

Alternative and Flat Beam Triplet

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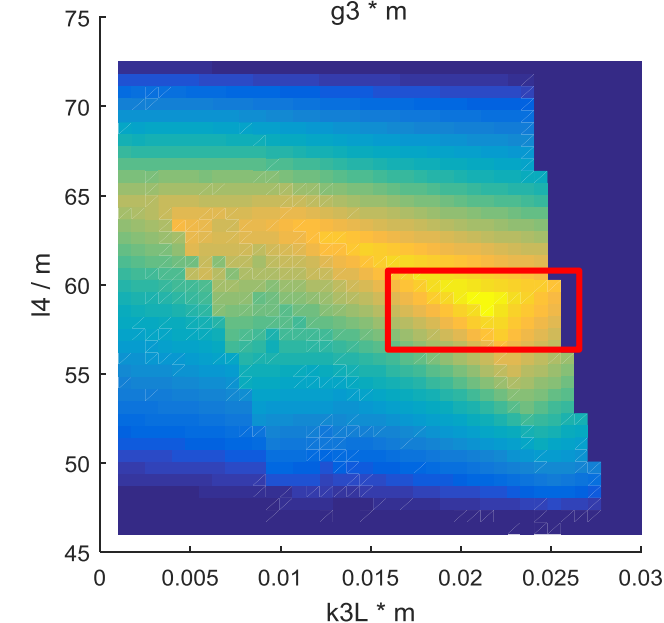
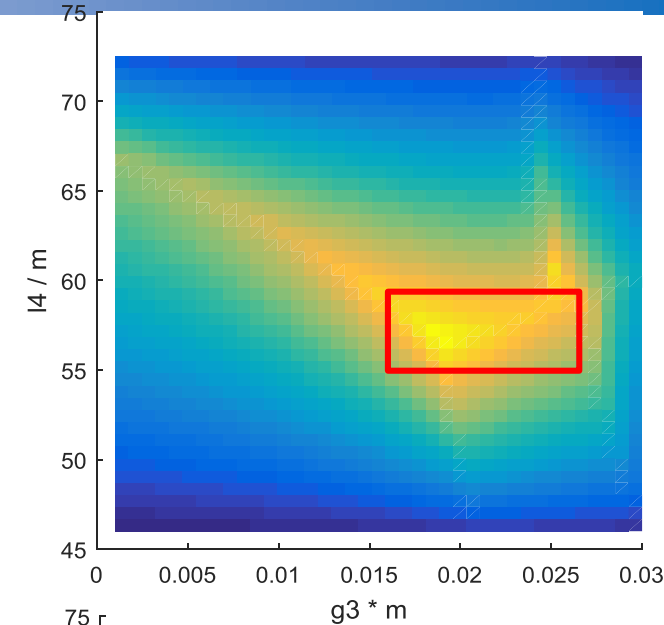
Thanks to Roman Martin and Rogelio Tomás

30th May 2017



- **Aim to have two possible optics**
 - $\beta^* = 0.3$ m round optics
 - $\beta^* = 1.2 \times 0.15$ m flat optics
 - Acceptable equivalent integrated luminosity
 - Ideally also lower β^* optics
- **Input into triplet optimisation code**
- **It would be nice to have identical magnets with slightly different currents**
- **Shortened EIR by 50 m on either side – total length now 1.4 km**
- **Matched to arcs (Roman Martin's Scripts)**

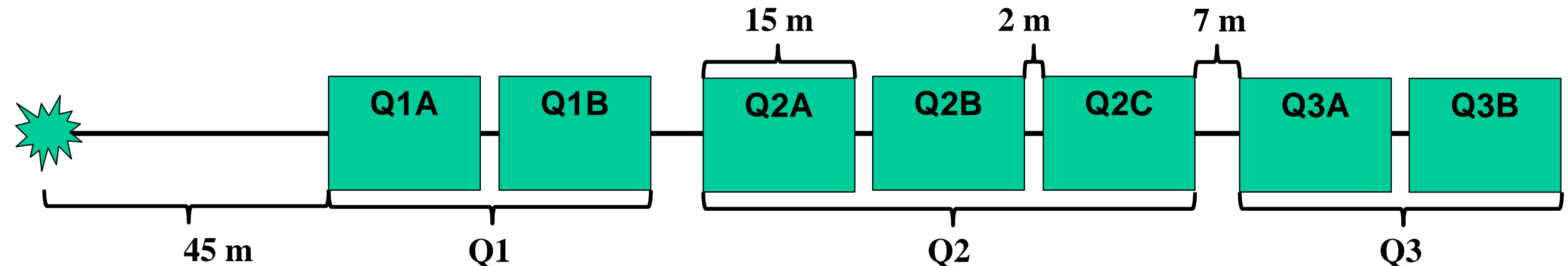
- **Optimisation code**
 - **Scans through parameter space**
 - Using thin lenses first
 - Then MADX aperture module
 - **Finds shortest triplet with sufficient beam stay clear**
 - **See poster**
- **Optics design and radiation studies worked closely together**
 - **Radiation studies done on triplet**
 - **Shielding adjusted if needed**
 - **Run optimisation again**

