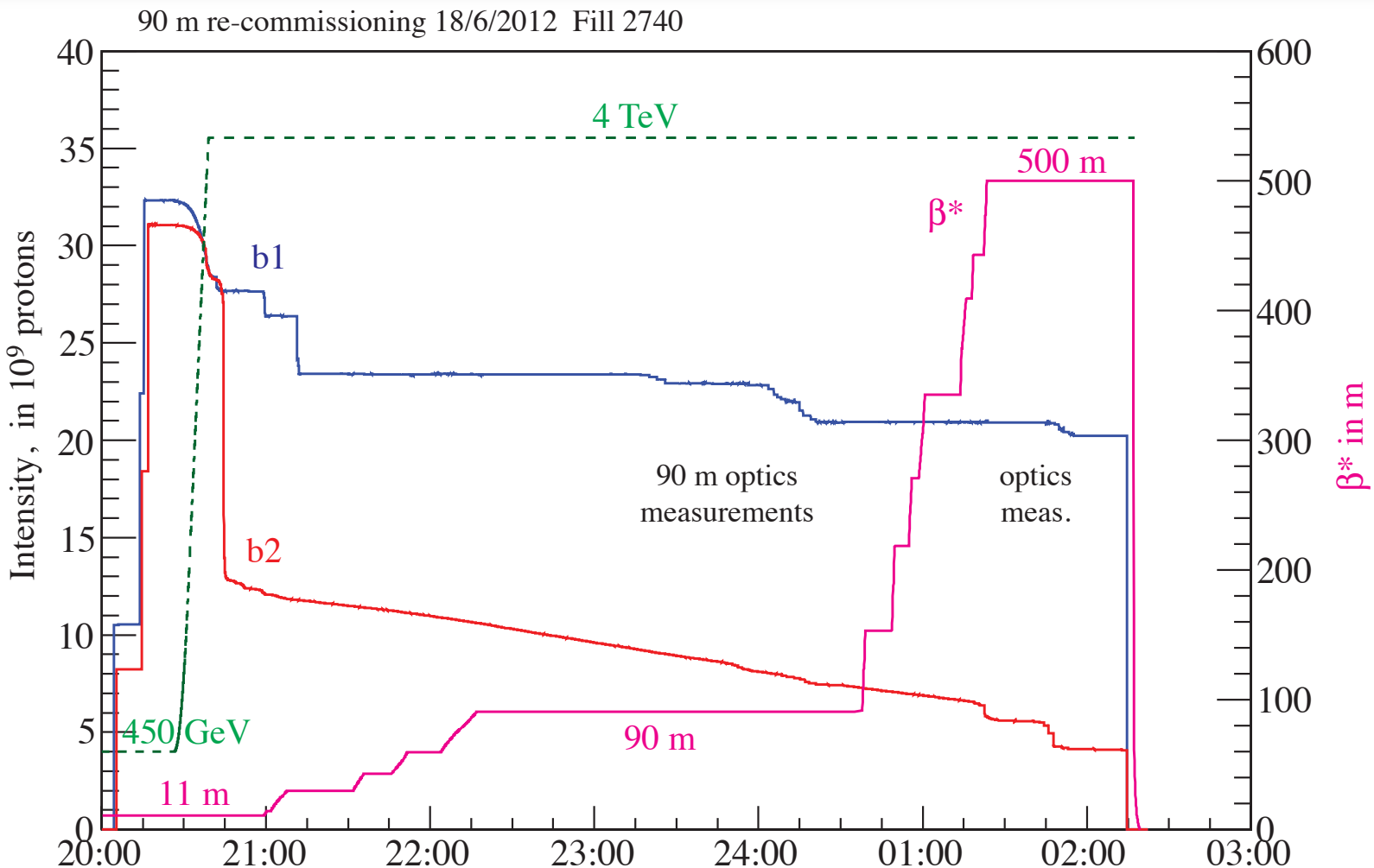
Before high-β MDs some remarks on 90 m

Intermediate β = 90 m for elastic pp + diffractive physics
TOTEM+CMS, ALFA/ATLAS

Higher luminosity : going to ~ nominal intensity and more bunches,
Theoretical maximum without crossing angle : 156 bunches, spaced by 525 ns

Required collimation + roman pot set-up
follwed by full MPS validation : loss maps and asynchrocnous dump check
and finally one 90 m fill for physics

Just before the MD, (partial) recommissioning 90 m



Time and (b2) loss due to RF-HW fault, just possible to see that

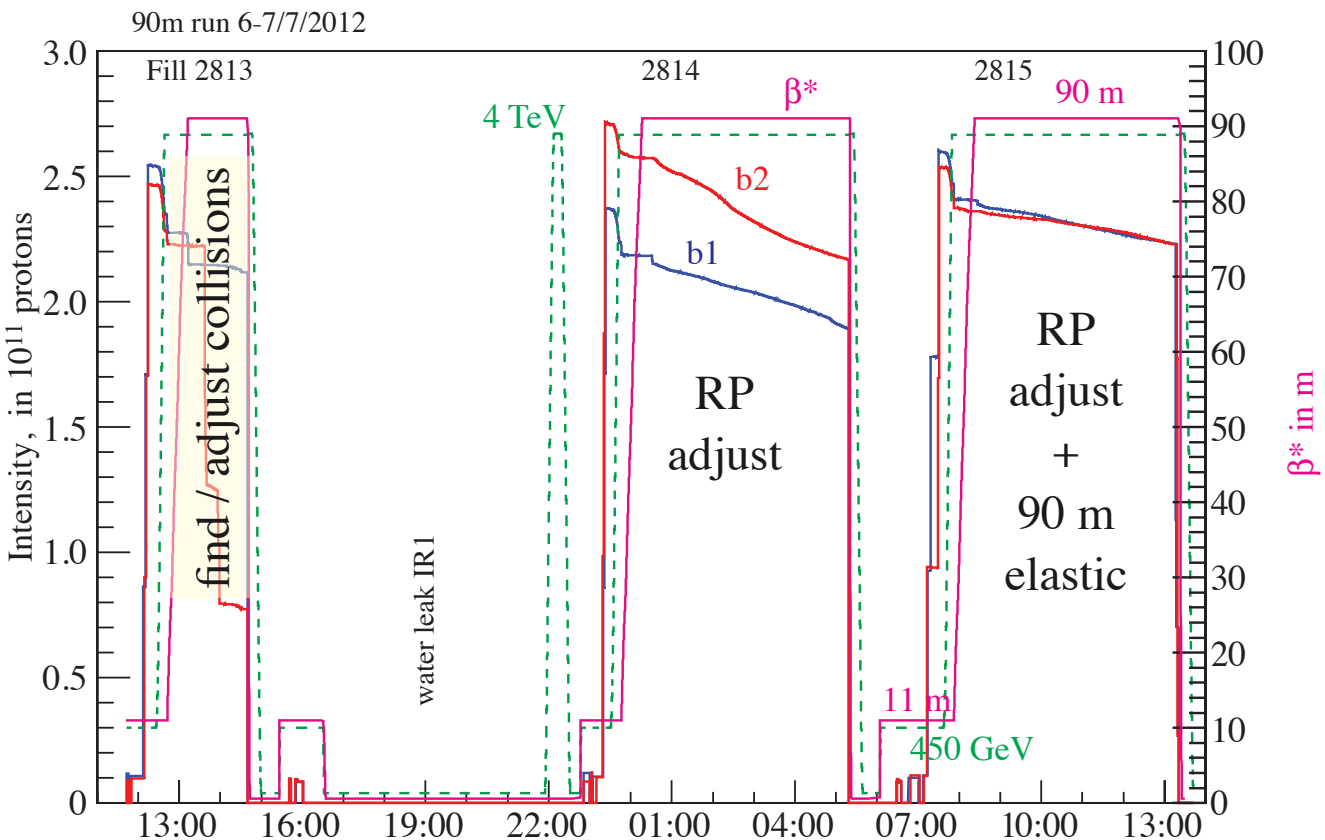
the cloning of de-squeeze from 11m to 90 m for 4 TeV worked well including optics correction

