A magnet for a muon collider detector

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MuCol

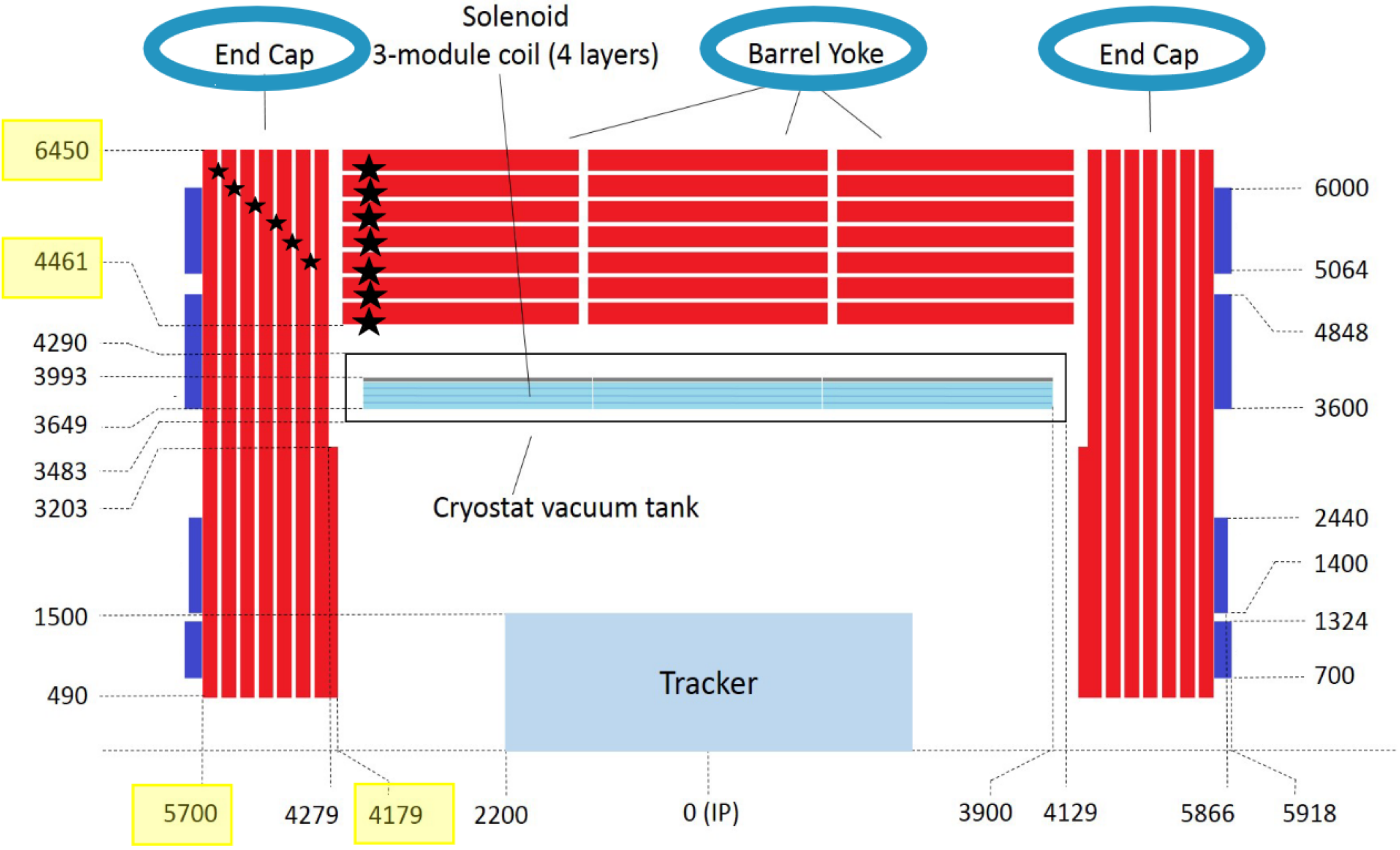
Workshop in October 2023

- Dedicated meeting has been held:
  - Detector requirements (M. Casarsa)
  - MDI requirements (D. Calzolari)
  - SC tech. for future colliders and detectors (A. Yamamoto)
  - Alu. stabilised SC cables R&D at CERN (B. Cure)
  - 3.6 T CLIC like detector (M. Mentink)
  - Detector magnet survey (AB)