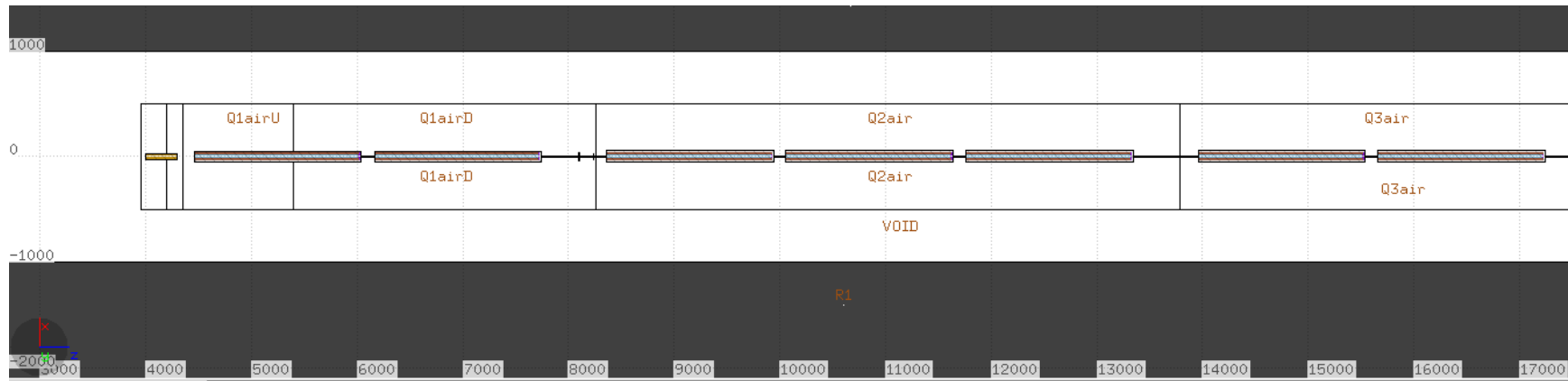


- Triplet made of 2-3-2 pattern of identical magnets

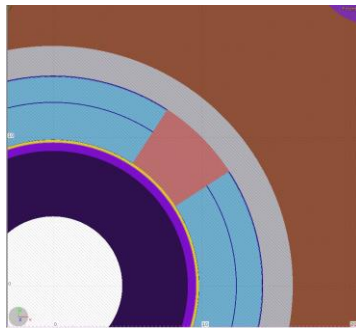
Quadrupole	Sub Quads	Length	Coil Radius	Shielding	$k \times m^2$	Gradient	Aperture
Q1	2	15 m	98.3 mm	44.2 mm	0.000637	106 T/m	43 mm
Q2	3	15 m	98.3 mm	33.2 mm	-0.000664	111 T/m	54 mm
Q3	2	15 m	98.3 mm	24.2 mm	0.000581	97 T/m	63 mm

- 2 m spacing between sub-magnets
- 7 m between groups – fit kickers and instruments



