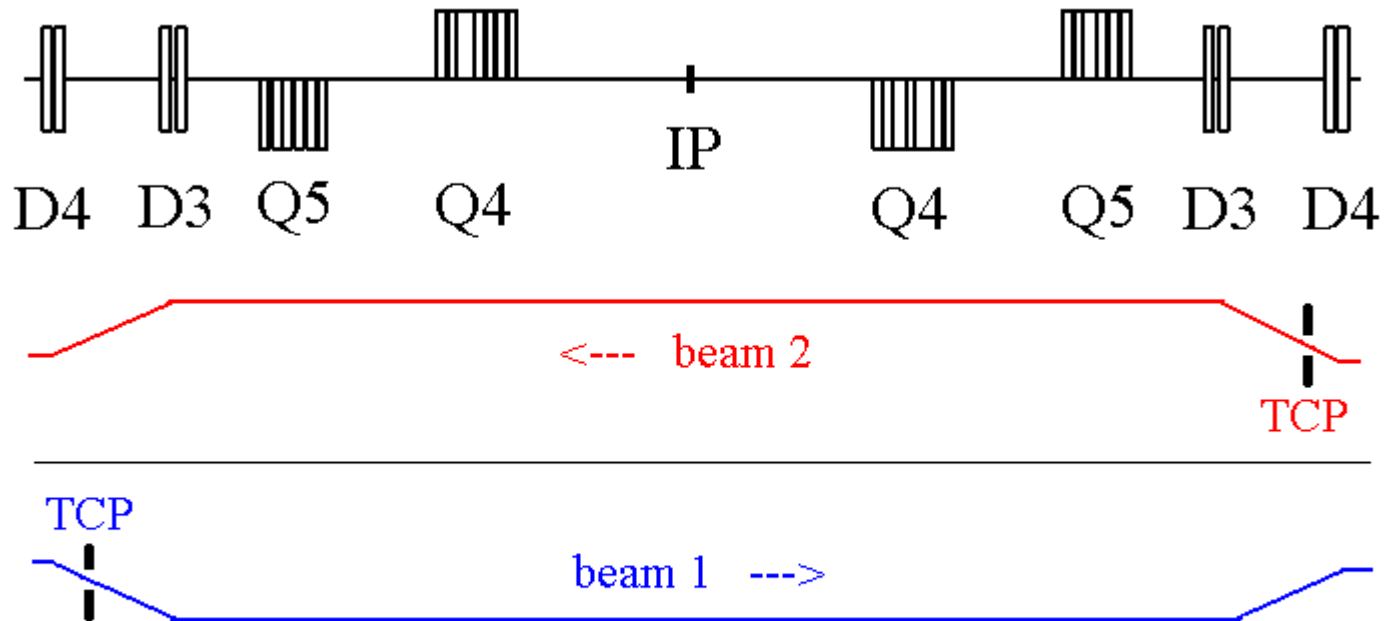


# Optical Corrections in the Central Regions of the LHC Cleaning Insertions

Thys Risselada

- Make beam 1 look again like beam 2
- Decide what to do with quad strengths too close to zero

# Schematic layout of central region



# Beam 1 - Beam 2 comparison

**Ideally:** beam 1 = beam 2 (looking at lattice parameters vs. time)

**But:**

- IR3/7 **magnet layout** is not symmetric w.r.t. IP beyond Q6, so beta functions can only be made identical **from Q6L to Q6R**
- **doglegs** in the two beams have opposite deflection angles

To achieve collimation optics of **equal performance** the value of dispersion was chosen to be identical at the primary collimators in both beams.

# Retuning Beam 1

A **retuning** of the beam 1 optics has become necessary, as it had drifted away from the “ideal” values, optimized in the collimation efficiency studies by Dobrin Kaltchev in 2003-2004 and subsequent impedance validation (beam 2 is OK).

