Fine tuning of MQXF cross section to optimize b6

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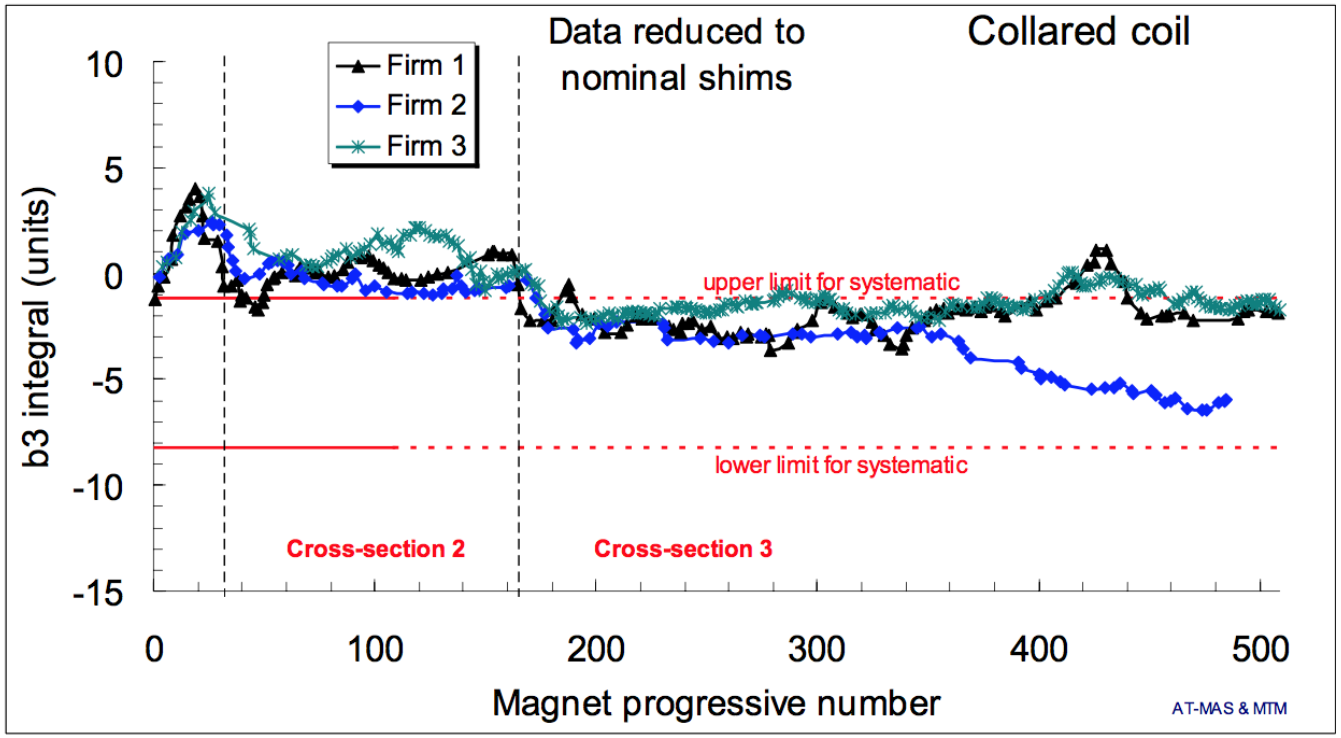
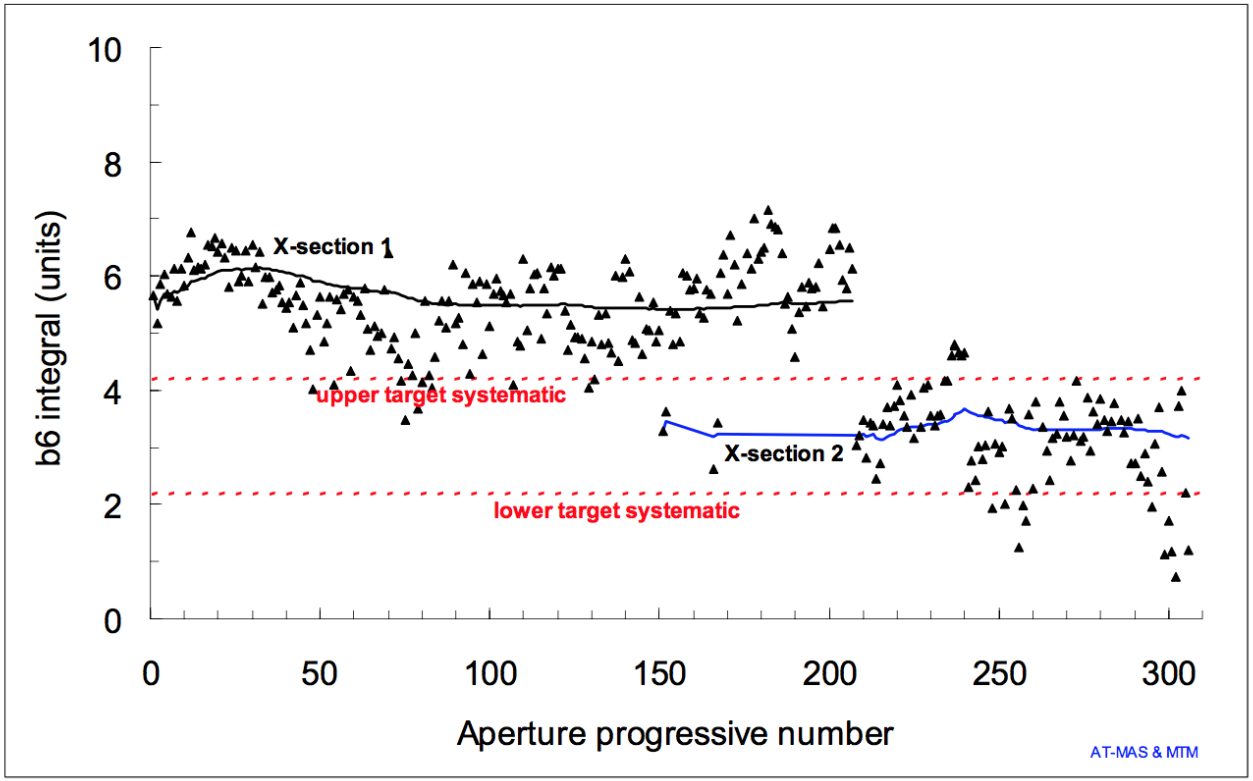
CONTEXT