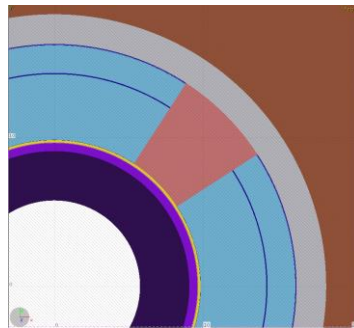


Q1
106 T/m



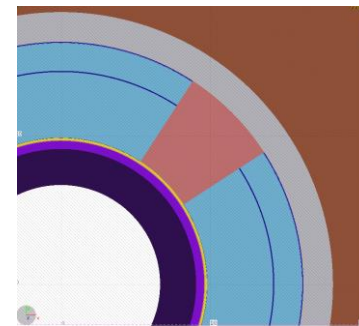
Abs: 4.4 cm

Q2
111 T/m



Abs: 3.3 cm

Q3
97 T/m

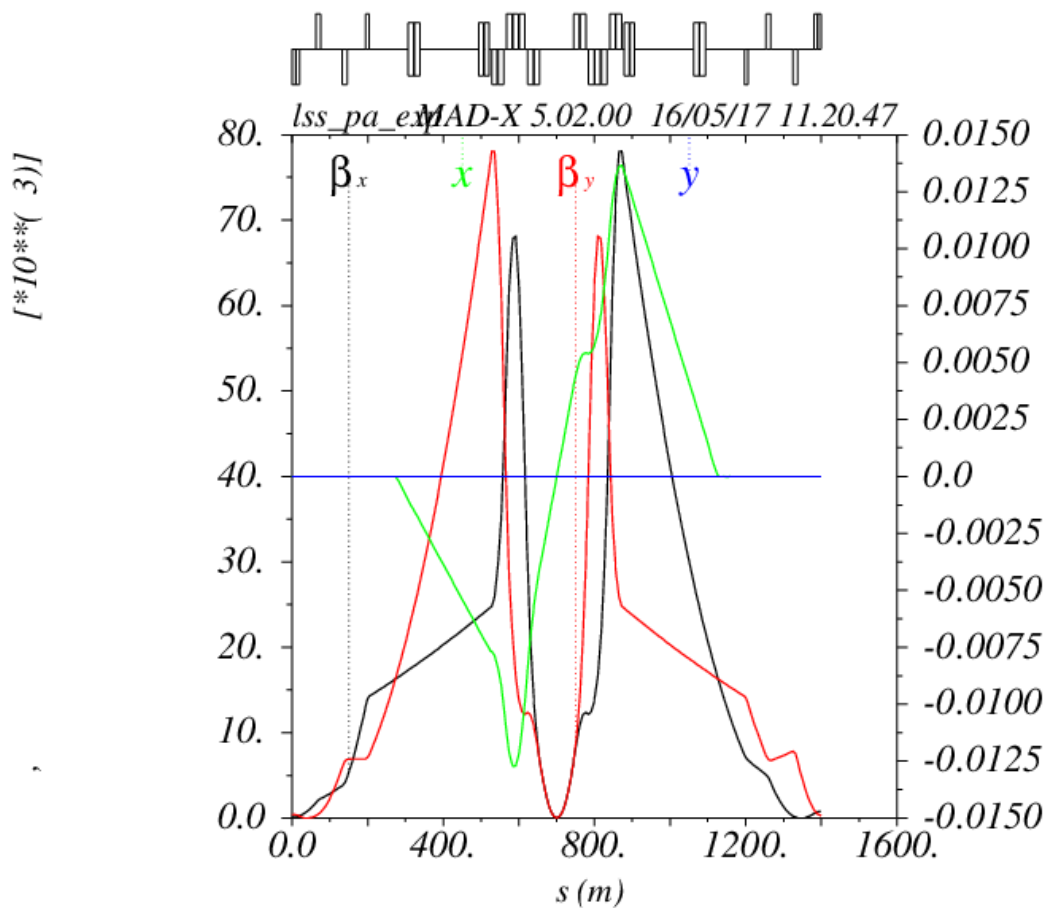


Abs: 2.4 cm