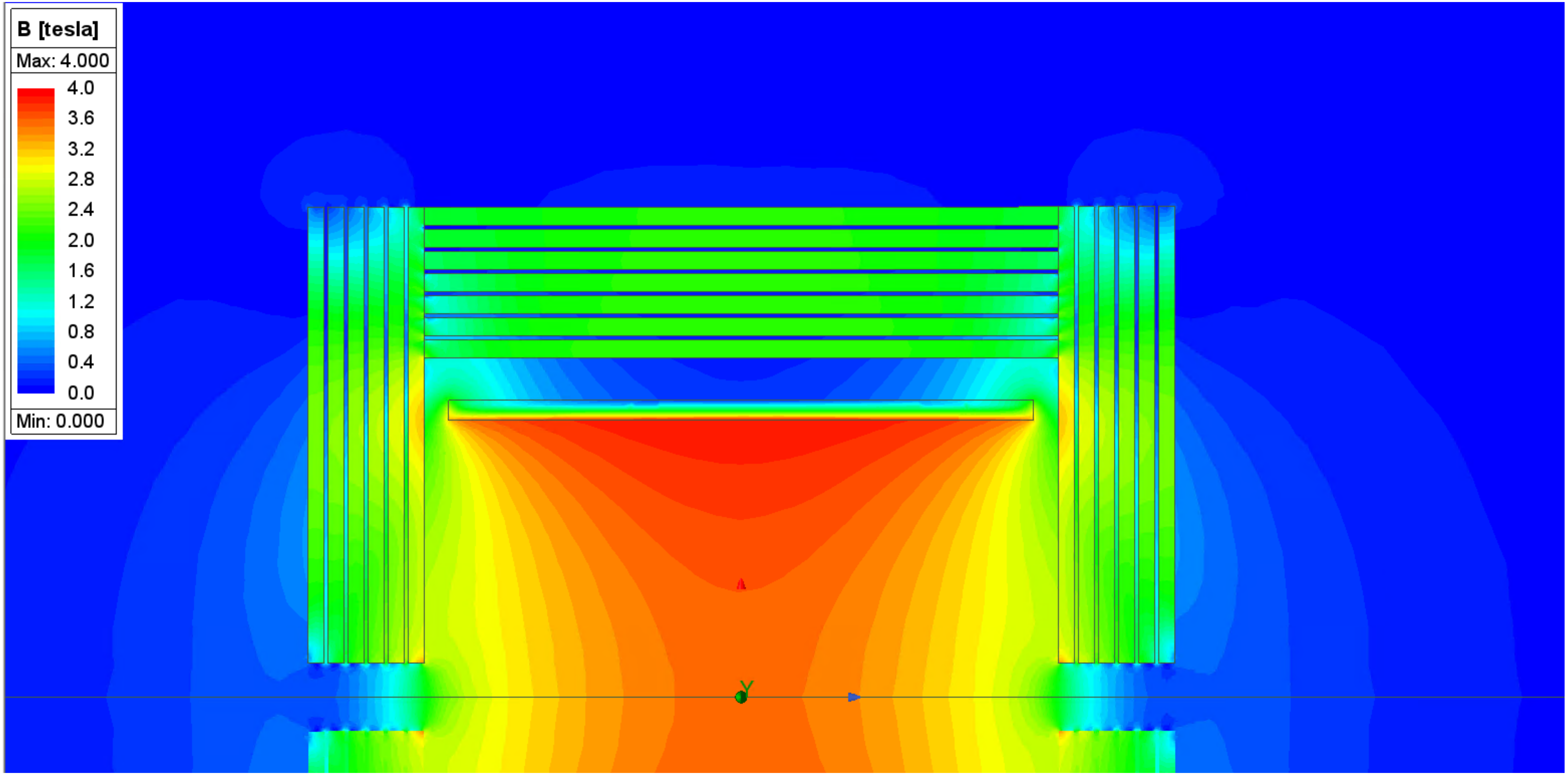
- CLIC detector is considered a good starting point for the Muon Collider detector
- "Traditional" aluminium stabilised NbTi based Rutherford cable is the baseline
- Other possibilities should be taken into account
  - different SC materials
  - different cable protection
  - different geometries

