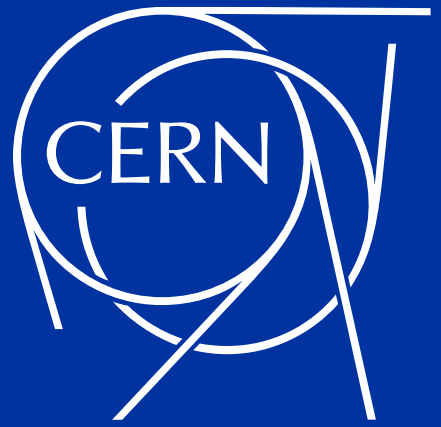

Shifting Q20 Magnets

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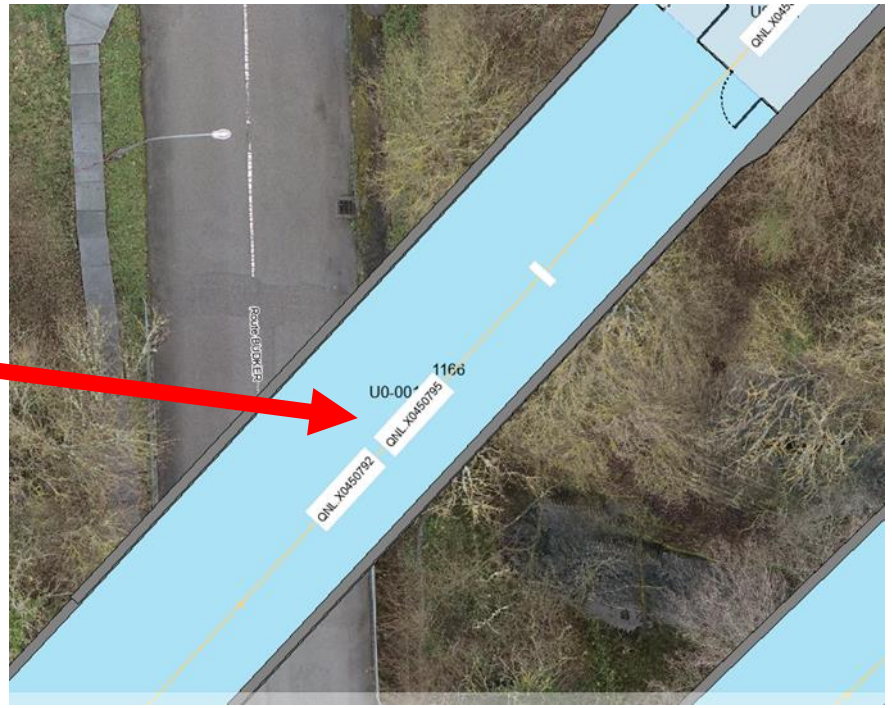
28/02/2024

