Optics studies for high-beta configuration in IR1 and 5 - Tune compensation with IR 2 and 8

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Masamitsu Aiba

AB/BI, CERN-Japan Fellow

Work with H. Burkhardt, S. M. White and M. Giovannozzi

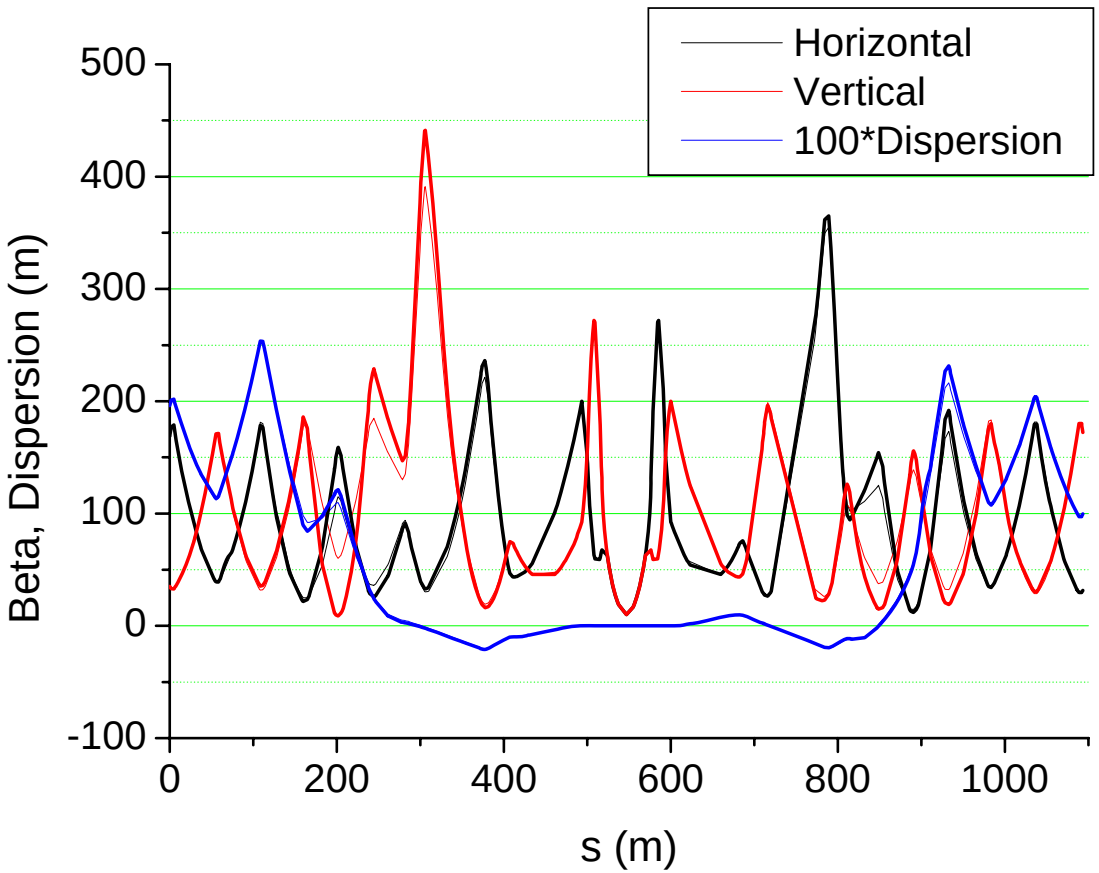
Introduction

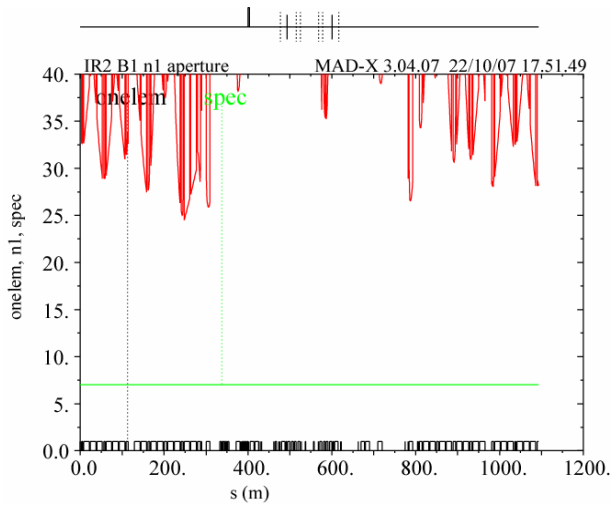
- High-beta optics in IR 1 and/or 5 (β^*>2000m)
  - For ATLAS, luminosity measurement
  - For TOTEM, total cross section measurement
  - Roughly, dQx~-0.5 and dQy~-1.0
- Optics issue
  - Reduction of betatron tunes due to increased beta function
- Study purpose
  - Find possible optics to compensate the tune reduction

