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New Triplet and EIR Optics

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on behalf of the JAI FCC team

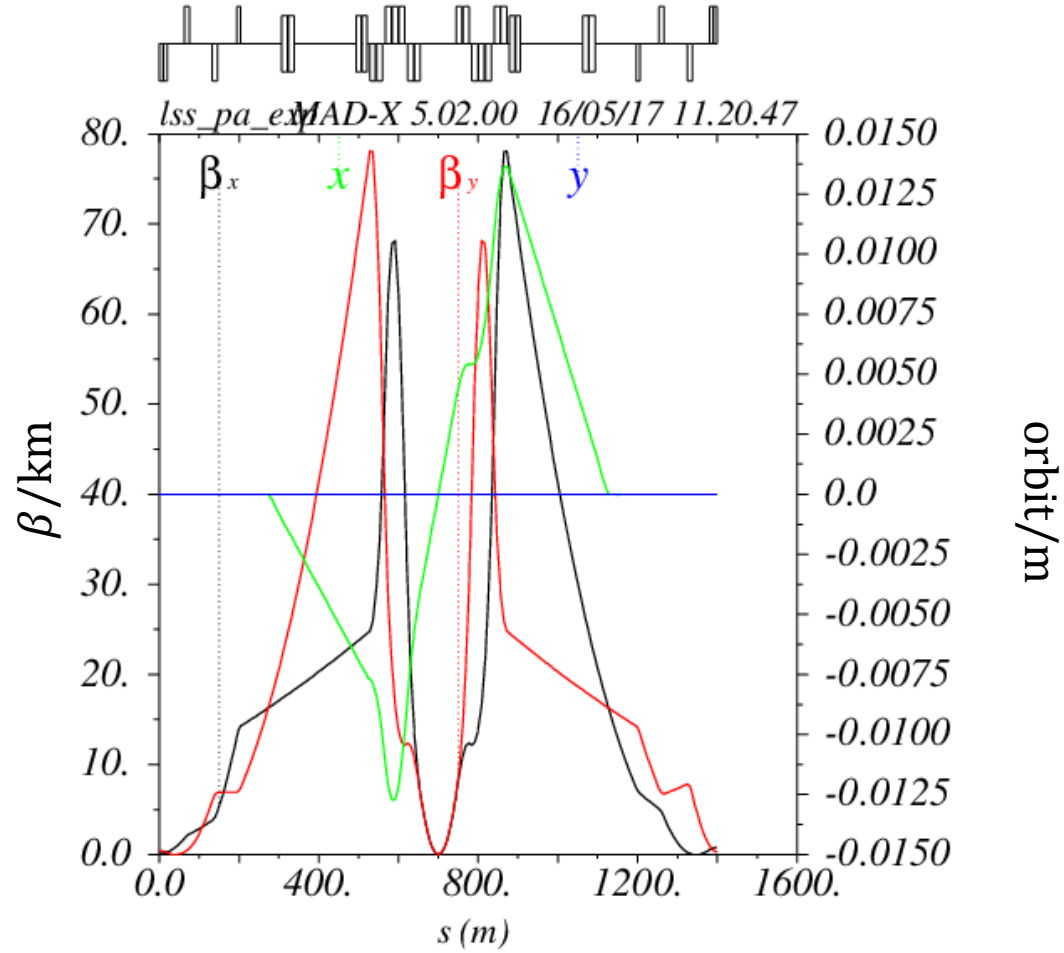
EuroCirCol

A key to New Physics

Before Berlin

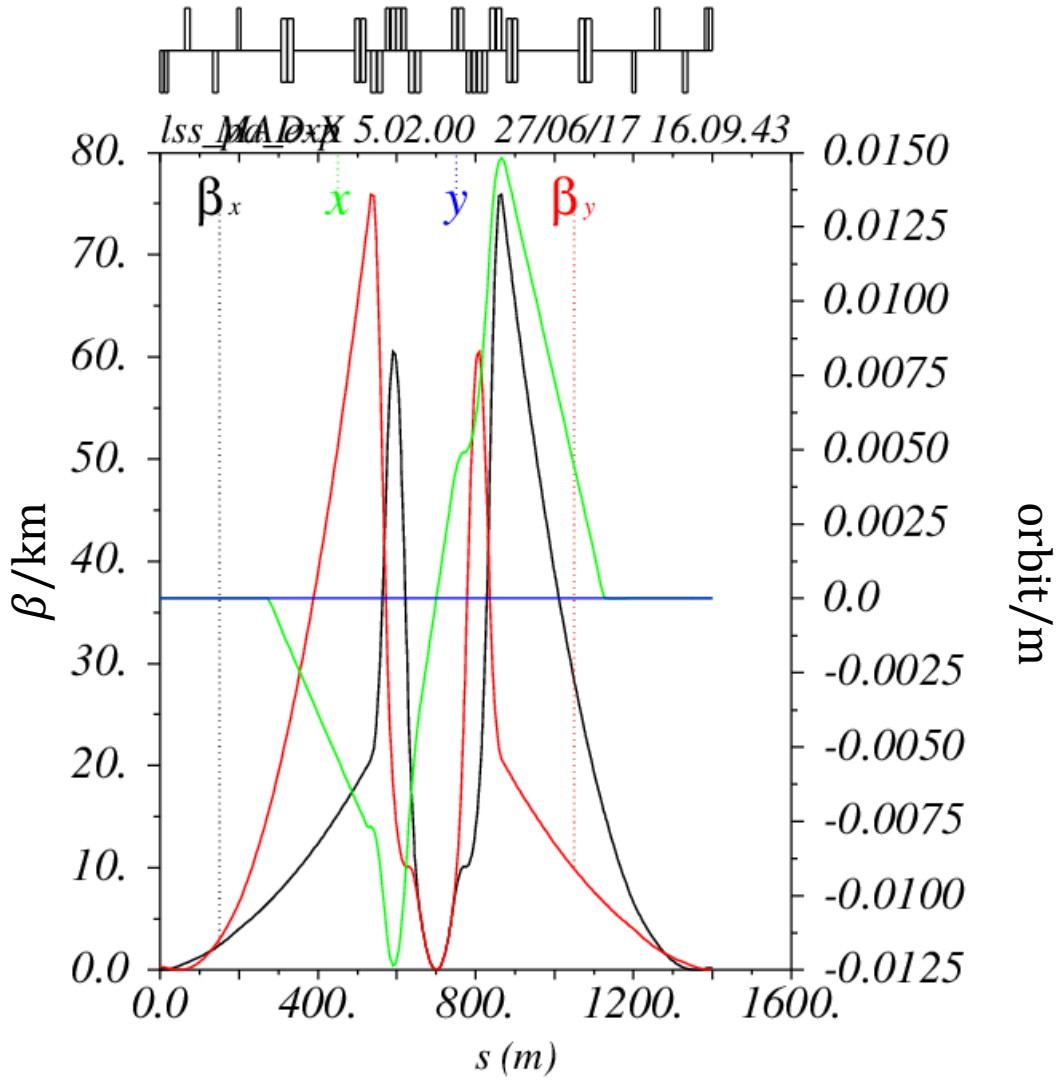
Alternative Triplet before Berlin

- $L^* = 45$ m
- Designed using 'triplet optimisation code'
- 2-3-2 configuration
  - Identical magnets
  - 15 m long
  - Varied shielding
  - Protected from debris (see J Abelleira)
- Integrated into lattice
  - Includes a flat optics



40 m L^*

- **First iteration triplet design with 'optimisation code'**
  - **Split to maximum 15 m**
  - **2-4-2 configuration**
  - **Q2 magnets shorter than Q1 and Q3 magnets**
  - **Same shielding maintained**



Next Iteration

- **This design was not followed up because**
  - **Magnets are not identical**
    - This was a key benefit of the 45 m design
  - **Optimisation code does not include splitting**
    - This might not be optimal solution once splitted
  - **Very similar to baseline**
    - Similar design already explored by Roman
- **Instead take the 45 m L^* triplet and move it forward 5 m**
  - **Slight re-matching needed to re-optimise x and y focal points**

Re-Matching

$$L^* = 45 \text{ m}$$

Quadrupole	Sub Quads	Length	Coil Radius	Shielding	$k \times m^2$	Gradient	Aperture
Q1	2	15 m	98.3 mm	44.2 mm	0.000637	106 T/m	43 mm
Q2	3	15 m	98.3 mm	33.2 mm	-0.000664	111 T/m	54 mm
Q3	2	15 m	98.3 mm	24.2 mm	0.000581	97 T/m	63 mm