Had to give up on 2nd fill with higher intensities re-adjusting collisions, collimators, RPs

Instead, first successful checkout of the sequence to 500 m with remaining beam + opt. meas. b1

90 m run 6-7/7/2012

3 bunches 8e10, of which 2 colliding in IP1&5
Program : find collisions, align TCTs in IR1&5, align all RPs
data taking with RPs close to beam - for elastic pp scattering

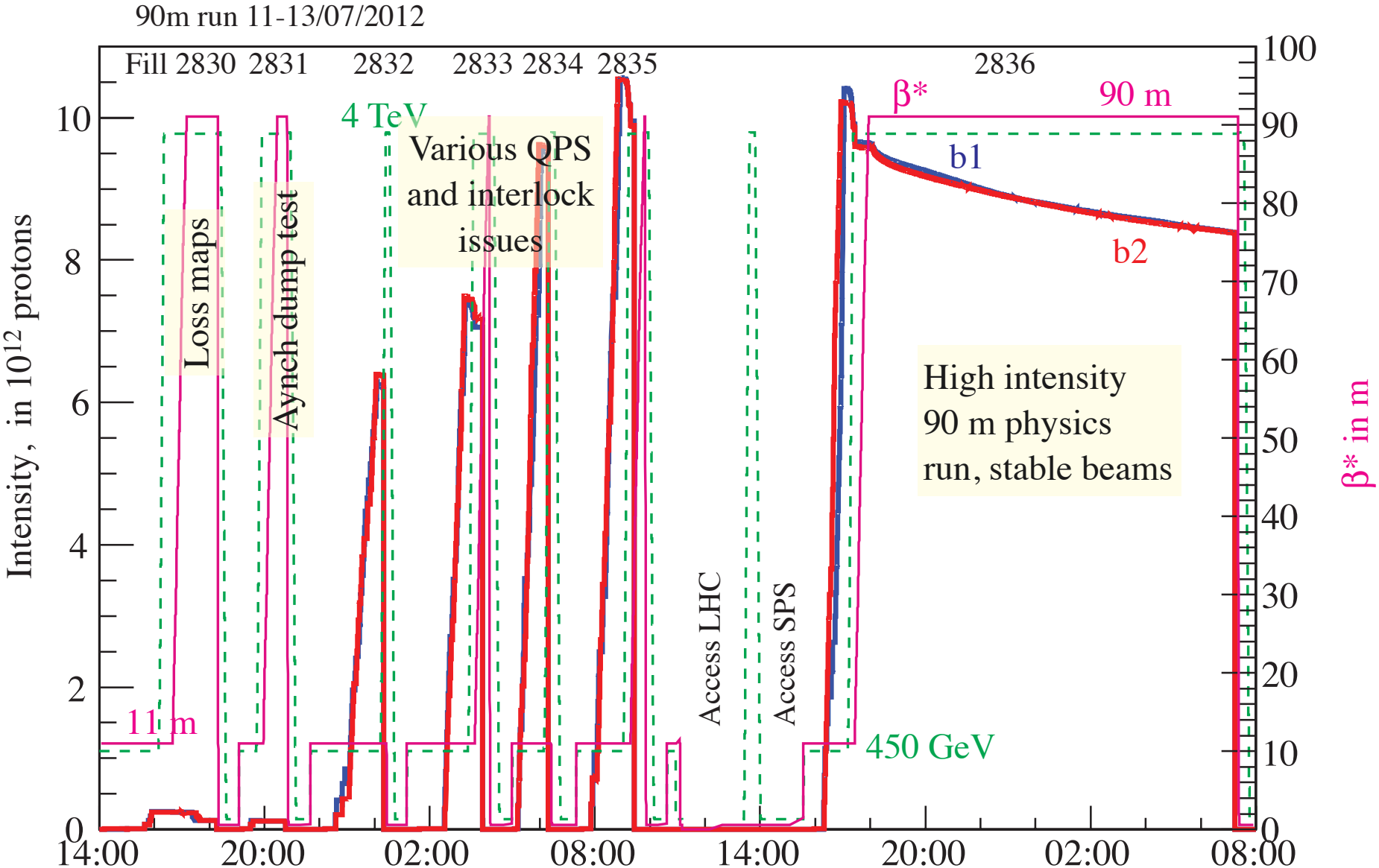


fill 2813 : much of b2 colliding bunches lost after collapsing separation
octupoles were at 200A, damper on, 2x reduced gain