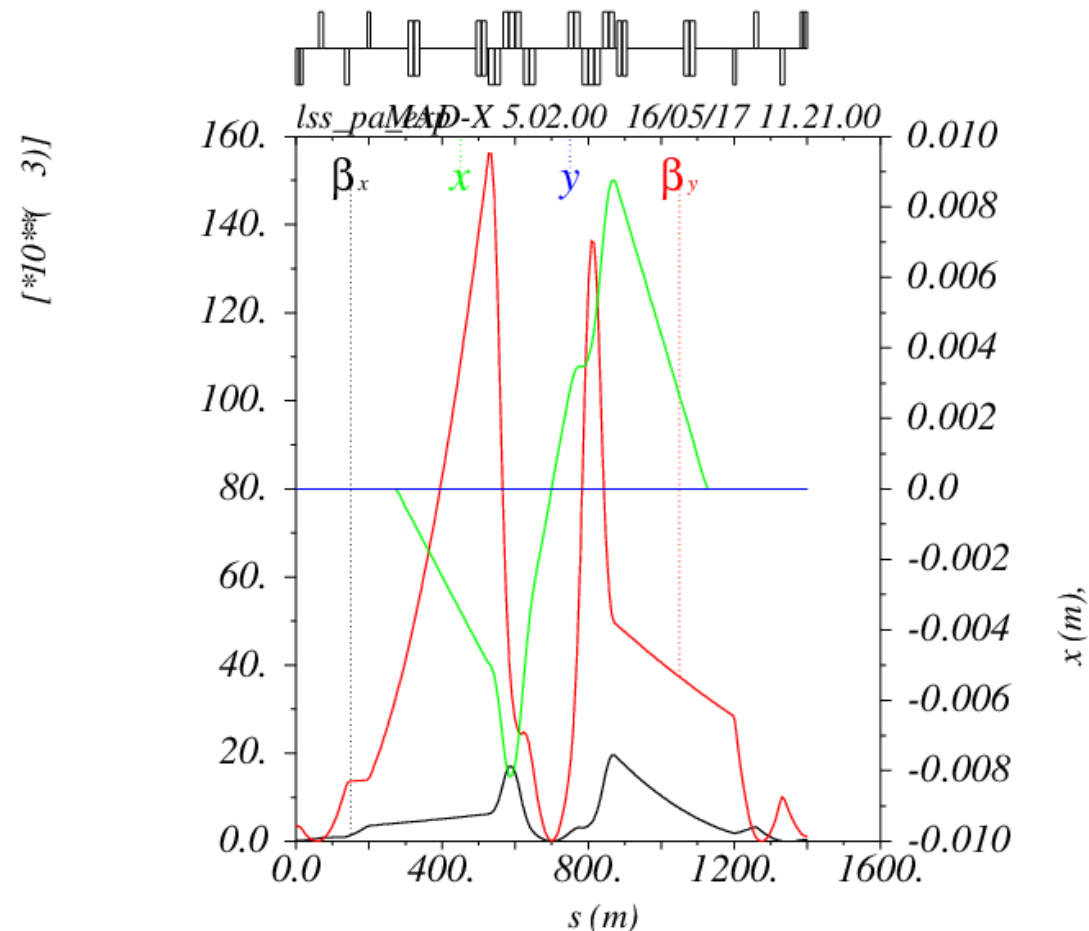
- Moved D1 close to triplet (consistent 7 m)
- Moved D2 and entire matching section 50 m closer to triplet
 - Conserves space for crab cavities
 - EIR now 1.4 km
- Re-matched matching section

