QDo, QFi & Shielding

Eugenio for the Magnetic Team

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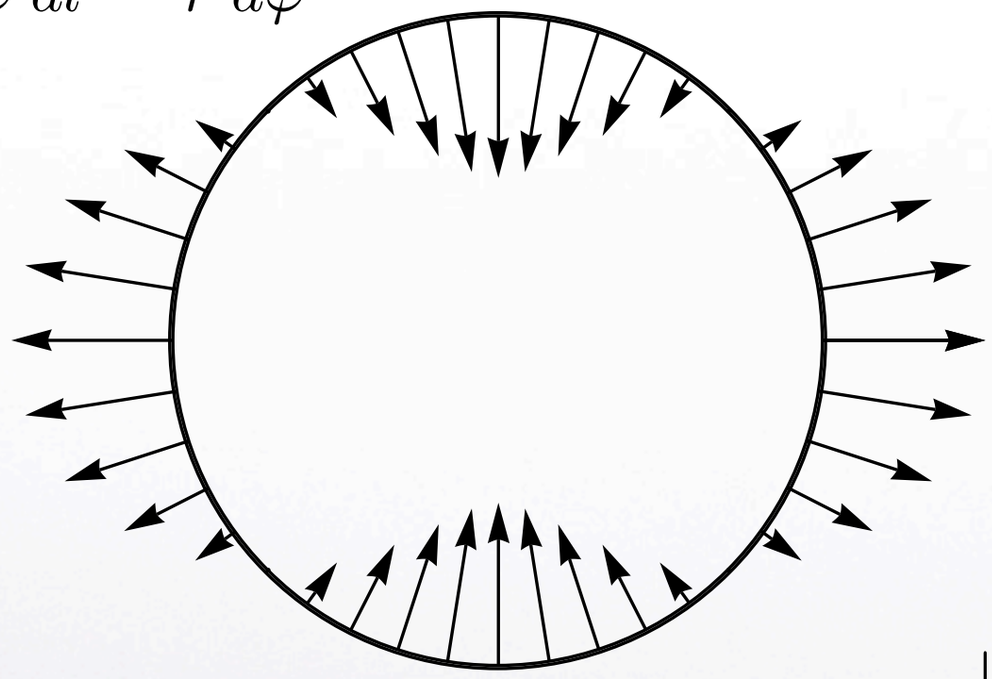
Mechanical stress analysis

A thin shell alone cannot bear the buckling force

$$\frac{d\vec{F}}{r\ d\varphi\ dl} = \frac{d\vec{j}}{r\ d\varphi} \wedge \vec{B}$$