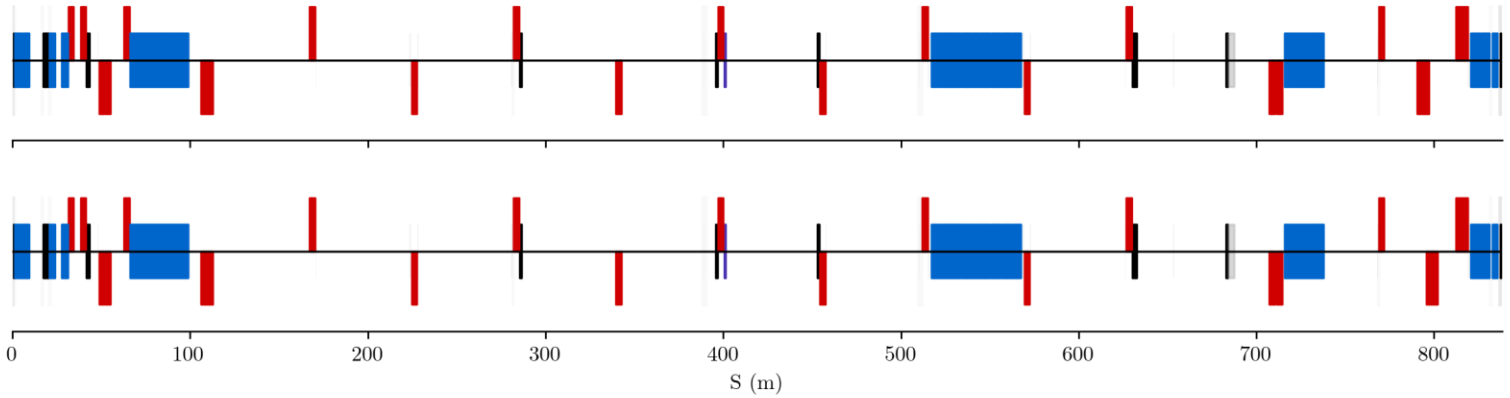
Introduction

- Outline
- Re-matching
- Strength changes and power converters
- Aperture restrictions
- Sensitivity

Outline

- Shifting Q20 magnets could reduce dose rate
  - Q20: QNL.X0450792 & QNL.X0450795
  - Both use same power supply
- Shift by 5 m
- Re-match optics