Tentative Design

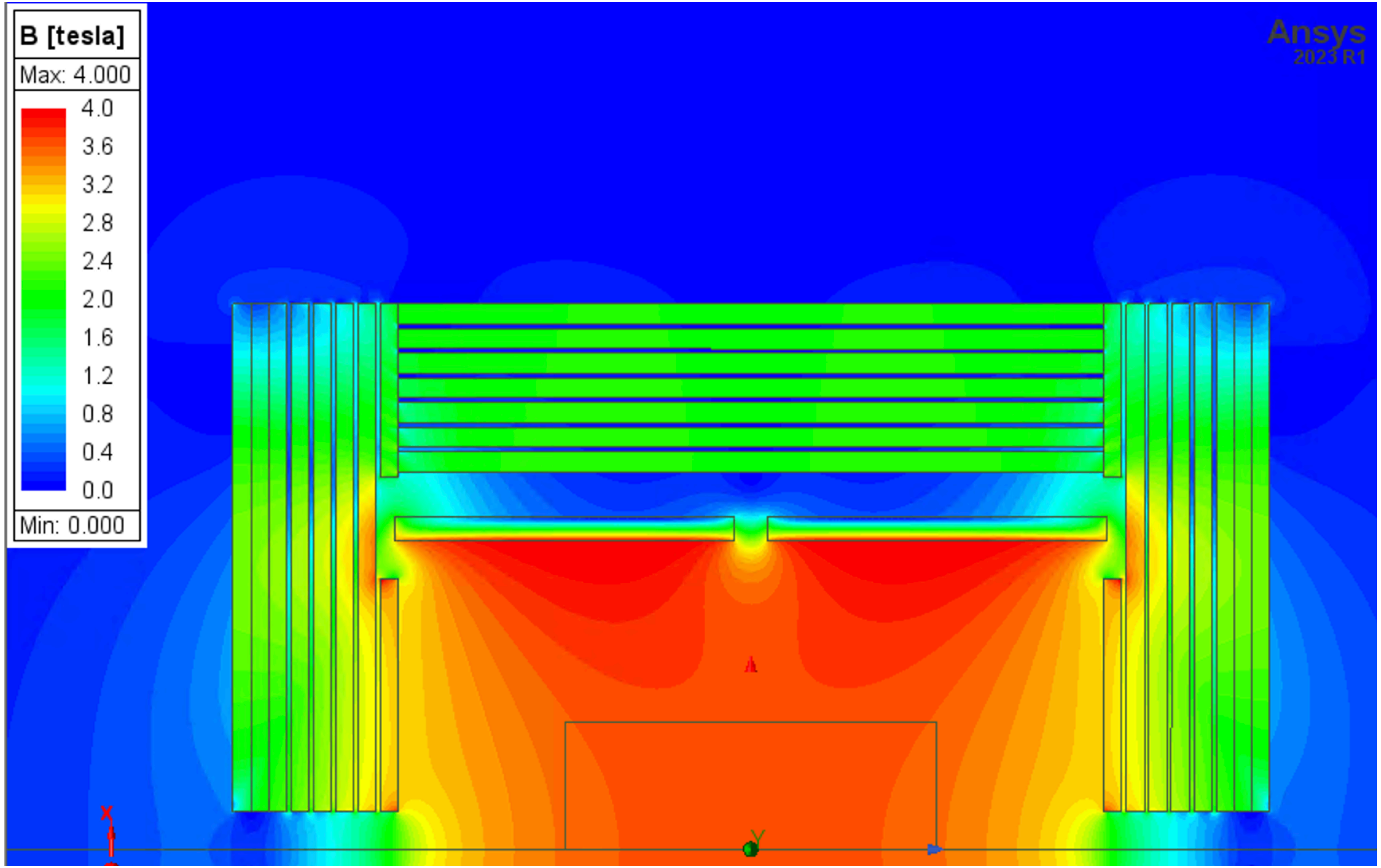
- To start, I took parameters from CLIC-based design
- I assumed a ~ 50 mm gap for muon chambers between iron layers (magnet design not so sensitive to this, at this level)
- 6 layers in the end-caps, 7 layers in the barrel
- Total coil length 7.8 meters, diameter 7.3 meters
- Field at centre 3.75 T
- Very similar calculations in M. Mentink slides