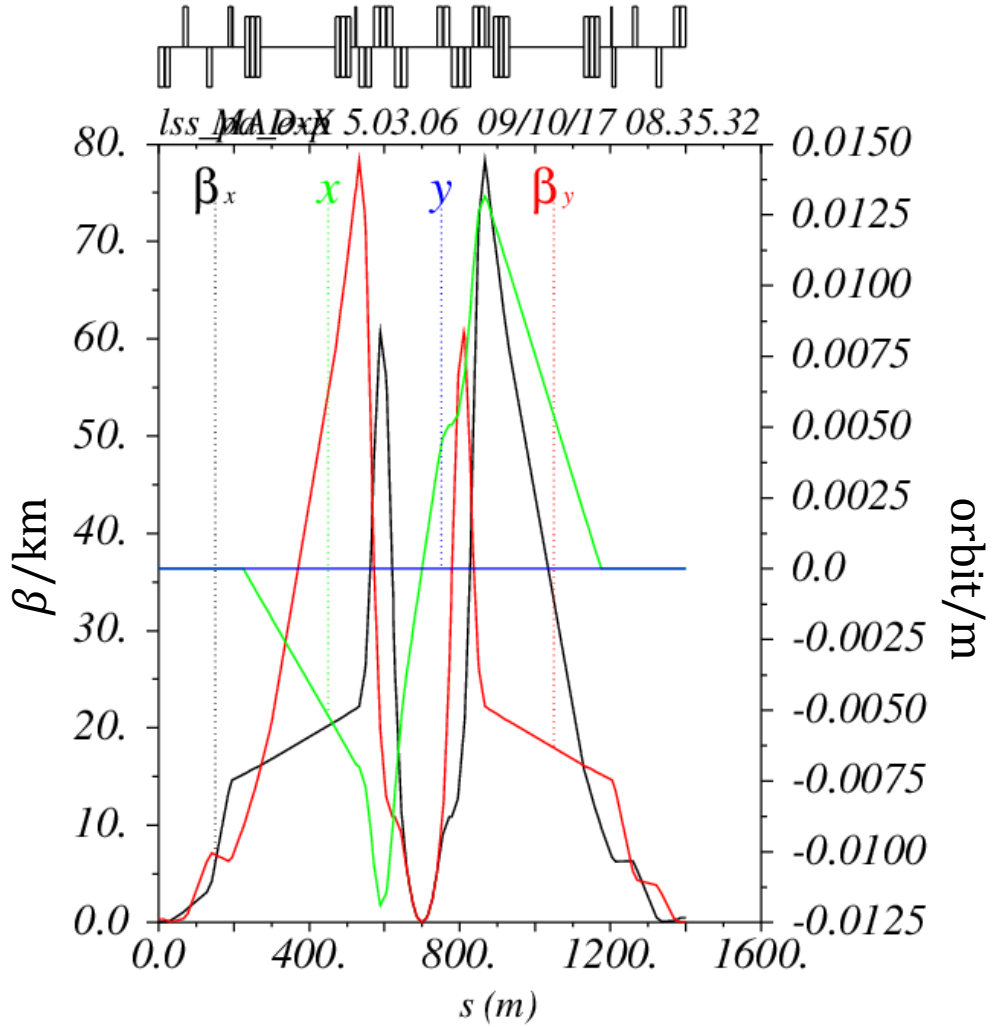
$$L^* = 40 \text{ m}$$

Quadrupole	Sub Quads	Length	Coil Radius	Shielding	$k \times m^2$	Gradient	Aperture
Q1	2	15 m	96.5 mm	44.2 mm	0.000647	108 T/m	41 mm
Q2	3	15 m	96.5 mm	33.2 mm	-0.000674	112 T/m	52 mm
Q3	2	15 m	96.5 mm	24.2 mm	0.000590	95 T/m	61 mm

Moved Triplet

- Same benefits as previous triplet
  - 7 Identical magnets
  - Same shielding as before
- Slightly decreased aperture due to larger strength