Dipole	Sub Magnets	Length	Coil Radius	Shielding	Angle	B field / T	Aperture
D1	2	12.5 m	87 mm	-	337 μ rad	4.50	87 mm
D2	2	15 m	42 mm	-	337 μ rad	3.75	42 mm

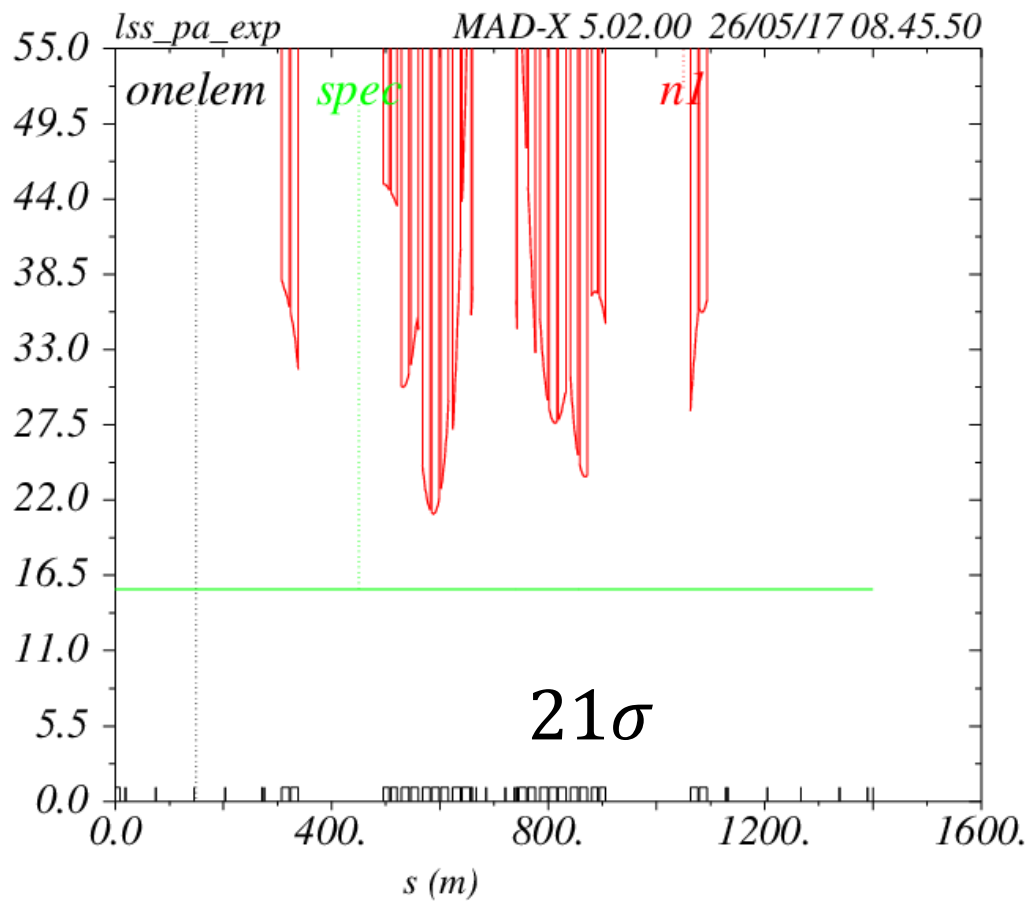
Round $\beta^* = 0.3 \text{ m}$



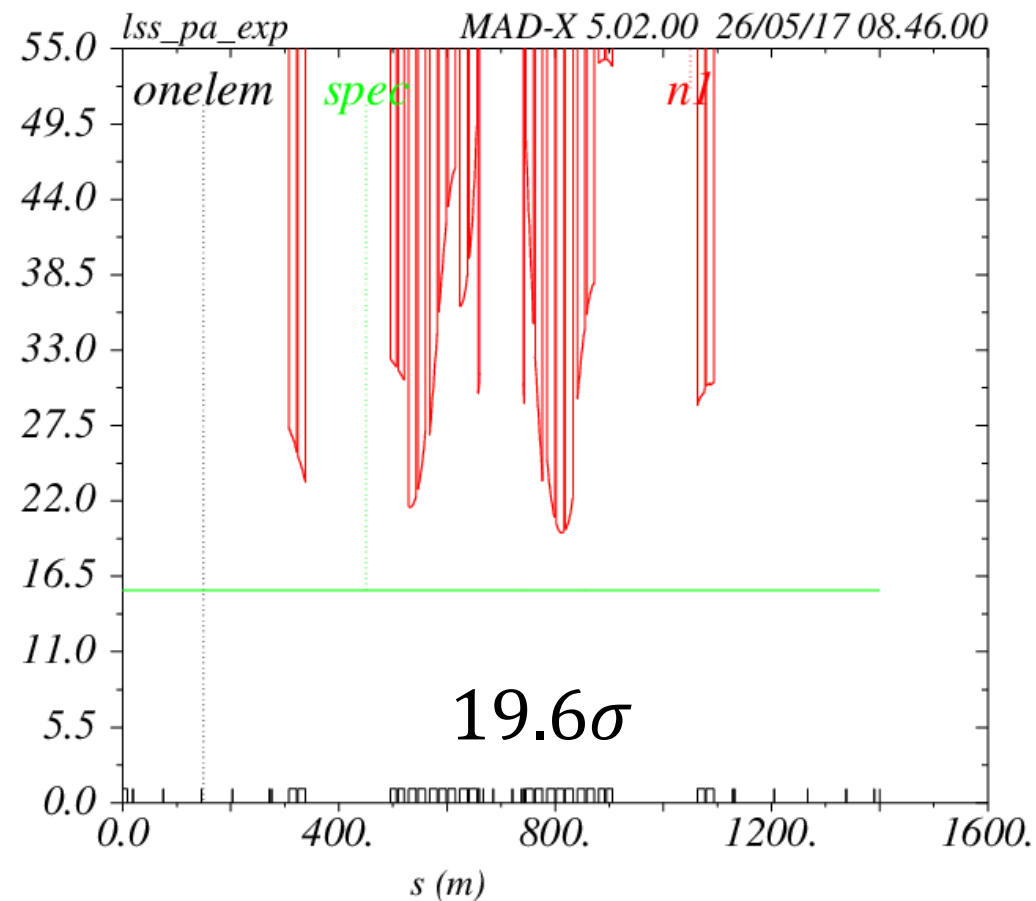
Flat $\beta^* = 1.2 \times 0.15 \text{ m}$



