Prévessin, 8 May 2014

New Optics of the PSB measurement line

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Recap of PSB ejection lines review

- Indico link: http://indico.cern.ch/event/274495/
- New optics solutions for BT-BTP presented and approved
- HW requirements established for all lines (GFR and gradients, slides 33, 34 and 36)
- The BTM optics was not changed → should be studied together with the potential 2 GeV ISOLDE upgrade

BT-BTM

Measurement line

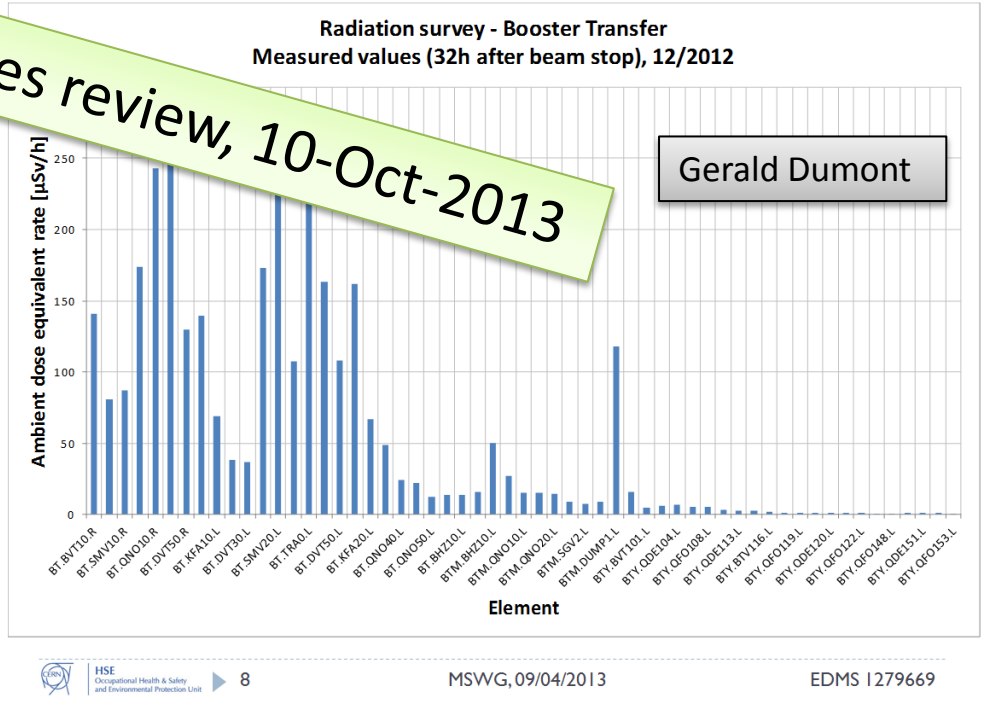
From PSB ejection lines review, 10-Oct-2013

- 4 optics setting
  - Dump, ISOLDE
  - Hor. Emittance (Large Dispersion)
  - Hor. Emittance (Small Dispersion)
  - Vertical Emittance

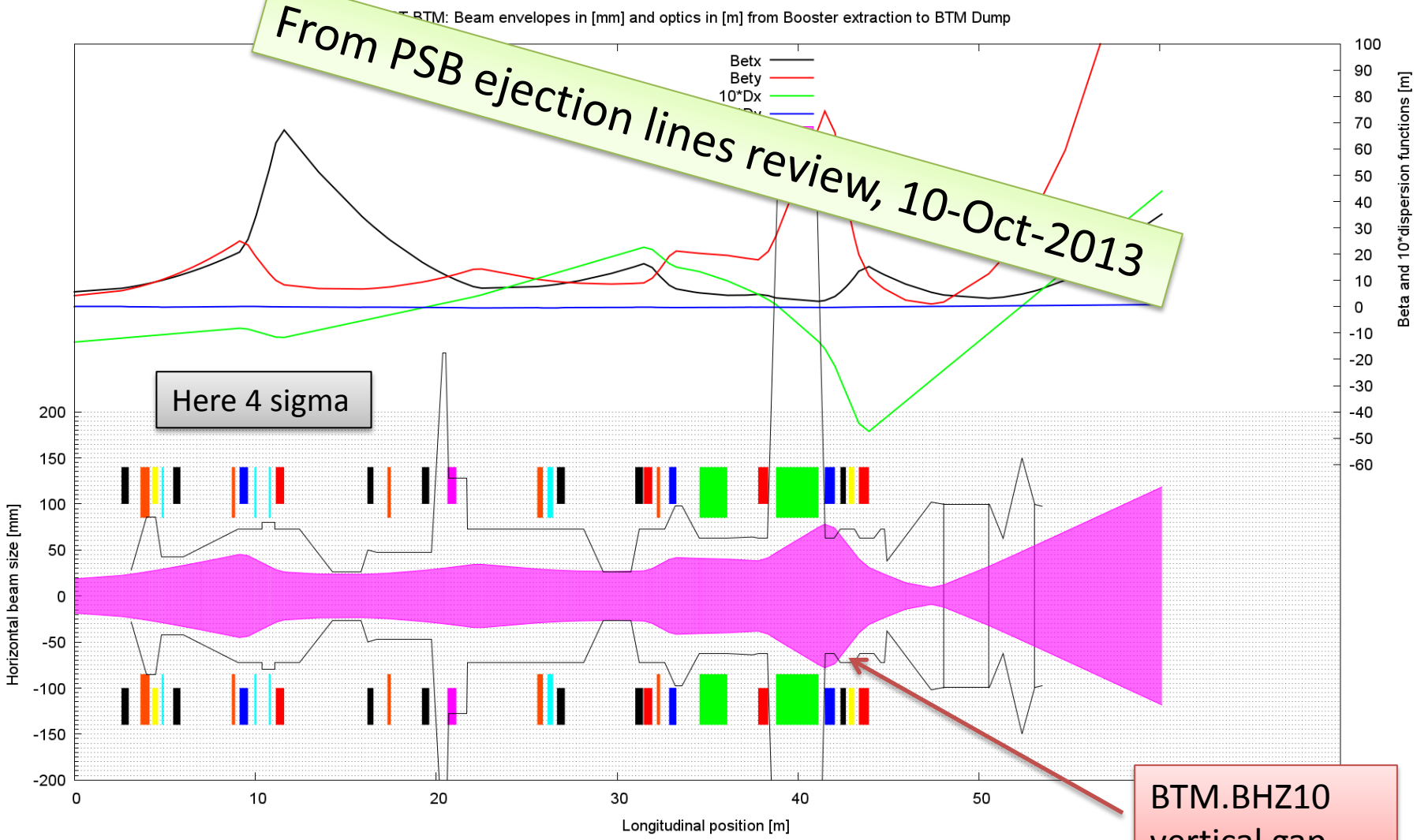
- Potential issue with losses in area of BTM.BHZ10
  - Rematch for beam size?

- Any change of the BTM line should not hinder the possible 2 GeV upgrade of BTY for ISOLDE

- Best to look at both upgrades simultaneously

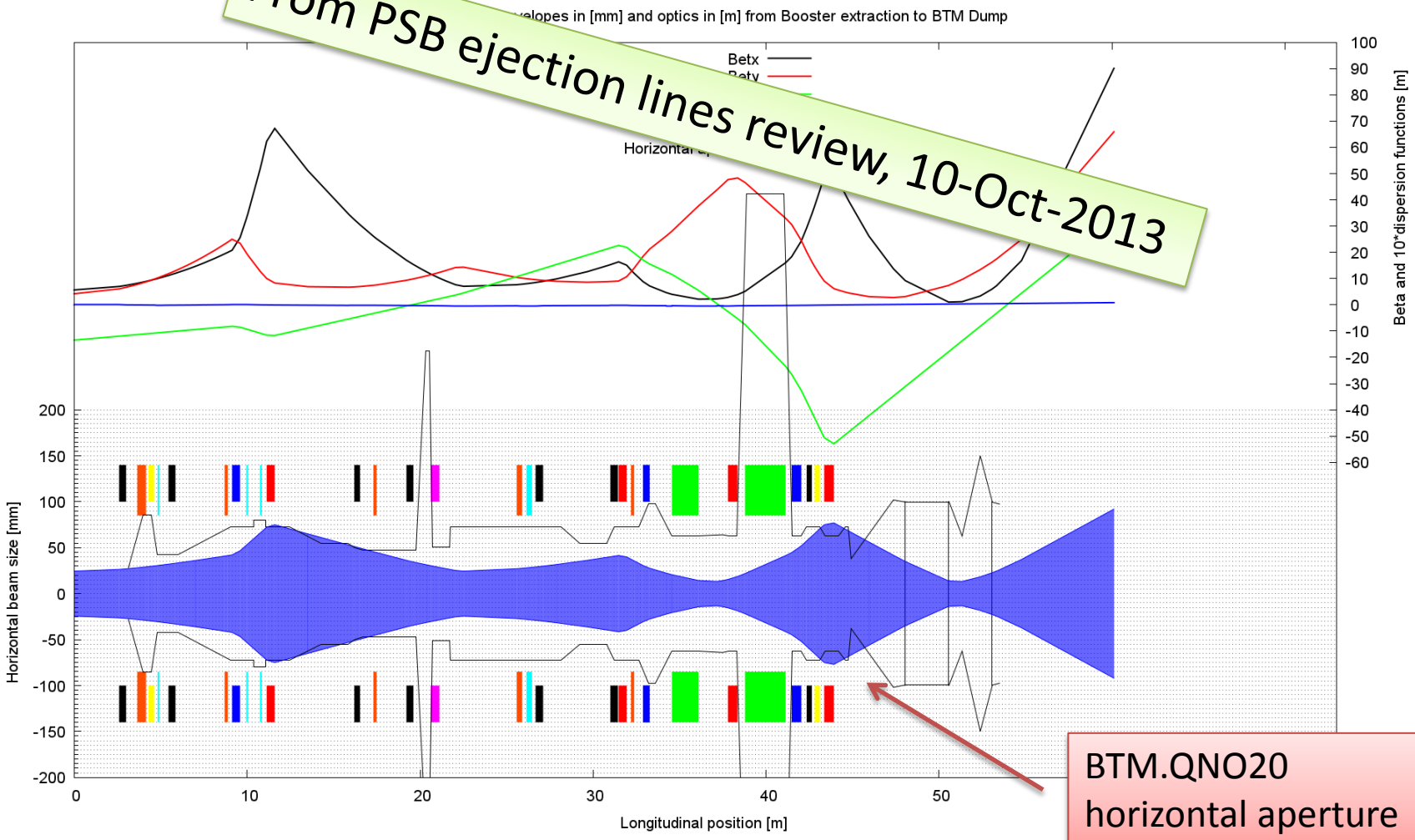


BTM aperture bottlenecks



BTM aperture bottlenecks

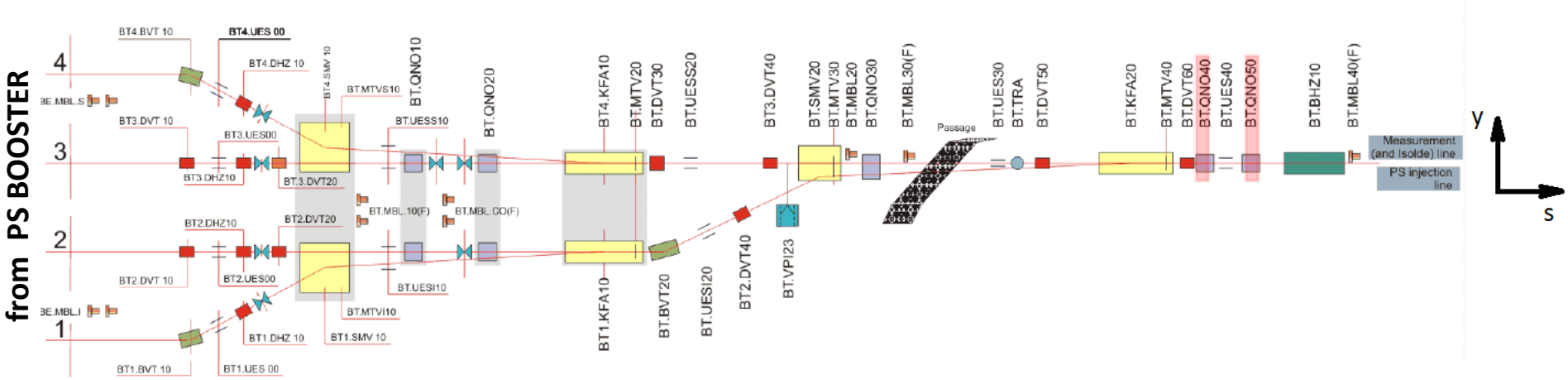
From PSB ejection lines review, 10-Oct-2013



