ATF2 ULTRA-LOW β^* STUDIES WITH FD SC MAGNET

Presenter: Edu Marin (Phd Student at CERN)
eduardo.marin.lacoma@cern.ch

OUTLINE

- ATF2 Ultra-low β^* ideal lattice
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- Different Scenarios for the ATF2 Ultra-low β^*
- Comparison between the NC and the SC QF1FF multipoles
- Tolerances for the SC SF1FF
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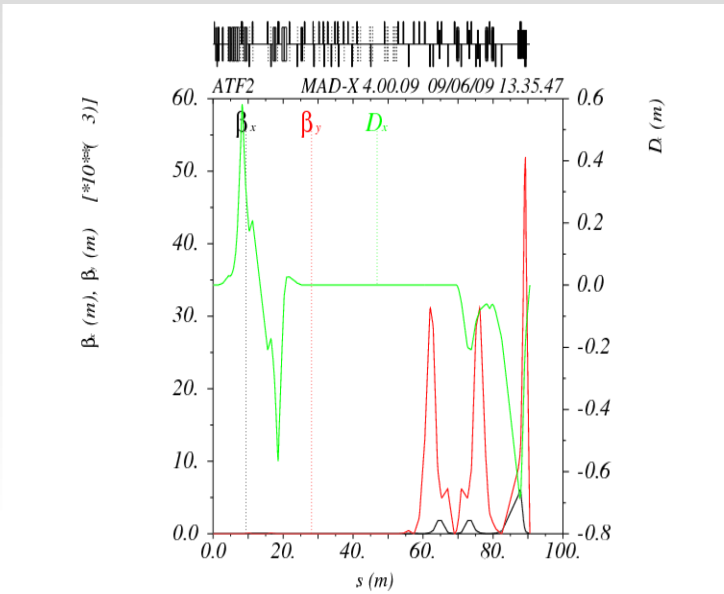
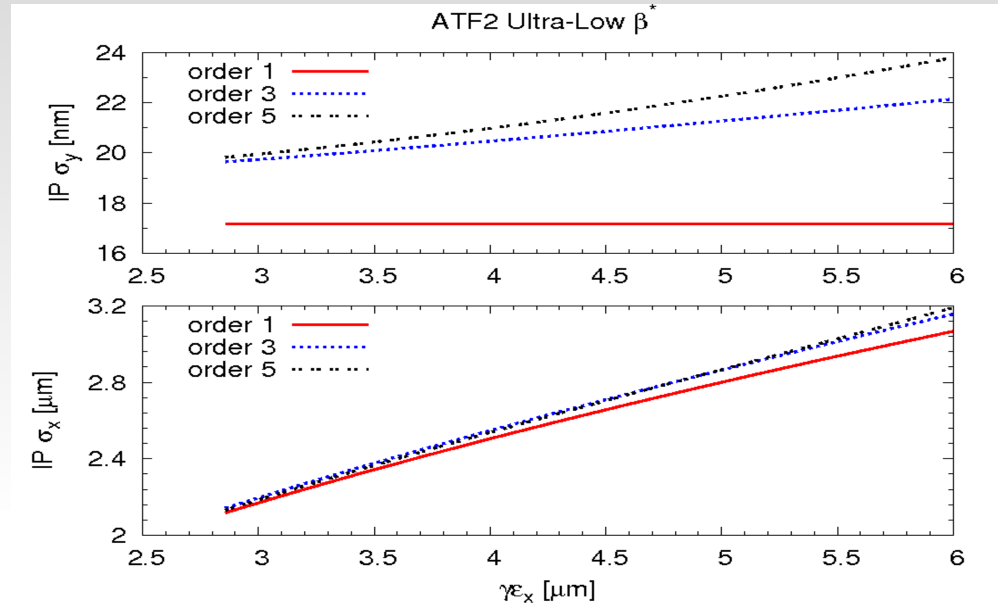
ATF2 Ultra-Low β^* ideal lattice

The ATF2 UL β^* proposal is the scaled lattice of the CLIC 3 TeV FFS.