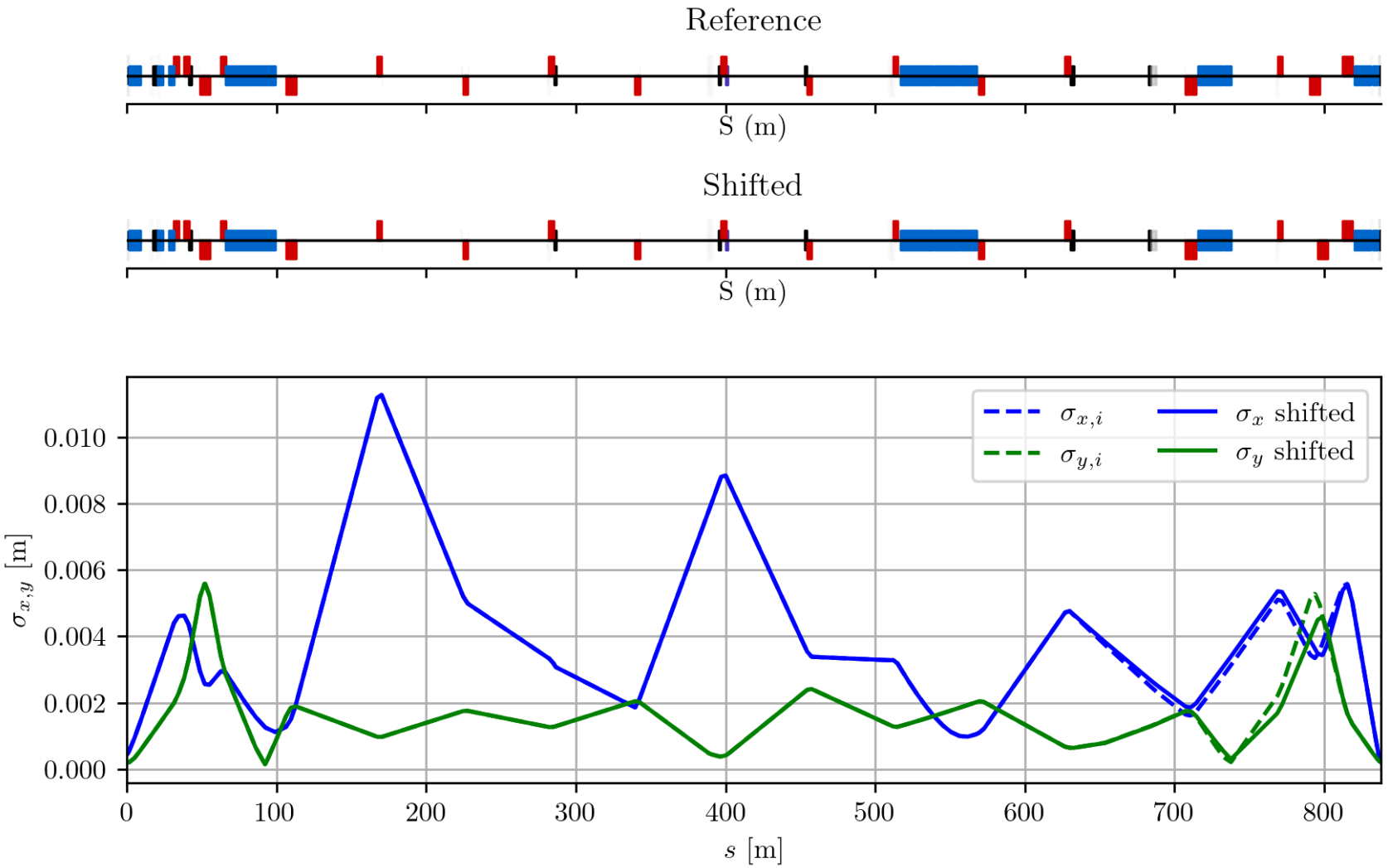
Reference

Shifted

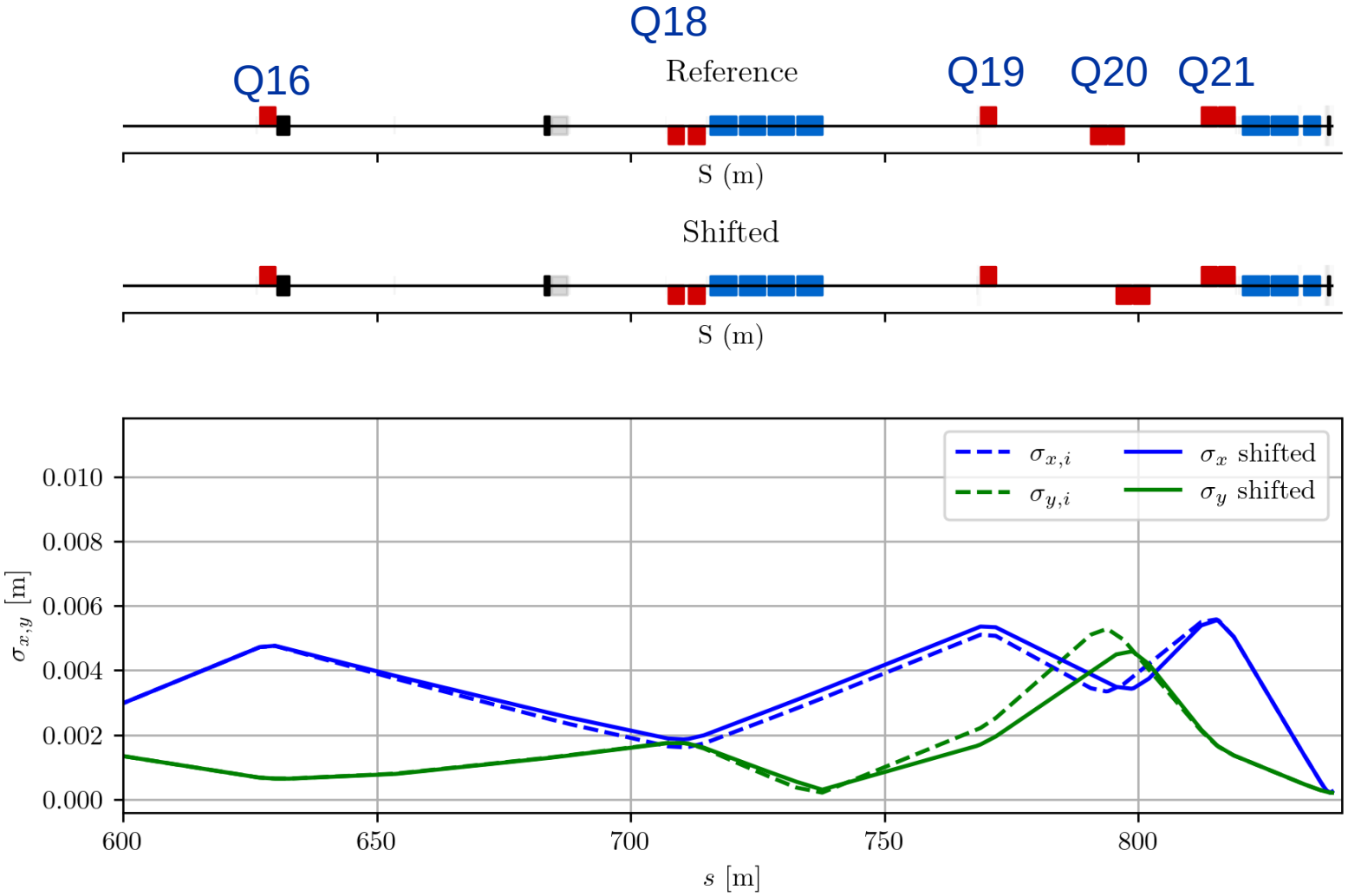
Initial re-matching

- QNL.X0450792 and QNL.X0450795 shifted 5 m
- Simple optimisation performed varying quads
- Target: sigX, sigY, sigPX, sigPY, same at T10
- Completed with latest P42 model