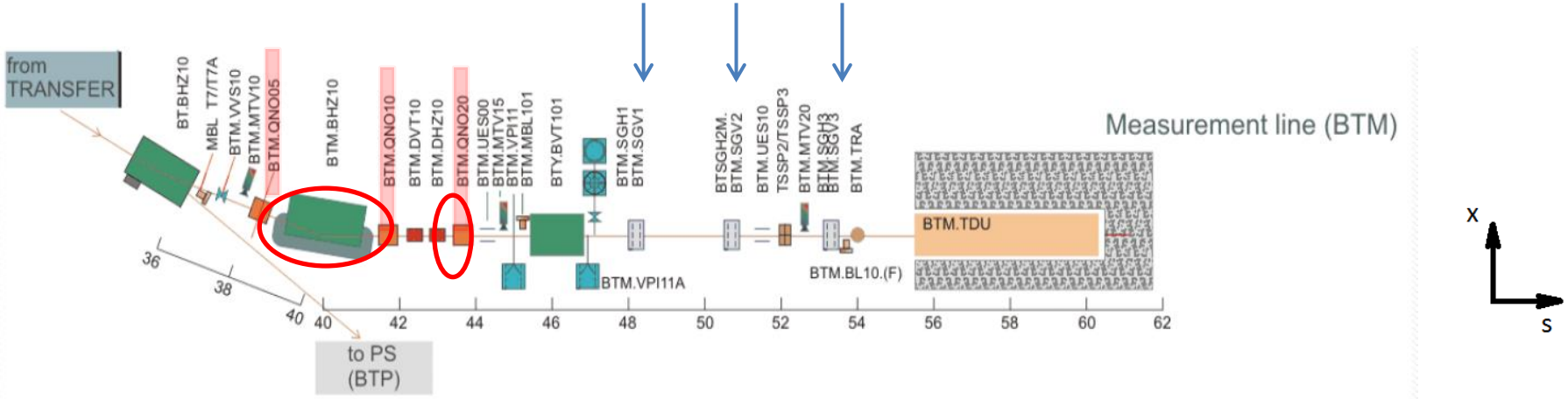
BTM.QNO20
horizontal aperture

- Minutes by Vivien Raginel:
  - *To conclude it was agreed that: The magnet and the power supply groups will start working on the basis of the presented optics. A status of their work will be presented beginning of 2014 during a LIU-PSB WG meeting.*
  - ***ABT will proceed with the optics studies in order to find a better solution for BTM line. it was agreed that the optics should be frozen the latest June 2014.***
  - *RP needs to estimate what would be the maximum losses accepted at the BTM.BHZ10.*

The PSB measurement line



3 grids for emittance measurement



New Optics of the PSB measurement line

With the purpose of reducing the beam size at some specific locations, only the strength of the quadrupoles

BT.QNO40, BT.QNO50, BTM.QNO05**,** BTM.QNO10, BTM.QNO20**.**

have been retuned, for the four configurations:

1. Dump optics (Isolde)
2. Horizontal measurement optics (large DX)
3. Horizontal measurement optics (small DX)
4. Vertical measurement optics

(Half) beam sizes computed as

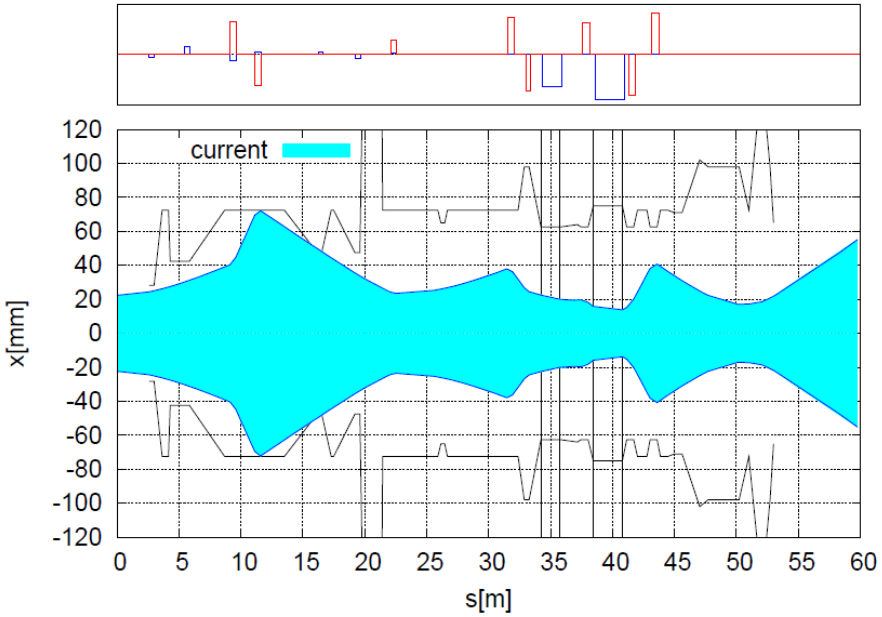
$$A_{x,y} = n_{sig} \cdot \sqrt{k_\beta \cdot \beta_{x,y} \cdot \frac{\epsilon_{N;x,y}}{\gamma_r \beta_r}} + |D_{x,y} \cdot \frac{\Delta p}{p}| + CO \cdot \sqrt{\frac{\beta_{x,y}}{\beta_{MAX;x,y}}}$$

With (NORMGPS beam)

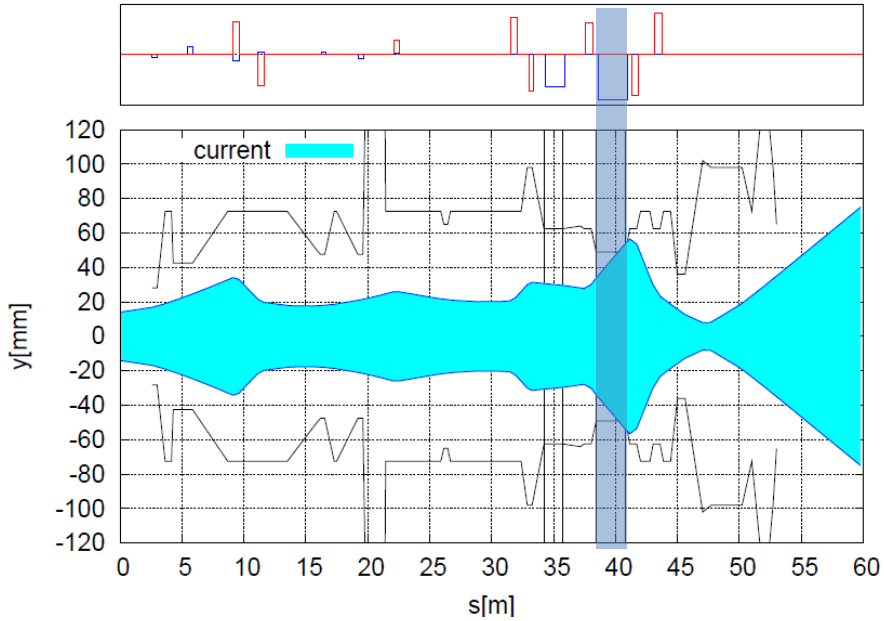
n_{sig}= 3
k_β = 1.2
$\epsilon_{N;x}$ = 15 π mm mrad
$\epsilon_{N;y}$ = 9 π mm mrad

$\frac{\Delta p}{p} = 1.35x10^{-3}$
CO = 1.5 mm
E_k = 1.4 GeV

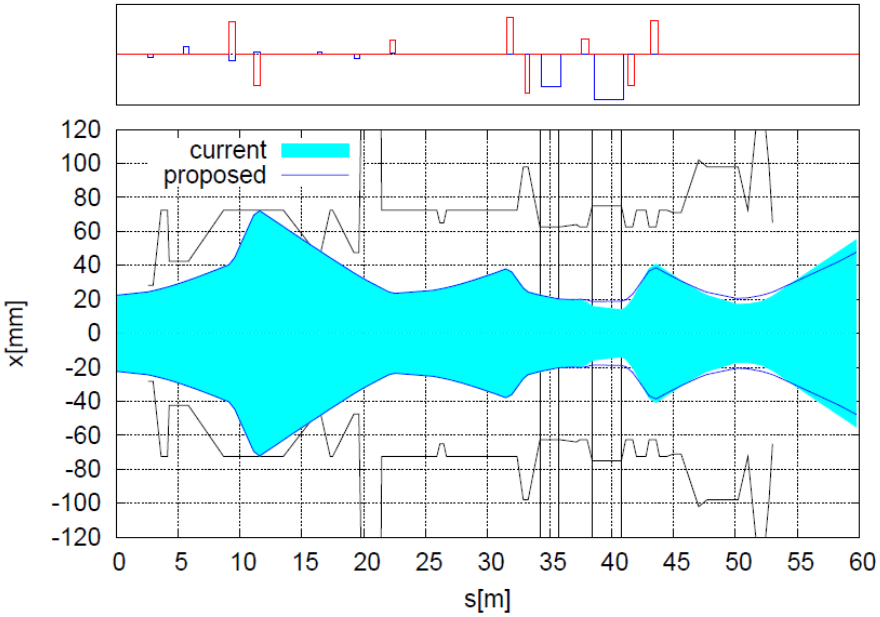
1. Dump optics



BTM.BHZ10

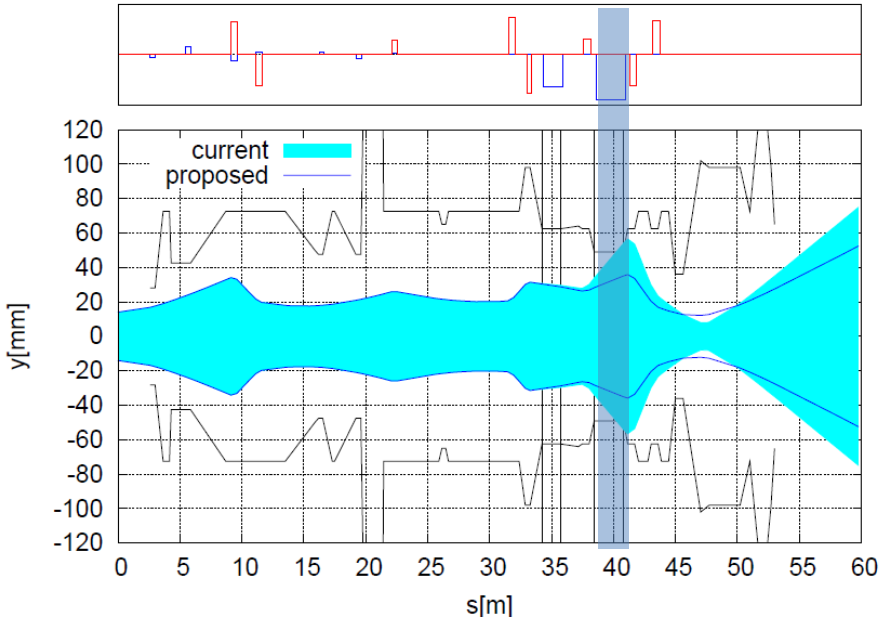


1. Dump optics



BTM.BHZ10

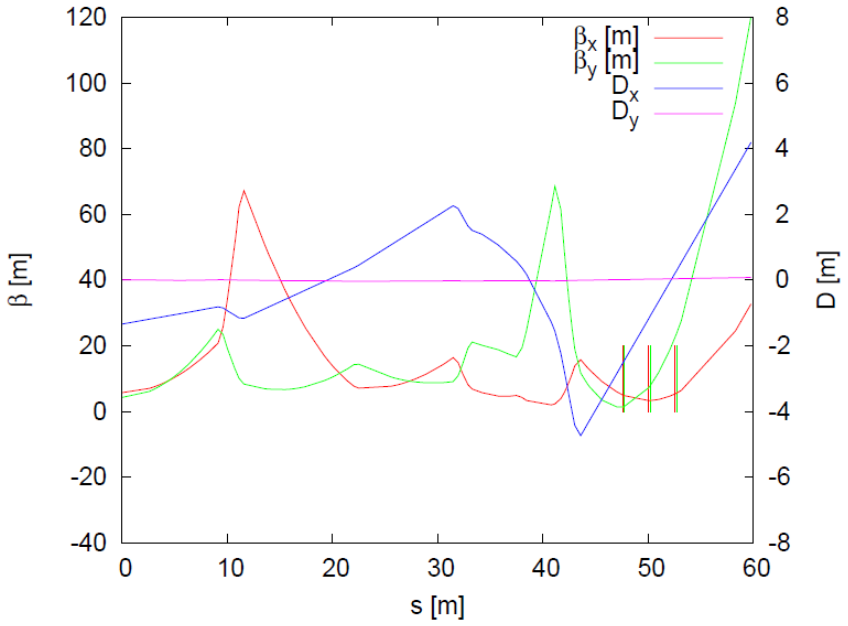
Beam size reduced from 55.7 mm to 36.2 mm