- Enough BSC for $\beta^* = 0.3$ m and 0.2 m round optics
- $\beta^* = 0.15$ m reachable with compromises
- Optics for $\beta^* = 0.15 \times 1.2$ m flat(ter) optics
  - See J Abelleira's talk for details
- Created injection optics for completeness

$\beta^* = 0.3$ m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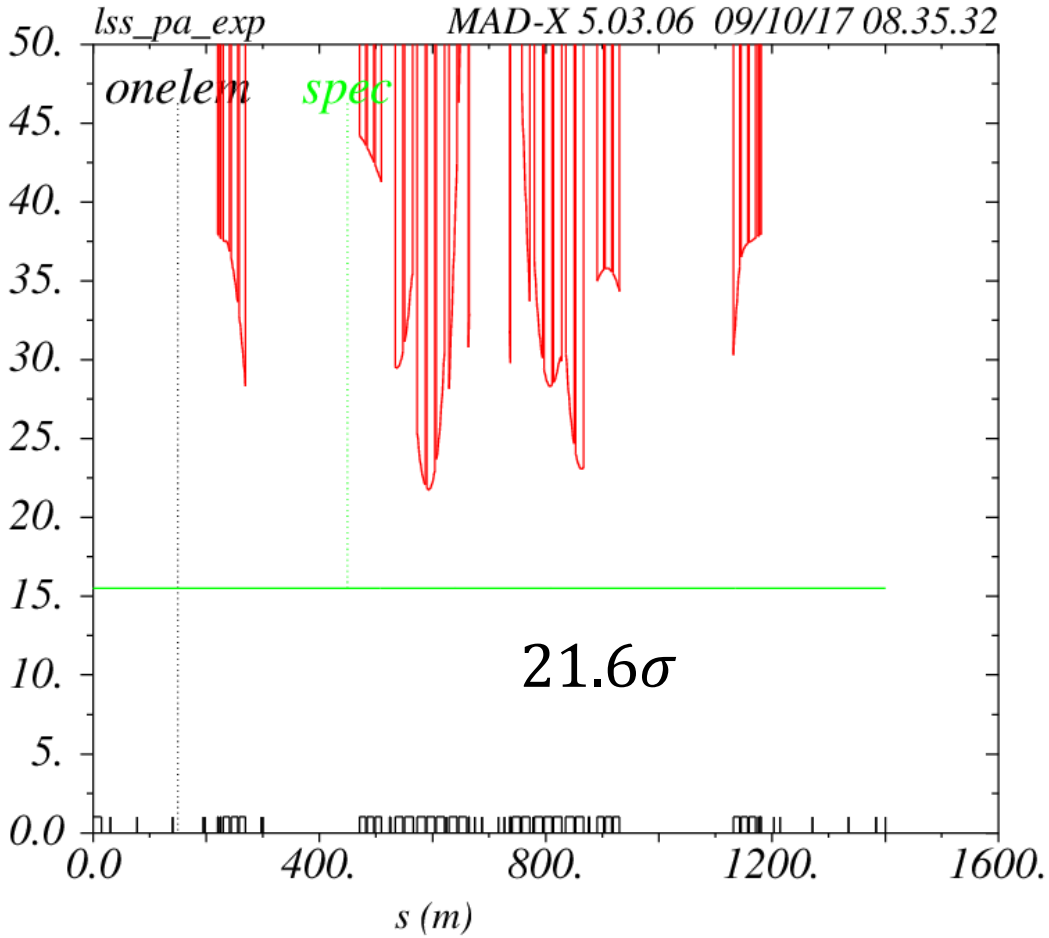
β x
x
y
β y
β/km
orbit/m
s (m)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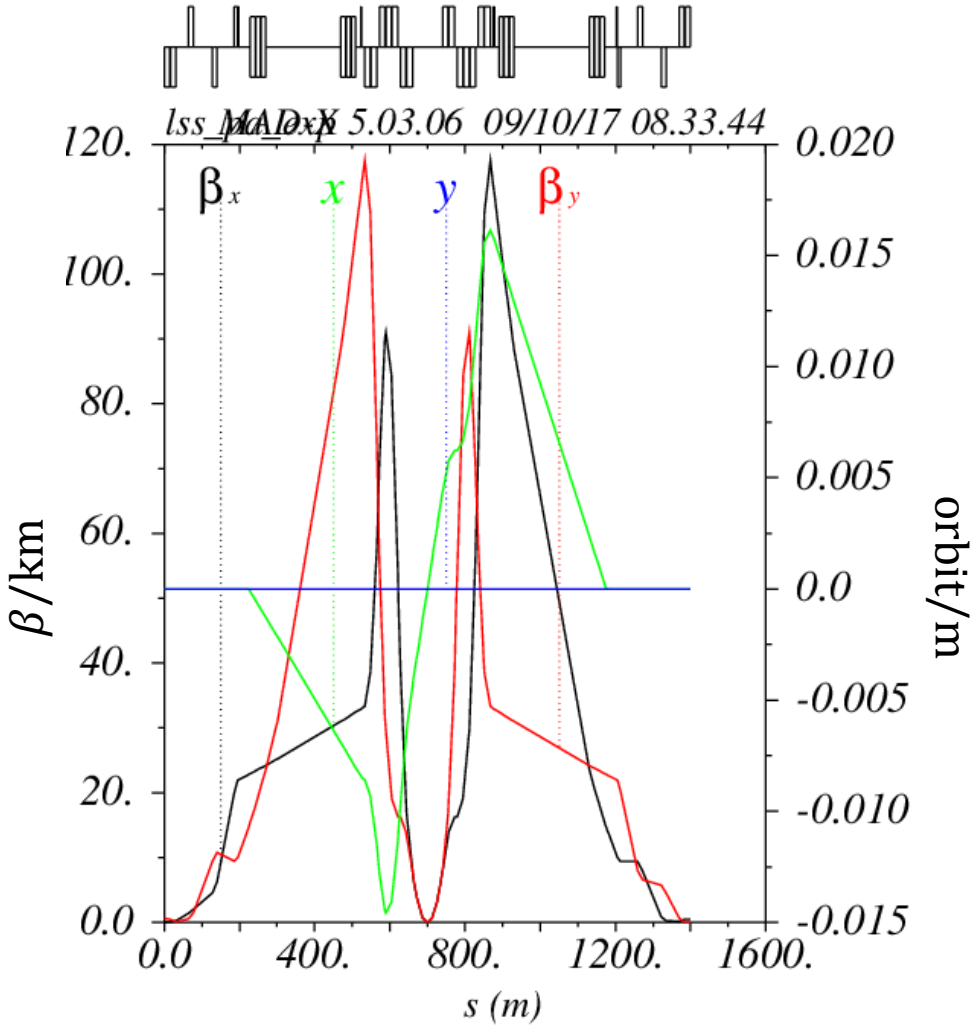
onelem
spec
21.6σ
s (m)