- **Dx is now set to 0** at the IR7 primary collimator (was 0.39 m)
- Dx is adjusted at the IR3 primary collimator to bring beam 1 to the same collimation performance level (**normalized dispersion**) as beam 2

# Optics at Primary Collimators in both beams

<b>V6.503</b>	BETX	BETY	DX	DX_N	DPX_N
TCP.L3.B1	132.561	143.463	2.186	0.1899	-0.000224
TCP.R3.B2	132.561	143.461	2.216	0.1925	-0.000237
TCP.L7.B1	160.146	77.608	0.393		
TCP.R7.B2	160.146	77.608	0.003		

(DX\_N, DPX\_N : normalized dispersion its and s-derivative)

- betas are OK
- dispersion needs to be rematched in beam 1

# Optics at Primary Collimators in both beams

<b>V6.503</b>	BETX	BETY	DX	DX_N	DPX_N
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## PROPOSAL 2010

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TCP.L7.B1	160.146	77.608	0.000		
TCP.R7.B2	160.146	77.608	0.000		

# Trim quadrupoles MQWB

The trim quads **MQWB** (a single module in each Q4 and Q5) allow quad strength differences between the **left** and **right** sides of IR3 and IR7. In theory differences may also be introduced **between the two beams**, but this feature is presently not used.

<b>450 GeV</b>	<b>AMPS</b>	<b>IMAX</b>	<b>PERCENT</b>
MQWB.5L3	29.18	600	4.86
MQWB.4L3	20.67	600	3.45
MQWB.5L7	0.98	600	0.16
MQWB.4L7	9.96	600	1.66

The main quads (**MQWA**) are powered in series (**left-right, B1-B2**) with strengths around 6 % at 450 GeV.

# Switching off low current MQWB ?

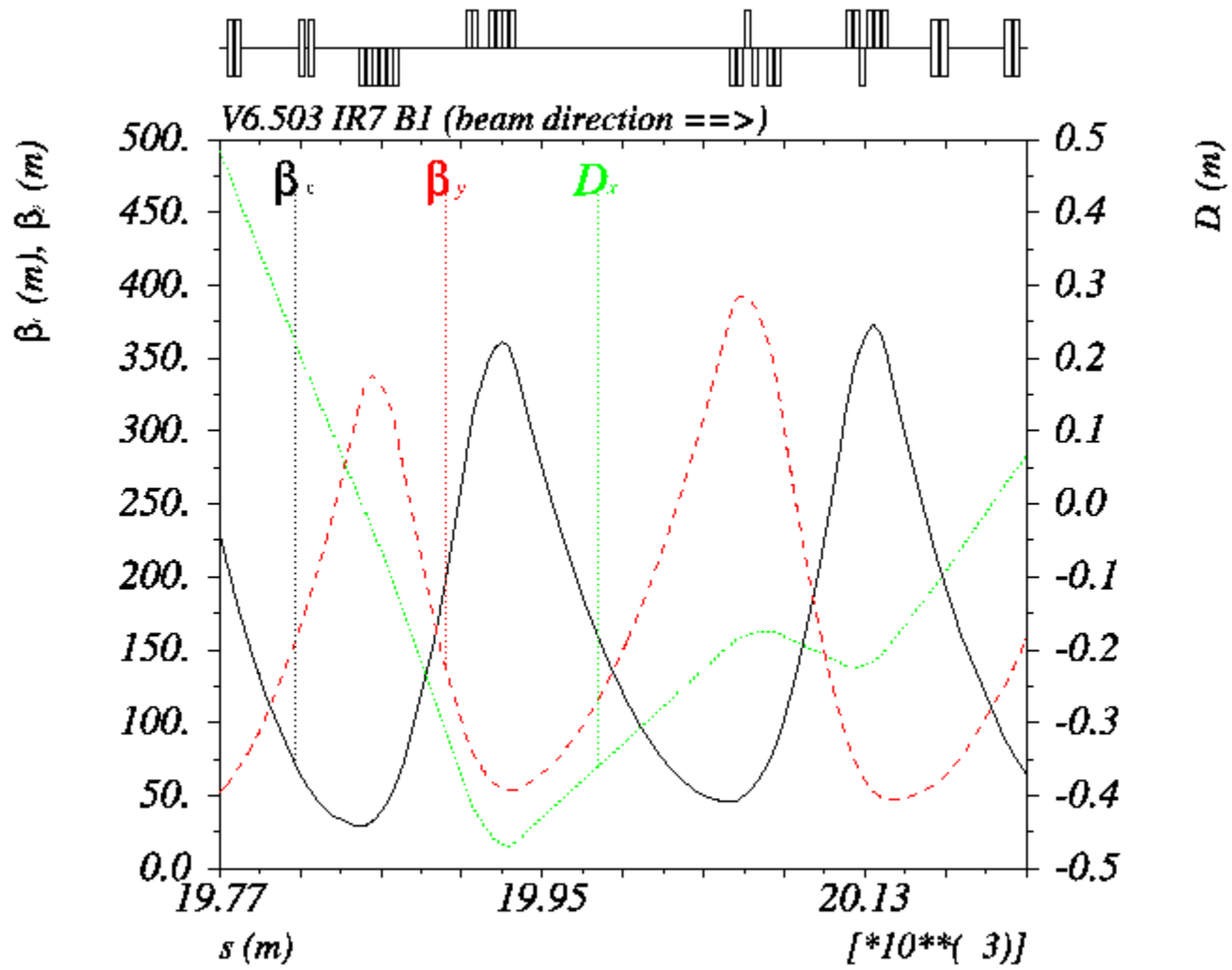
In **IR7** the **MQWB** modules in **Q5** run at very low strength (0.16 % at 450 GeV), and are thus not really needed.