beam1 Qx' = +3.3, Qy' = 3.7
beam2 Qx' = +2.4, Qy' = 1.9

Next fill : octupoles 300 A, colliding first IP1, then IP5, OK

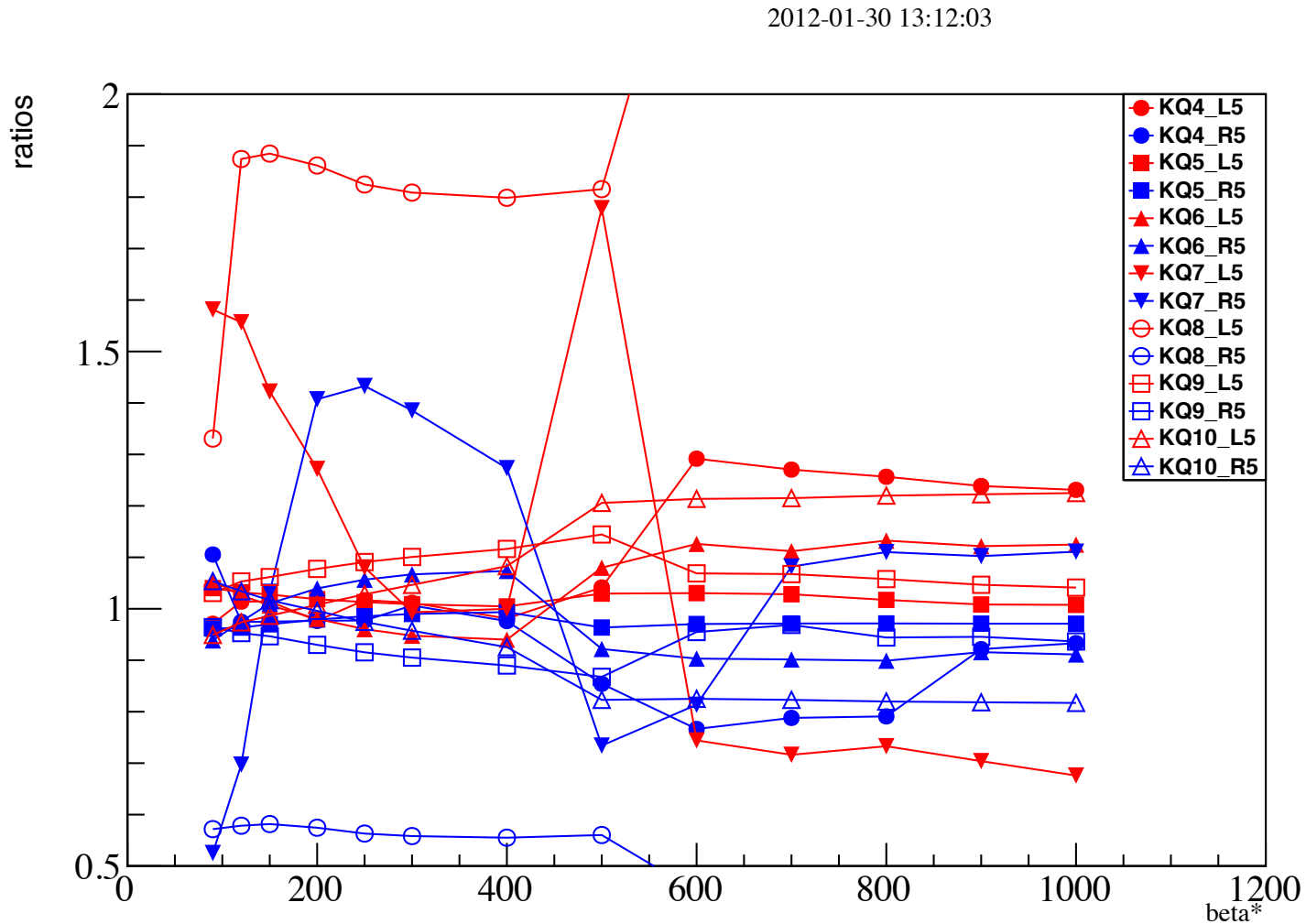
11-13/7/2012 90m runs with many bunches



Filling schemed : 650ns_112b_4bpi_28inj_highBeta