$\beta^* = 0.2$ m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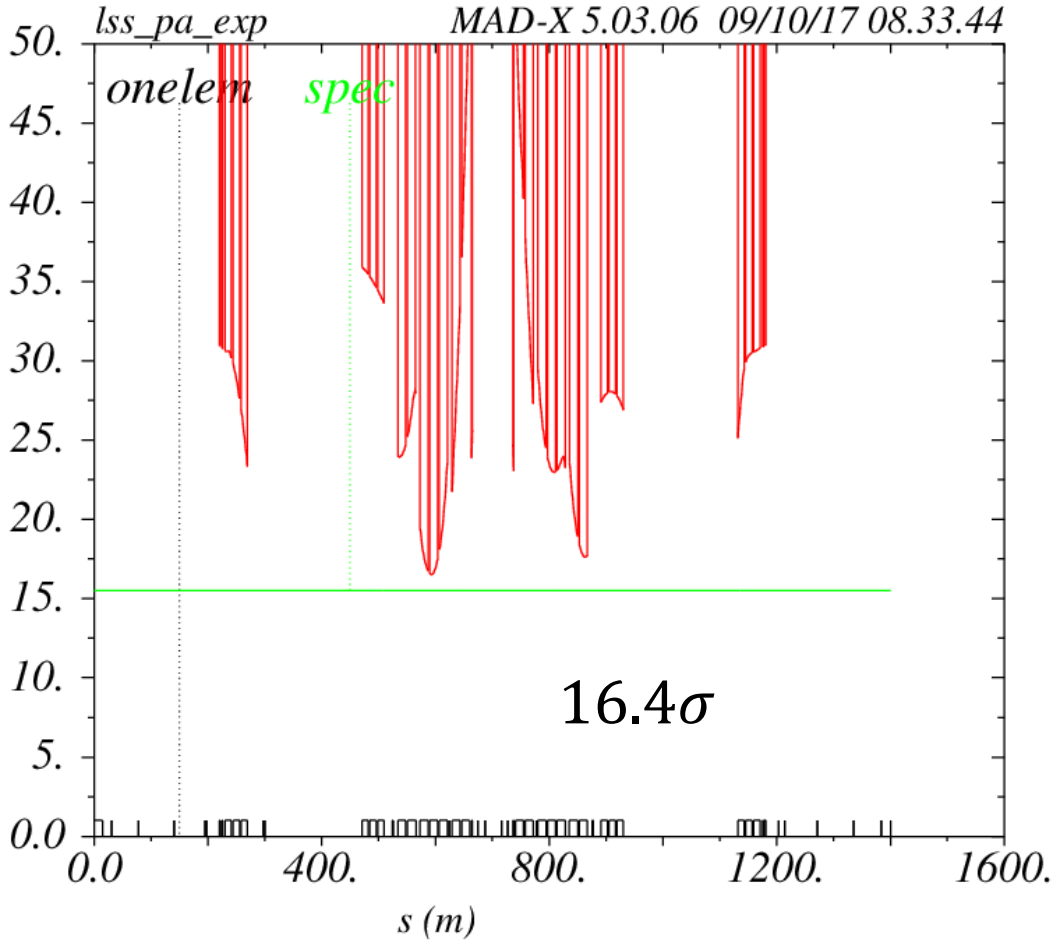
β x
x
y
β y
β/km
orbit/m
s (m)
0.0
20.
40.
60.
80.
100.
120.
0.020
0.015
0.010
0.005
0.0
-0.005
-0.010
-0.015
0.0
400.
800.
1200.
1600.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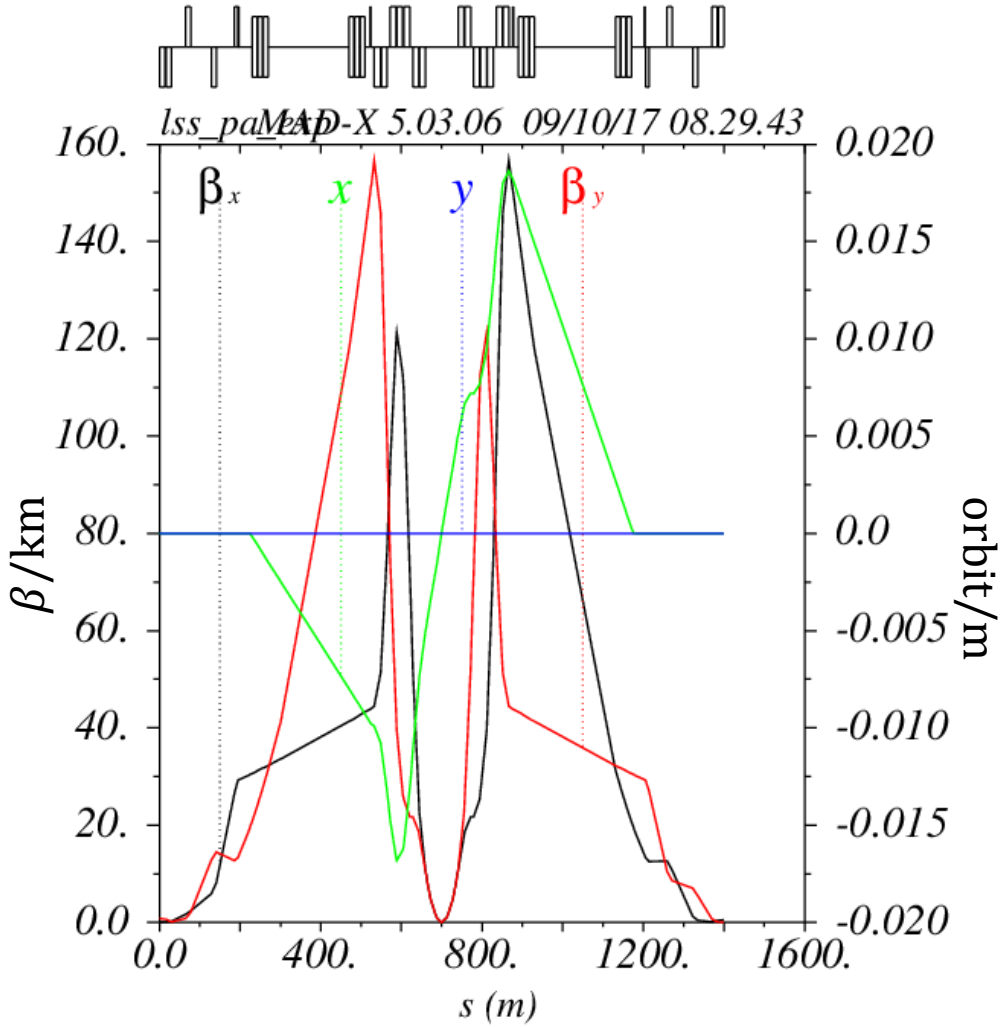
onelem
spec
16.4σ
s (m)
0.0
5.
10.
15.
20.
25.
30.
35.
40.
45.
50.
0.0
400.
800.
1200.
1600.