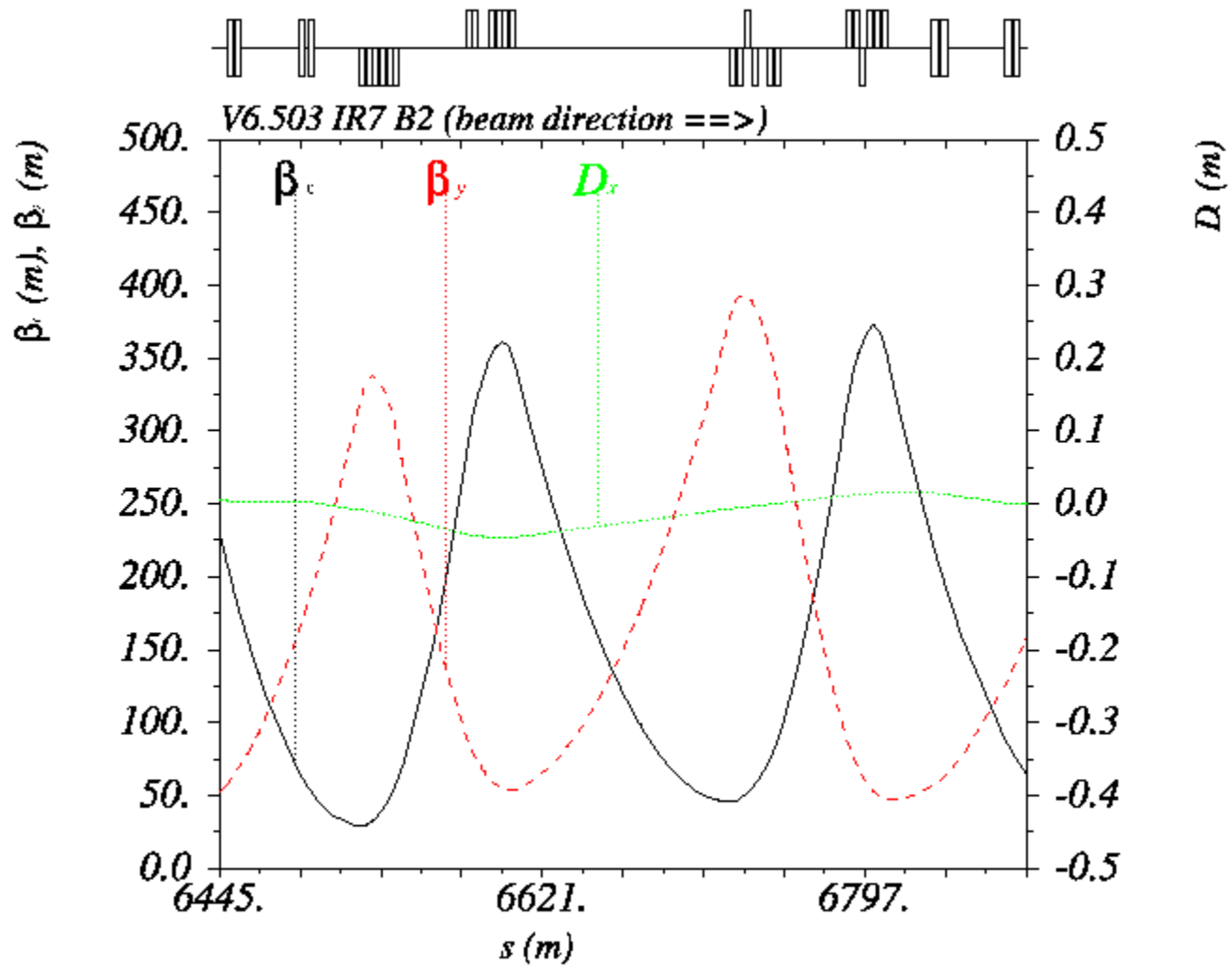
On the other hand, switching off also the **Q4** trims (1.66 % at 450 GeV), changes the optics visibly. Equally, this requires a too large strength in Q7L, and decreases the mechanical aperture in beam 2.