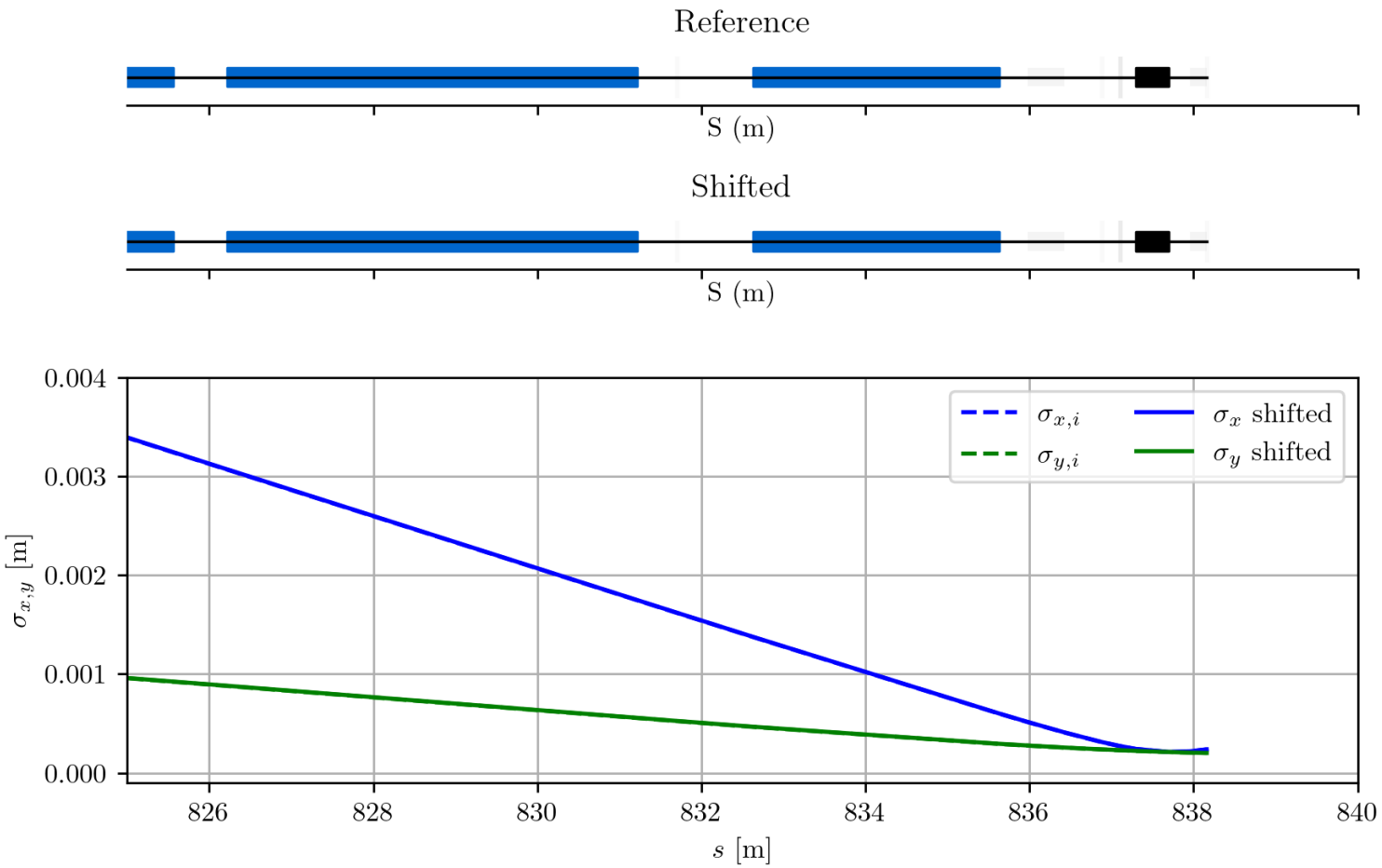
Beam size


Reference
S (m)
Shifted
S (m)
$\sigma_{x,i}$
$\sigma_{y,i}$
σ_x shifted
σ_y shifted
$\sigma_{x,y}$ [m]
0.010
0.008
0.006
0.004
0.002
0.000
0
100
200
300
400
500
600
700
800
s [m]