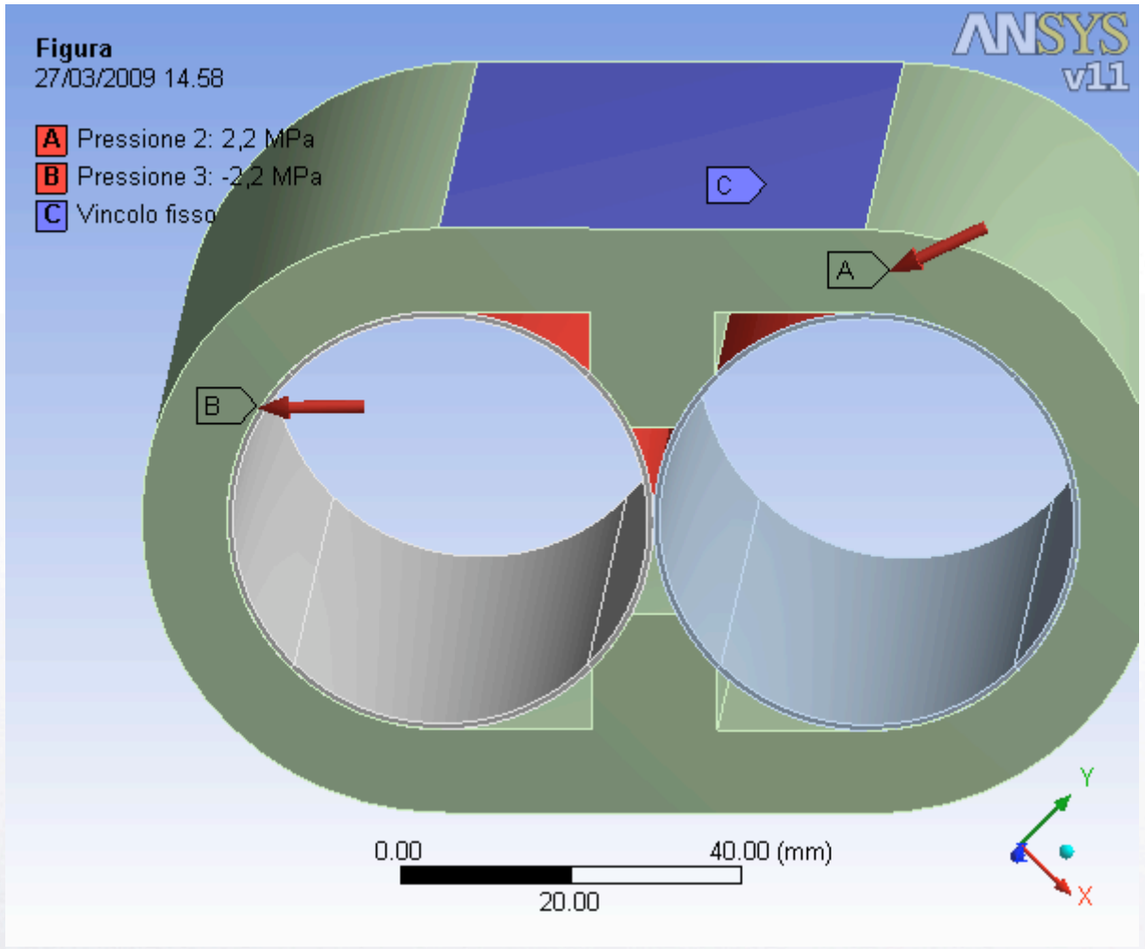
$$|\vec{B}| \sim 3\ \mathrm{T}$$

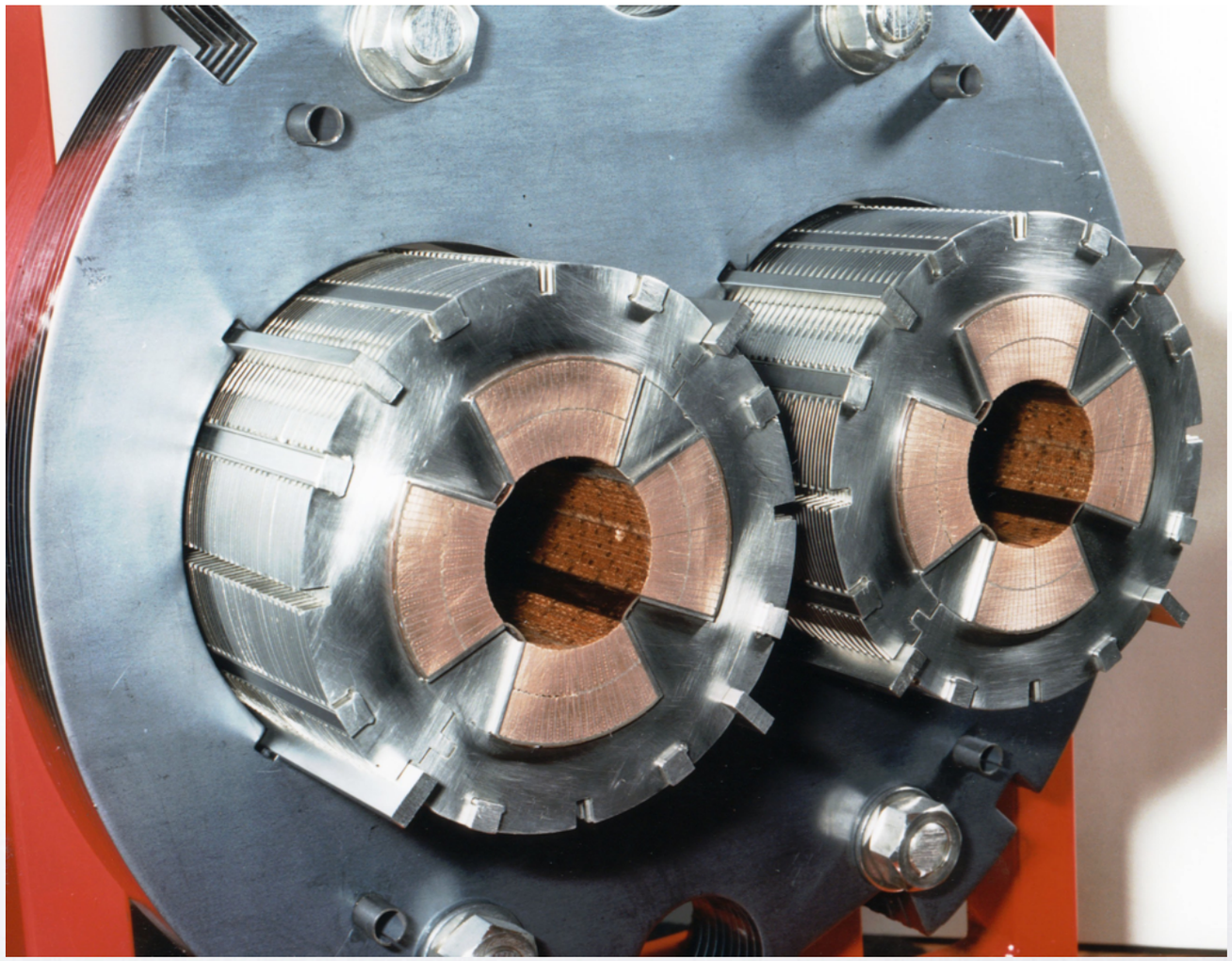
$$j_z \sim 2 \times 1400\ \mathrm{A/mm} \cdot \cos 2\varphi$$

$$P \sim 2 \times 4\ \mathrm{MPa} \cdot \cos 2\varphi \sim 2 \times 40\ \mathrm{kg/cm^2}$$