- Fine tuning of field quality is usually required
- LHC experience:
  - Two iterations in main dipoles, one after 35 magnets and one after 154 magnets
  - b_3 reduction of 3 - 6 units



CONTEXT

- Fine tuning of field quality is usually required
- LHC experience:
  - One iteration on the main quadrupoles after 70 magnets, b_6 reduction of 3 units



CONTEXT

- Fine tuning of field quality is usually required
- LHC experience:
  - One iteration in MQXFB

« A shift of 0.85 units of b_6 was predicted by the calculation, and one unit was observed. Following the result from warm measurement of MQXB04, the shim pattern was modified in MQXB05 and fixed for the production of MQXB06 and later »

Velev et al., EPAC 2004

DATA

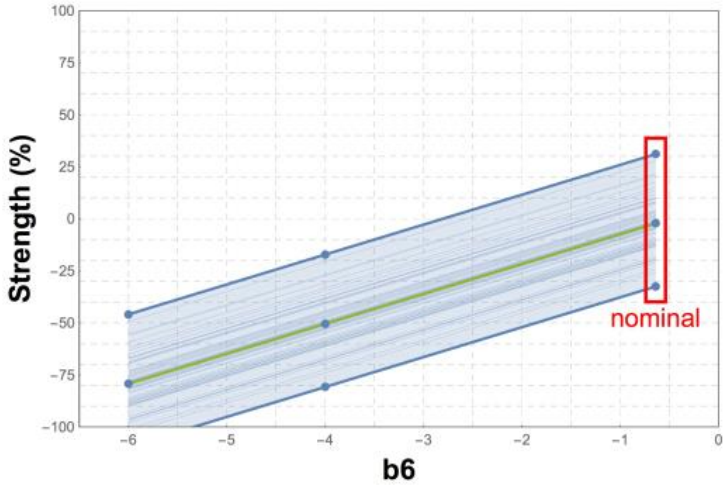
- These are data of the straight part, at room temperature
  - Heads give a contribution of +0.5 to +1 unit to nominal
  - MQXFS1 with first cross-section, not significant
  - MQXFAP1 with mixed coils, not measured

Magnet	b6 room temperature	b6 nominal
MQXFS1	3.57	1.49
MQXFS3	-1.90	-1.83
MQXFS5	-4.84	-4.26
MQXFS4	-4.36	-4.23
MQXFAP1		
MQXFAP2	-5.72	

- Target is within 1 unit, sigma is 1.1 units
- Situation presented to WP2 in 31 July

FEEDBACK FROM WP2
(MY INTERPRETATION)