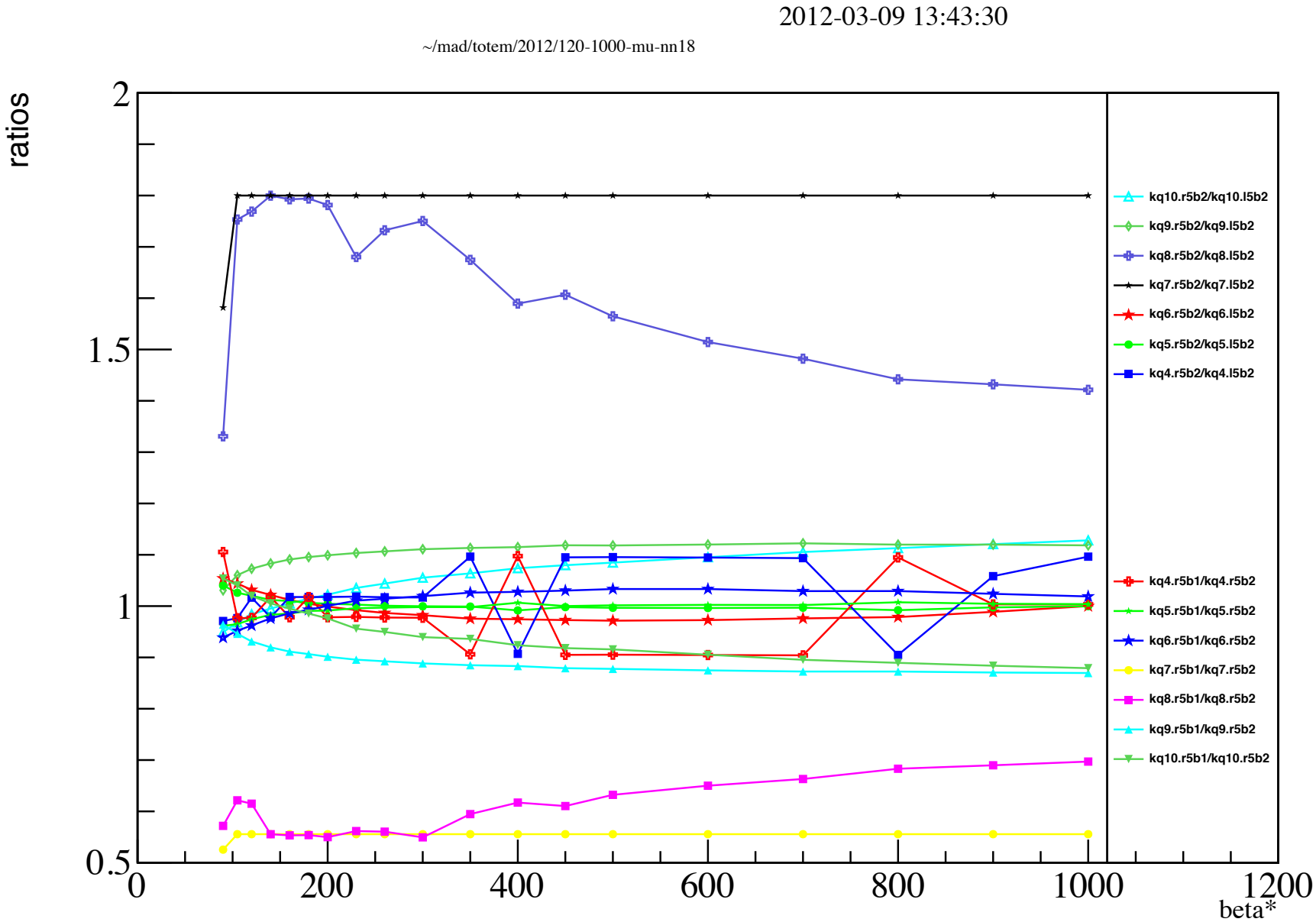
Steps to develop the 2012 high-β optics

plotting the ratio b1/b2 ratios - at the end of a matching campaign

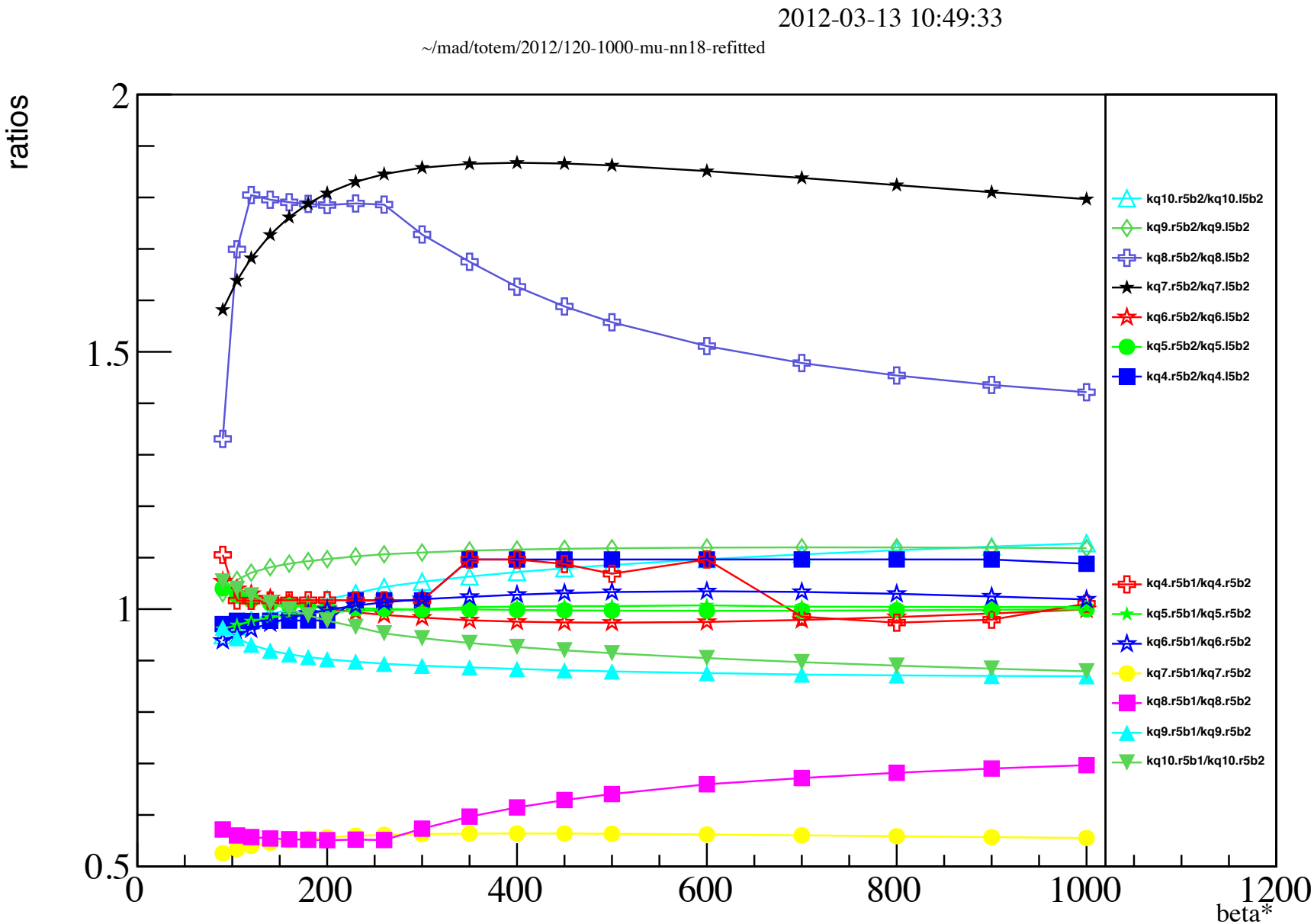


ratio limits, 30 Nov. 2011

ratio limits early march 2012