Mechanical Support

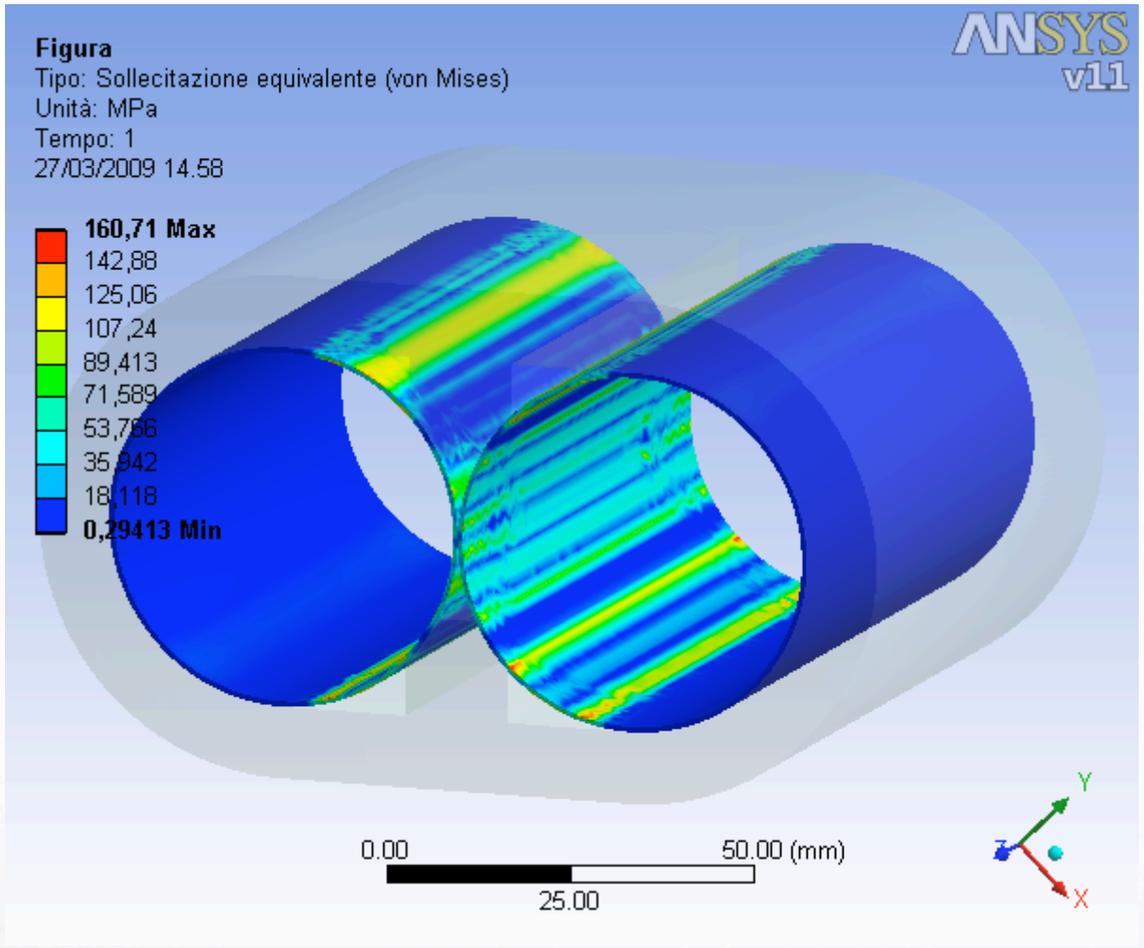
(Filippo Bosi + Maurizio Massa)