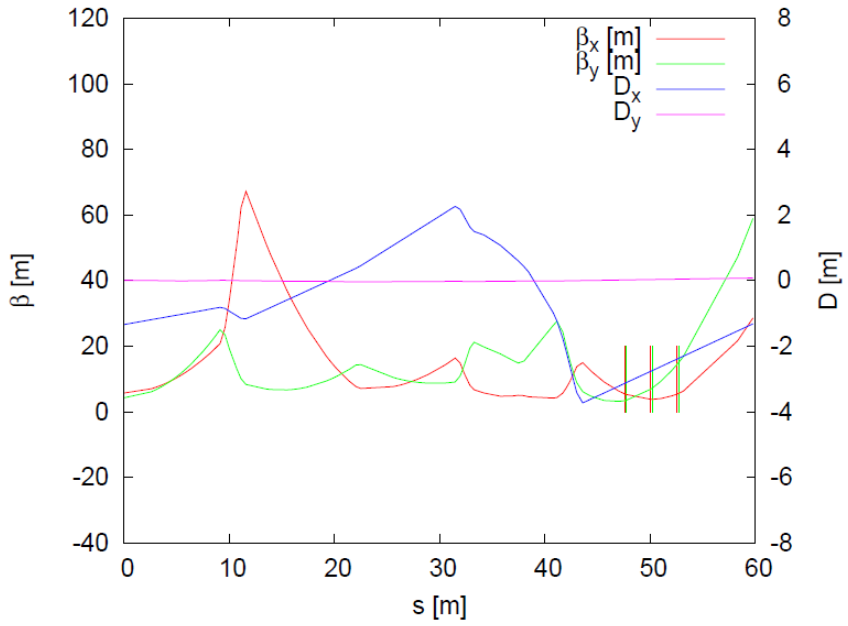
1. Dump optics

Element	MADX	Length [m]	Current strength [m^{-2}]	Proposed strength [m^{-2}]	g [T/m] @ 1.0 GeV	g [T/m] @ 1.4 GeV	g [T/m] @ 2.0 GeV	g Max [T/m]= (g@2 GeV)x1.2
BT.QNO40	kbtqno40	0.466	0.73355	0.7436822858	4.2072	5.3129	6.9071	8.29
BT.QNO50	kbtqno50	0.388	-0.73616	-0.7744080152	-4.3811	-5.5324	-7.1925	-8.63
BTM.QNO05	kbtmqno05	0.560	0.62599	0.3061023617	1.7317	2.1868	2.8430	3.41
BTM.QNO10	kbtmqno10	0.560	-0.81000	-0.6291331443	-3.5592	-4.4946	-5.8432	-7.01
BTM.QNO20	Kbtmqno20	0.560	0.84011	0.6823519170	3.8603	4.8748	6.3375	7.60

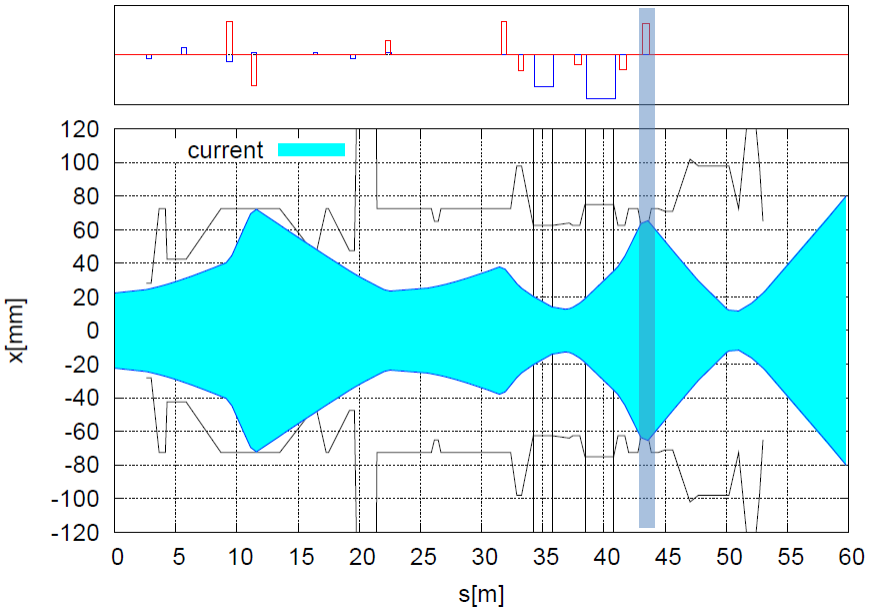
Current



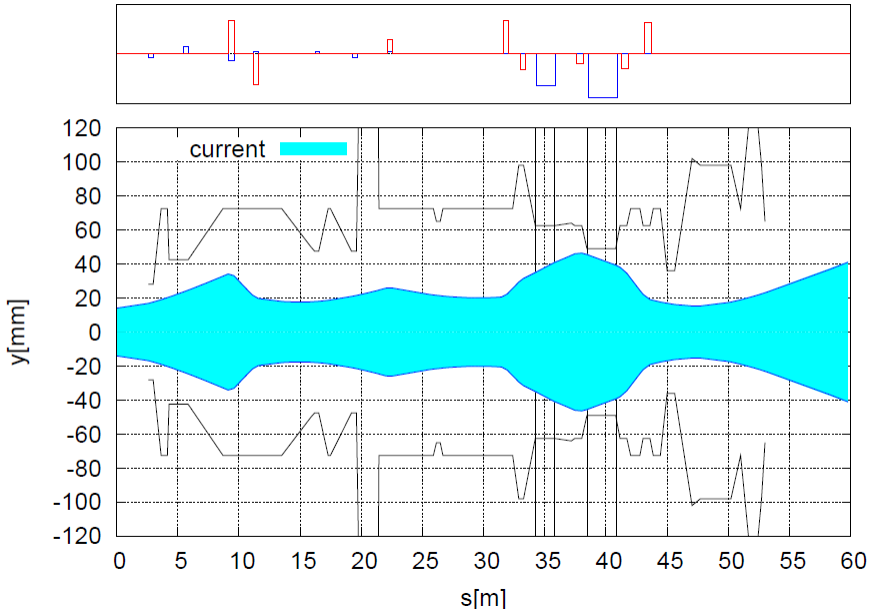
Proposed



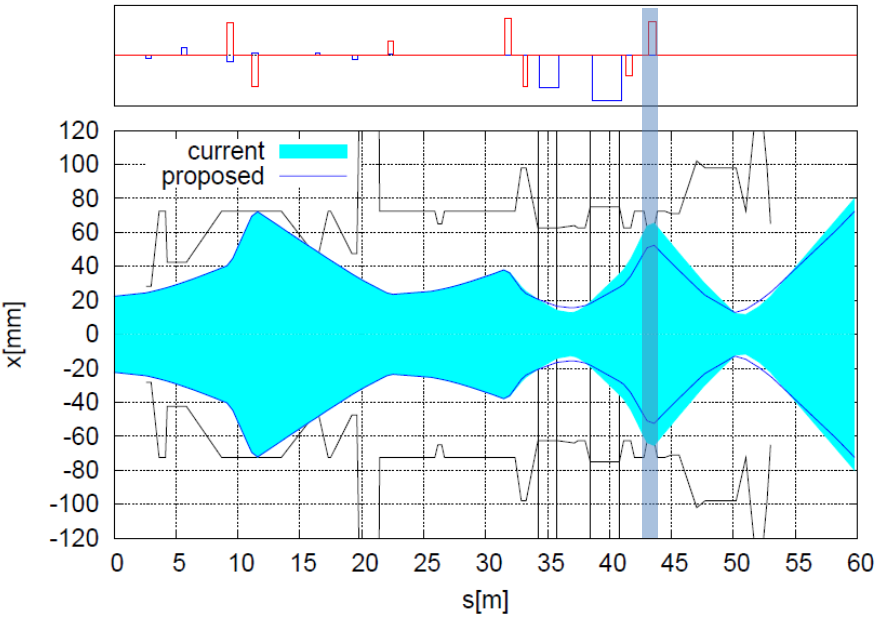
2. Hor. measurement optics (large Dx)



BTM.QNO20



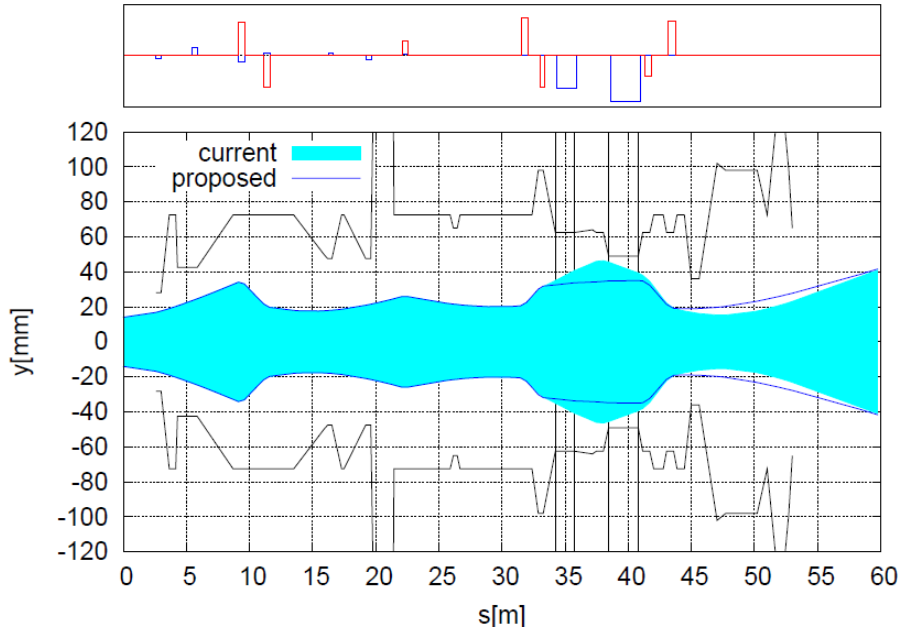
2. Hor. measurement optics (large Dx)



BTM.QNO20
Beam size reduced from
65.1 to 52.2 mm

Same size as for the dump optics

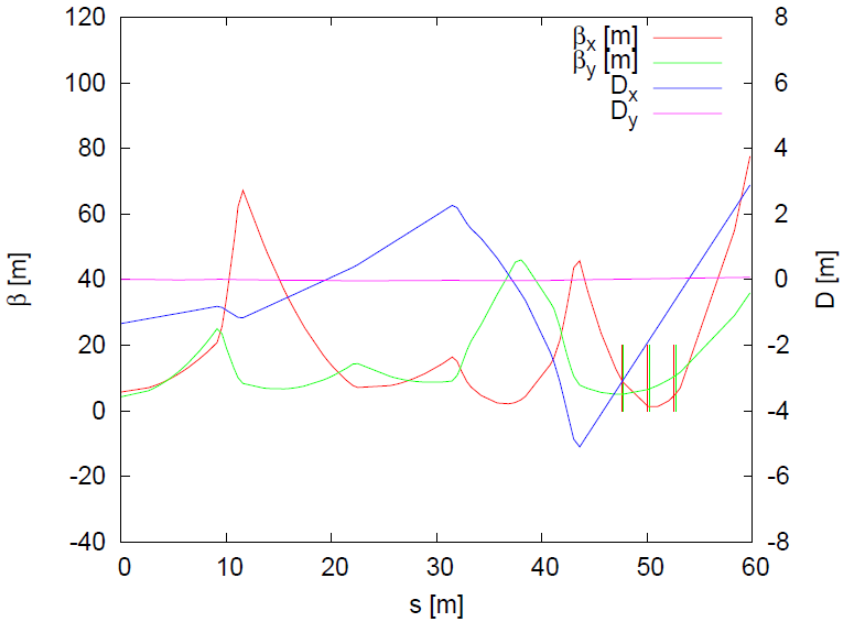
BTM.BHZ10
Beam size reduced from
47.0 mm to 36.2 mm