Beam size


Q18
Q16
Reference
Q19
Q20
Q21
S (m)
Shifted
S (m)
$\sigma_{x,i}$
$\sigma_{y,i}$
σ_x shifted
σ_y shifted
0.010
0.008
0.006
0.004
0.002
0.000
$\sigma_{x,y}$ [m]
600
650
700
750
800
s [m]

Beam size



Parameter @ T10	Ref / rematch
SigX	0.9992
SigY	1.0008
SigPX	0.9995
SigPy	1.0003

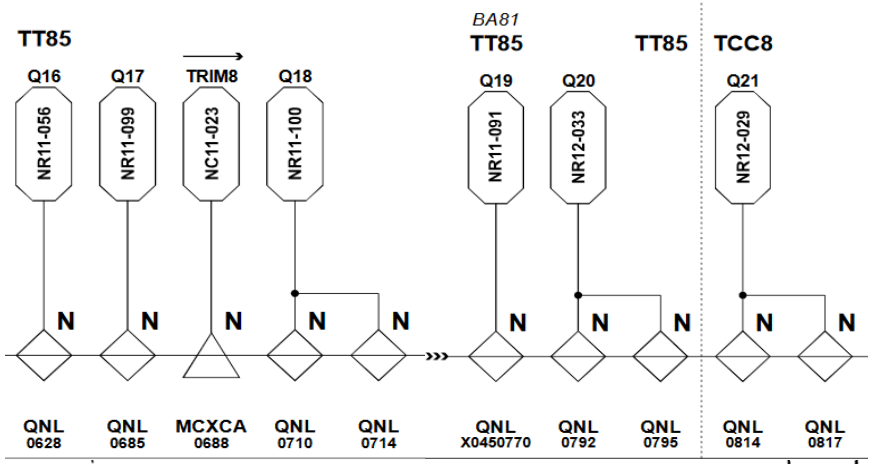
Strength changes

Magnet	K1 reference	K1 Shifted	
Q16	0.0077769	0.00752751	
Q18	-0.0087076	-0.00779441	
Q19	0.0098506	0.00881501	
Q20	-0.0103969	-0.011321	
Q21	0.0119863	0.01310909	

Power Converters

- All magnets are QNL
- Rated to 412 A pulsed (~500 max)
- Two power converters used
- Q16, Q18, Q19 use R11 type
- Q20, Q21 use R12 type
- Both can go up to 500 A
- (Q3 uses R12 @ ~306 A)

Magnet ‘bible’



Supply Type	Typical Load	Output Rating DC (V)	(A)	(kW)	Thyristor Circuit	Free-wheeling Diodes	Fundam. Ripple Frequ. (Hz)	No.
1	2		3		4	5	6	
	Correction magnets	100	240	23				C11
Load oriented units R11	Individually powered quadrupoles	150	500	75	3-phase thyristor bridge (6 pulse output)	2 connected against secondary starpoint	300	R11
R12		300	500 pulsed 750	150				R12
Multi-purpose units	All sorts of bendings and quadrupoles	300	1000	300	Two 3-phase thyristor bridges parallel connected via interphase transformer (12 pulse output)	2 x 2 connected against secondary starpoint		R21
		250	1500 pulsed 2250	375			600	R22