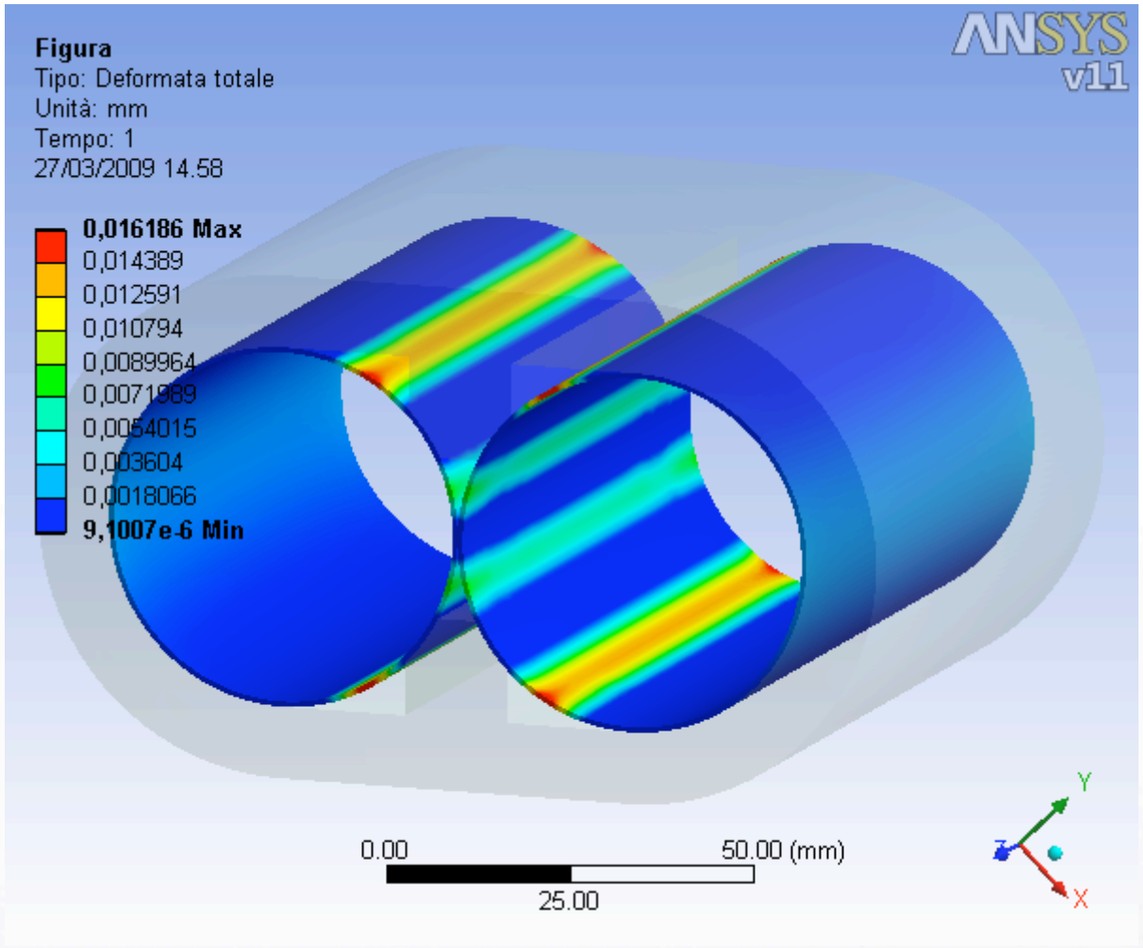




Small scale version of the LHC twin quads design

Stress & Deformations





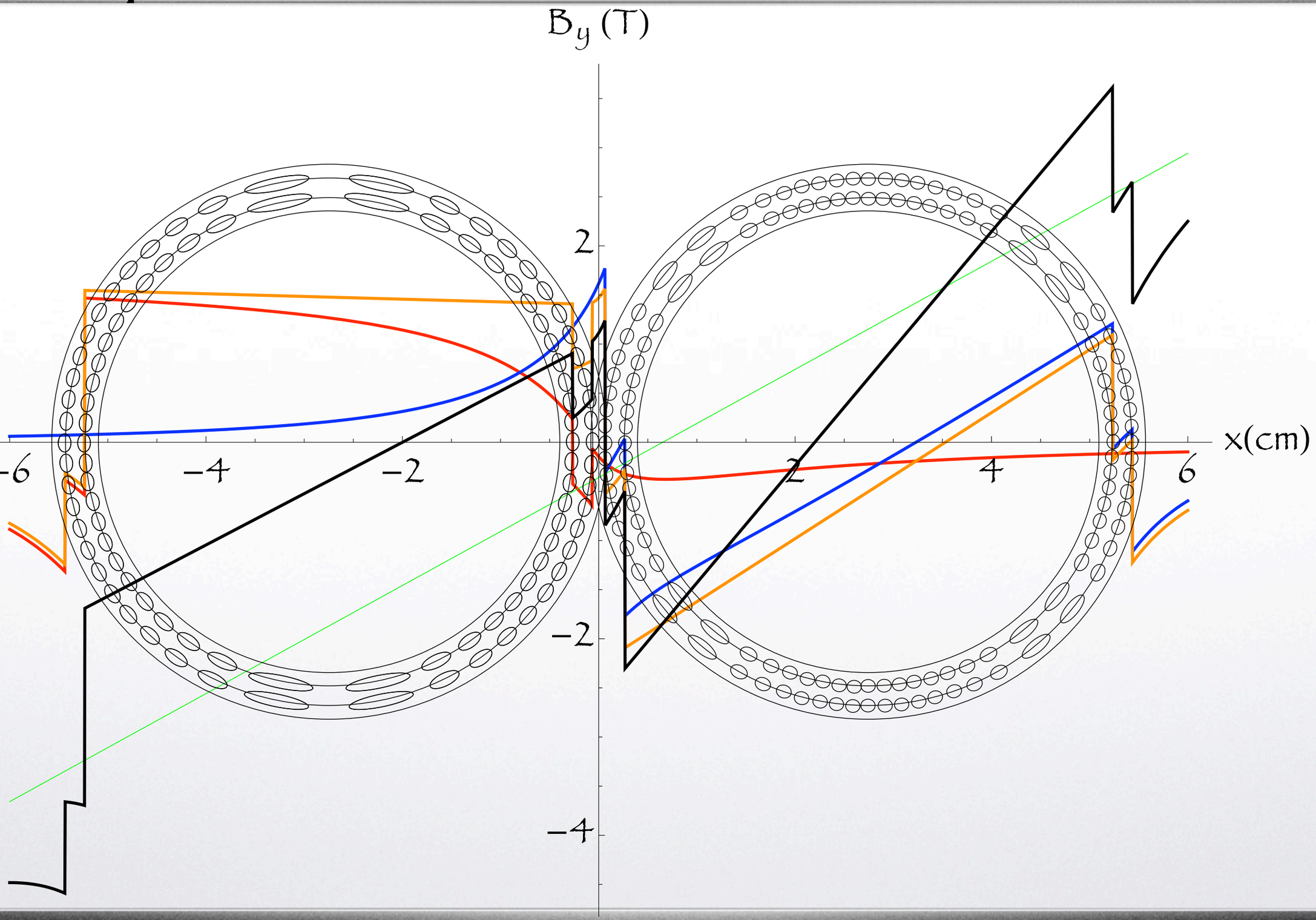
- Support cylinder thickness 0.7 mm, load 2.2 MPa
  - Von Mises stress < 150 MPa (Steel, high strength alloy ASTM A514 yield strength ~ 690 MPa)
  - Maximum deformation < 0.016 mm