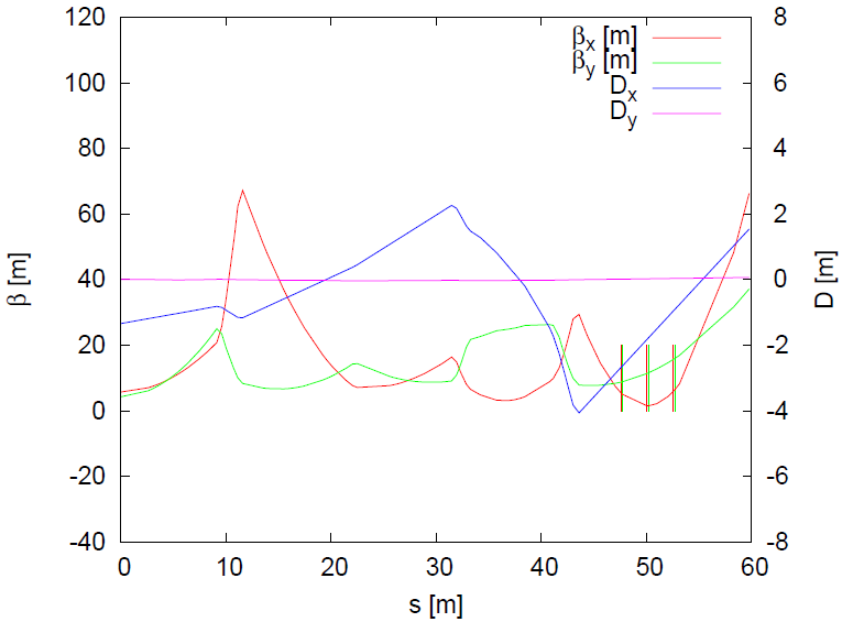
2. Hor. measurement optics (large Dx)

Element	MADX	Length [m]	Current strength [m^{-2}]	Proposed strength [m^{-2}]	g [T/m] @ 1.0 GeV	g [T/m] @ 1.4 GeV	g [T/m] @ 2.0 GeV	g Max [T/m]= (g@2 GeV)x1.2
BT.QNO40	kbtqno40	0.466	0.67782	0.7443325855	4.2109	5.3176	6.9132	8.30
BT.QNO50	kbtqno50	0.388	-0.32477	-0.6160139352	-3.4850	-4.4008	5.7214	-6.87
BTM.QNO05	kbtmqno05	0.560	-0.19195	0.01257887986	0.0712	0.0899	0.1168	0.14
BTM.QNO10	kbtmqno10	0.560	-0.29569	-0.4107113135	-2.3235	-2.9342	-3.8146	-4.58
BTM.QNO20	Kbtmqno20	0.560	0.63928	0.6804084300	3.8493	4.8609	6.3195	7.58

Current



Proposed

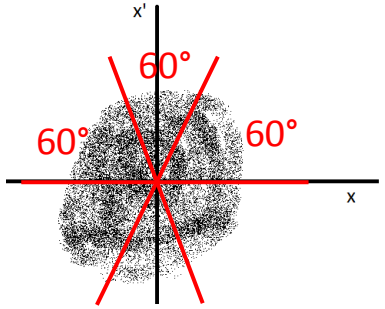


2. Hor. measurement optics (large Dx)

Three grids for horizontal emittance measurement:
BTM.BSGH01, BTM.BSGH02, BTM.BSGH03

For optimum emittance measurements

- α_x(BTM.BSGH02) = 0
- Minimize $dx^2+dx'^2$ (*);
- 60° of horizontal phase advance between grids



current optics (Ring 3)

	D_X [m]	D'_X	α_X	β_X [m]	$dx^2+dx'^2$	μ_X [degrees]
BTM.BSGH01	- 3.14	0.49	2.75	9.45	2.72	0
BTM.BSGH02	-1.91	0.49	0.48	1.36	2.72	44.2
BTM.BSGH03	-0.67	0.49	-1.79	4.62	2.72	130.8

proposed optics (Ring 3)

	D_X [m]	D'_X	α_X	β_X [m]	$dx^2+dx'^2$	μ_X [degrees]
BTM.BSGH01	-2.69	0.35	1.65	5.50	2.49	0
BTM.BSGH02	-1.82	0.35	-0.04	1.48	2.49	61.3
BTM.BSGH03	-0.96	0.35	-1.74	5.93	2.49	118.9

Conditions are improved

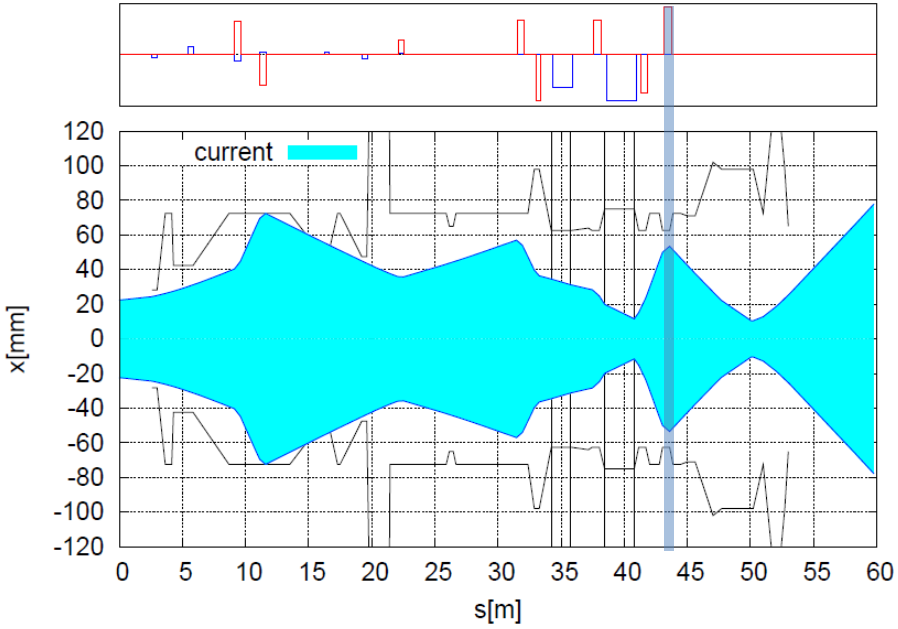
(dx,dx') is normalized (D_x, D'_x). $d_x{}^2 + d_x{}^2 = \frac{D_x{}^2}{\beta_x} + \left(\frac{\alpha_x}{\sqrt{\beta_x}} D_x + \sqrt{\beta_x} D'_x\right)^2$

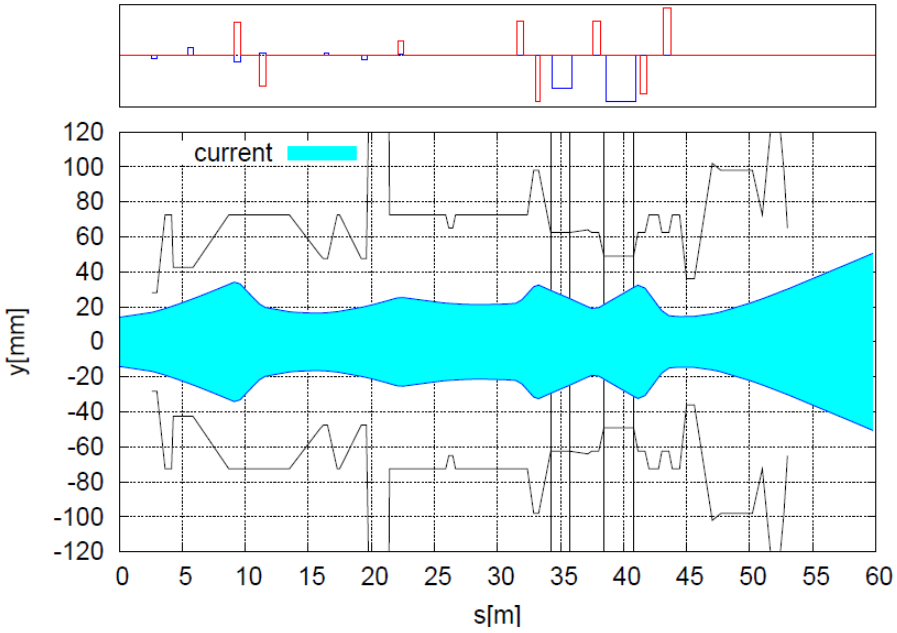
2. Hor. measurement optics (large Dx)

Comparison of the measurement optics (all the rings)

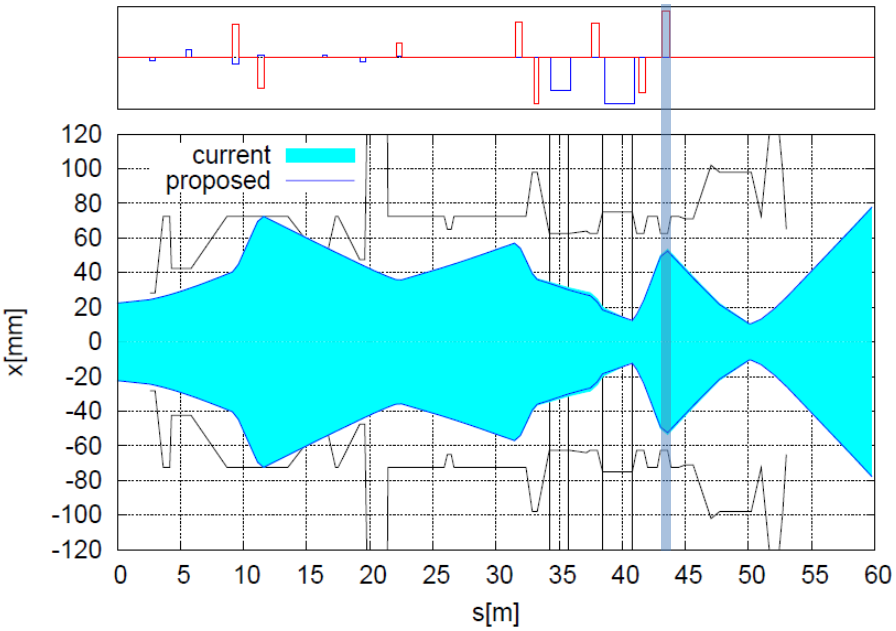
		current						proposed					
		D_x [m]	D'_x	α_x	β_x [m]	$dx^2+dx'^2$	μ_x [degrees]	D_x [m]	D'_x	α_x	β_x [m]	$dx^2+dx'^2$	μ_x [degrees]
Ring 1	BTM.BSGH01	3.27	0.53	1.99	7.18	2.52	0.00	-2.79	0.37	1.17	4.12	2.63	0.00
	BTM.BSGH02	-1.96	0.53	0.26	1.55	2.52	48.51	-1.87	0.37	-0.27	1.86	2.63	64.52
	BTM.BSGH03	-0.64	0.53	-1.46	4.54	2.52	118.91	-0.95	0.37	-1.71	6.80	2.63	109.15
Ring 2	BTM.BSGH01	-3.17	0.50	2.17	7.44	2.69	0.00	-2.71	0.35	1.33	4.34	2.71	0.00
	BTM.BSGH02	-1.92	0.50	0.25	1.39	2.69	51.03	-1.84	0.35	-0.27	1.67	2.71	68.12
	BTM.BSGH03	-0.67	0.50	-1.66	4.91	2.69	124.19	-0.97	0.35	-1.87	7.01	2.71	115.01
Ring 3	BTM.BSGH01	-3.14	0.49	2.75	9.45	2.72	0.00	-2.69	0.35	1.65	5.50	2.49	0.00
	BTM.BSGH02	-1.91	0.49	0.48	1.36	2.72	44.24	-1.82	0.35	-0.04	1.48	2.49	61.31
	BTM.BSGH03	-0.67	0.49	-1.79	4.62	2.72	130.80	-0.96	0.35	-1.74	5.93	2.49	118.92
Ring 4	BTM.BSGH01	-3.25	0.52	2.50	8.90	2.56	0.00	-2.77	0.37	1.46	5.12	2.42	0.00
	BTM.BSGH02	-1.95	0.52	0.46	1.49	2.56	43.41	-1.86	0.37	-0.07	1.65	2.42	59.43
	BTM.BSGH03	-0.64	0.52	-1.58	4.28	2.56	125.84	-0.94	0.37	-1.59	5.80	2.42	113.39