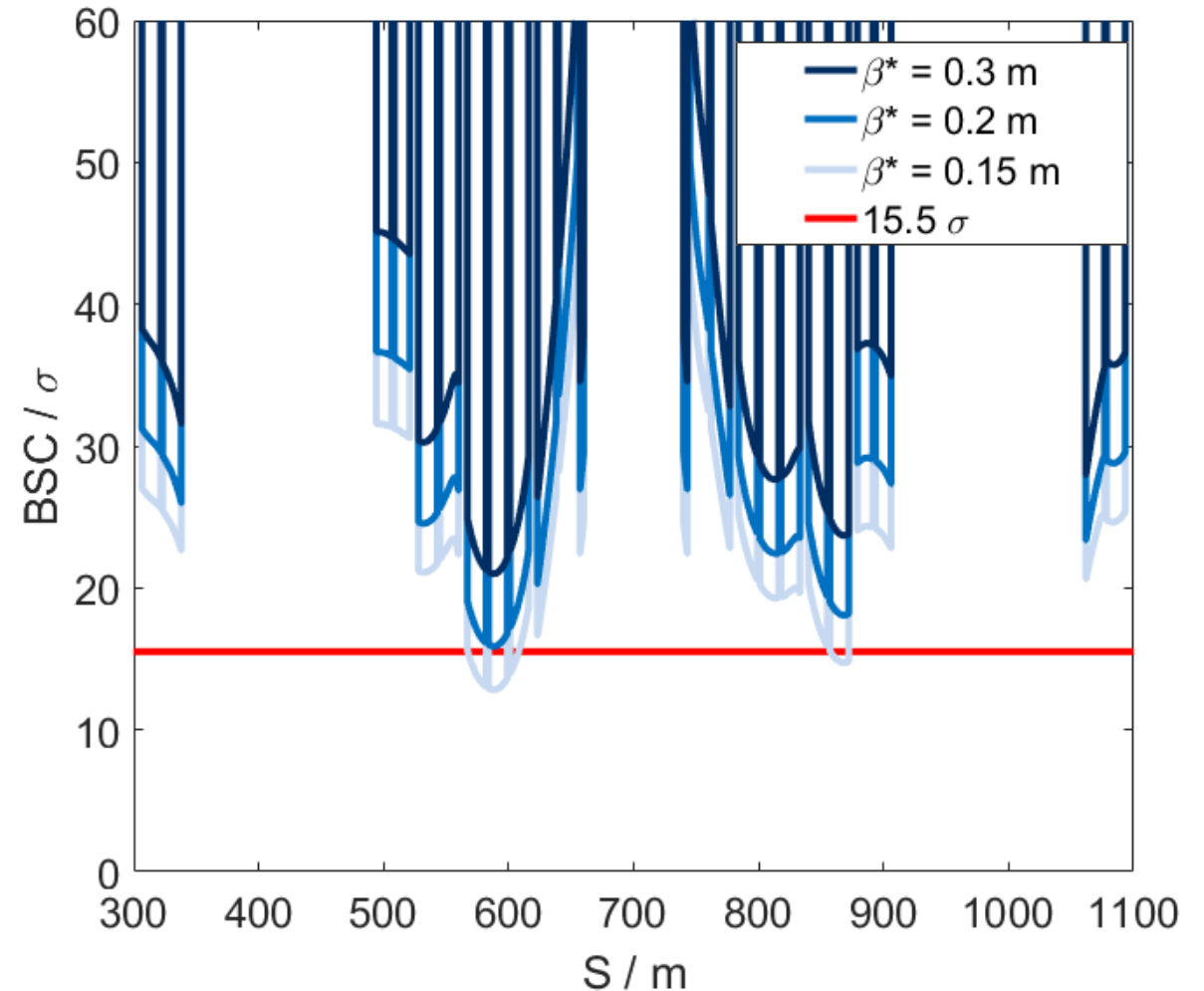
Round $\beta^* = 0.3$ m



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

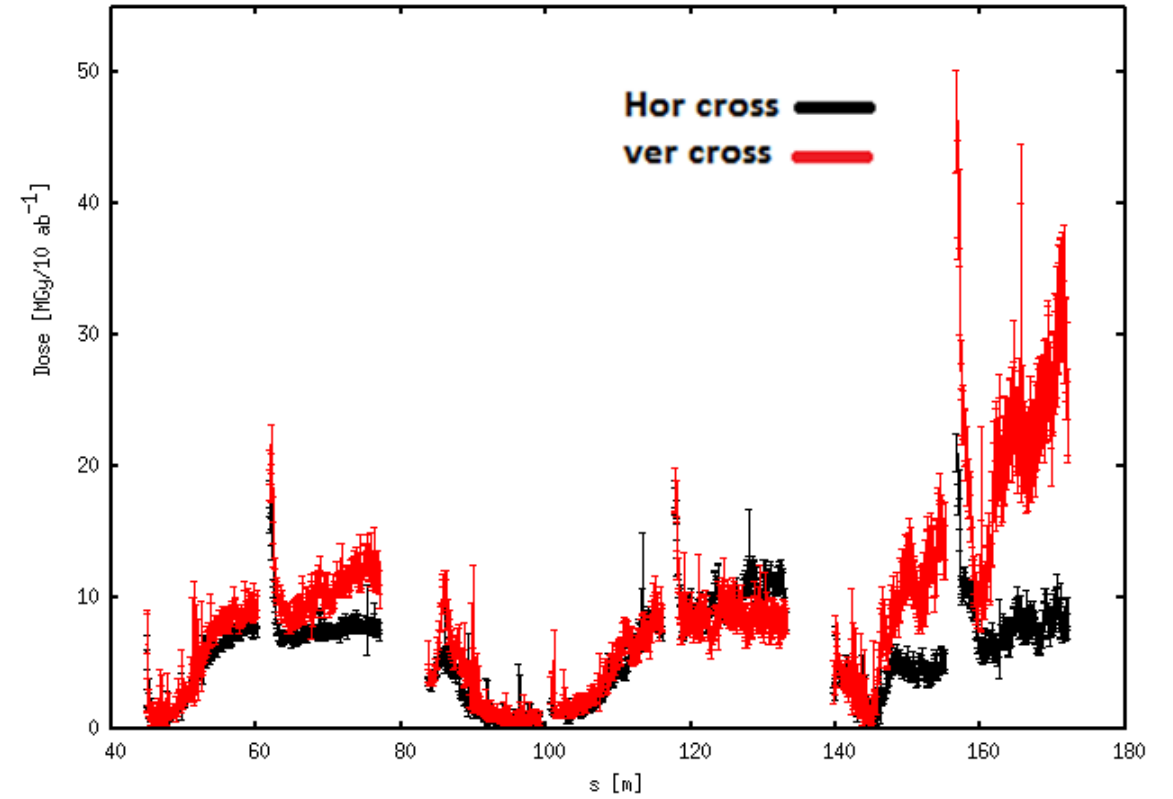
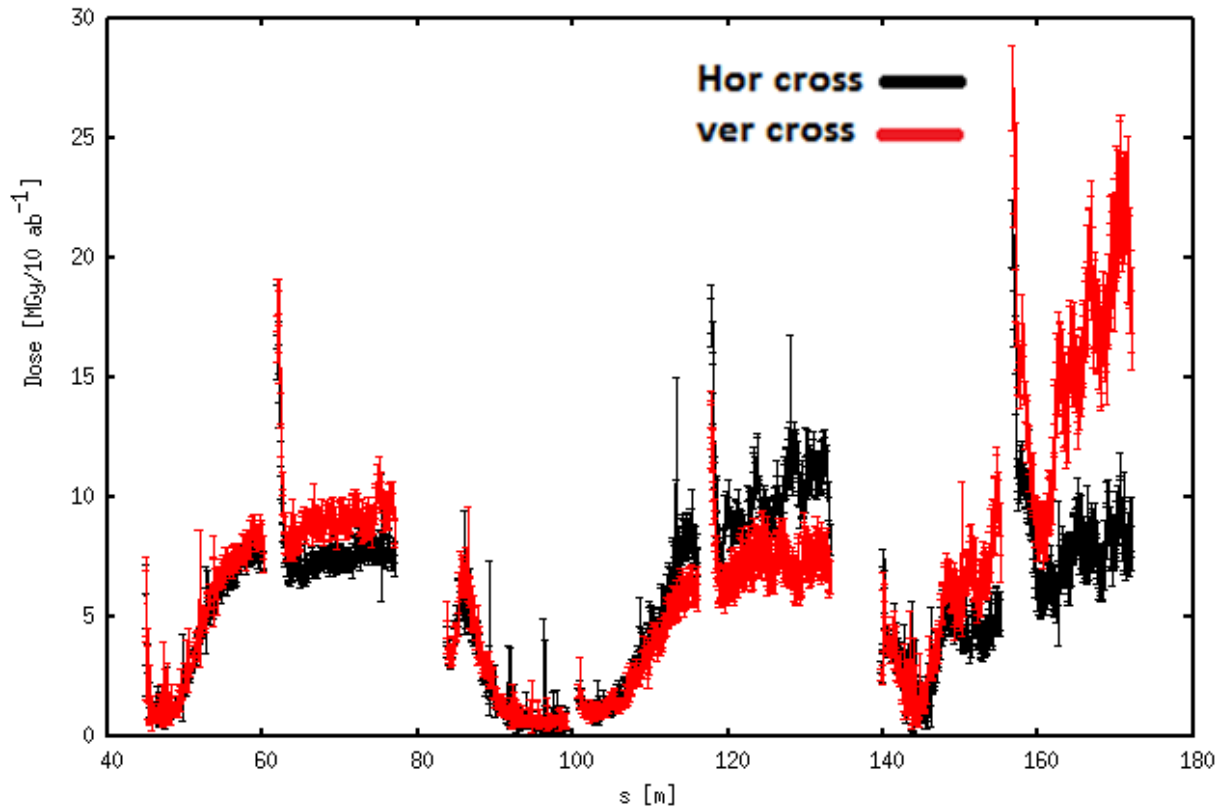


- Sometimes need room to decrease β^* beyond ultimate
 - Good Luminosity handle
- $\beta^* = 0.2$ m achievabler
- $\beta^* = 0.15$ m below 15.5σ
 - Low current could be one reason for luminosity
 - Could scrape more beam