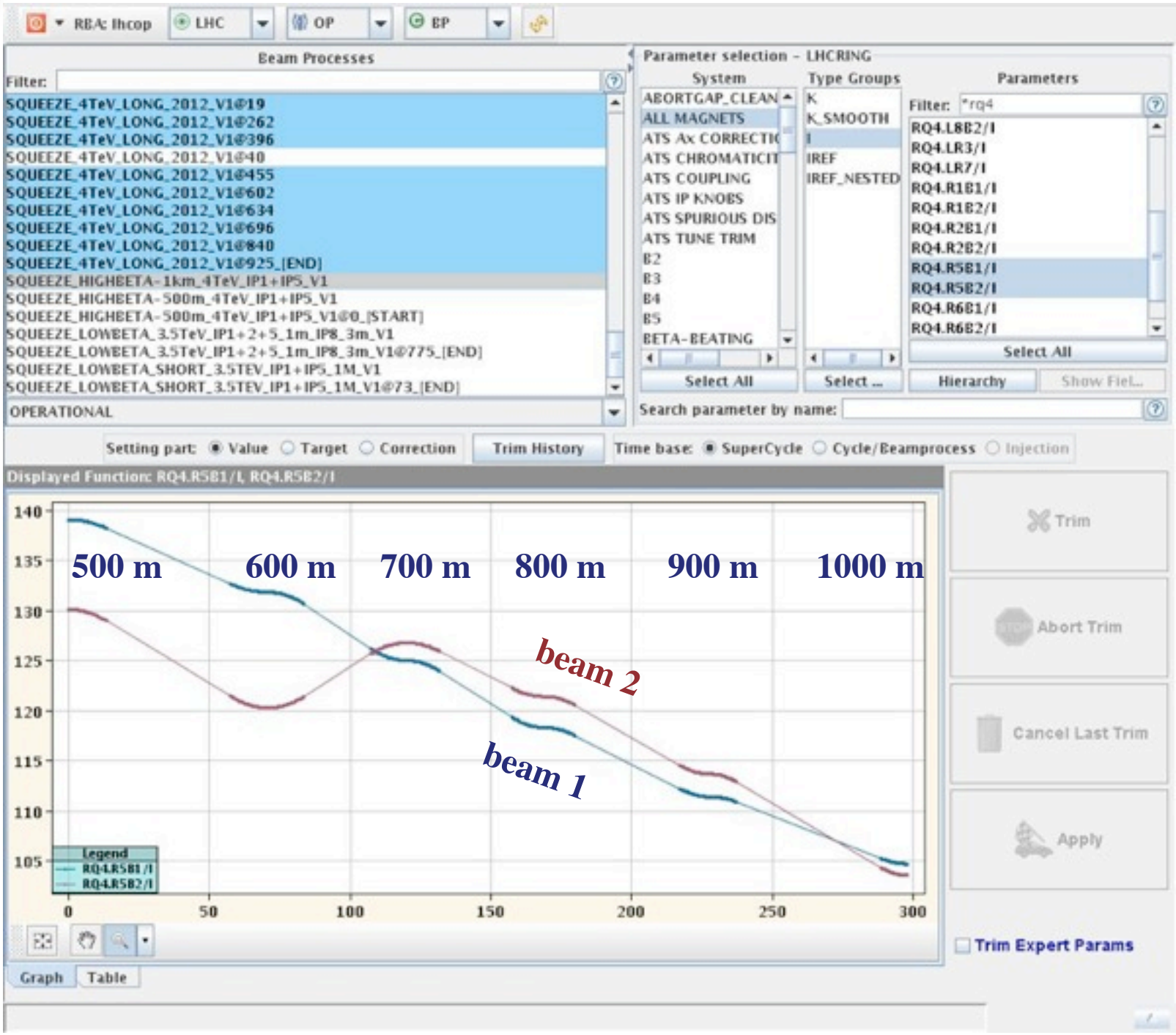


Now

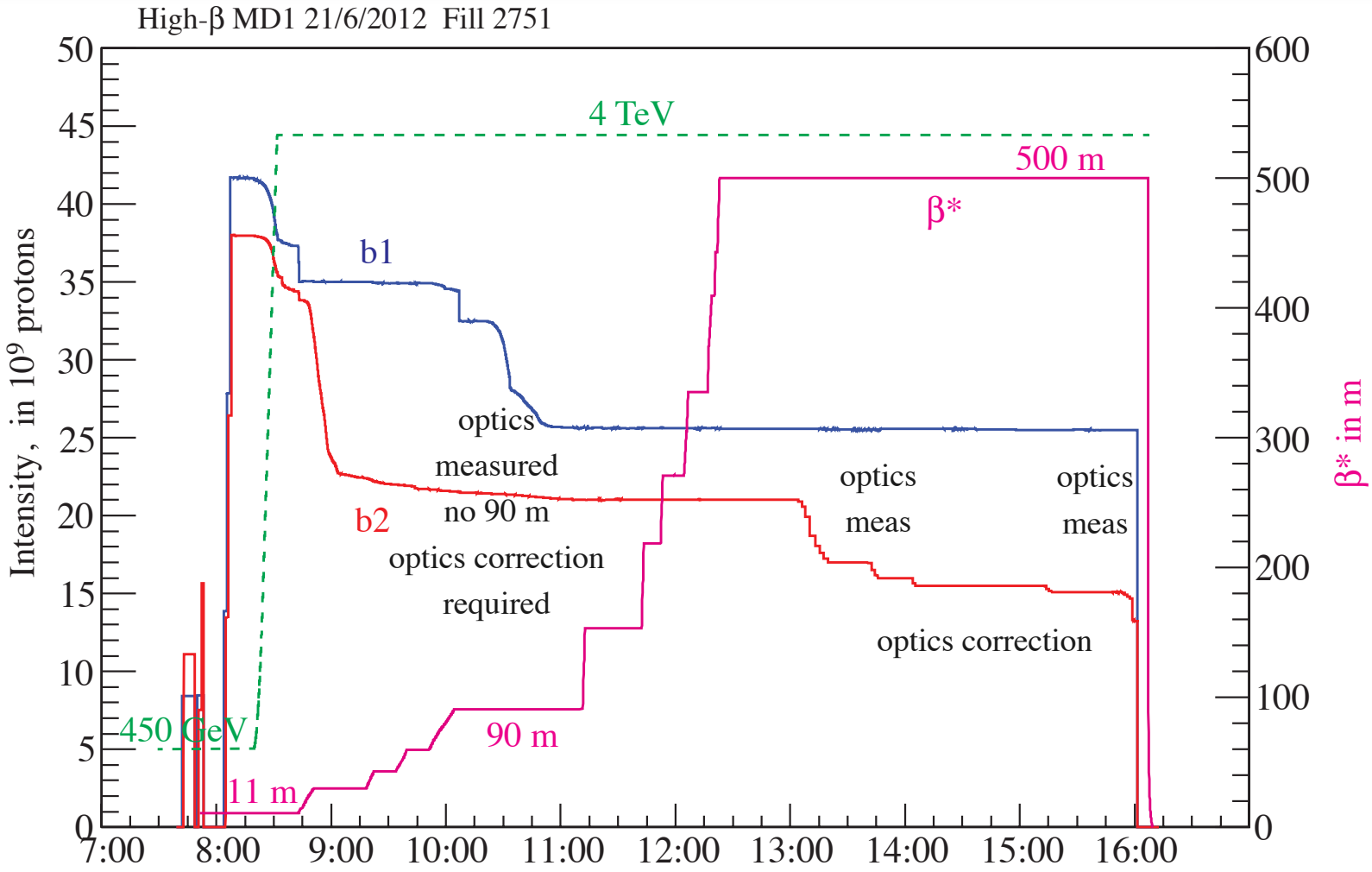


Q8, Q7 ratios at the limit

Example for the remaining “fluctuations”, RQ4R



High-β MD1



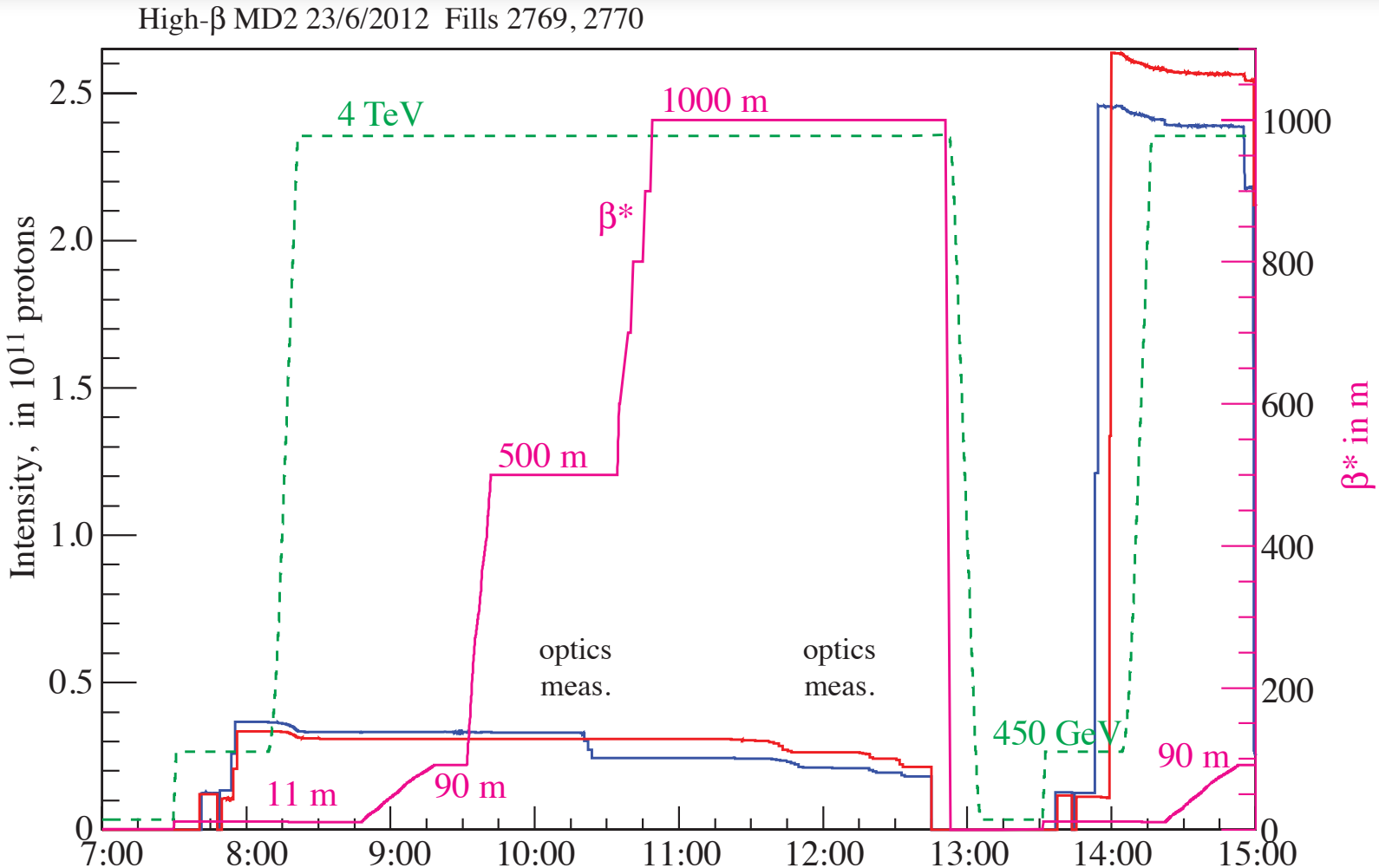
de-squeeze from 90 m to 500 m without loss