3. Hor. measurement optics (small Dx)





3. Hor. measurement optics (small Dx)

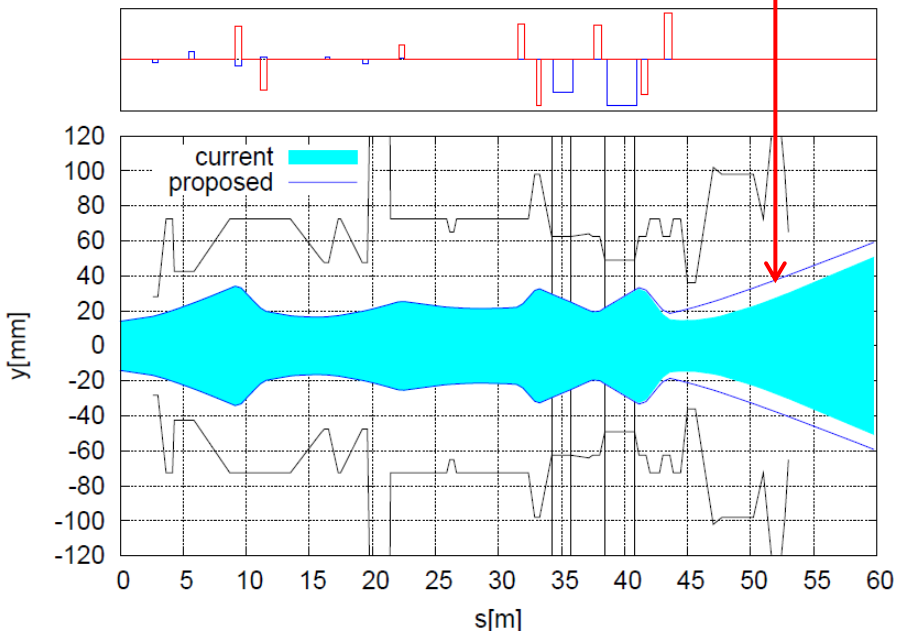


BTM.QNO20
Beam size reduced from 53.3 to 52.2 mm

Same size as for the large-Dx measurement optics

Side effect: beam size enlargement

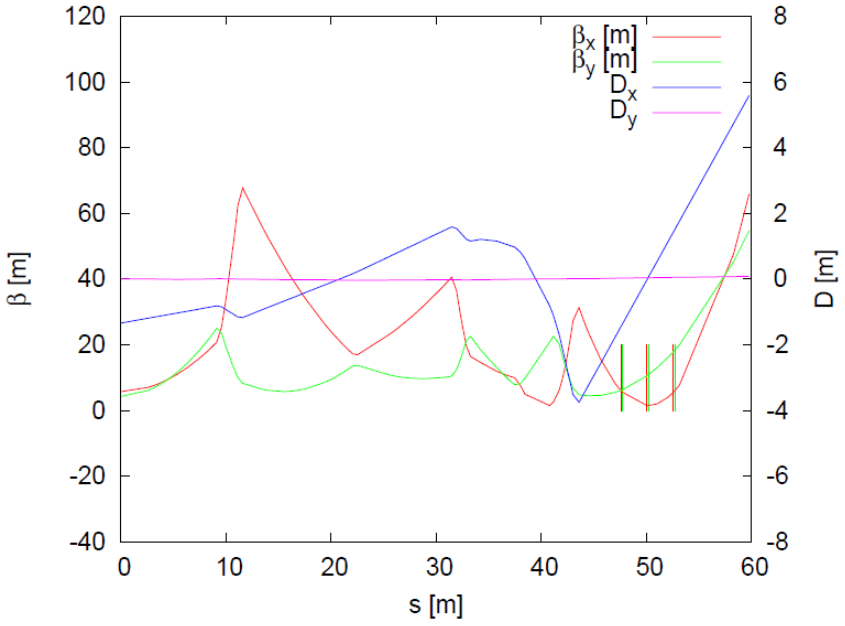
BTM.BHZ10
Beam size 32.9 mm



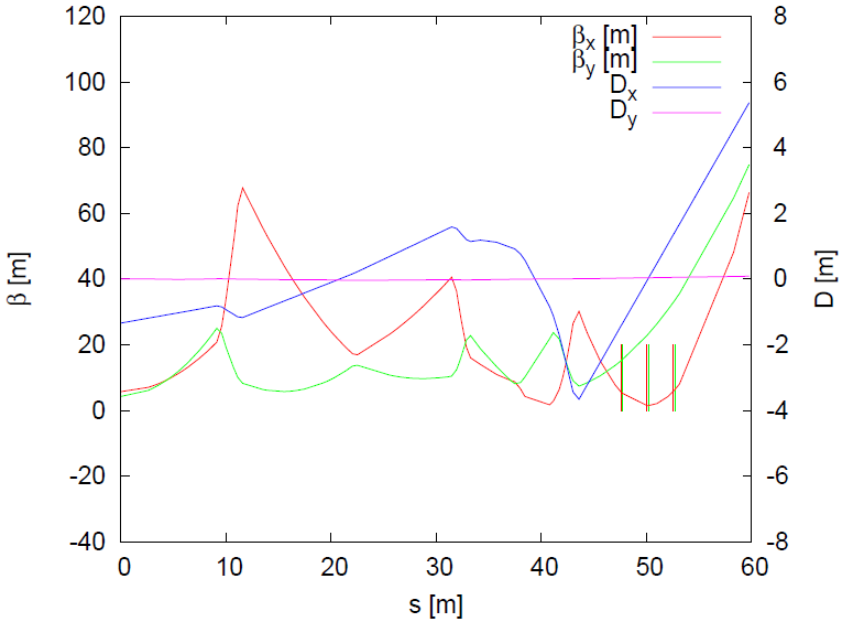
3. Hor. measurement optics (small Dx)

Element	MADX	Length [m]	Current strength [m^{-2}]	Proposed strength [m^{-2}]	g [T/m] @ 1.0 GeV	g [T/m] @ 1.4 GeV	g [T/m] @ 2.0 GeV	g Max [T/m]= (g@2 GeV)x1.2
BT.QNO40	kbtqno40	0.466	0.68125	0.6908710012	3.9085	4.9356	6.4166	7.70
BT.QNO50	kbtqno50	0.388	-0.89763	-0.8976300000	-5.0782	-6.4127	-8.3370	-10.00
BTM.QNO05	kbtmqno05	0.560	0.67236	0.6723600000	3.8037	4.8034	6.2447	7.49
BTM.QNO10	kbtmqno10	0.560	-0.75464	-0.6768447055	-3.8291	-4.8354	-6.2864	-7.54
BTM.QNO20	Kbtmqno20	0.560	0.93745	0.9202474311	5.2061	6.5743	8.5470	10.26

Current



Proposed



3. Hor. measurement optics (small Dx)

current optics (Ring 3)

	D_X [m]	D'_X	α_X	β_X [m]	$dx^2+dx'^2$	μ_X [degrees]
BTM.BSGH01	-1.46	0.58	1.79	6.06	0.48	0
BTM.BSGH02	0.016	0.58	0.055	1.44	0.48	57.7
BTM.BSGH03	1.43	0.58	-1.68	5.51	0.48	120.1

proposed optics (Ring 3)

	D_X [m]	D'_X	α_X	β_X [m]	$dx^2+dx'^2$	μ_X [degrees]
BTM.BSGH01	-1.44	0.56	1.71	5.70	0.455	0
BTM.BSGH02	-0.046	0.56	-0.01	1.46	0.455	60.2
BTM.BSGH03	1.35	0.56	-1.73	5.80	0.455	119.5

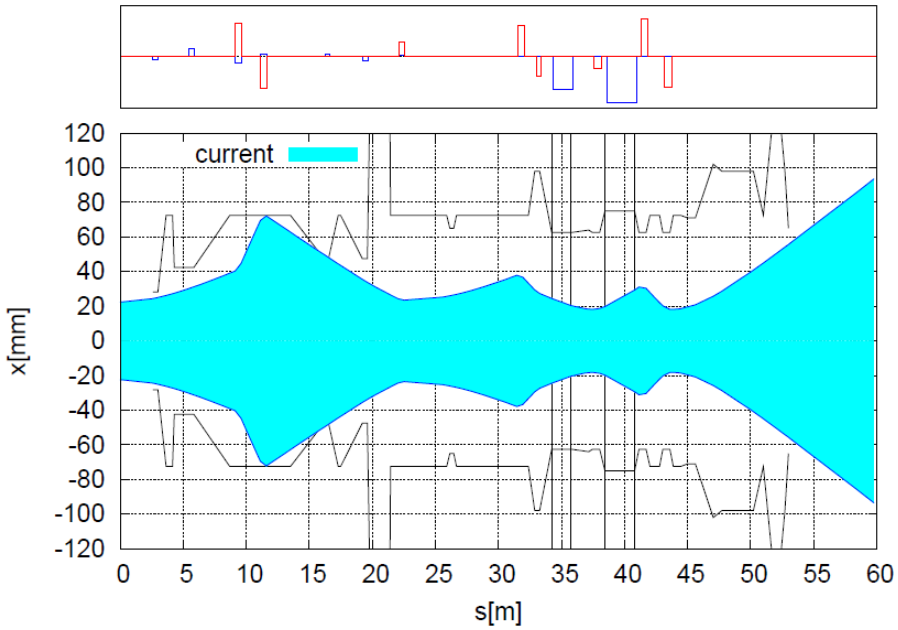
As in the case for the large Dx, conditions are (slightly) improved

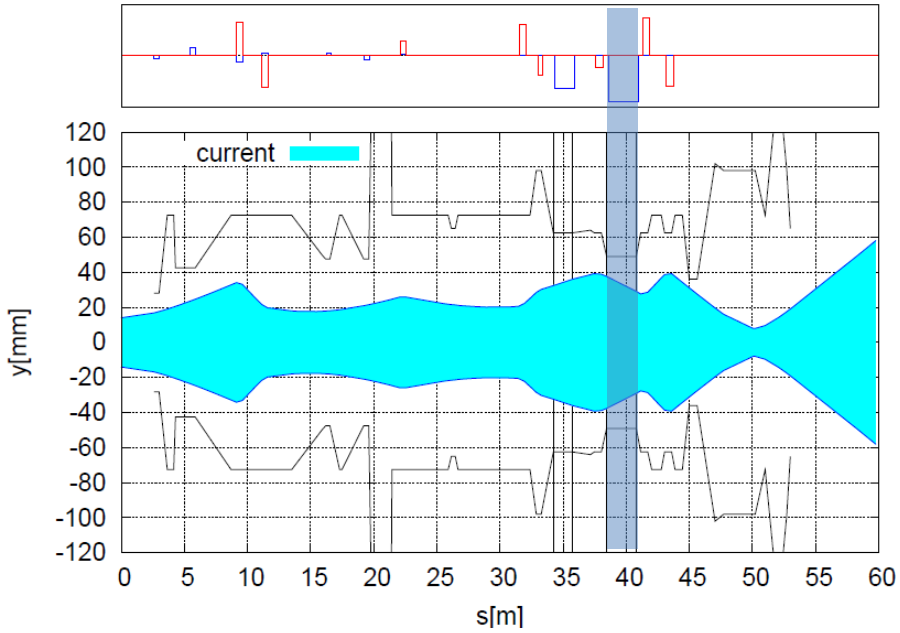
3. Hor. measurement optics (small Dx)

Comparison of the measurement optics (all the rings)