Compensation with IR 2 and 8

- Compensation with IR 2 and 8
  - IR 2 and 8 will be available during high beta runs
  - Does not disturb the collimation, RF and beam dump
- Optics solution
  - Not unique, a lot of possible optics
- Matching strategy
  - Brute force matching with ~20 parameters easily fails
  - By half, i. e. left and right separately
  - Keep $\alpha_x=\alpha_y=Dx=Dx'=0$ and (in today's results) $\beta^*=10m$
- Constraints
  - Not to exceed the maximum quad. strength
  - 0.5*KQ_beam1 < KQ_beam2 < 2.0*KQ_beam1
  - Keep sufficient aperture

IR2 Beam1

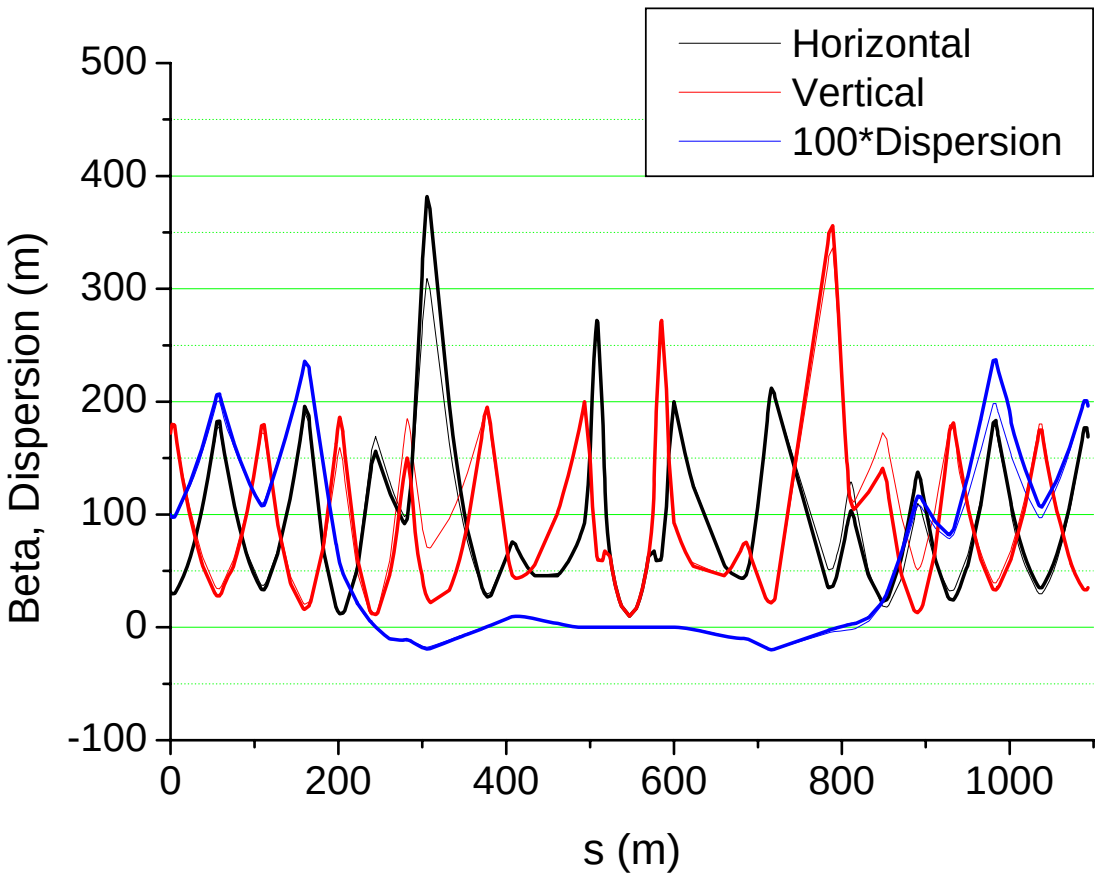