$\beta^* = 0.15$ m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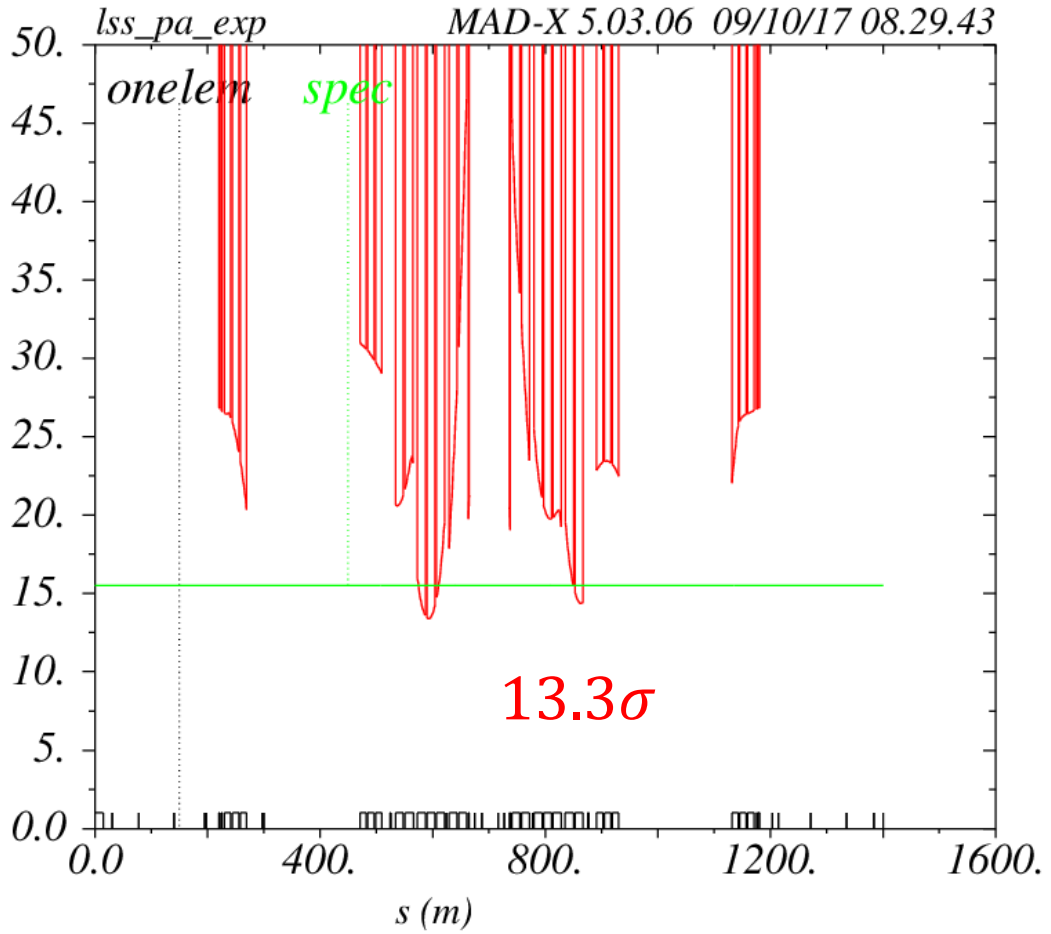