Mechanical tollerances

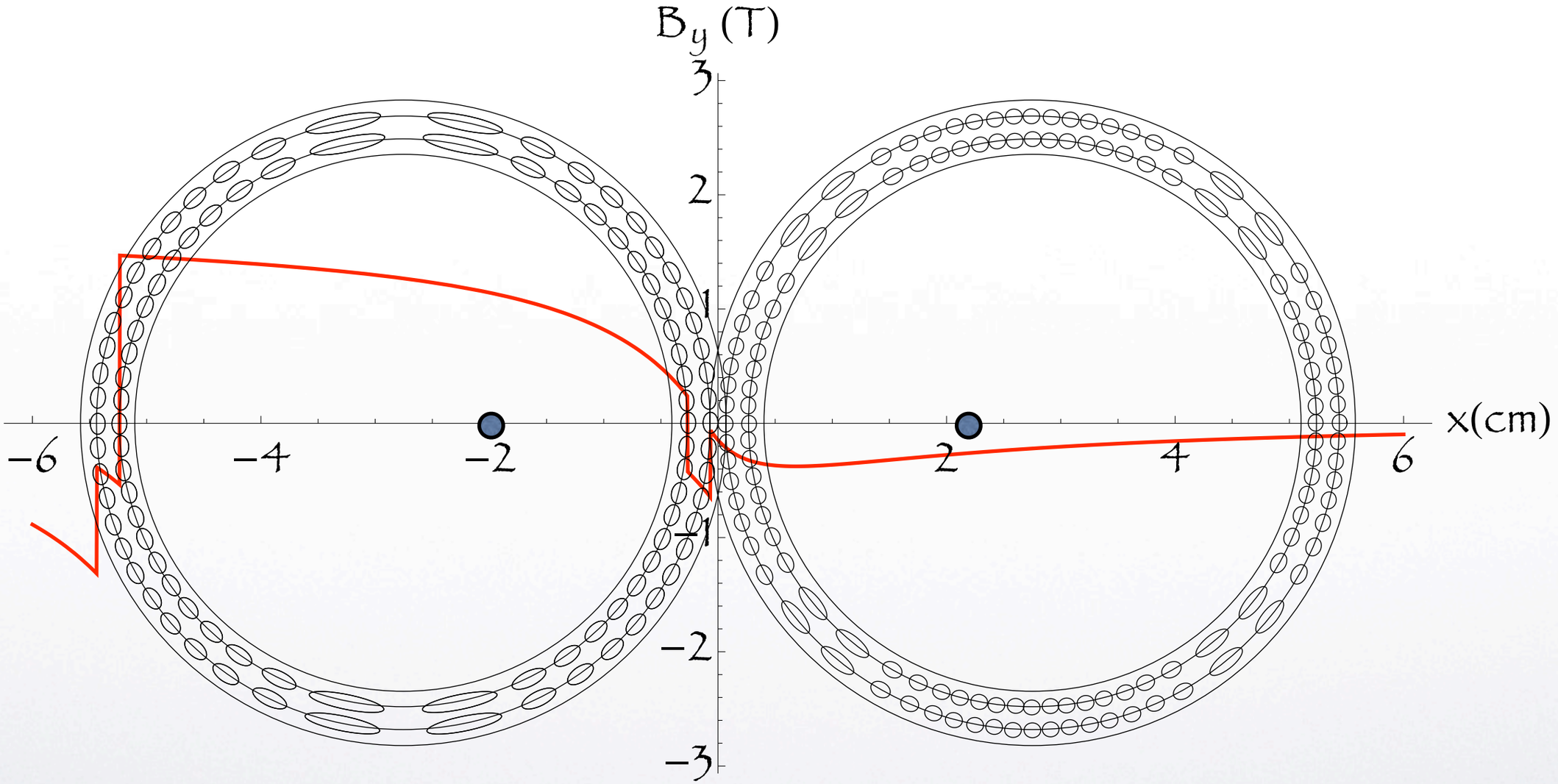
- So far the 3D finite element analysis considered an error-free mechanical assembly
- What is the effect of... ?

