



Follow-up on MQXFA simulations

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HL-LHC WP2 Meeting, CERN

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25 July 2023

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- Context
- Results with correction
- Corrector strength
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General context

- E. Todesco reported in the Kick-off meeting (31/08/2022) that the a_4 and a_6 from the prototype magnets are larger than anticipated.
- It was decided to check if this might have an impact on the DA.
- With regard to field quality, all HL-LHC magnet families were used in the simulations, except MCBXFs.

	Simulation	New	Ref.
a_4S	[0, 3]	1.575	0.00
a_4R	[0, 4]	1.930	0.65
a_6S	[0, 2]	0.958	0.00
a_6R	[0, 1]	0.500	0.31

MQXFA Field Quality (Reference: *lhcopt*)

Integrated strength	TDR 20
Skew oct. [Tm]	0.0690
Skew dodec. [Tm]	0.0170

Corrector Specification ($R=50$ mm)

Baseline (v1.4 Optics)

$$\begin{aligned}Q_x &= 62.31 \\Q_y &= 60.32 \\Q' &= 3\end{aligned}$$

$$\begin{aligned}\frac{1}{2}\theta_c^{1,5} &= 250 \mu\text{rad} \\d_{sep}^{1,5} &= \pm 0.75 \text{ mm} \\I_{MO} &= 0 \text{ A}\end{aligned}$$

$$\begin{aligned}\beta_{1,5}^* &= 0.15 \text{ m} \\\beta_2^* &= 10 \text{ m} \\\beta_8^* &= 1.5 \text{ m}\end{aligned}$$

$$\begin{aligned}E &= 7000 \text{ GeV} \\\epsilon_n &= 2.5 \mu\text{m}\end{aligned}$$

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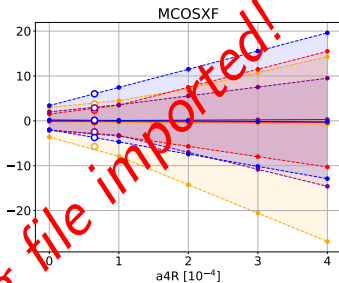
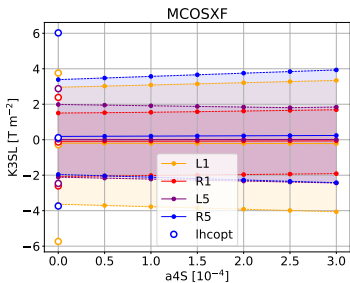
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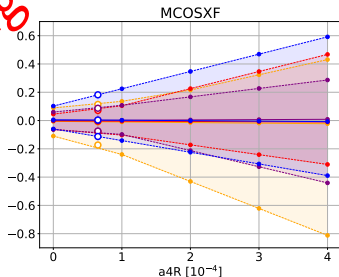
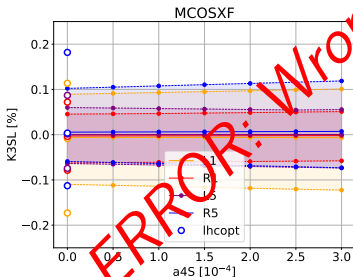
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MCOSXF Main strength

Absolute strength



Relative strength

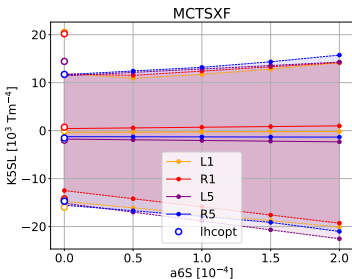


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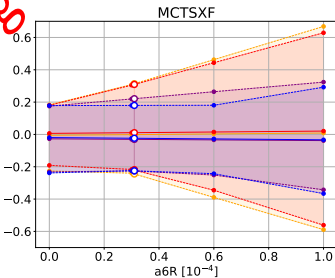
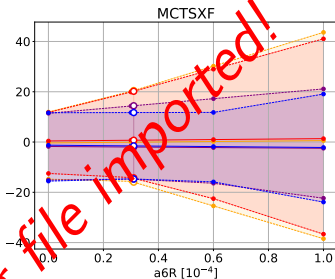
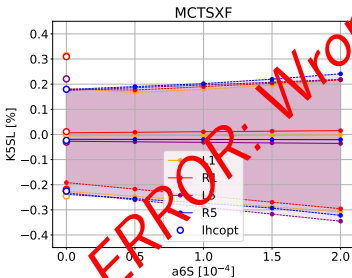
When a multipole component is varied, the other 3 are set to 0 for the MQXFA.