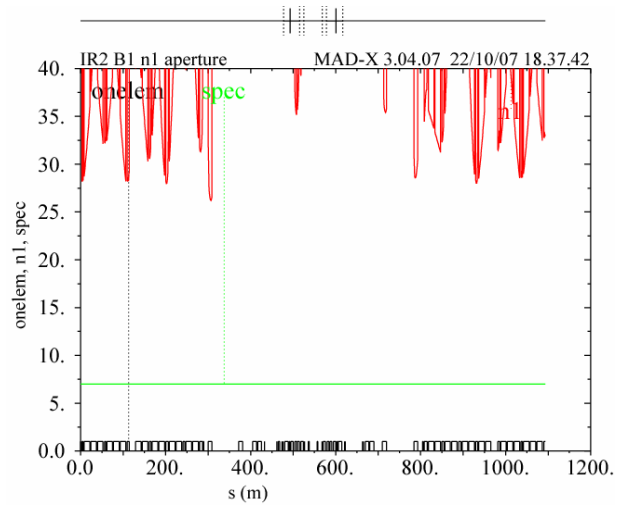


dQx=0, dQy=+0.5

$\alpha_x=\alpha_y=Dx=Dx'=0,\ \beta_x^*=\beta_y^*=10m$

IR2 Beam2

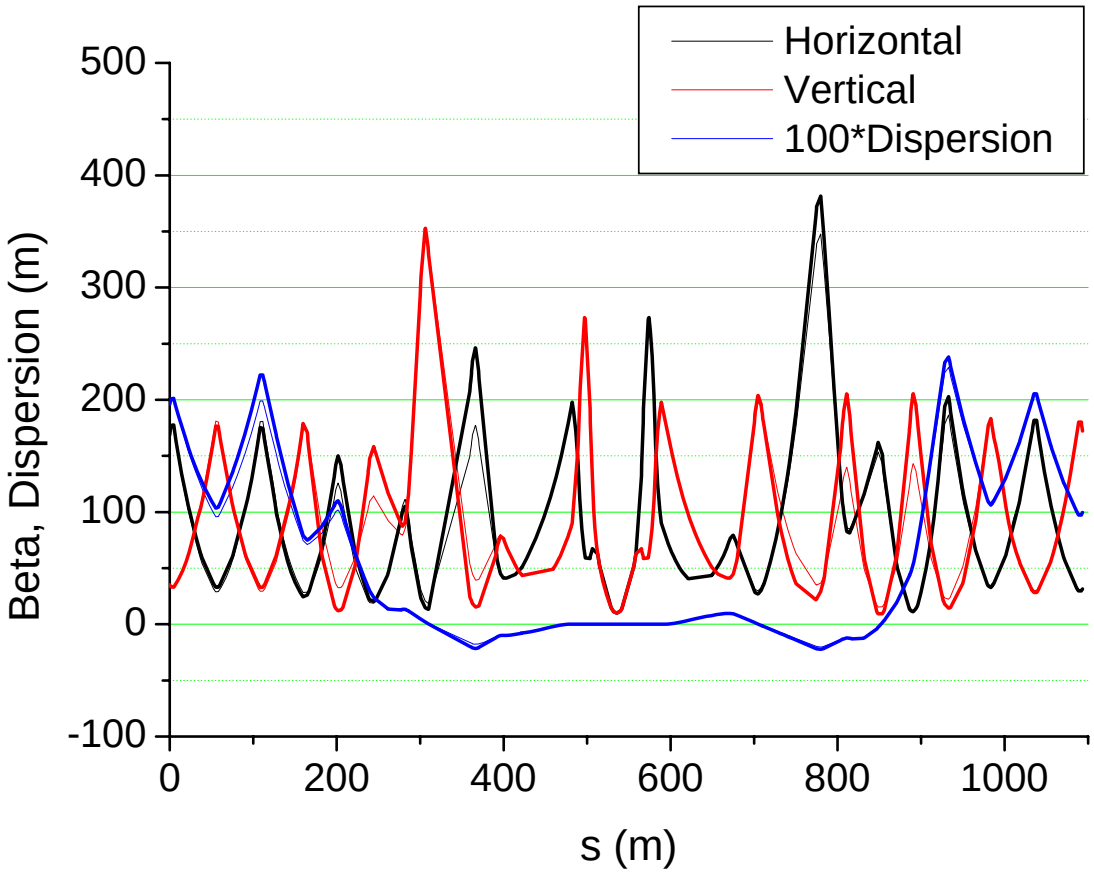


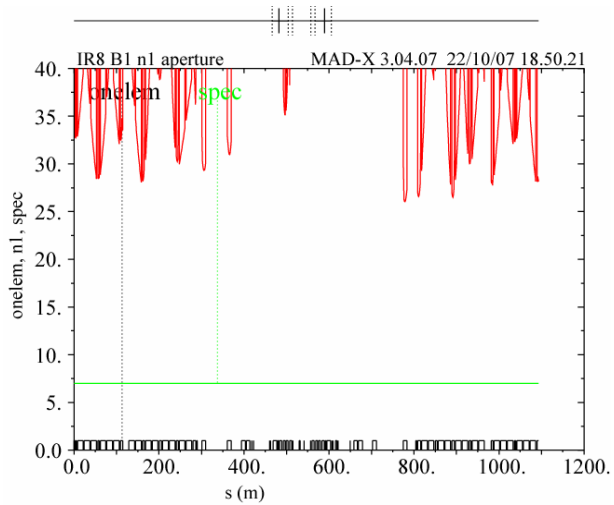


dQx=0, dQy=+0.5

$\alpha_x=\alpha_y=Dx=Dx'=0,\ \beta_x^*=\beta_y^*=10m$

IR8 Beam1

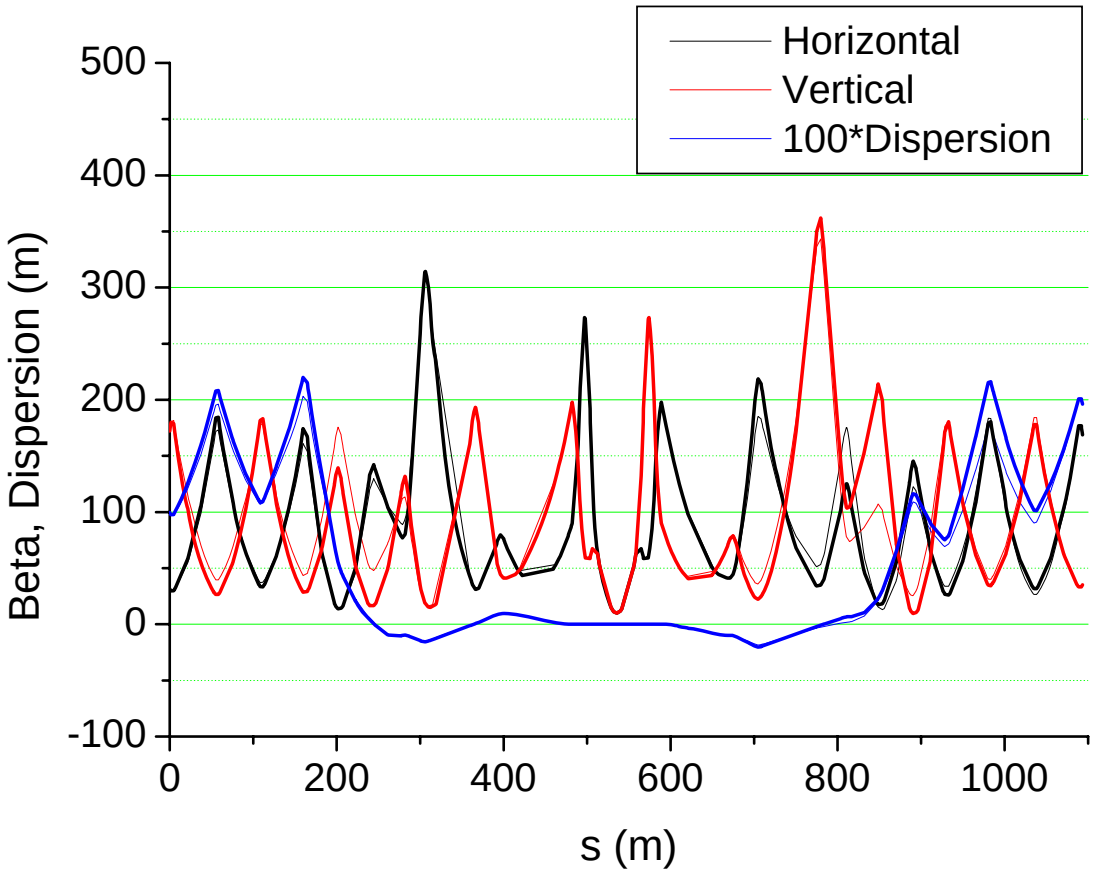


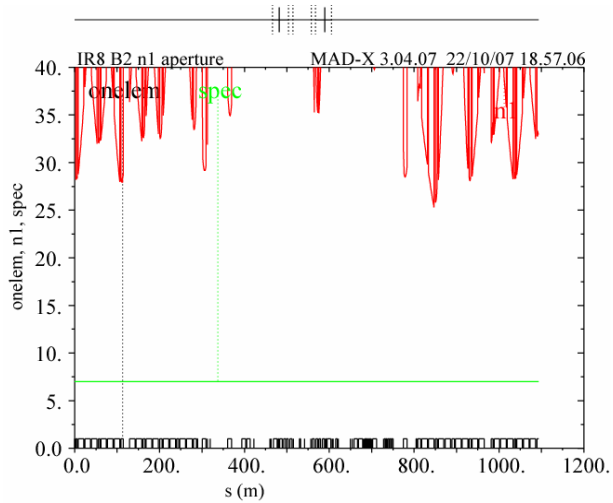


dQx=0, dQy=+0.5

$\alpha_x=\alpha_y=Dx=Dx'=0,\ \beta_x^*=\beta_y^*=10m$

IR8 Beam2





dQx=0, dQy=+0.5

$\alpha_x=\alpha_y=Dx=Dx'=0,\ \beta_x^*=\beta_y^*=10m$

Quadrupole strengths (IR2)