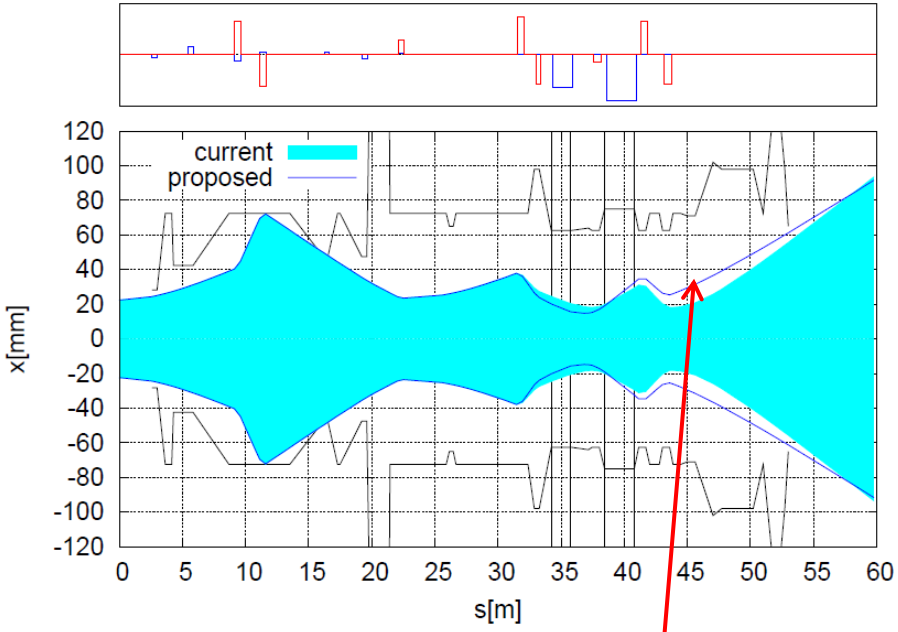
		current						proposed					
		D_x [m]	D'_x	α_x	β_x [m]	$dx^2+dx'^2$	μ_x [degrees]	D_x [m]	D'_x	α_x	β_x [m]	$dx^2+dx'^2$	μ_x [degrees]
Ring 1	BTM.BSGH01	-1.58	0.61	1.11	4.34	0.75	0.00	-1.56	0.59	1.04	4.12	0.74	0.00
	BTM.BSGH02	-0.06	0.61	-0.18	2.01	0.75	57.86	-0.09	0.59	-0.22	2.07	0.74	58.81
	BTM.BSGH03	1.45	0.61	-1.46	6.10	0.75	103.43	1.37	0.59	-1.49	6.36	0.74	102.33
Ring 2	BTM.BSGH01	-1.50	0.58	1.22	4.36	0.63	0.00	-1.48	0.56	1.15	4.11	0.62	0.00
	BTM.BSGH02	-0.04	0.58	-0.21	1.82	0.63	62.53	-0.07	0.56	-0.26	1.89	0.62	63.74
	BTM.BSGH03	1.42	0.58	-1.64	6.45	0.63	109.36	1.34	0.56	-1.68	6.74	0.62	108.22
Ring 3	BTM.BSGH01	-1.46	0.58	1.79	6.06	0.48	0.00	-1.44	0.56	1.71	5.70	0.46	0.00
	BTM.BSGH02	-0.02	0.58	0.05	1.44	0.48	57.69	-0.05	0.56	-0.01	1.46	0.46	60.20
	BTM.BSGH03	1.43	0.58	-1.68	5.51	0.48	120.09	1.35	0.56	-1.73	5.80	0.46	119.53
Ring 4	BTM.BSGH01	-1.55	0.60	1.61	5.76	0.58	0.00	-1.53	0.58	1.53	5.44	0.55	0.00
	BTM.BSGH02	-0.05	0.60	0.05	1.61	0.58	55.08	-0.08	0.58	-0.00	1.63	0.55	57.13
	BTM.BSGH03	1.45	0.60	-1.50	5.23	0.58	114.44	1.38	0.58	-1.54	5.49	0.55	113.85

4. Ver. measurement optics





4. Ver. measurement optics

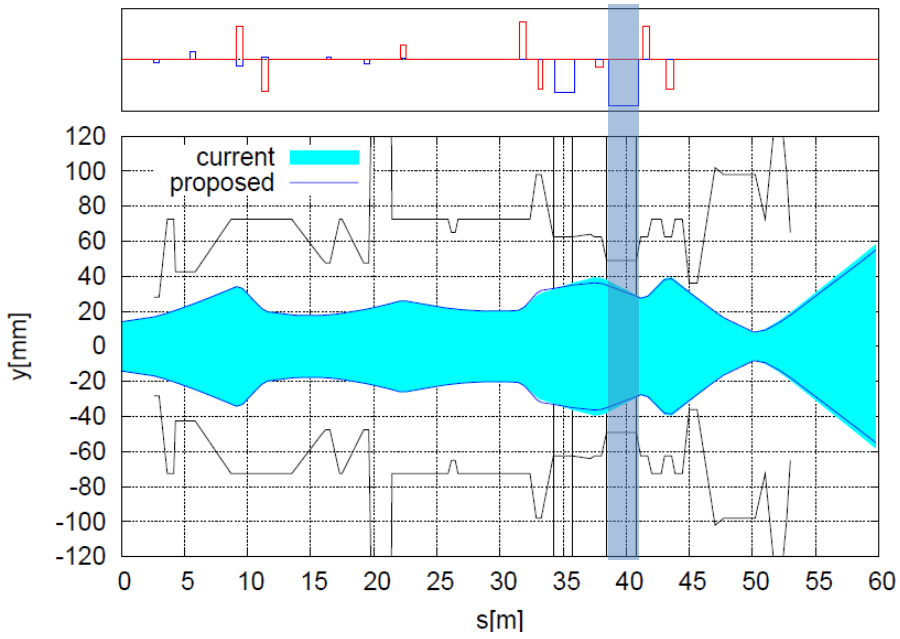


Same size as for the dump optics

BTM.BHZ10

Beam size reduced from 38.8 to 36.1mm

Side effect: beam size enlargement



4. Ver. measurement optics

Three grids for vertical emittance measurement:

BTM.BSGV01, BTM.BSGV02, BTM.BSGV03

For optimum emittance measurements

- α_Y(BTM.BSGV02)=0
- Minimize $dy^2+dy'^2$ (*)
- 60° of vertical phase advance between grids

current optics (Ring 3)

	D_Y [m]	D'_Y	α_Y	β_Y [m]	$dy^2+dy'^2$	μ_Y [degrees]
BTM.BSGV01	3.0e-3	3.9e-3	1.77	5.50	0.13e-3	0
BTM.BSGV02	0.013	3.9e-3	-0.11	1.34	0.13e-3	66.8
BTM.BSGV03	0.022	3.9e-3	-1.99	6.60	0.13e-3	123.9

proposed optics (Ring 3)

	D_Y [m]	D'_Y	α_Y	β_Y [m]	$dy^2+dy'^2$	μ_Y [degrees]
BTM.BSGV01	3.4e-3	3.7e-3	1.73	5.77	0.13e-3	0
BTM.BSGV02	0.013	3.7e-3	0.00	1.44	0.13e-3	60.0
BTM.BSGV03	0.022	3.7e-3	-1.73	5.77	0.13e-3	120.0

Conditions are improved

(*) (dy,dy') is normalized (D_y, D'_y). $d_y{}^2 + d_y{}^2 = \frac{D_y{}^2}{\beta_y} + \left(\frac{\alpha_y}{\sqrt{\beta_y}} D_y + \sqrt{\beta_y} D'_y\right)^2$

4. Ver. measurement optics

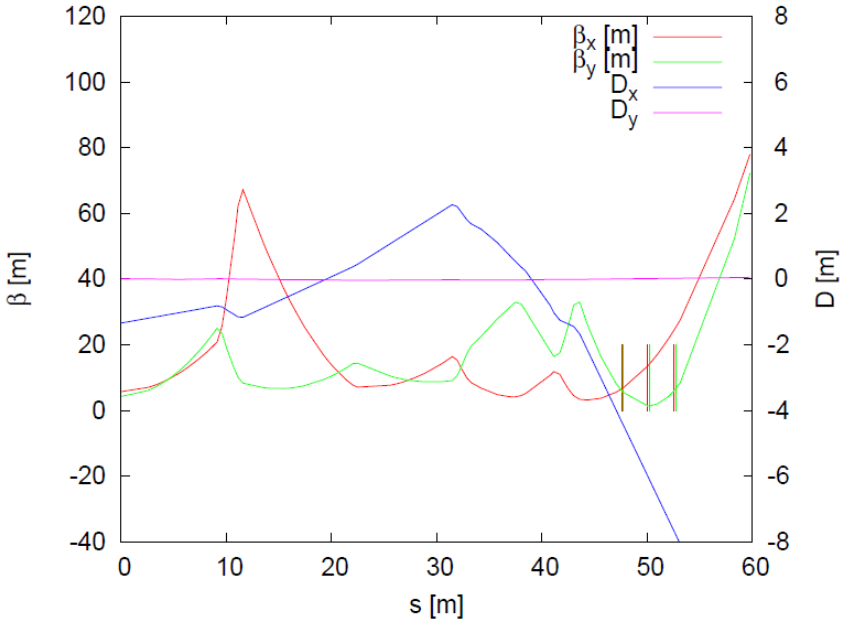
Comparison of the measurement optics (all the rings)

		current						proposed					
		D_y [m]	D'_y	α_y	β_y [m]	$dy^2+dy'^2$	μ_y [degrees]	D_y [m]	D'_y	α_y	β_y [m]	$dy^2+dy'^2$	μ_y [degrees]
Ring 1	BTM.BSGV01	0.38	-0.14	1.77	5.49	0.03	0.00	0.39	-0.13	1.73	5.77	0.03	0.00
	BTM.BSGV02	0.03	-0.14	-0.11	1.34	0.03	67.09	0.06	-0.13	-0.00	1.44	0.03	60.23
	BTM.BSGV03	-0.32	-0.14	-2.00	6.63	0.03	124.06	-0.28	-0.13	-1.74	5.80	0.03	120.17
Ring 2	BTM.BSGV01	0.24	-0.05	1.76	5.49	0.01	0.00	0.25	-0.05	1.72	5.76	0.01	0.00
	BTM.BSGV02	0.11	-0.05	-0.11	1.35	0.01	66.54	0.12	-0.05	0.00	1.45	0.01	59.74
	BTM.BSGV03	-0.01	-0.05	-1.98	6.56	0.01	123.56	0.00	-0.05	-1.72	5.74	0.01	119.64
Ring 3	BTM.BSGV01	0.00	0.00	1.77	5.50	0.00	0.00	0.00	0.00	1.73	5.77	0.00	0.00
	BTM.BSGV02	0.01	0.00	-0.11	1.34	0.00	66.85	0.01	0.00	0.00	1.44	0.00	60.00
	BTM.BSGV03	0.02	0.00	-1.99	6.60	0.00	123.91	0.02	0.00	-1.73	5.77	0.00	120.01
Ring 4	BTM.BSGV01	-0.14	0.09	1.79	5.51	0.02	0.00	-0.14	0.09	1.75	5.78	0.02	0.00
	BTM.BSGV02	0.09	0.09	-0.12	1.33	0.02	67.40	0.08	0.09	-0.00	1.43	0.02	60.49
	BTM.BSGV03	0.33	0.09	-2.02	6.67	0.02	124.41	0.31	0.09	-1.76	5.83	0.02	120.55

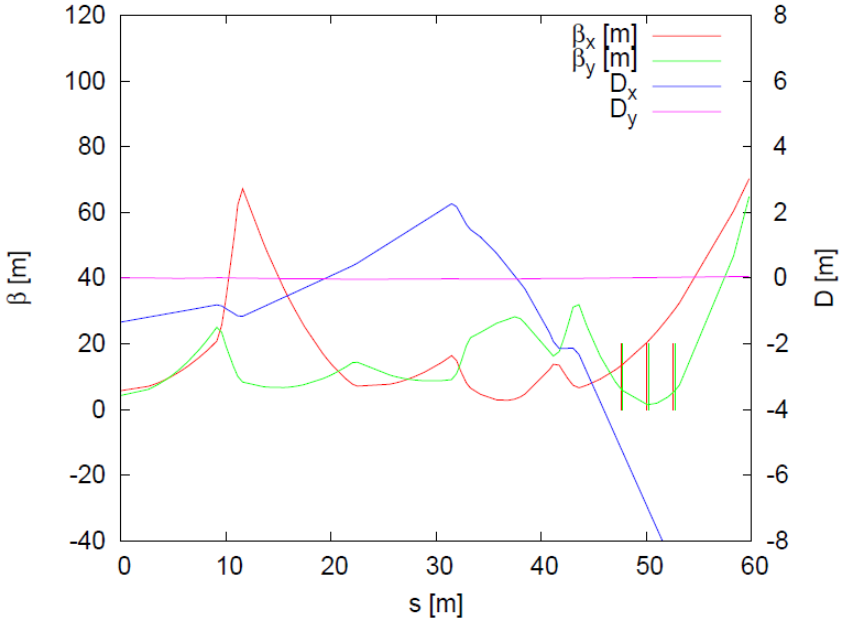
4. Ver. measurement optics

Element	MADX	Length [m]	Current strength [m^{-2}]	Proposed strength [m^{-2}]	g [T/m] @ 1.0 GeV	g [T/m] @ 1.4 GeV	g [T/m] @ 2.0 GeV	g Max [T/m]= (g@2 GeV)x1.2
BT.QNO40	kbtqno40	0.466	0.60386	0.7443325855	4.2109	5.3176	6.91	8.30
BT.QNO50	kbtqno50	0.388	-0.39158	-0.5765297078	-3.2616	-4.1188	-5.35	-6.43
BTM.QNO05	kbtmqno05	0.560	-0.22342	-0.1467232411	-0.8301	-1.0482	-1.36	-1.64
BTM.QNO10	kbtmqno10	0.560	0.74961	0.6595280978	3.7312	4.7117	6.126	7.35
BTM.QNO20	Kbtmqno20	0.560	-0.60803	-0.5861613365	-3.3161	-4.1876	-5.44	-6.53