MCTSXF Main strength

Absolute strength



Relative strength

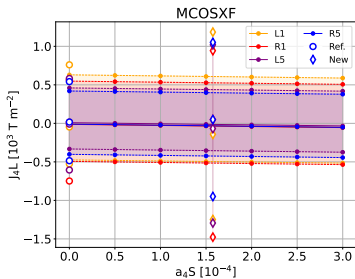


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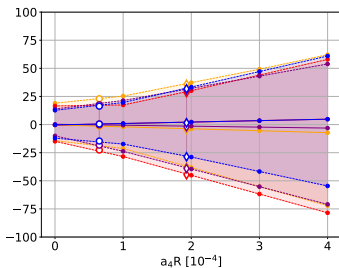
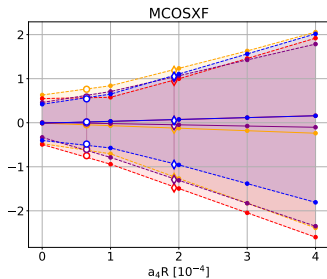
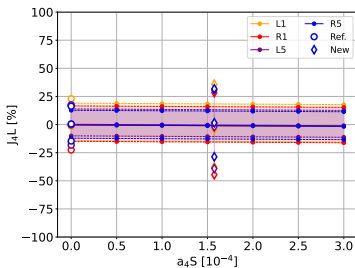
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MCOSXF Main strength

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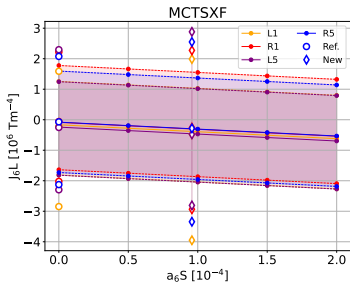
Relative strength



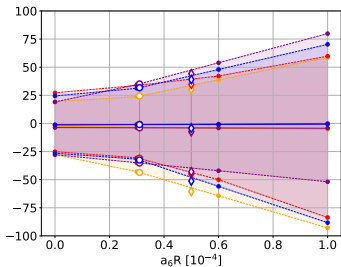
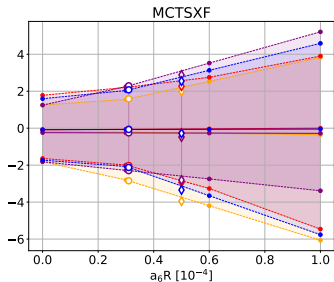
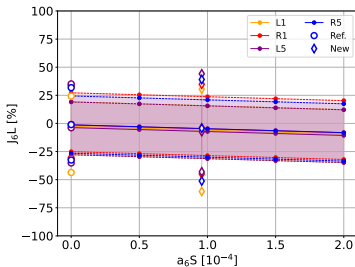
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Absolute strength



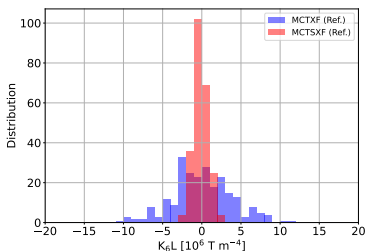
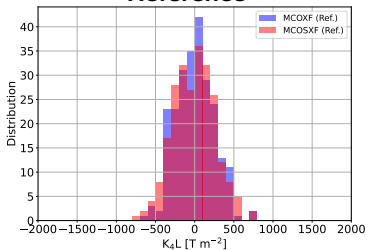
Relative strength