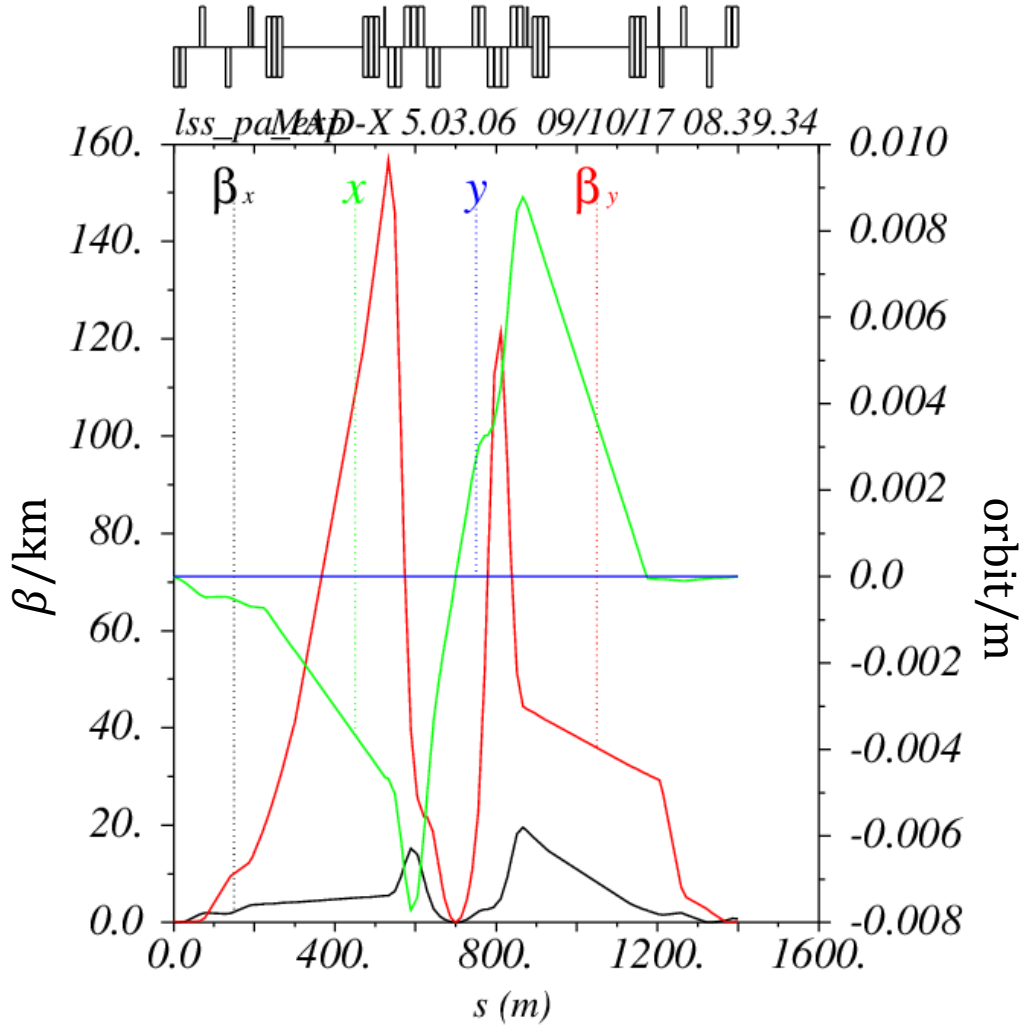
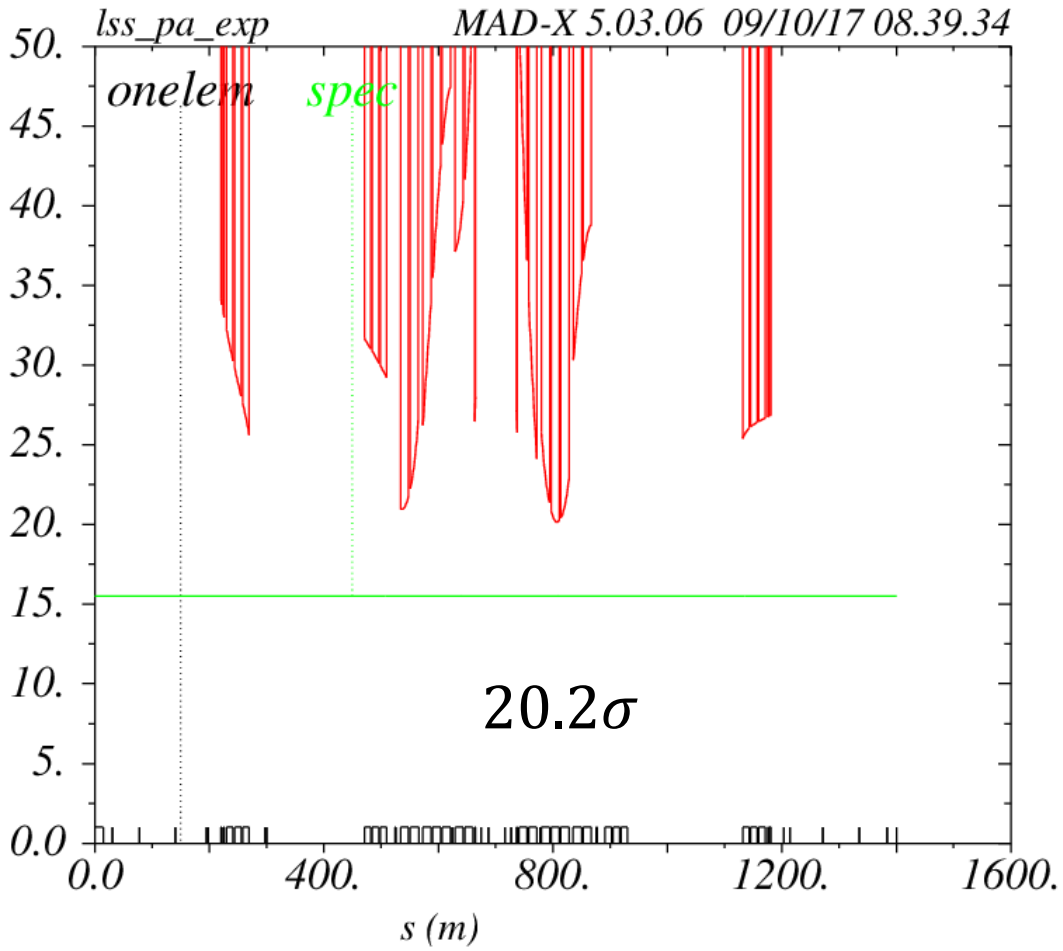
β x
x
y
β y
β/km
orbit/m
s (m)