Current



Proposed



Total

Required values of the gradient for the actual optics @ 2 GeV

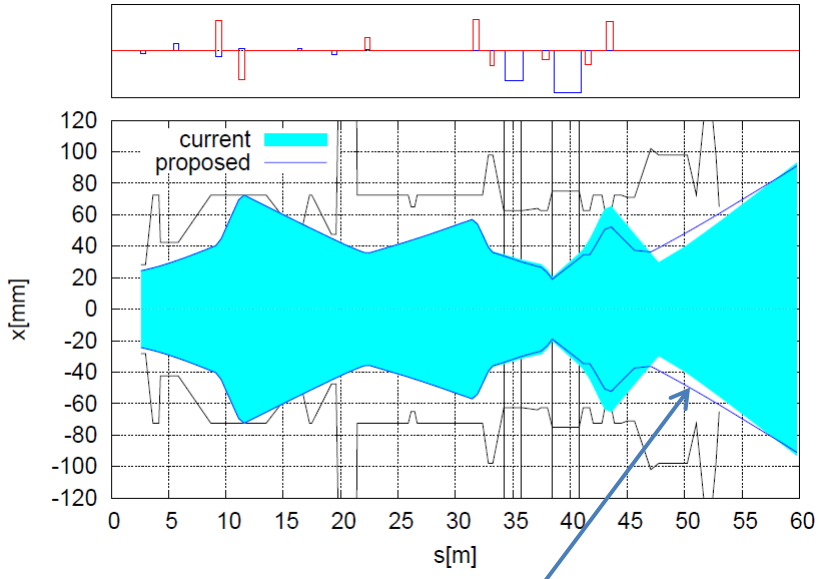
Required values for the new optics

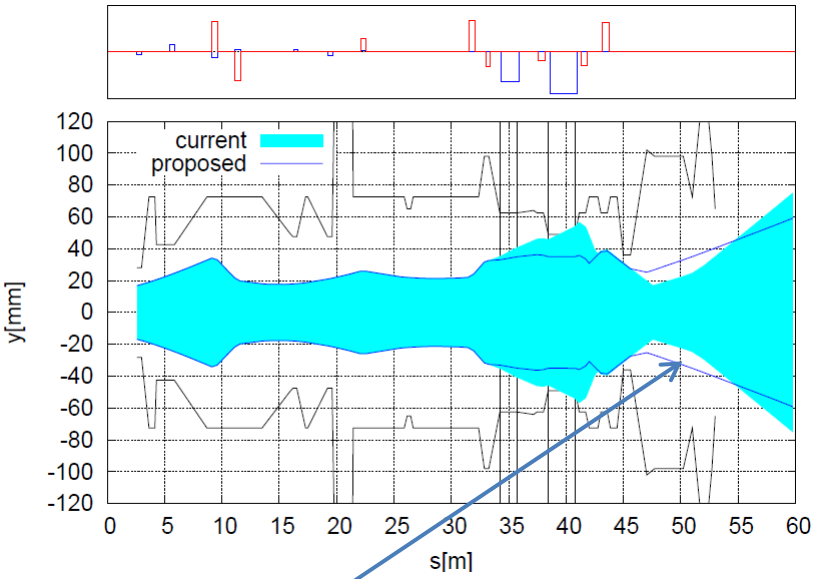
Element	MADX	current g Max [T/m]	proposed g Max [T/m]	Δg
BT.QNO40	kbtqno40	8.18	8.30	+1.5 %
BT.QNO50	kbtqno50	-10.00	-10.00	0
BTM.QNO05	kbtmqno05	7.49	7.49	0
BTM.QNO10	kbtmqno10	-9.03	-7.54	-16.5 %
BTM.QNO20	Kbtmqno20	10.45	10.26	-1.8 %

Values of the gradient http://indico.cern.ch/event/274495/

Total

Beam size only gets bigger after BTY.BVT101.
The plots represent the maximum beam envelopes for the 4 optics.





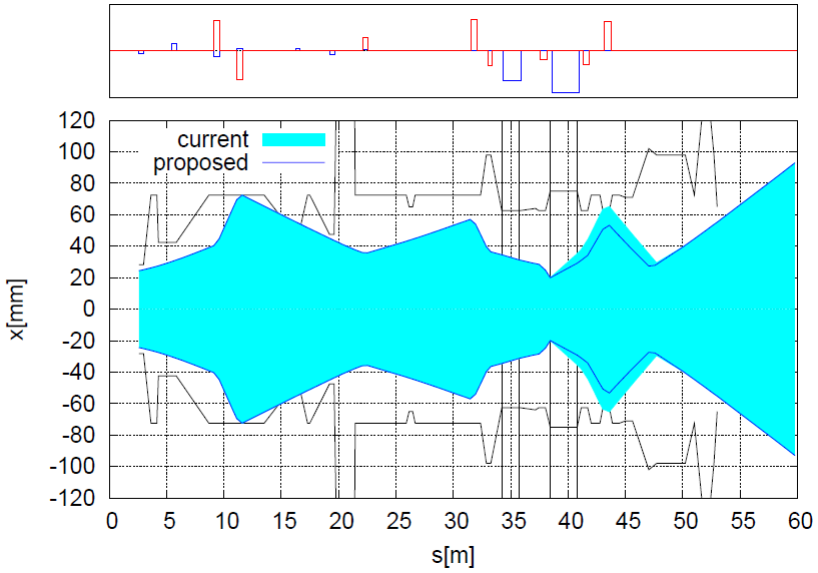
The enlarged values correspond to the new horizontal measurement optics (small Dx) and the new vertical measurement one.

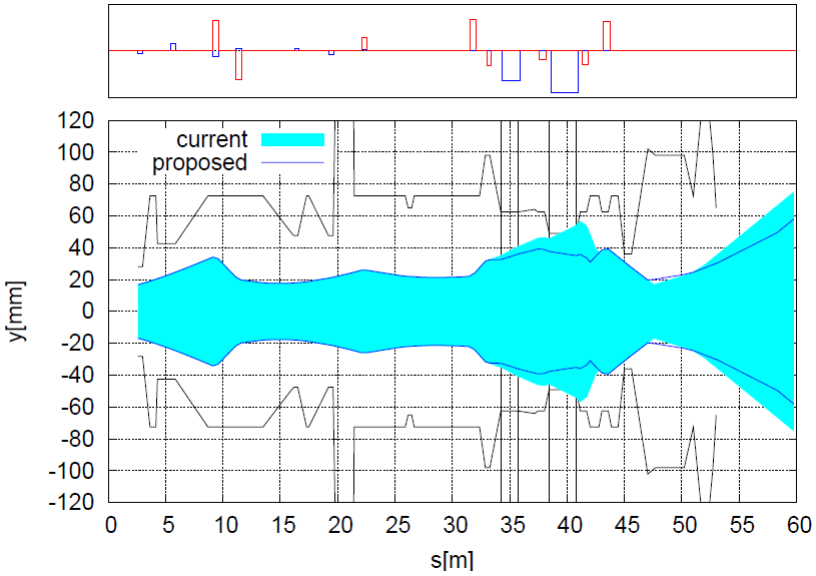
Significant improvement

	Ax/Ay [mm]	
	current	proposed
BT.QNO40	57.0/24.7	57.0/24.7
BT.QNO50	39.7/33.4	39.4/33.5
BT.BHZ10	34.5/42.0	33.8/36.1
BTM.QNO05	28.4/47.8	26.7/37.4
BTM.BHZ10	35.3/55.7	32.3/36.2
BTM.QNO10	44.2/58.4	34.5/37.1
BTM.QNO20	65.1/40.5	52.2/39.8
BTY.BVT101	47.5/28.5	37.4/28.3

Beam sizes in elements

By using the present values for these two optics (low DX and vertical), the beam size at the end of the line is reduced





Current

1.Dump optics
2.Horizontal measurement optics (large DX)
3.Horizontal measurement optics (small DX)
4.Vertical measurement optics

Proposed

1.Dump optics
2.Horizontal measurement optics (large DX)
3.Horizontal measurement optics (small DX)
4.Vertical measurement optics

Sizes in dump

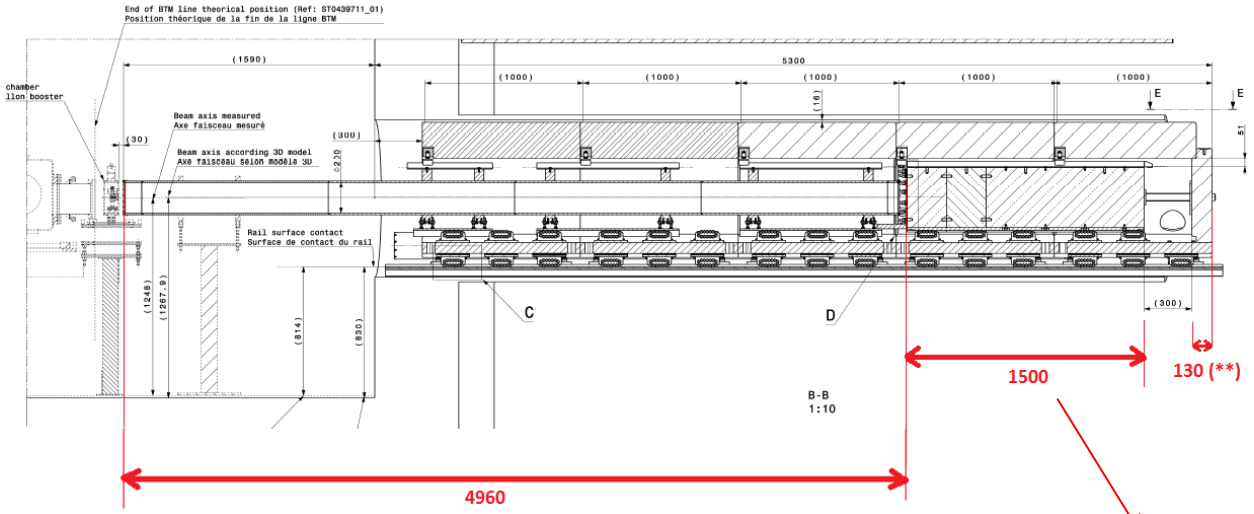
Reference positions modified

!window that makes the end of the vacuum, defined as 9.843 (*) away from BTM.QNO20 window , at = 18.9293 - ISOPoint ;

~~!BTM.TDU10 , at = 25.55460 - ISOPoint;~~

!beginning of the dump defined as 0.190 + 4.960 away from the window BTM.TDU10, at = 24.0793 - ISOPoint;

PSBTDE__0001



(*) V. Raginel

(**) A. Sarrio

The specification for the beam sizes allowed in the dump are given in PSBTDE__0041

https://edms.cern.ch/file/1229493/1.1/PBU-T-ES-0002-10-10.docx

For the different users:

	$\varepsilon_{N,x}$ [π mm mrad]	$\varepsilon_{N,y}$ [π mm mrad]	σ_δ
LHC@25ns	2	2	1.07×10^{-3}
CNGS-like and TOF	10	5	1.35×10^{-3}
NORMGPS	15	9	1.35×10^{-3}

Sizes in dump

Horizontal/vertical beam sizes [mm] for the dump optics

		E_K=1.0 GeV		E_K=1.4 GeV		E_K=2.0 GeV	
		n_{sig} =1.17	n_{sig} = 5	n_{sig} =1.17	n_{sig}=5	n_{sig} =1.17	n_{sig} = 5
LHC25ns	window	6.3/6.8	17.4/24.9	5.9/6.2	15.8/22.3	5.6/5.6	14.2/19.7
	core	8.8/11.4	29.3/41.7	8.1/10.4	26.4/37.3	**7.4**/9.4	23.4/33.0
CNGS-like and TOF	window	11.1/10.0	35.8/38.6	10.3/9.1	32.3/34.5	9.5/8.1	28.7/30.4
	core	17.0/16.8	62.8/64.7	15.4/15.2	56.2/57.8	13.9/13.6	49.7/50.9
NORMGPS	window	12.8/13.0	43.1/51.4	11.8/11.7	38.7/45.9	10.8/10.4	34.4/40.4
	core	20.1/21.8	76.3/86.0	18.2/19.6	68.2/76.8	16.4/17.5	60.2/67.6