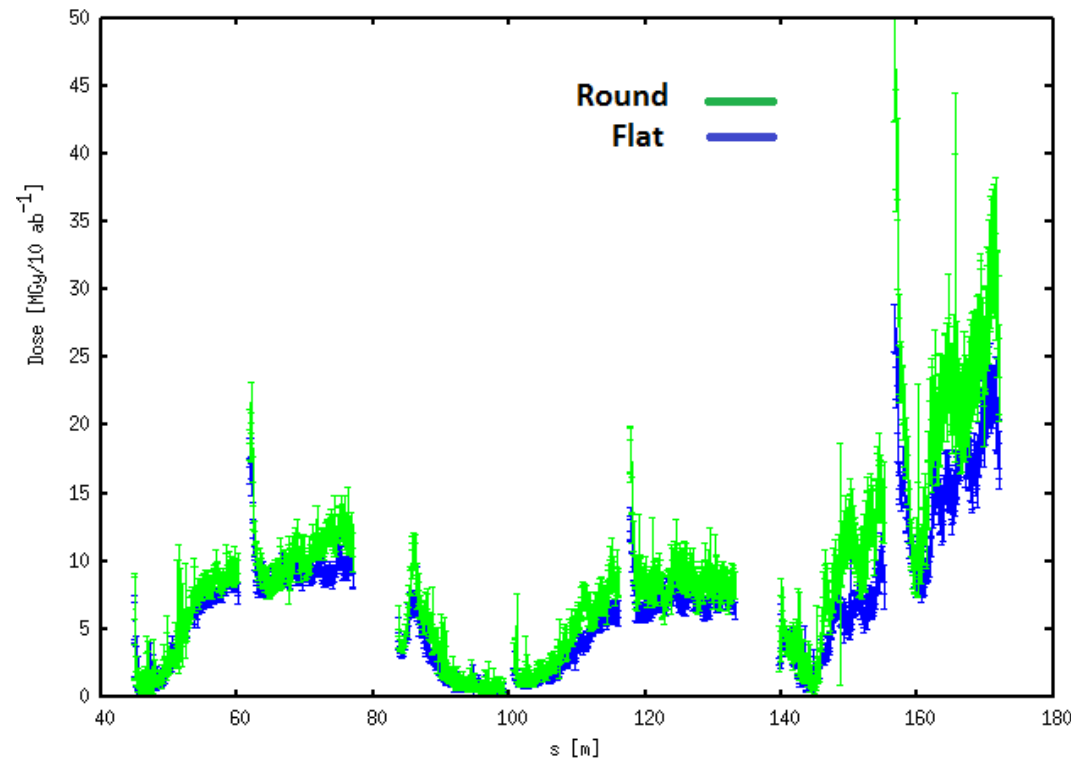
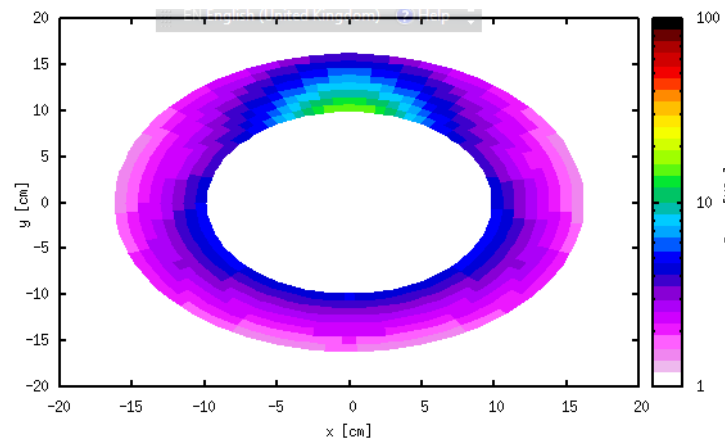
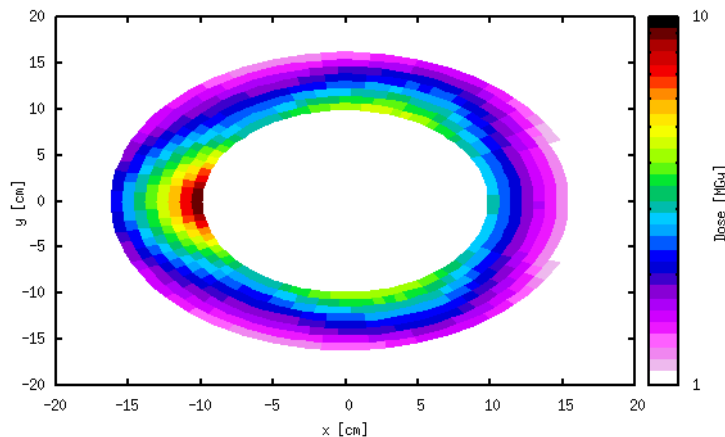
Round $\beta^* = 0.3$ m

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



Changing Crossing Planes

Peak dose (50 % hor, 50% vertical cross.)



- Q1-Q2 below 15 MGy (45MGy for 30 ab⁻¹).
- Q3 still high. Can be potentially reduced by increasing shielding – still some margin.

- **Designed a triplet that:**
 - **Made of identical magnets**
 - 15 m long, 98.3 mm coil radius, 97-111 T/m
 - **2 m and 7 m spacing**
 - **Can accommodate nominal round and flat optics**
 - $\beta^* = 0.3$ m round optics (and $\beta^* = 0.2$ m achievable)
 - $\beta^* = 1.2 \times 0.15$ m flat optics
 - Can reach lower β^* (with compromises)
 - **Right length of total EIR**
 - **Enough shielding to protect from lifetime radiation**