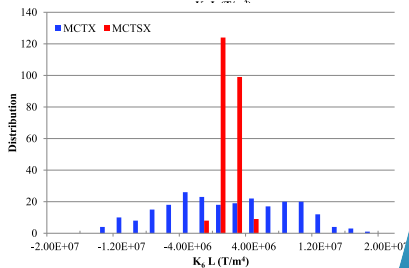
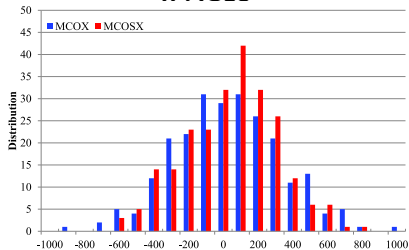
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Comparison with IPAC13

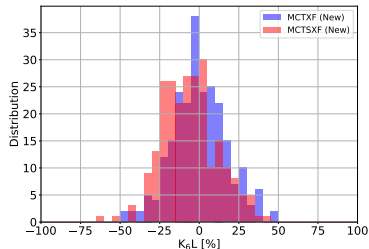
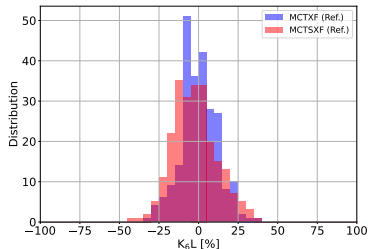
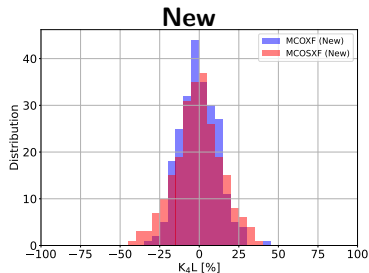
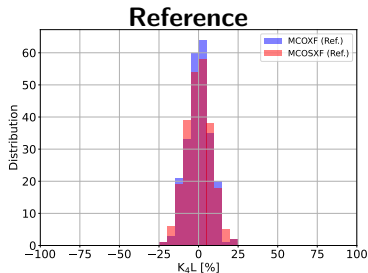
Reference



IPAC13



and between New and Reference



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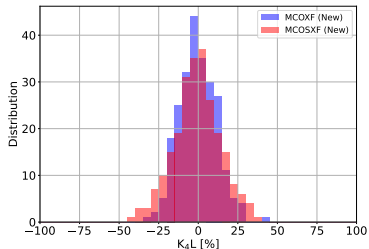
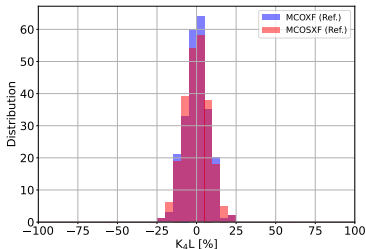
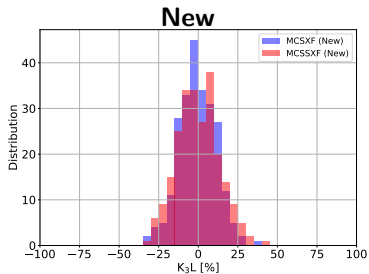
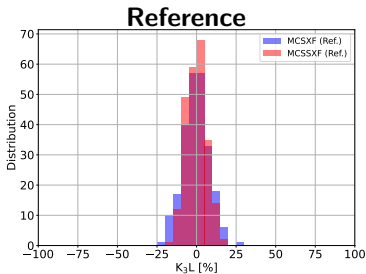
- DA is not affected by the increase of a_6 . No extra correction is needed.
- Without correction, DA is significantly affected by the increase of a_4 .
- The IT correctors are effective in mitigating the impact of the increase in a_4 , and the required strength is within the specifications, also leaving a bit less than 50% margin.

Thank you very much!

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... between Reference and New



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