Horizontal/vertical beam sizes [mm] for the horizontal measurement optics (large Dx)

		E_K=1.0 GeV		E_K=1.4 GeV		E_K=2.0 GeV	
		n_{sig}= 1.17	n_{sig}= 5	n_{sig} = 1.17	n_{sig}=5	n_{sig}= 1.17	n_{sig}= 5
LHC25ns	window	5.2/6.8	17.8 /24.9	4.8/6.2	16.0/22.3	4.4/5.6	14.2/19.7
	core	11.8/9.3	42.4/34.1	10.7/8.5	38.0/30.6	9.7/**7.7**	33.6/27.0
CNGS-like and TOF	window	10.2/10.0	38.5/38.7	9.2/9.1	34.4/34.6	8.3/8.1	30.4/30.5
	core	23.6/13.8	92.1/53.0	21.3/12.4	82.3/47.3	19.0/11.1	72.5/41.7
NORMGPS	window	12.1/13.0	46.7/51.5	11.0/11.7	41.8/46.0	9.8/10.4	36.8/40.5
	core	28.3/17.8	122.2/70.5	25.5/16.1	100.2/62.9	22.7/14.3	88.2/55.4

Sizes in dump

Horizontal/vertical beam sizes [mm] for the horizontal measurement optics (small Dx)

		E_K=1.0 GeV		E_K=1.4 GeV		E_K=2 GeV	
		n_{sig}= 1.17	n_{sig}= 5	n_{sig} = 1.17	n_{sig}=5	n_{sig}= 1.17	n_{sig}= 5
LHC25ns	window	6.2/9.9	18.7/36.2	5.7/ 9.0	16.9/32.4	5.3/8.1	15.1/28.7
	core	15.5/13.3	46.2/ 48.8	14.5/ 12.1	41.8/43.7	13.5/11.0	37.4/38.7
CNGS-like and TOF	window	11.4/14.6	39.3/56.2	10.4/13.2	35.3/50.2	9.5/11.8	31.3/44.3
	core	28.4/19.7	96.9/75.8	26.1/17.8	87.0/67.7	23.8/15.9	77.2/59.7
NORMGPS	window	13.3/18.9	47.6/74.8	12.1/17.0	42.6/66.7	11.0/15.2	37.7/58.8
	core	33.1/25.5	117.0/100.8	30.3/23.0	104.9/ 90.0	27.5/20.5	92.9/79.2

Horizontal/vertical beam sizes [mm] for the vertical measurement optics

		E_K=1.0 GeV		E_K=1.4 GeV		E_K=2 GeV	
		n_{sig} =1.17	n_{sig} = 5	n_{sig} =1.17	n_{sig}=5	n_{sig} =1.17	n_{sig} = 5
LHC25ns	window	18.6/4.5	43.7/16.5	17.7/4.1	40.1/14.8	16.9/3.7	36.5/13.1
	core	25.7 /11.3	60.0/41.5	24.5/10.3	55.1/37.1	23.4/9.3	50.2/32.8
CNGS-like and TOF	window	30.6/6.7	86.9/25.6	28.7/6.0	78.8/22.9	26.9/5.4	70.7/20.2
	core	42.2/16.7	119.0/64.4	39.7/15.1	107.9/57.5	37.1/13.5	97.0/50.7
NORMGPS	window	34.5/8.6	103.3/ 34.1	32.2/7.8	93.4/30.5	29.9/6.9	83.6/26.8
	core	47.5/21.7	141.5/85.7	44.4/19.5	128.0/76.5	41.2/17.4	114.5/67.3

Total

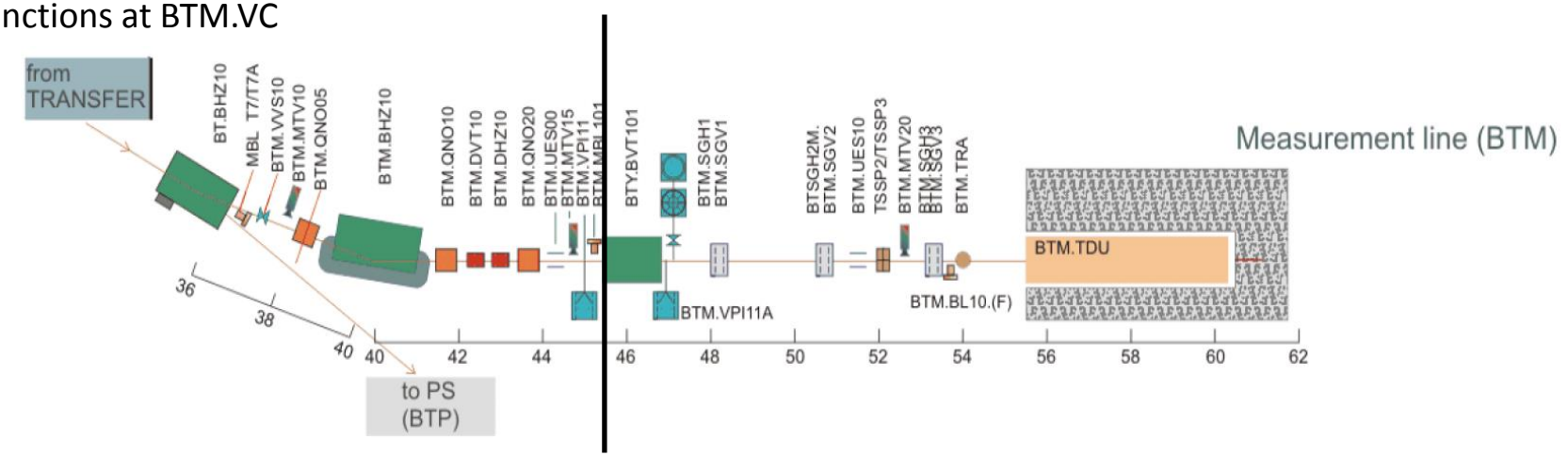
Horizontal/vertical beam sizes [mm] Min-max values for the current optics

		E_K=1.0 GeV		E_K=1.4 GeV		E_K=2 GeV	
		$n_{sig} = 1.17$	$n_{sig} = 5$	$n_{sig} = 1.17$	n_{sig}= 5	$n_{sig} = 1.17$	n_{sig} = 5
LHC25ns	window	3-18/5-38	9-43/21-75	3-17/4-37	8-39/18-70	2-17/4-36	8-36/16-65
	core	8-24/9-51	29-72/40-102	7-23/8-49	26-65/35-94	**6**-22/**7**-48	23-58/31-86
CNGS-like and TOF	window	6-28/8-45	18-83/33-103	5-26/7-43	16-75/29-95	5-24/6-41	15-67/26-87
	core	16-41/15-59	65-152/63-148	14-37/13-56	58-136/56-134	13-33/12-54	51-120/49-120
NORMGPS	window	7-31/10-51	22-99/44-130	6-29/9-48	20-89/39-118	6-27/8-46	17-79/34-107
	Core	19-49/20-66	79-185/84-192	17-44/18-63	71-165/75-173	15-39/16-59	62-146/66-154

Horizontal/vertical beam sizes [mm] Min-max values for the proposed optics

		E_K=1.0 GeV		E_K=1.4 GeV		E_K=2 GeV	
		$n_{sig} = 1.17$	$n_{sig} = 5$	$n_{sig} = 1.17$	n_{sig}= 5	$n_{sig} = 1.17$	n_{sig} = 5
LHC25ns	window	5.2-18.6/4.5-9.9	17.4-43.7/16.5-36.2	4.8-17.7/4.1-9.0	15.8-40.1/14.8-32.4	4.4-16.9/3.7-8.1	14.2-36.5/13.1-28.7
	core	8.8-25.7/9.3-13.3	29.3-60.0/34.1-48.8	8.1-24.5/8.5-12.1	26.4-55.1/30.6-43.7	**7.4**-23.4/**7.7**-11.0	23.4-50.2/27.0-38.7
CNGS-like and TOF	window	10.2-30.6/6.7-14.6	35.8-86.9/25.6-56.2	9.2-28.7/6.0-13.2	32.3-78.8/22.9-50.2	8.3-26.9/5.4-11.8	28.7-70.7/20.2-44.3
	core	17.0-42.2/13.8-19.7	62.8-119.0/53.0-75.8	15.4-39.7/12.4-17.8	56.2-107.9/47.3-67.7	13.9-37.1/11.1-15.9	49.7-97.0/41.7-59.7
NORMGPS	window	12.1-34.5/8.6-18.9	43.1-103.3/34.1-74.8	11.0-32.2/7.8-17.0	38.7-93.4/30.5-66.7	9.8-29.9/6.9-15.2	34.4-83.6/26.8-58.8
	core	20.1-47.5/17.8-25.5	76.3-141.5/70.5-100.8	18.2-44.4/16.1-23.0	68.2-128.0/62.9-90.0	16.4-41.2/14.3-20.5	60.2-114.5/55.4-79.2

Optical functions at BTM.VC



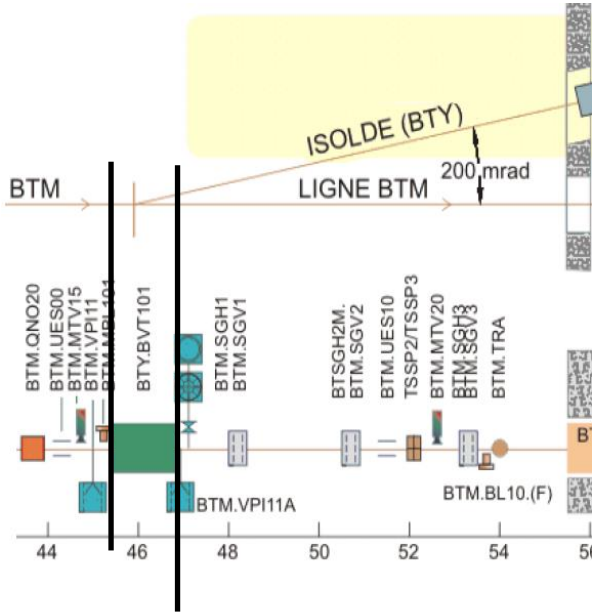
BTM.VC

	BETAX [m]		BETAY [m]		ALFAX		ALFAY	
	current	proposed	current	proposed	current	proposed	current	proposed
Dump	9.072752691	9.089489245	3.428810811	3.433058557	1.331686192	1.184099009	1.269584842	0.3348833776
largeDX	23.68520808	14.55030766	5.59573508	7.763945984	4.528308358	2.978139449	0.3473134716	-0.1126448929
lowDX	15.71834583	14.98841755	4.543521645	10.55594346	3.14939598	3.047475652	-0.1695480798	-0.9684875596
vert	3.71146422	9.237686302	16.29663781	16.14004913	-0.4030916982	-0.8424540071	3.357083517	3.191462334

	DX [m]		DY [m]		DPX		DPY	
	current	proposed	current	proposed	current	proposed	current	proposed
Dump	-3.624138186	-3.430126657	0.5514377941	0.1489340935	0.002627958173	0.009060375035	0.005143388929	0.004682709473
largeDX	-4.105112004	-3.366154455	0.4932848157	0.3461776101	0.002120436029	0.004200684349	0.004678797319	0.004121555262
lowDX	-2.587116954	-2.530933747	0.5771695316	0.557843524	0.01684831238	0.01697528553	0.004492313888	0.004681176836
vert	-3.026814775	-3.777717799	-0.6694184318	-0.7146570242	-0.005091209911	-0.004412074194	0.003858983991	0.003700440012

ISOLDE

Beam sizes (Ax/Ay [mm])



By enlarging BTY.BVT101+30%

	current	proposed
extended ini	48.8/29.5	38.5/29.4
ini	47.5/28.6	37.4/28.5
end	38.8/22.8	34.8/25.1
ext end	37.5/22.0	35.3/25.5

Beam sizes at BTM.VC should be modelled as a PLACEHOKDER in MADX

Conclusions

- The new optics offers better conditions for emittance measurements
- Considerable reduction of the specifications for the vertical GFR (good field region) BTM.BHZ10 : from 78 to 70 mm (h) and from 116 mm to 80 mm(v) (no sagitta taken into account)
- The minimum value of beam size in dump core is not reduced
- No alignment errors are taken into account
- Optics to Isolde assures good matchability and aperture
- Optics will be checked with present energies in a MD