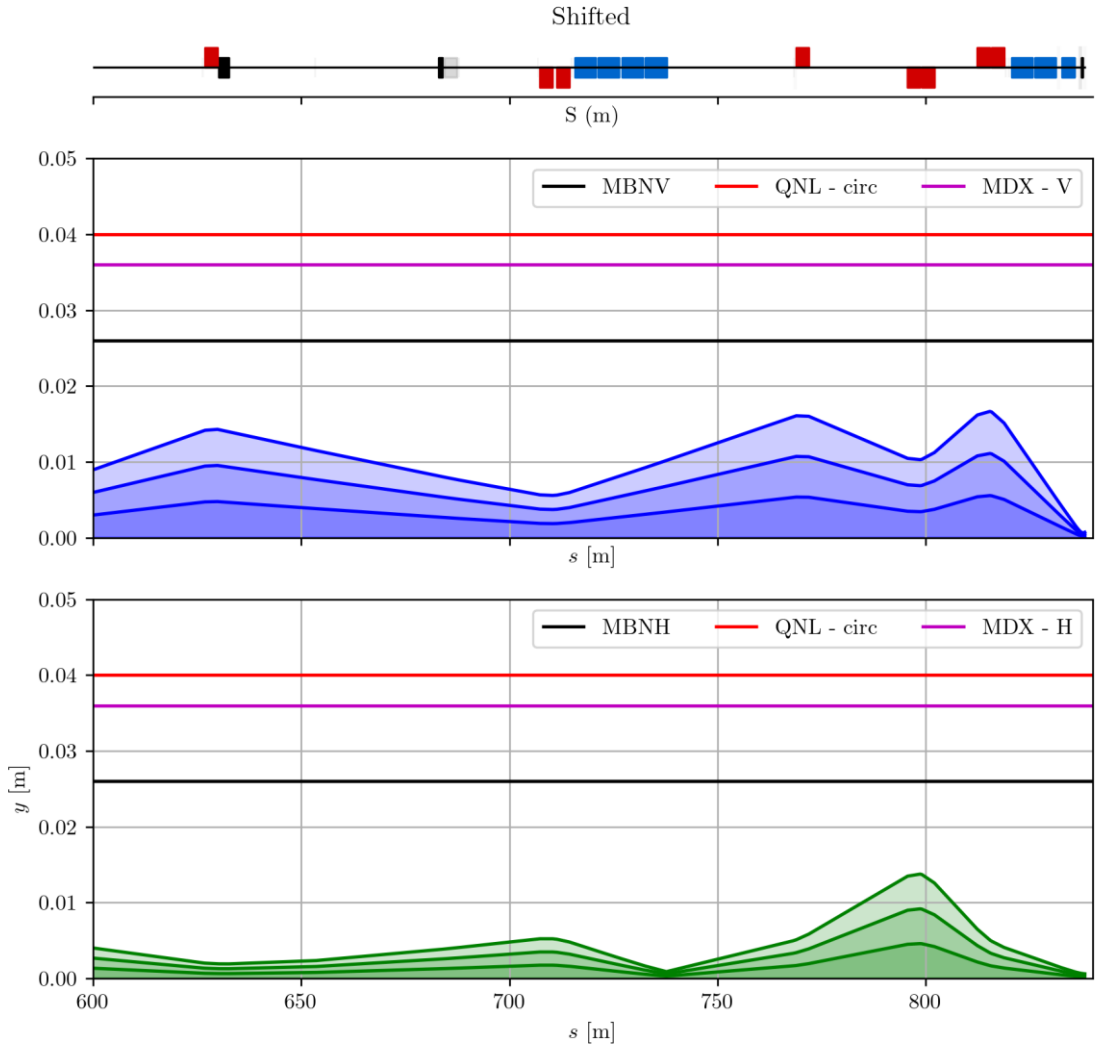
Magnets kit

Strength changes

Magnet	K1 reference	K1 Shifted	Current Shifted
Q16	0.0077769	0.00752751	151.4 A
Q18	-0.0087076	-0.00779441	156.8 A
Q19	0.0098506	0.00881501	177.3 A
Q20	-0.0103969	-0.011321	227.8 A
Q21	0.0119863	0.01310909	264.0 A

Do we fit inside apertures?

- Biggest restriction is final MBN vertical bend
- Beam in that bend is almost identical to reference
- Need to plot these properly
- Should not increase background.