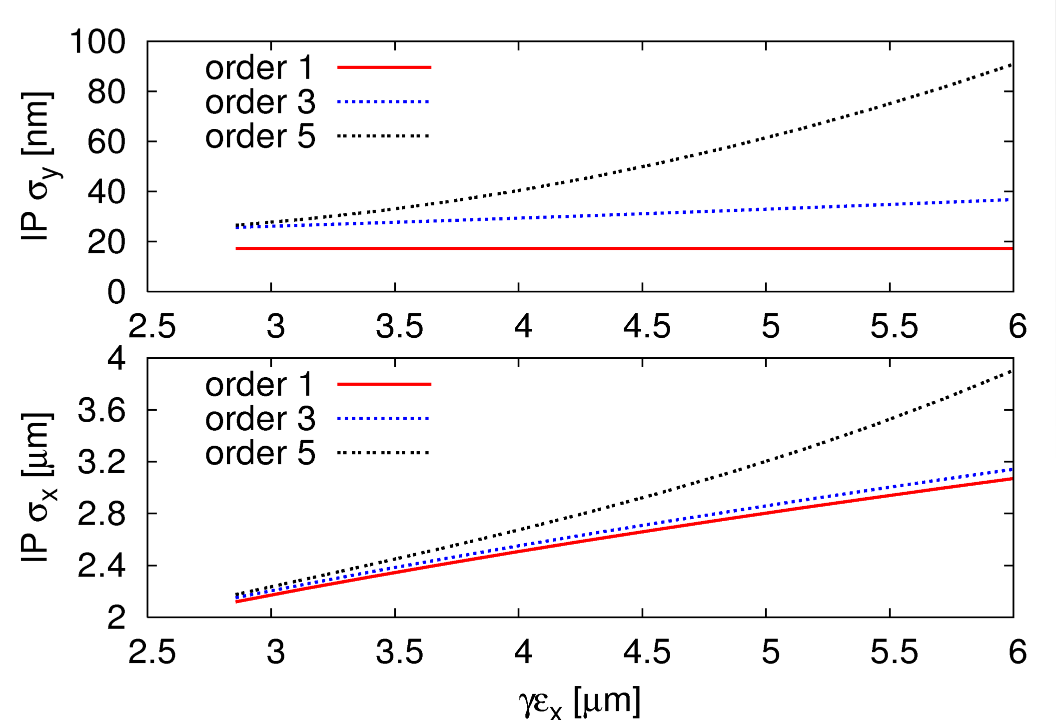




@ IP	ATF2 NL	ILC 500GeV	ATF2 UL	CLIC
β_y [mm]	0.1	0.4	0.025	0.2
σ_x [µm] σ_y [nm]	3 40	0.640 5.7	3 20	0.043 1
Chromaticity	19000	15000	76000	70000

ATF2 Ultra-Low β^* with Multipoles

The multipoles of the FD, the sextupoles and the bending magnets have been measured.



The beam size $(\gamma\,\varepsilon_x{=}6\mu m)$ @ IP :

σ_x = 3.9 μm

σ_y = 92.8 nm

The same issue appears for the ATF2 Nominal Lattice.

From an order by order analysis it is inferred that the skew octupole and dodecapole components of QF1are the main responsible for such behaviour.

Possible Solutions:

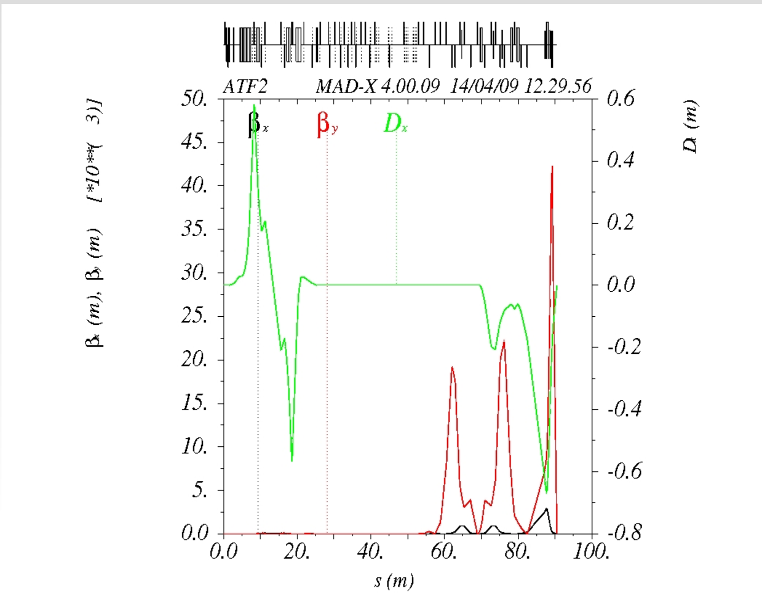
1. Decrease β_x at QF1

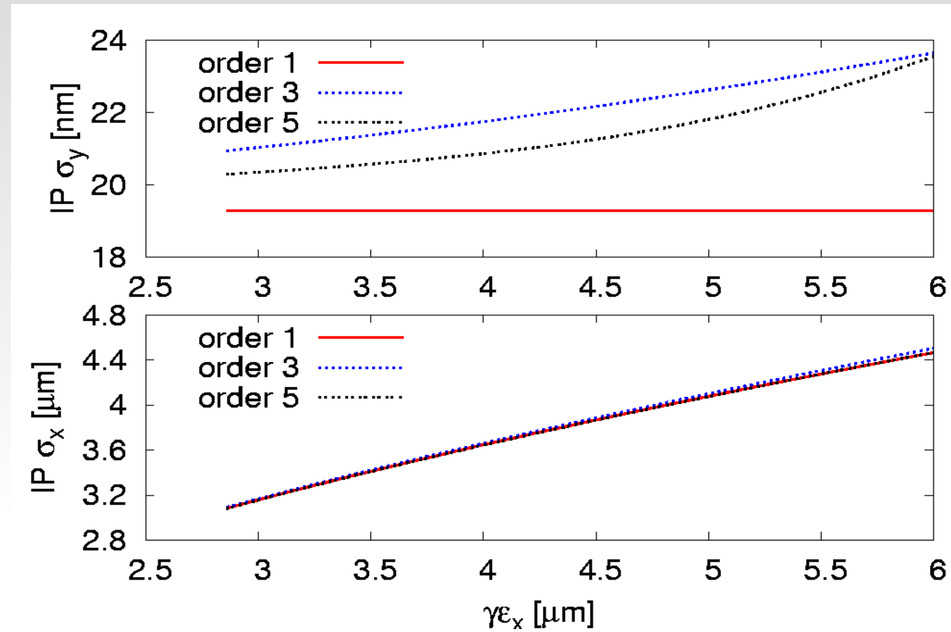
2. Replace the normal conducting magnet by a super conducting one.

3. Introduce a dodecapole magnet to correct explicitly the multipole component. (only valid for the Nominal Lattice)

The new ATF2 Ultra-Low β_y^*

Re-matching the quads and sext of the FFS to decrease β_x at QF1FF.





Lattice Properties:

- <u>Beta functions @ IP:</u>

  $\beta_x = 8.4$ mm $\quad \beta_y = 31.5$ μm

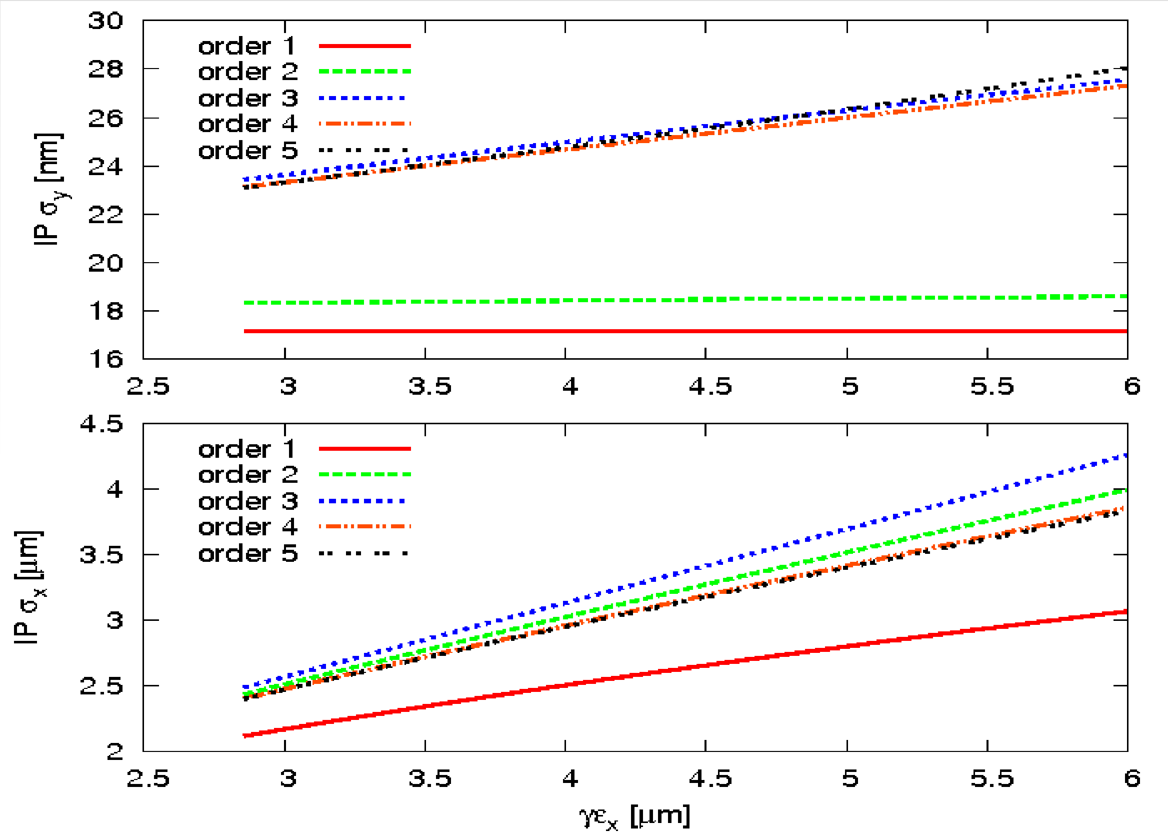
- <u>Beam sizes @ IP:</u>

  $\sigma_x = 4.4$ μm $\quad \sigma_y = 23.8$ nm

This is a non desirable solution since some of the scaled properties from CLIC FFS are modified.

ATF2 Ultra-Low β^* with the SC QF1FF

Results according to the multipoles measured for the SC Quadrupole at BNL the 26th of March.



Lattice Properties:

- Beta functions @ IP:

  $\beta_x = 4$ mm

  $\beta_y = 25.0$ μm

- Beam sizes @ IP:

  $\sigma_x = 4.3$ μm

  $\sigma_y = 28.0$ nm

The skew dodecapole contribution has been removed completely.

Still present a small contribution from the octupole component.

Comparison between the multipoles of NC and SC

The tolerances are obtained at a radius of 10mm and correspond to a 5% of variation in vertical beam size, in terms of RMS or in terms of a Shintake convolution.

QF1FF Skew Mults	Normal conducting	Super conducting	Tolerances ATF2 NL		Tolerances ATF2 UL	
			RMS	Shintake	RMS	Shintake
a_3 [10^{-4}]	2.74	-0.49	0.175	0.25	0.1	0.15
a_4 [10^{-4}]	0.58	-0.35	0.15	0.25	0.1	0.175
a_5 [10^{-4}]	0.128	-0.016	0.175	0.45	0.1	0.25
a_6 [10^{-4}]	3.6	-0.001	0.2	0.5	0.1	0.3

Tolerances for SF1FF

Assuming that the SC QF1 is installed, the tolerances for the SF1 are the followings:

SF1FF Skew Mults	Tolerances ATF2 NL		Tolerances ATF2 UL	
	RMS	Shintake	RMS	Shintake
a_4 [10^{-4}]	**1.0**	**1.5**	**0.275**	**0.35**
a_5 [10^{-4}]	**1.5**	**5.0**	**0.75**	**1.4**
a_6 [10^{-4}]	**5.0**	**25**	**2.0**	**4.6**

These tolerances are evaluated at R=28mm.

Conclusions and Future work

- The Super-conducting magnet is the preferable solution since the scaled lattices are unmodified.
- For the ATF2 Ultra-Low β^* proposal, the tolerances for the quadrupole become even more tight.
- The tolerances for the Sextupole magnet are very tight.
- Integrate all the measured multipoles from both quadrupole and sextupole magnet into the simulations.