- finite precision on the mechanical assembly of the left and right part Coherent motion of the sources.
- finite precision on wire positioning

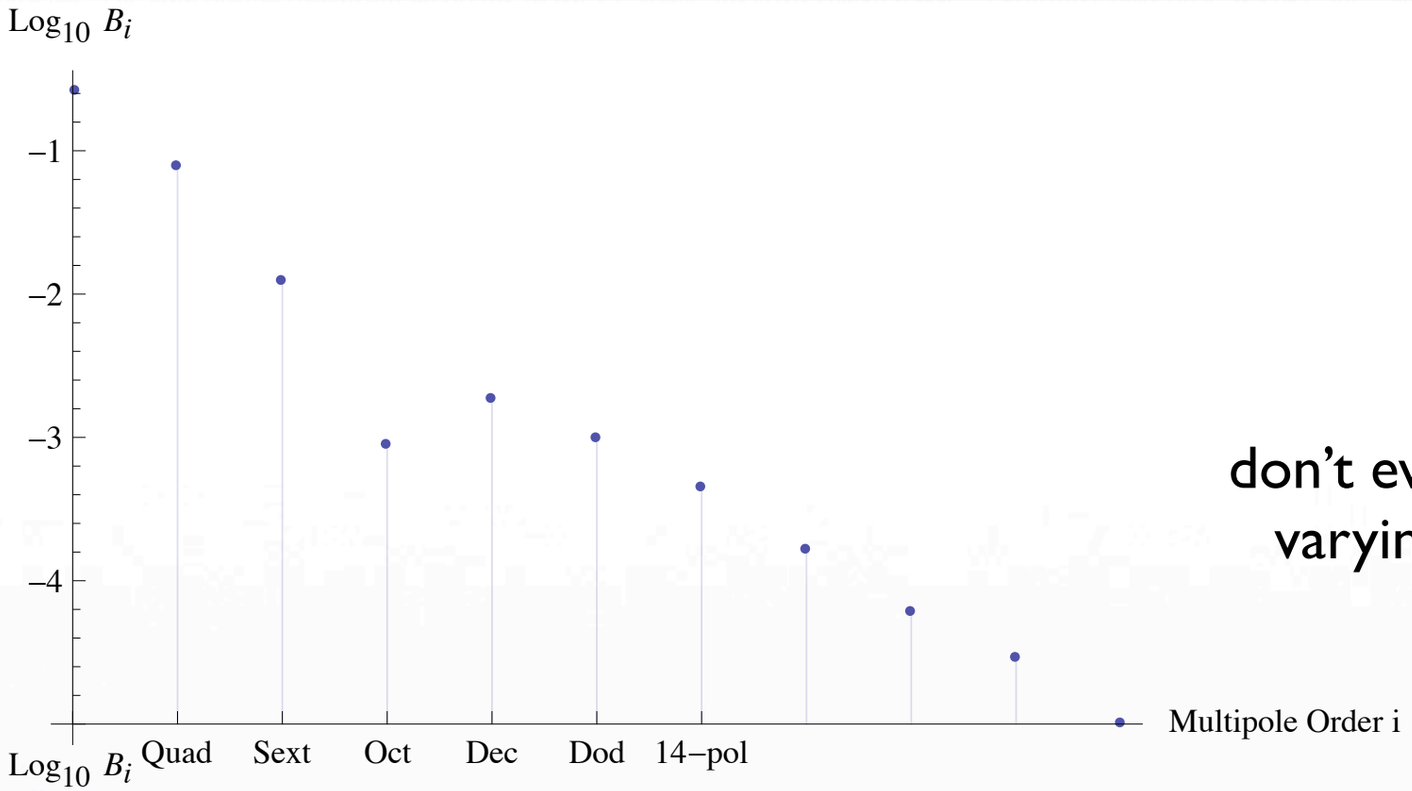