- Very fast feedback presented in WP2 meeting on August 29 https://indico.cern.ch/event/751331/
  - Correctors can still manage with most of the possible configurations with -4 units of systematic, and even -6 units
  - But we are at the edge
  - Starting the production with this offset does not look wise to us, we will be sensitive to any trend going in the wrong sense
  - And we will not have so much time to react as for LHC



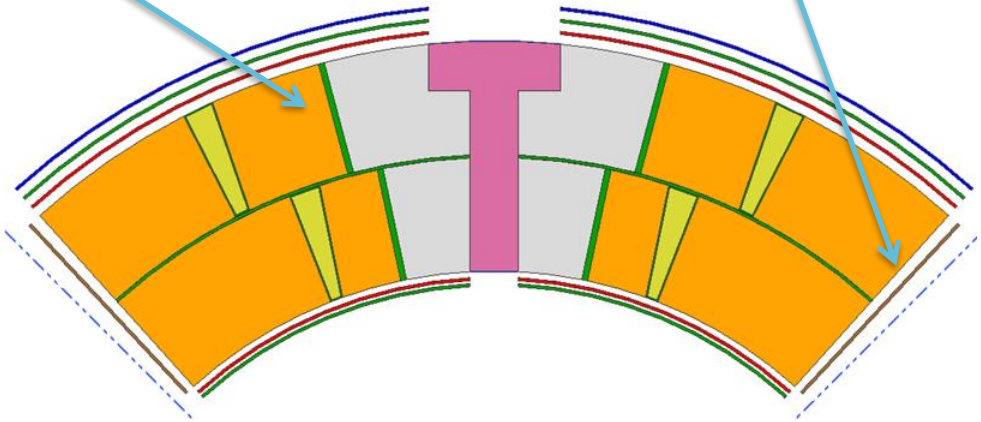
Required strength of the dodecapole corrector versus systematic b6
[F. van der Veken, M. Giovannozzi]

ACTIONS

- Increase b_6 means decreasing midplane insulation or increase pole shim (or both)
- Today we have in the impregnated coil

  4 sheets of 0.125 mm on the pole

  One shim of 0.250 mm on the midplane
- Moreover we have two sheets of 0.125 mm in the midplane between each couple of coils, to be put during coil pack assembly

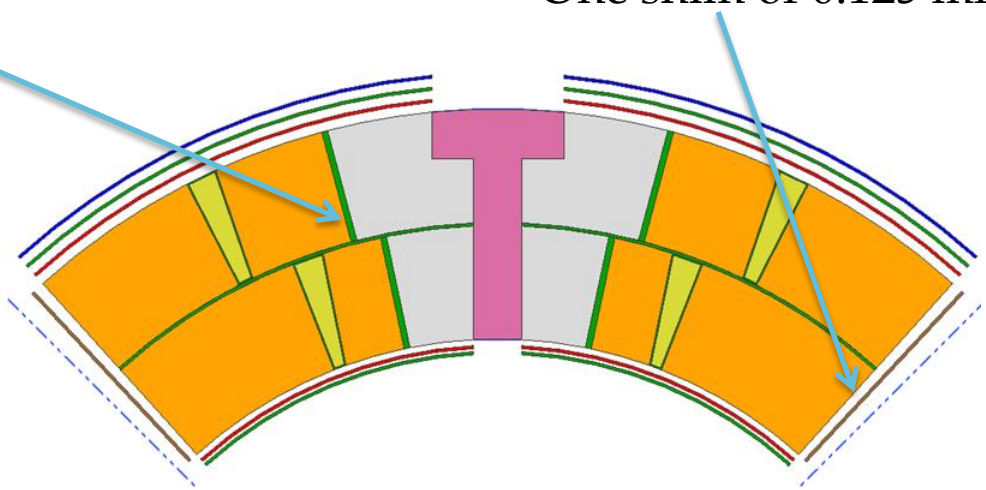


PROPOSAL

- Add 0.125 mm on the pole before winding and remove 0.125 mm on the midplane before impregnation
  - This shall shift up b_6 of 5.3 units
- This change only in the straight part, no need of changing also the heads
- If b_6 shall be too high, reduction is possible through insertion of additional insulation in the midplane during assembly

5 sheets of 0.125 mm on the pole

One shim of 0.125 mm on the midplane



WHEN

- CERN shall include this change from the coils needed for MQXFBP2 (PIT)
- AUP shall include this change from the coil needed for MQXFB04
- In this case we shall have one prototype (MQXFBP1) and two magnets (MQXFAP2 and MQXFA03) with around -4 units
- Design change shall be circulated before September 15

https://edms.cern.ch/document/2019517