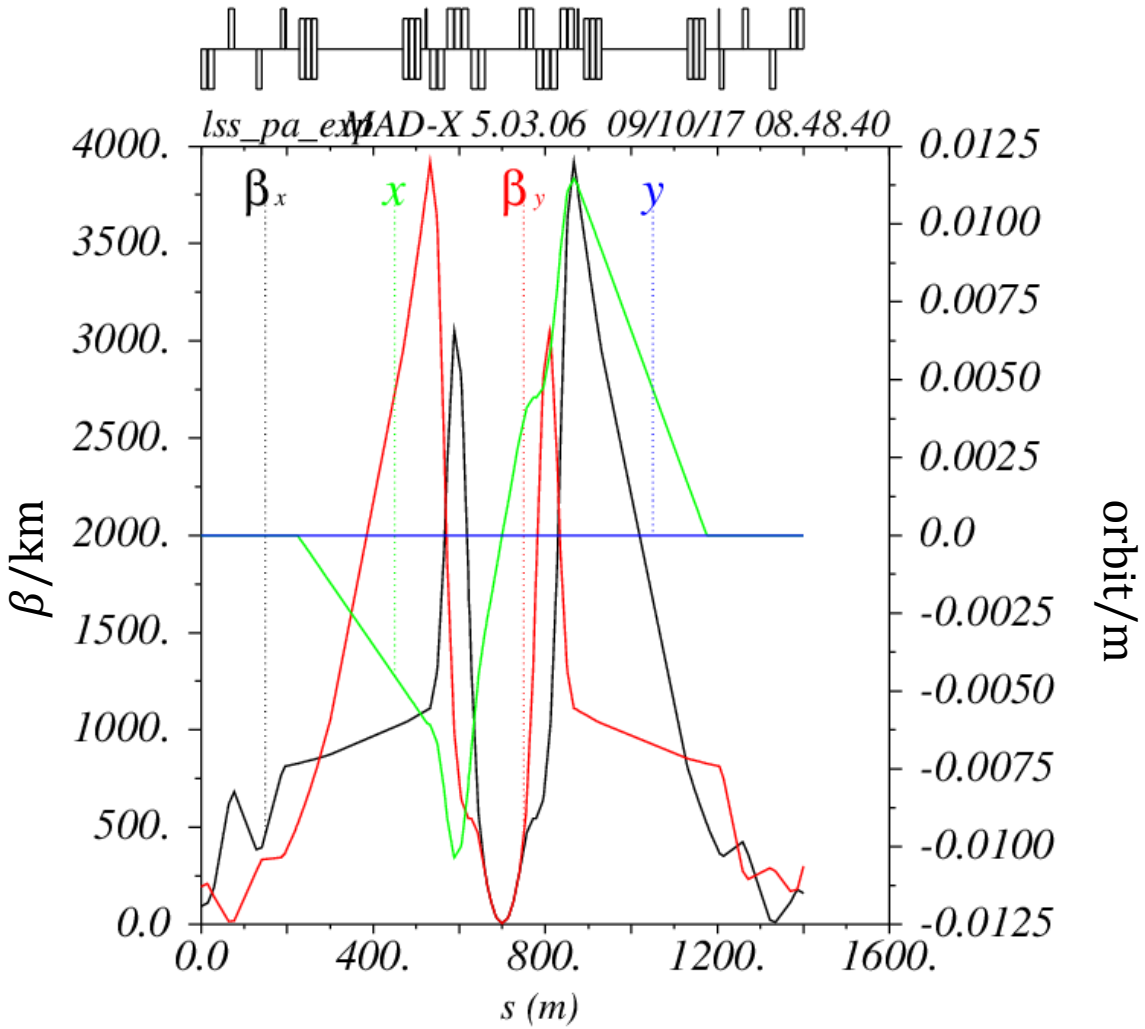

lss_pa_exp MAD-X 5.03.06 09/10/17 08.29.43
onelem
spec
13.3σ
s (m)

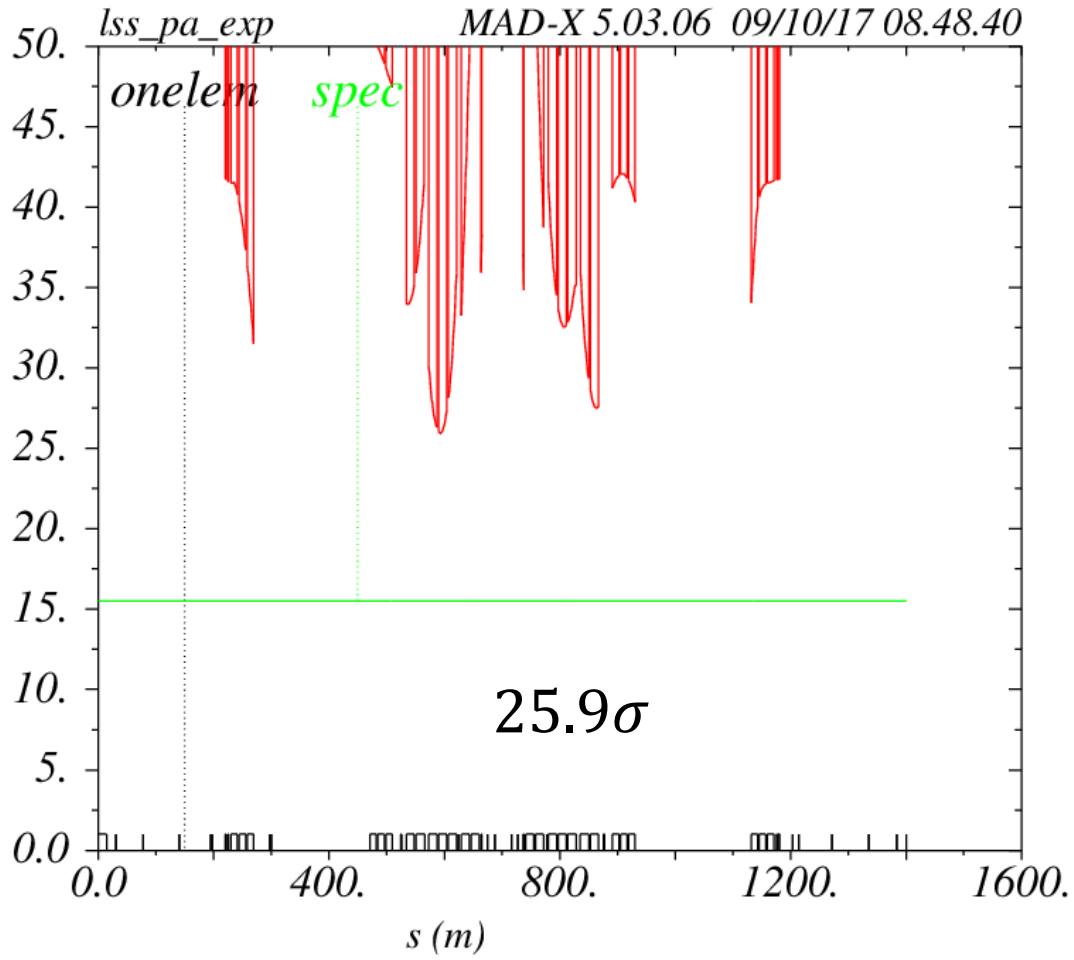
$\beta^* = 0.15 \times 1.2$ m





$\beta^* = 6$ m Injection Optics @ 3.3TeV





Summary and Outlook

- $L^* = 45$ m triplet moved forward 5 m
- Achieve similar optics as before
  - Can reach $\beta^* = 0.2$m round optics comfortably
  - New flat optics
  - Injection optics
- Still identical magnets and ‘short’ design
- Enough debris protection (see J Abelleira)
- New flat optics
- Integrated into most recent IR of R Martin
- Integration into ring ongoing (A Chance)
  - Can perform chromaticity studies
  - Also interesting for flat beam-beam