Compensation scheme



Let us focus on the LER coils

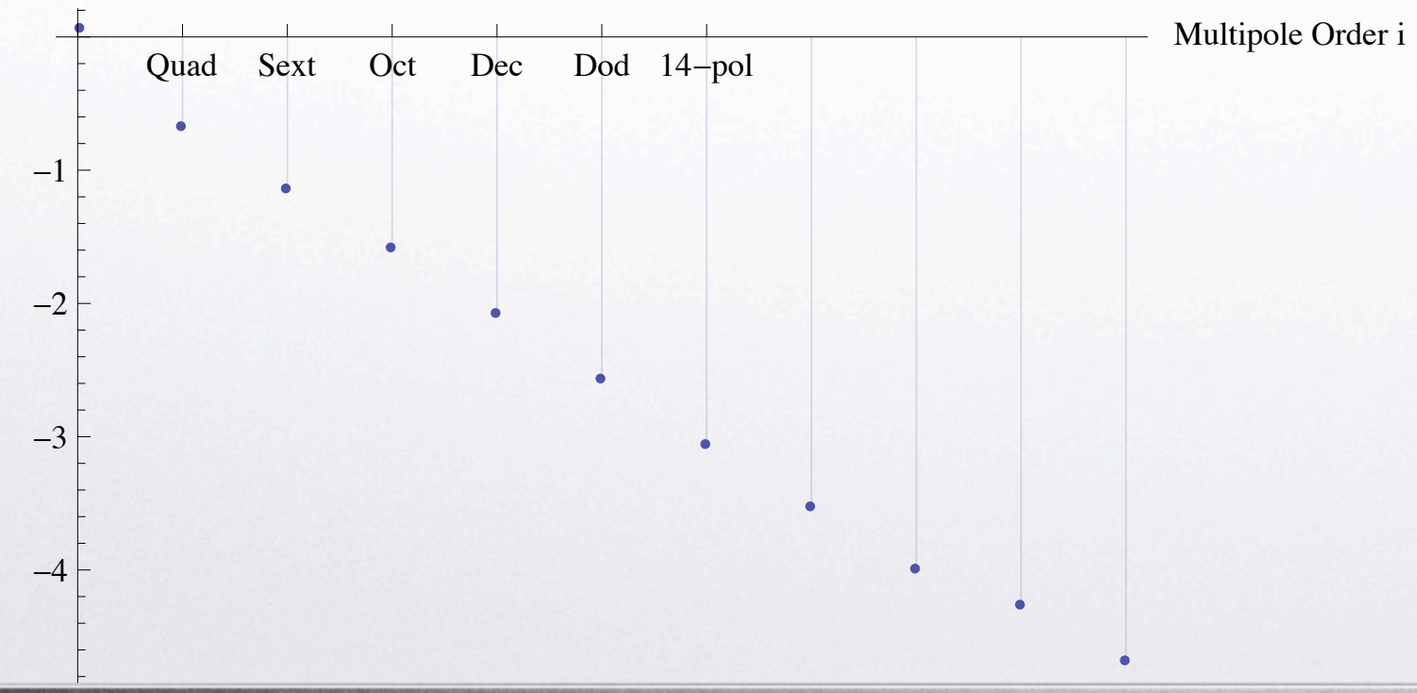


LER coils harmonic analysis (1cm)



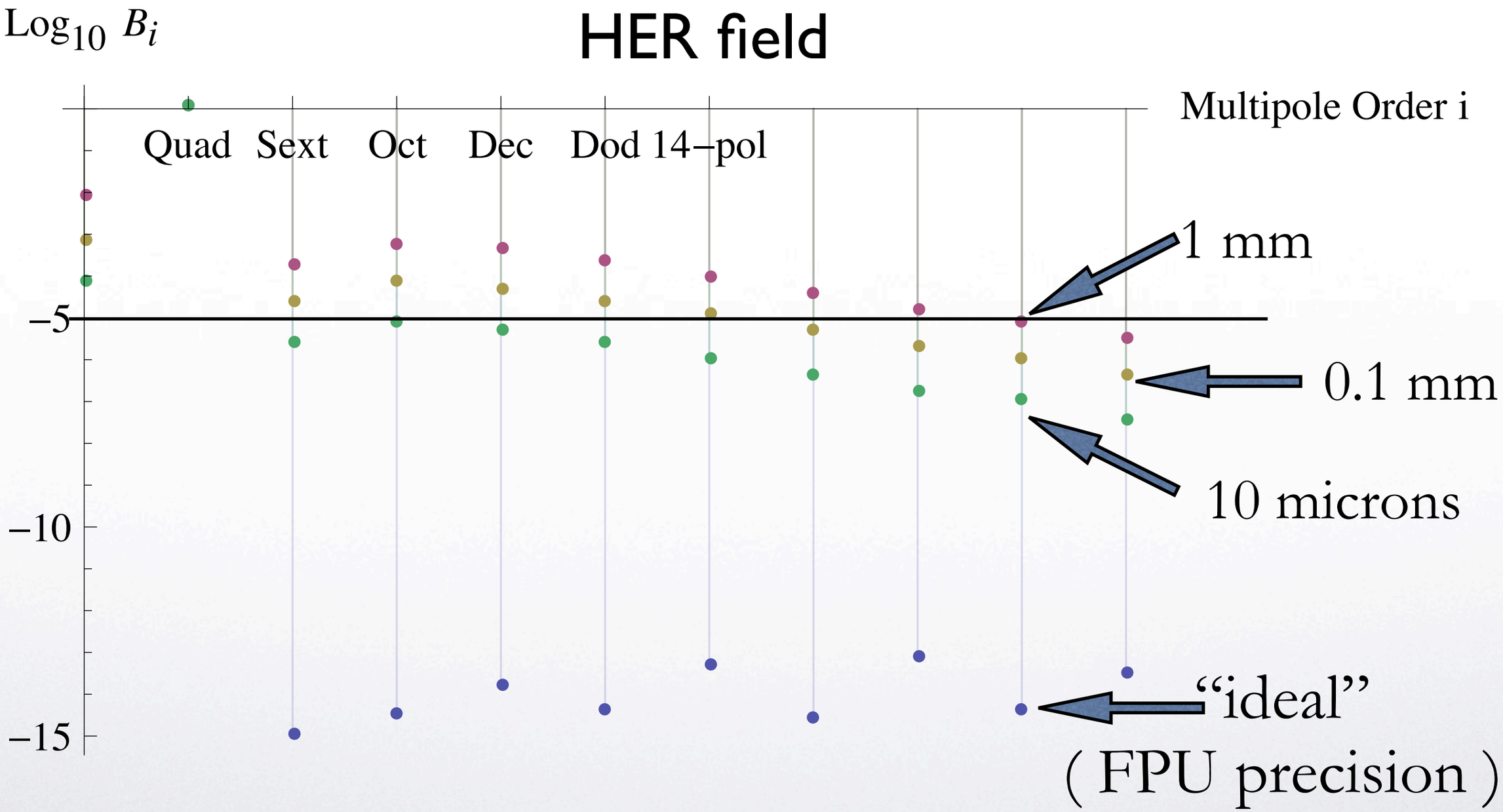
"Inside field"