flat machine, measure + correct orbits, tune, coupling, chromaticity

at 500 m : optics measurement, optics correction, re-measure optics

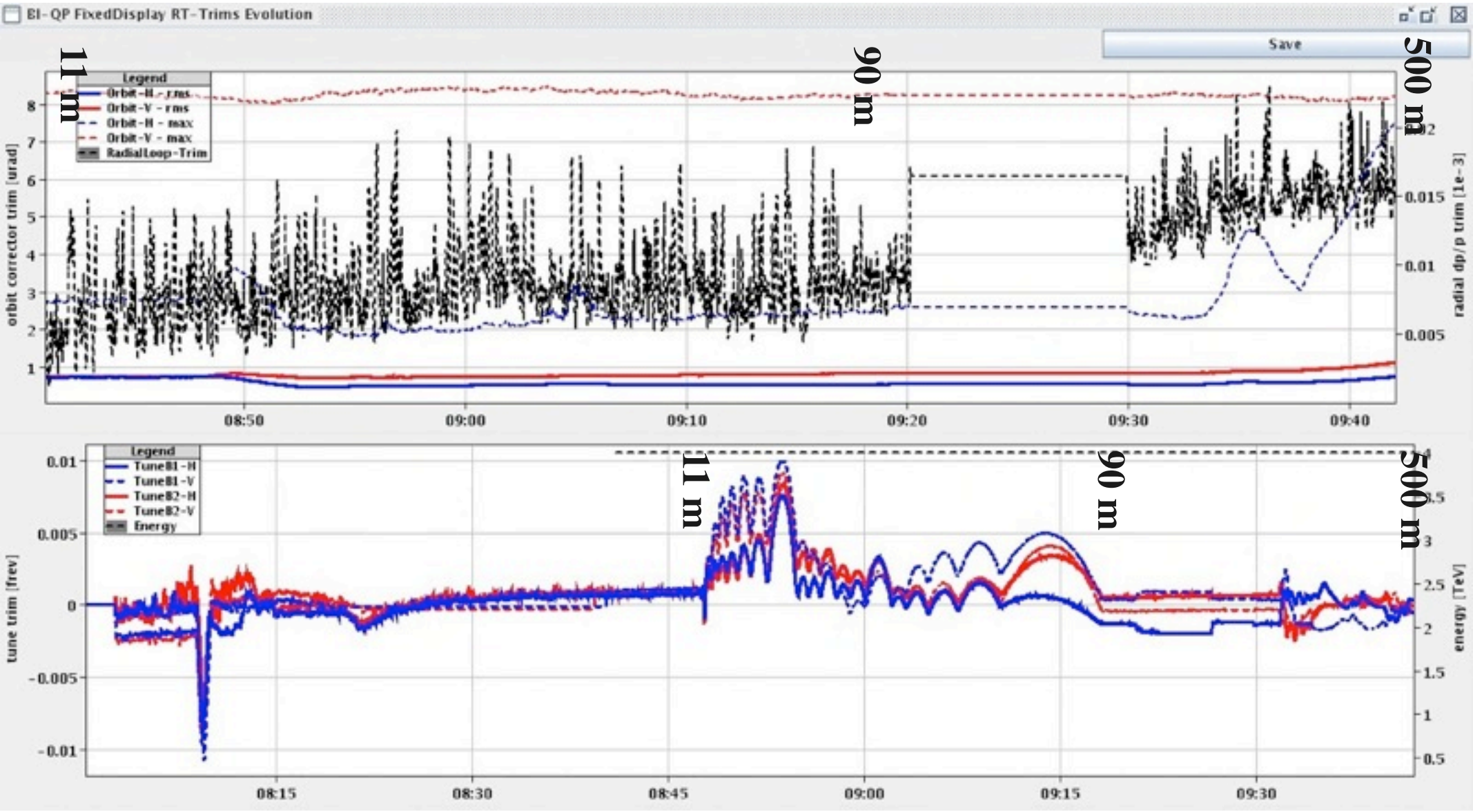
no AC dipole b1 H (but some b1 data from Monday night)