Therefore only the **Q5** trims are set to zero in the proposed solution.

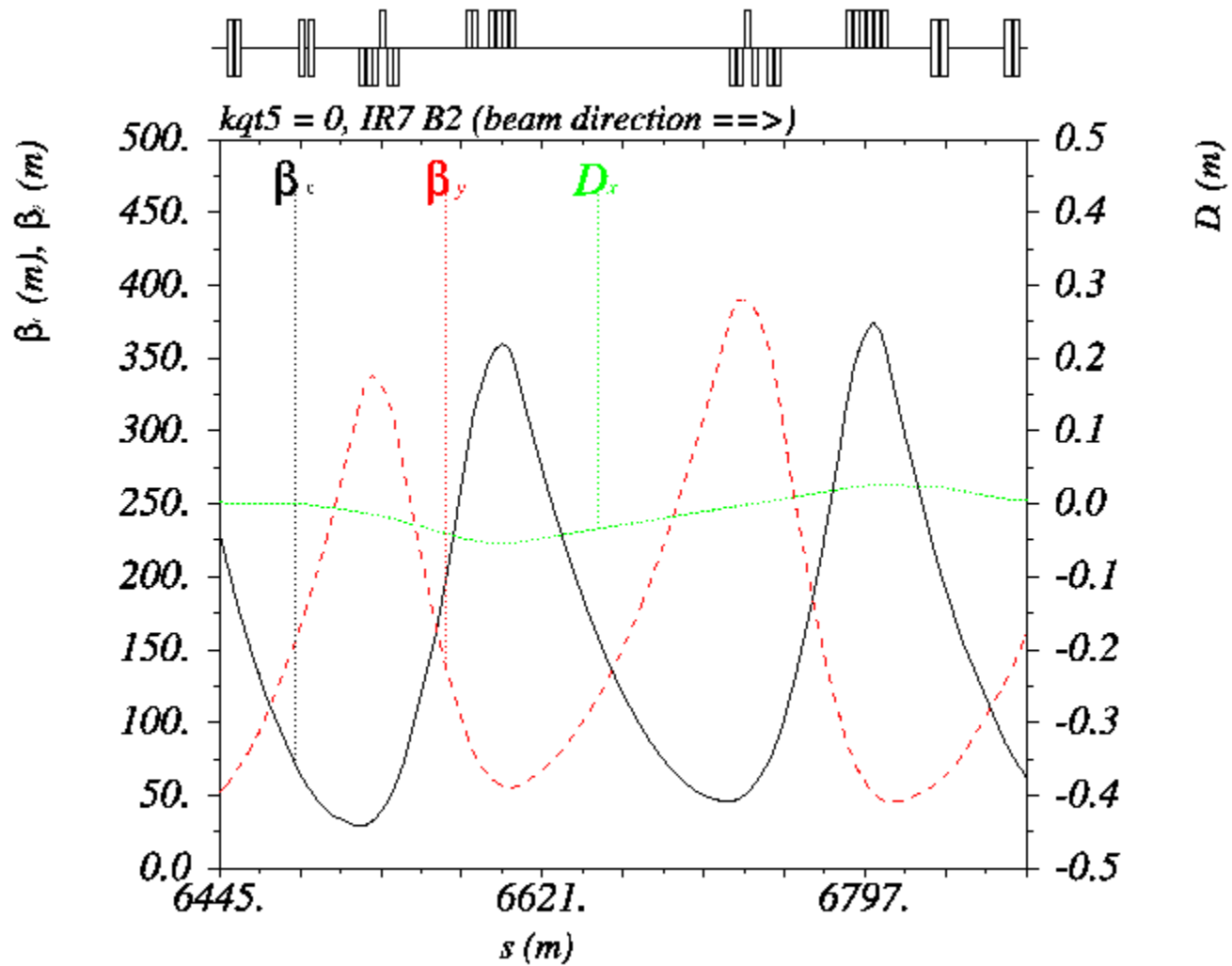
The **IR3** trim quad modules run above 3 % at 450 GeV.