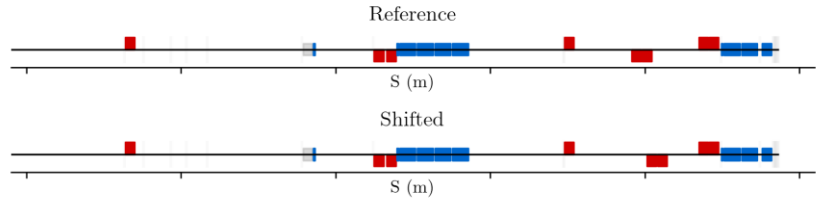
Crude plot of aperture restrictions – 3 sigma

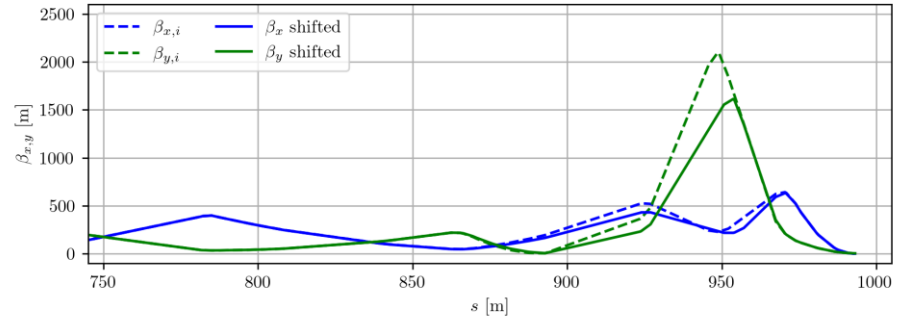
Sensitivity

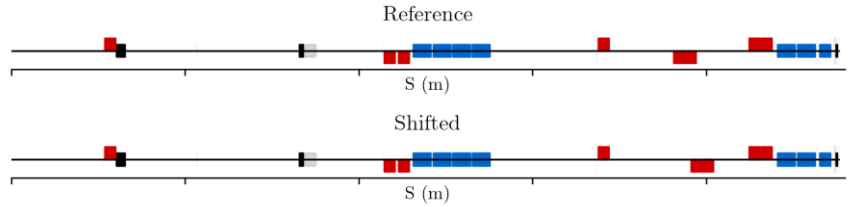
- Worth noting that present situation is similarly sensitive to changes
- Full error study on initial conditions has been delayed
  - Needs debugging, but should work when done
- But I did make a mistake earlier which gives insight

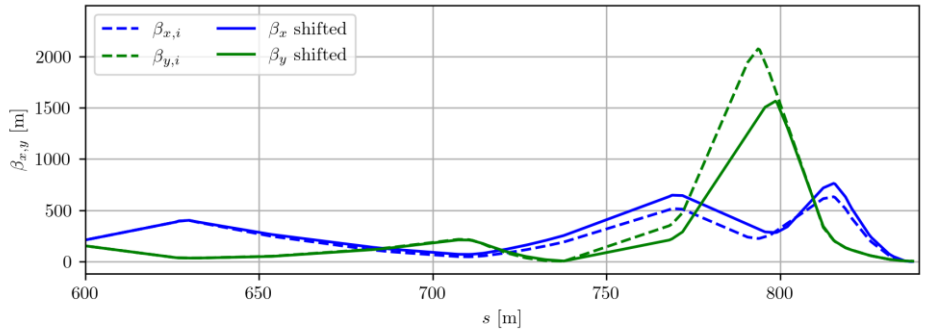
Sensitivity

- Matching was initially done with Rebecca 2021 model
- I made the mistake of using 2021 T4 conditions for 2023 P42
- Divergence to T4 no longer the same
- But beam size roughly converges
- A full study will quantify this



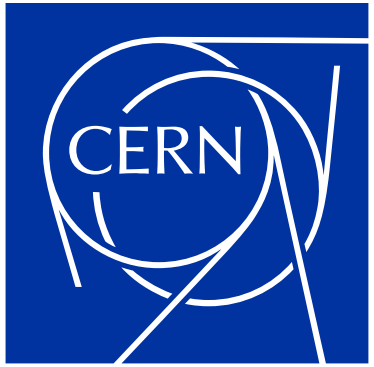






Conclusions

- Q20 magnets could be shifted by 5 m
- Optics for experiment have to be the same
- Beamline re-matched using madx
- Can reproduce same beam
- The magnets/power converters should be able to achieve these strengths
- Optics are as sensitive as ever
  - But needs more work



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