High-β MD2



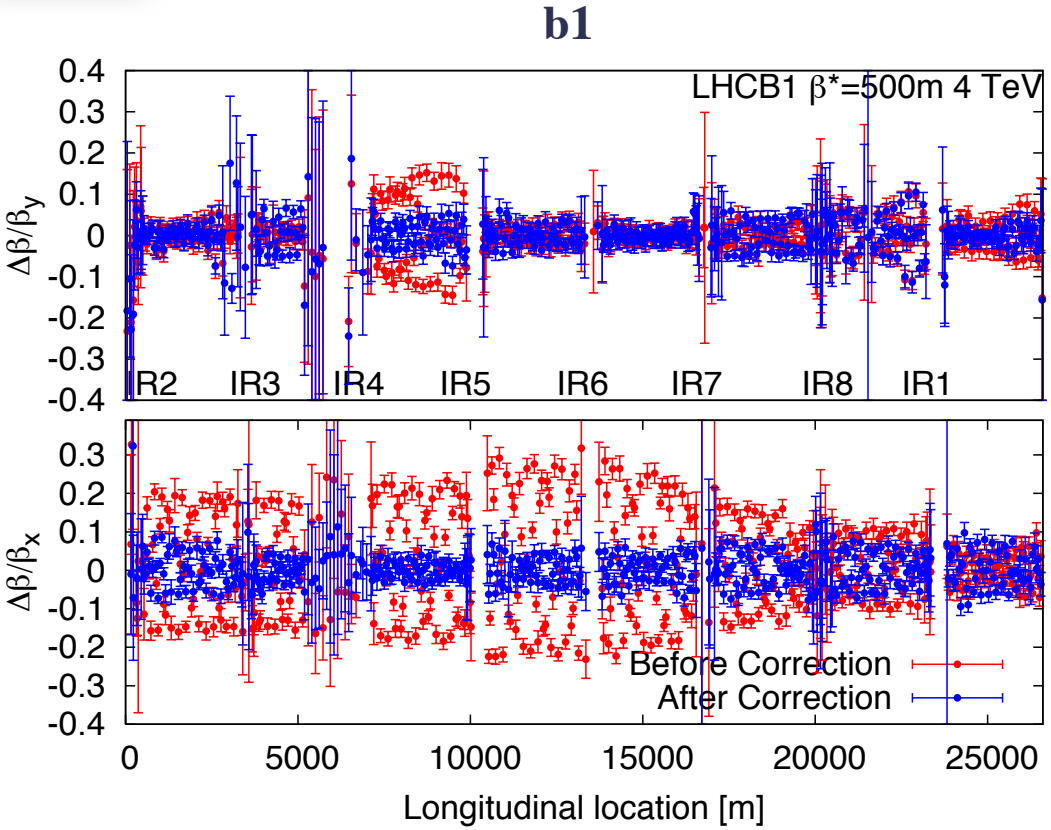
- **separation on, de-squeeze to 90 m and 500 m without stops**
- **completion of 500 m measurements of the corrected optics**
- **successful attempt to continue to 1000 m + optics measurements (uncorrected)**
- at very end started with 2 nominal bunches, ok to 90 m (lost by OFB on in collapse sep. bump)

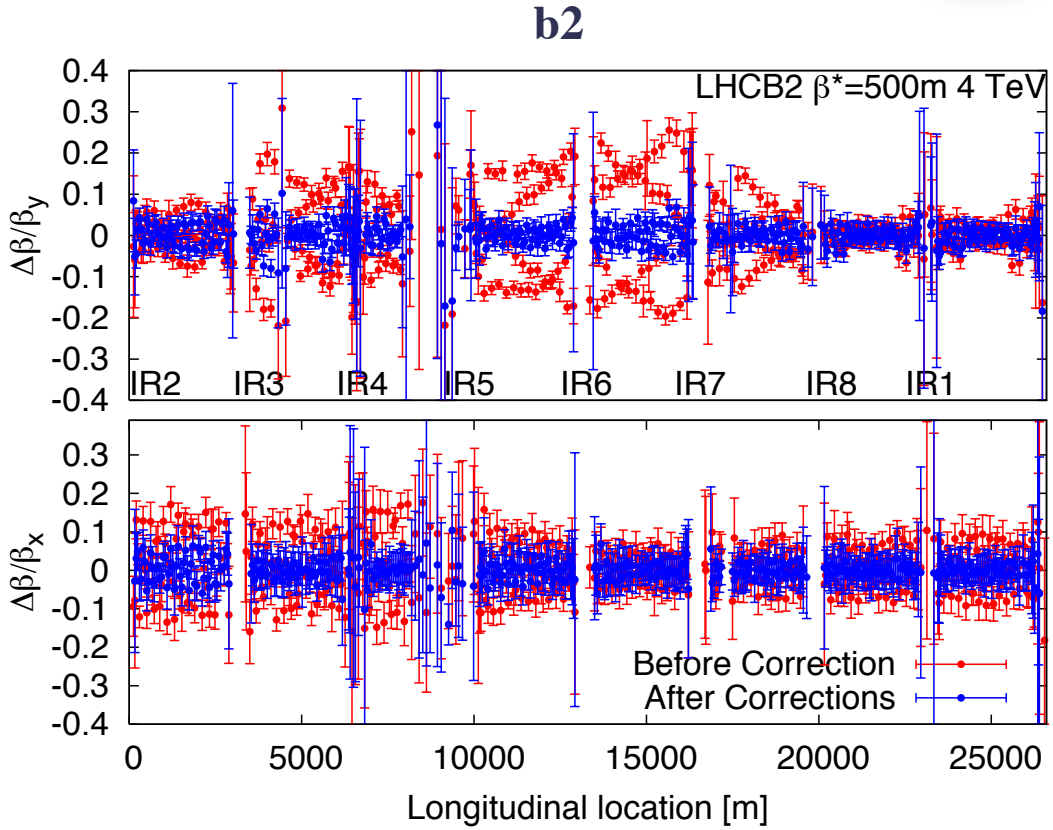
Orbit and Tune in de-squeeze, MD2



shown : tune adjust at stops already done, here remaining feedback trim to keep tune constant, with visible small tune excursion between match points, -- these were also incorporated, so that tunes should now be flat (could run without feedback)