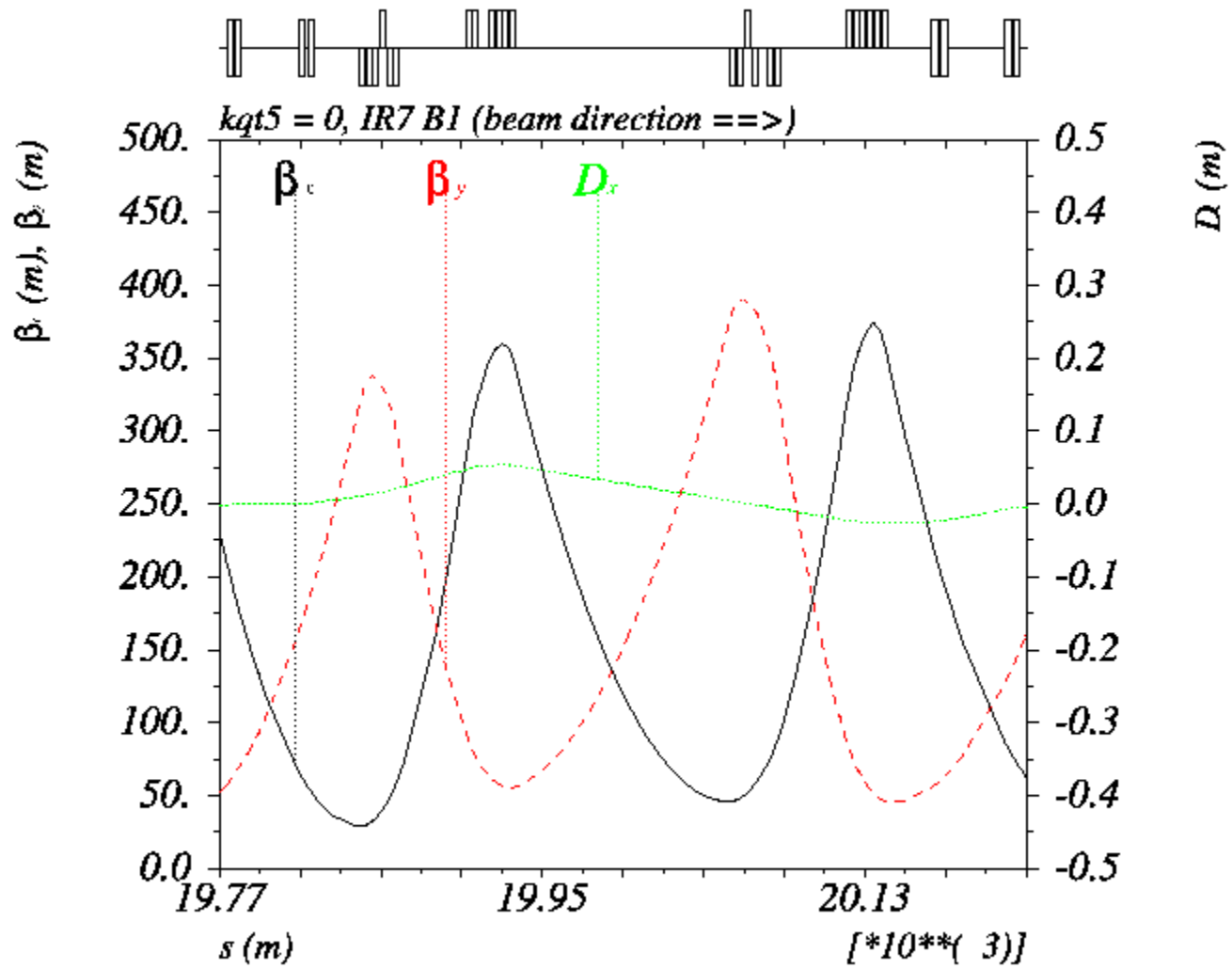


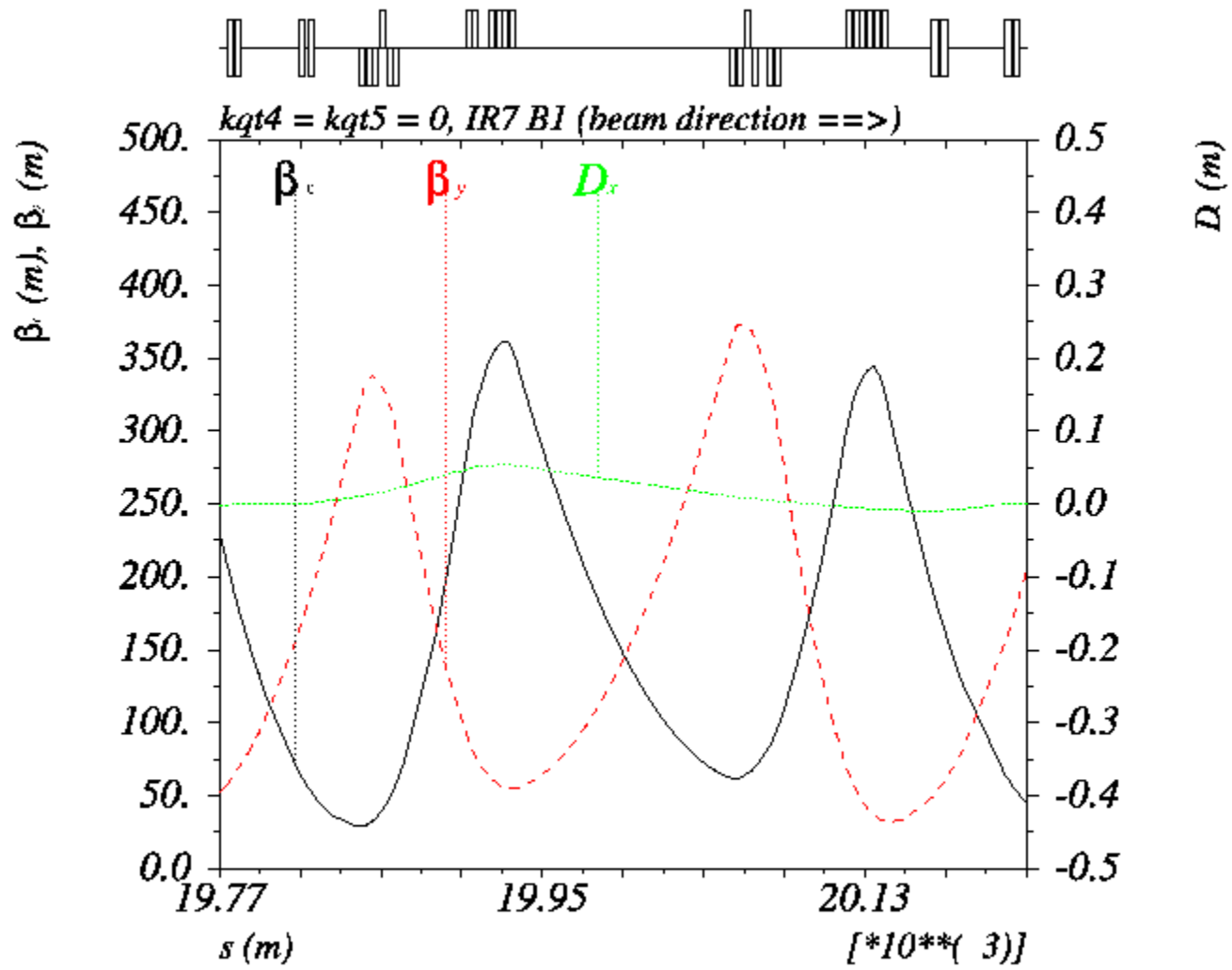


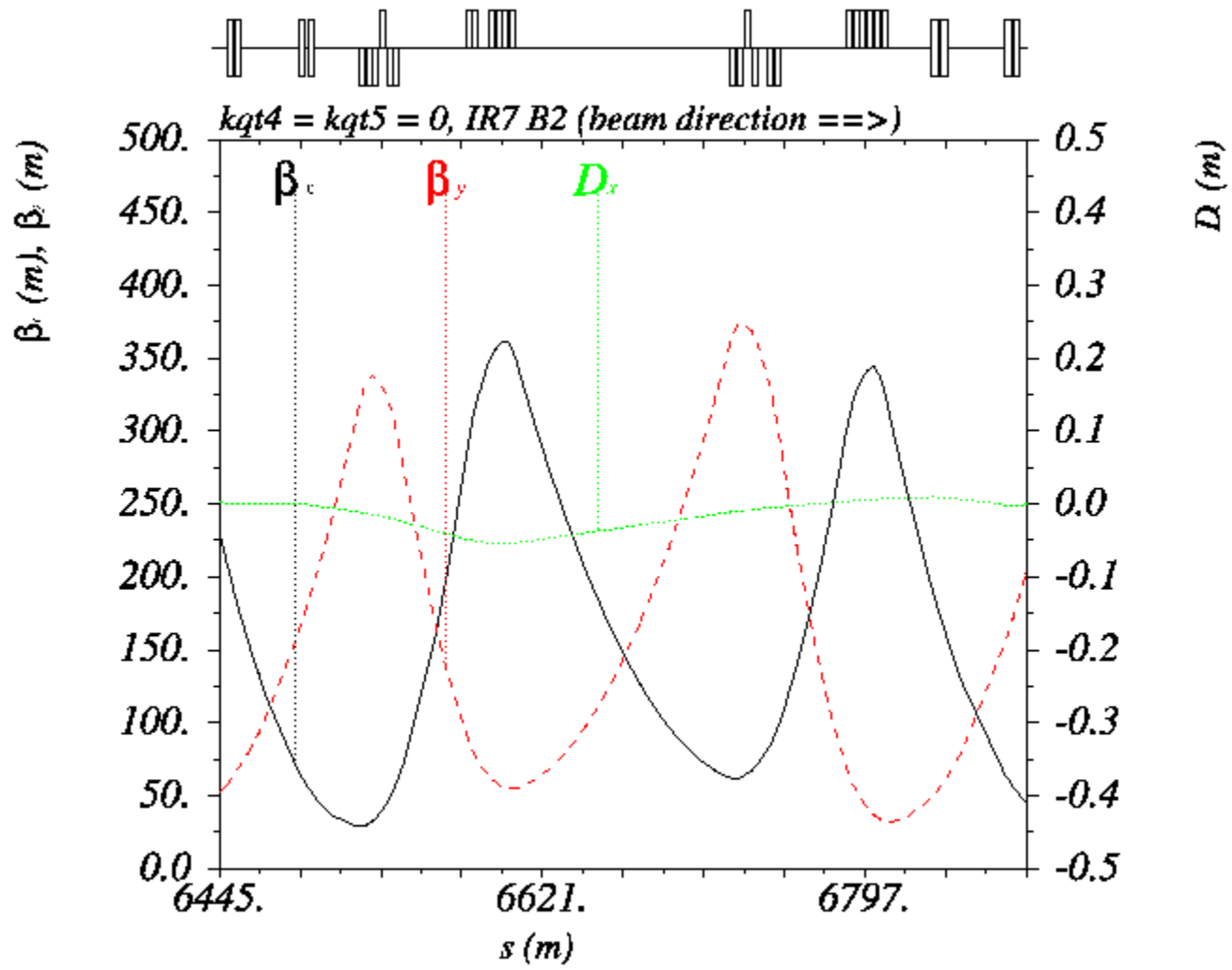
# proposed solution



# proposed solution







# Conclusions

**Dispersion matching constraints** in central regions of IR3 and IR7 were incorrect for beam 1.

Beam 1 optics can be corrected **without change of beta functions**, thus remaining compatible with the 2003-2004 collimation and impedance studies.

Solutions for **low-field trim quads** in IR7 are yet to be finalized.