BEAM1	B' (T/m)	BEAM2	B' (T/m)	Limit (T/m)	B1/B2
kq4.l2b1	-136.39	kq4.l2b2	112.76	160	-1.210
kq5.l2b1	111.51	kq5.l2b2	-120.58	160	-0.925
kq6.l2b1	-97.58	kq6.l2b2	105.98	160	-0.921
kq7.l2b1	140.80	kq7.l2b2	-186.07	200	-0.757
kq8.l2b1	-145.25	kq8.l2b2	151.96	200	-0.956
kq9.l2b1	151.41	kq9.l2b2	-179.10	200	-0.845
kq10.l2b1	-184.97	kq10.l2b2	176.60	200	-1.047
kqtl11.l2b1	10.89	kqtl11.l2b2	-104.52	125	-
kqt12.l2b1	26.57	kqt12.l2b2	-49.49	123	-
kqt13.l2b1	-116.40	kqt13.l2b2	-71.08	123	-
kq4.r2b1	113.37	kq4.r2b2	-122.29	160	-0.927
kq5.r2b1	-117.44	kq5.r2b2	108.51	160	-1.082
kq6.r2b1	105.63	kq6.r2b2	-101.72	160	-1.038
kq7.r2b1	-178.49	kq7.r2b2	146.82	200	-1.216
kq8.r2b1	149.65	kq8.r2b2	-137.18	200	-1.091
kq9.r2b1	-170.07	kq9.r2b2	151.77	200	-1.121
kq10.r2b1	176.08	kq10.r2b2	-174.60	200	-1.008
kqtl11.r2b1	-71.49	kqtl11.r2b2	10.26	125	-
kqt12.r2b1	-72.21	kqt12.r2b2	17.18	123	-
kqt13.r2b1	-34.29	kqt13.r2b2	-68.58	123	-

KQ< Limit

0.5*KQ_b1 < KQ_b2 <2.0*KQ_b1

Summary

- Study of tune compensation with IR 2 and 8 has been started
- The first results, dQx=0, dQy=0.5 for IR 2/8 and Beam 1/2, are obtained
- Plans
  - Find tuning ranges, dQx~±0.2, dQy=+0.3~0.7
  - Find dQy~1.0 with smaller β_y*