500 m before and after correction

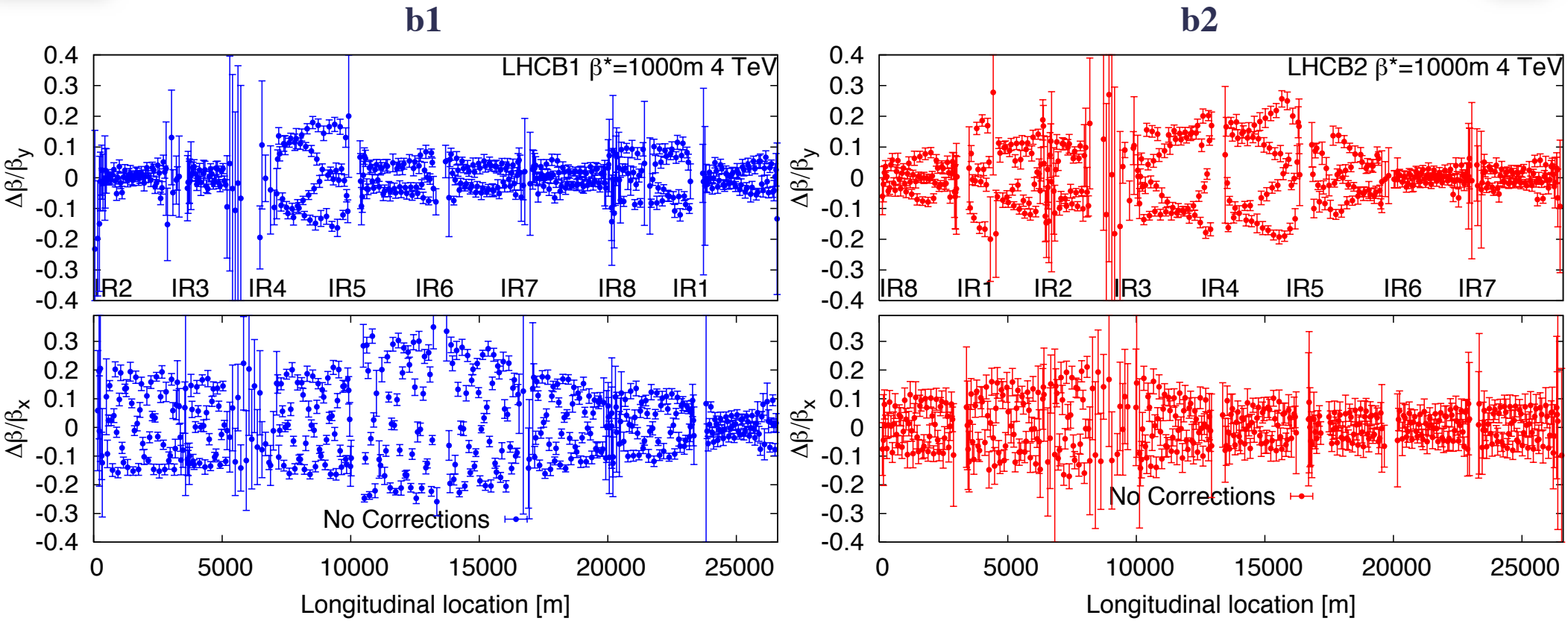




500 m optics well measured and corrected

available as backup in case of unforeseen problems at 1 km

1000 m optics, uncorrected



1000 m optics looks good, β-beating similar to 500 m

should be corrected and re-measured before spending time on finding collisions, collimation, roman pot adjust

Summary

- Very good start for high-β this year
- 90 m back ok, this year commissioned for the first time with full MPS for many bunches and physics with stable beam (can get unstable with 8e10 colliding few σ off in both IP1&5)
- de-squeeze to 500 m and even 1000 m work

Next steps at high-β

Going for 1000 m (500 m as backup)

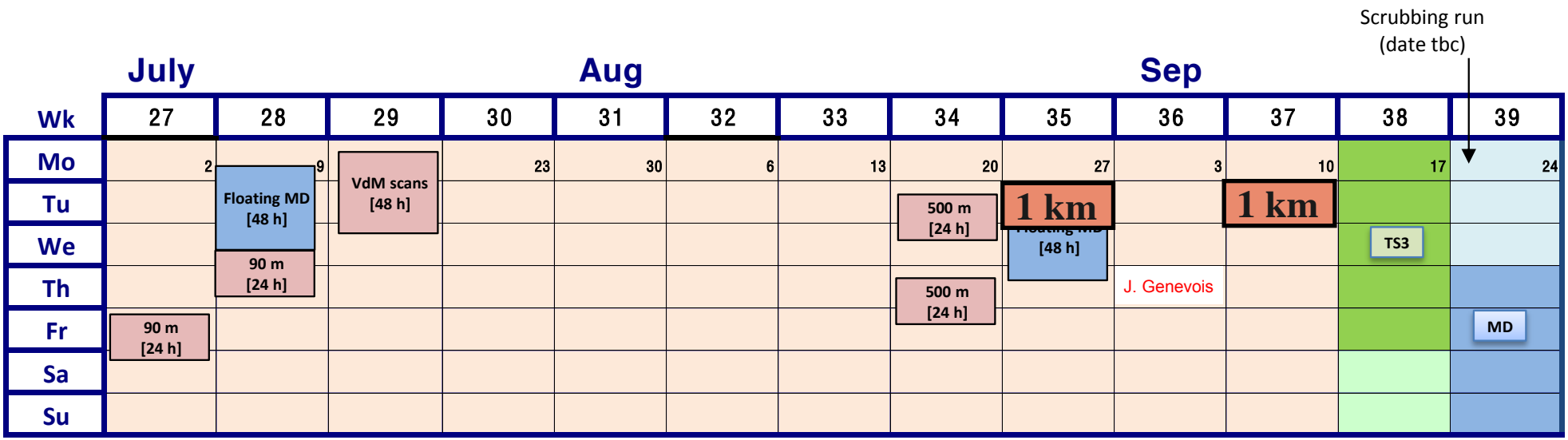
- finding collisions, non-trivial at high-β (corrector and aperture limits) requires ~ nominal intensities
- minimum emittance (~ 1 μm , w/o scraping ?)
- roman pots very close to beam

Reserve

Calender - discussed to day in LPC

preferred schedule for the 1 km runs

- **matched to availability of key people**
- **allows for time to react in case of surprises at 1 km**
- **possibility of follow up in machine studies (separation bumps, emittance, scraping, collimation + RP closest approach to core ..)**



using the current schedule V2.0, from 4/7/2012

Aperture

B1

B2

IP5

IP1