Picking inspiration from CMS



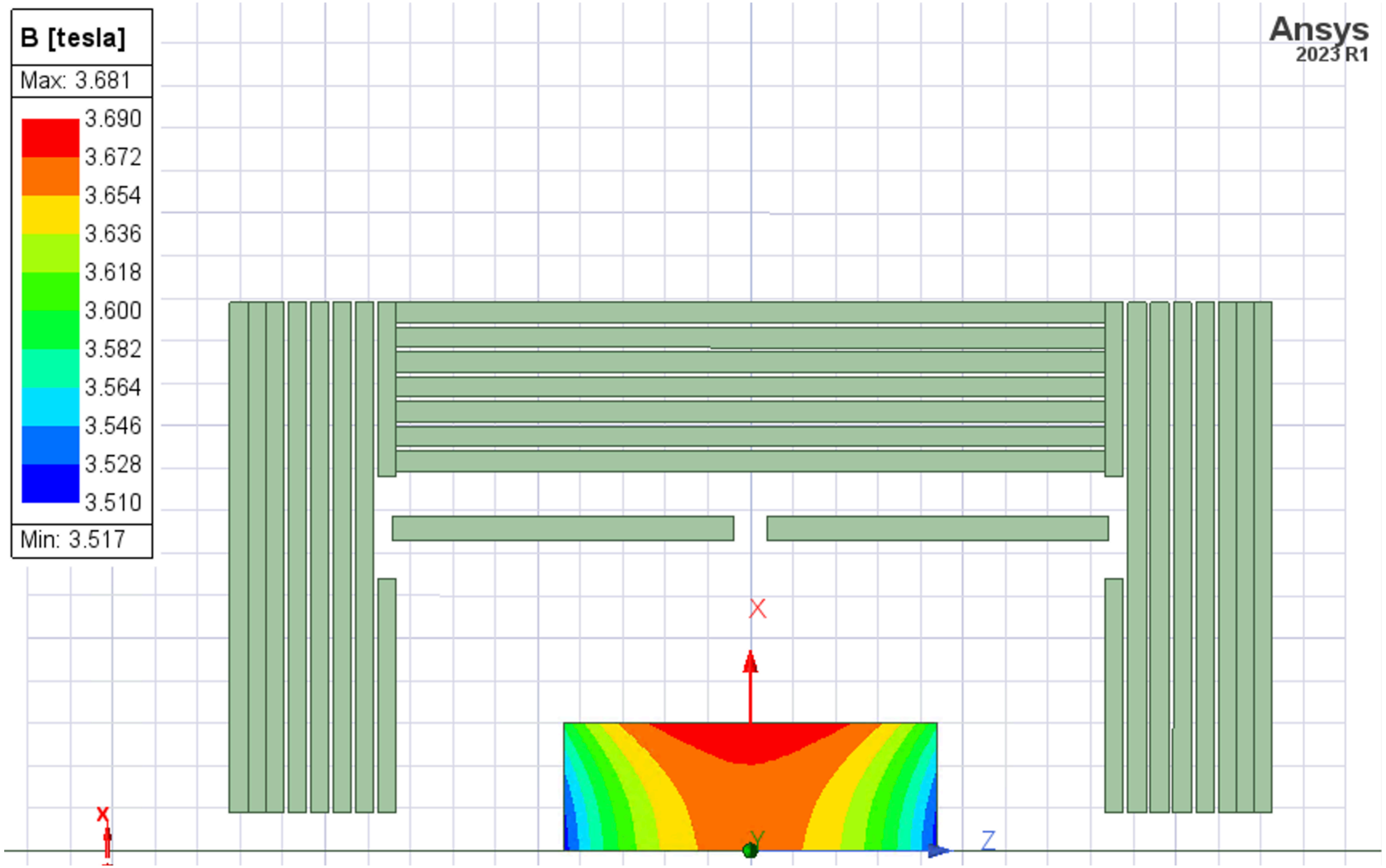
Minimally optimised design



Some remarks on field quality

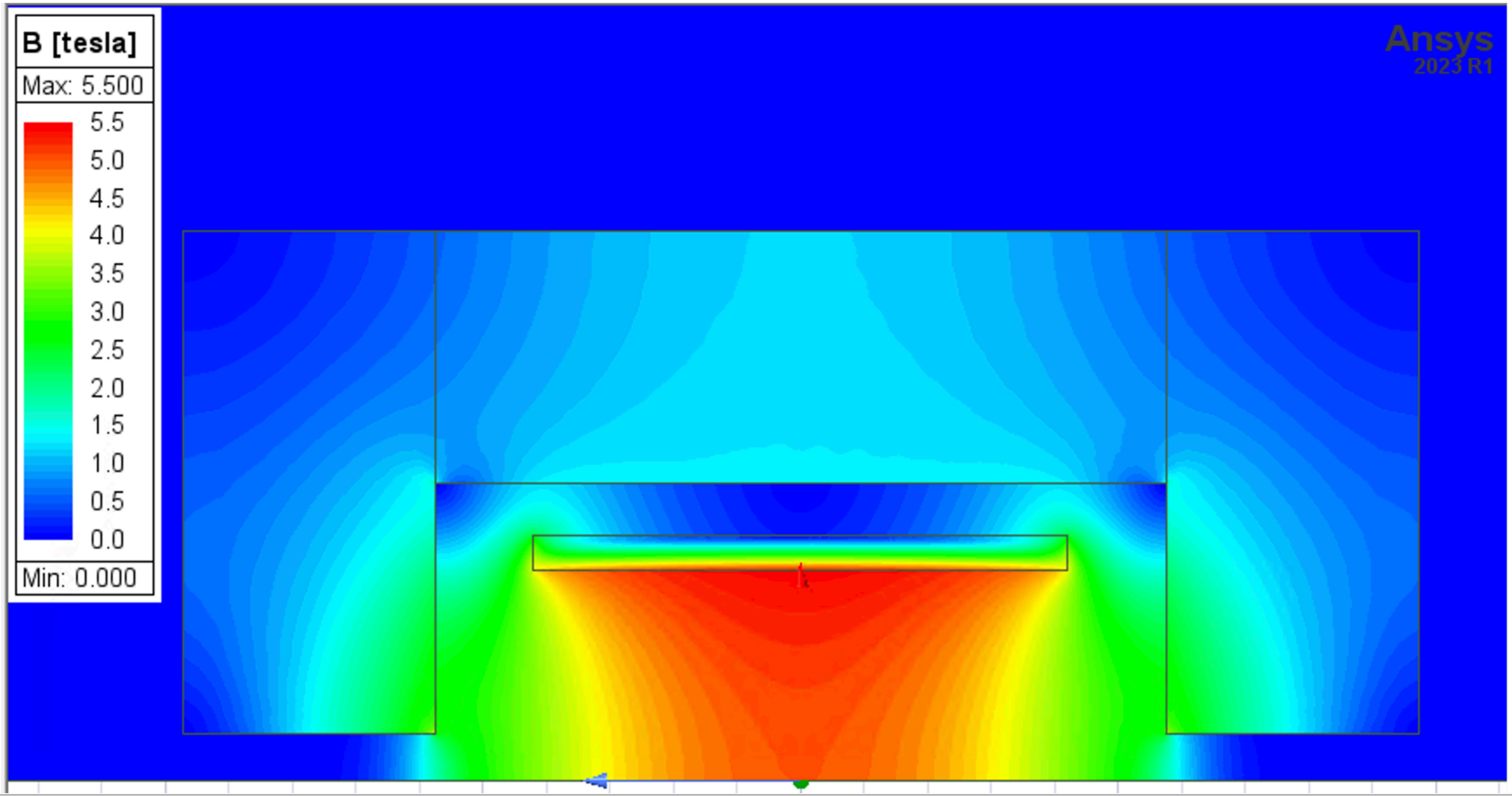
- Tracker region: -2200 < z < 2200, 0 < r < 1500
- B at IP: 3.66 T
- B = 3.60 ± 0.08 T
- Field uniformity: ±2.3%
- (Almost no optimisation)
- Max Br = 0.12 T

- Yesterday values
- B at IP: 3.75 T
- B = 3.63 ± 0.2 T
- Field uniformity: ±5.5%
- (No optimisation)
- Max Br = 0.2 T



Shamefully preliminary 10 TeV

- Few modification w.r.t. Benjamin's slides
- Looks feasible at a first glance (with all the caveats already exposed)
  - Nos so much space for optimisation
  - Field quality looks… m…



Outlook

- A magnet capable of 3.75 T, cold bore dia. ~ 7 m, length ~ 8 m should be technically feasible
- Due to the magnet form factor (length is very similar to diameter), the field uniformity is very limited
- Forces on the coil are completely to be studied
- There is plenty of space for optimisation
- According to detectors requirements some further study can be started
- Future activities
  - better implementation of detector requirements and constraints
  - 2D and 3D models for different detectors architectures
  - preliminary studies for magnetic-mechanical-thermal model
- All according to detector design development
- Requests:
  - some money for travels and a contribution for software licenses and workstation renewal
  - depending on the work load, a significant manpower could be needed in the future