Side remark:
don't ever think to tune K_{LER} and K_{HER} by varying independently the 2 currents

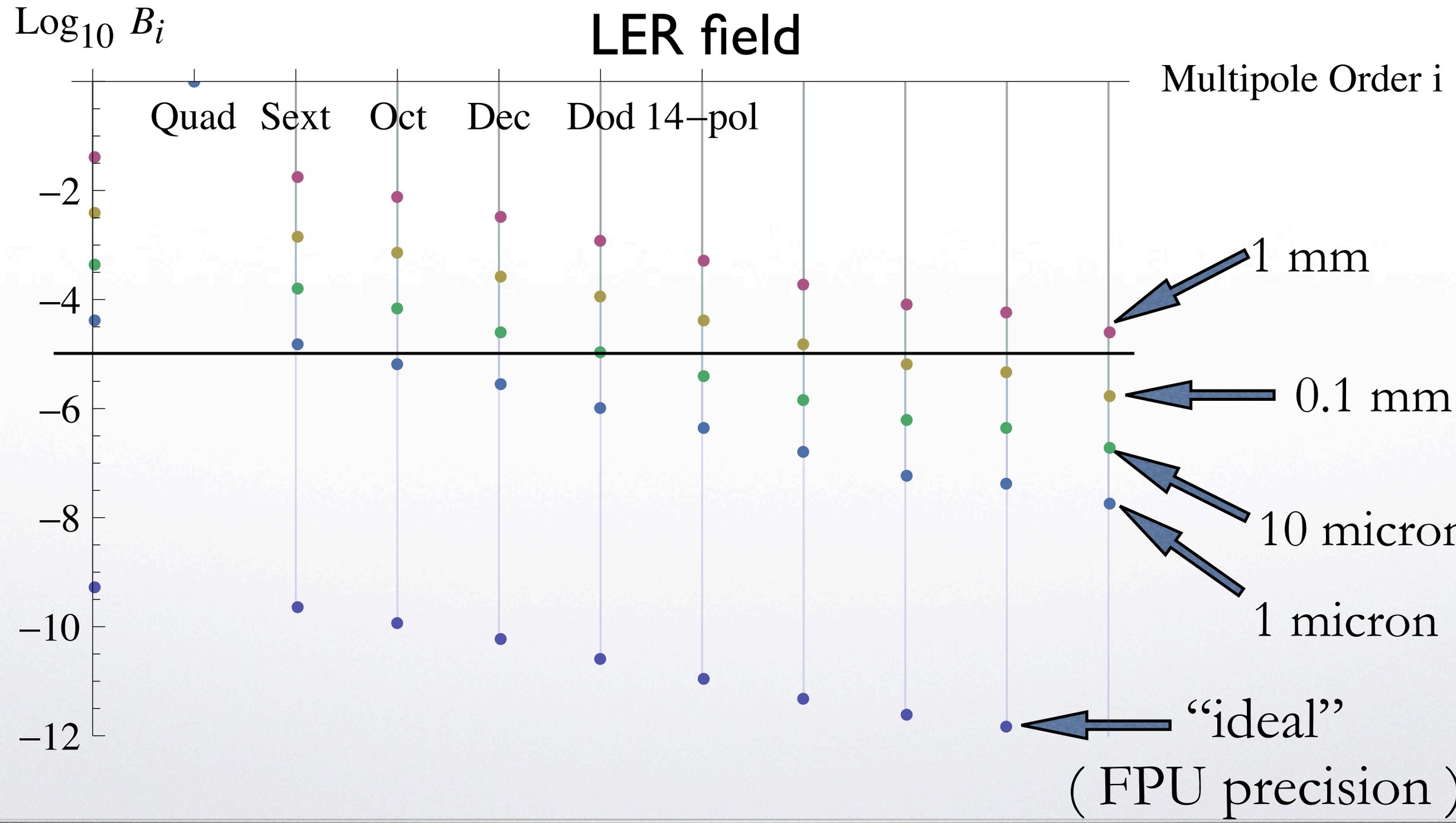


"Outside field"

What if the LER coil is displaced?



What if the LER coil is displaced?



Left + right assembly tolerances

- 10 microns routinely achievable
- 1 micron still feasible with state of the art machining
- What hapens during cool down from room temperature down to 2 K?

Conclusions

- Mechanical design started
- No show stopper at present
- Still to evaluate sensitivity to other coherent misalignments using 3D model
- Required winding precision to achieve 10^{-5} precision still to be evaluated

Shielding

- Mike Beam line P3 described in Geant4
- 3cm thick tungsten shielding around the beam line
- Small production of beam-strahlung events completed (Sunday night...)
- Detector people finally have something to look at (and rejoy/complain for)