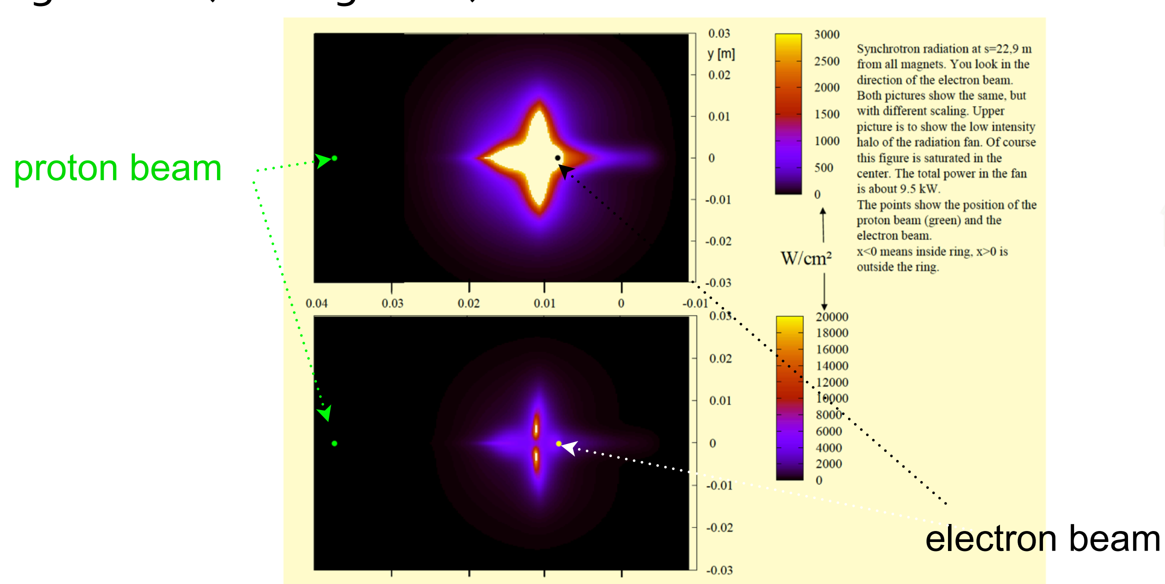
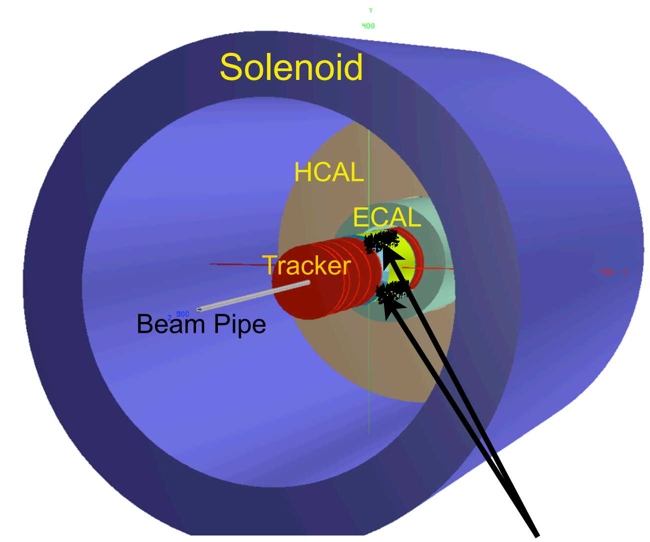
# Towards the CDR - Detector 1

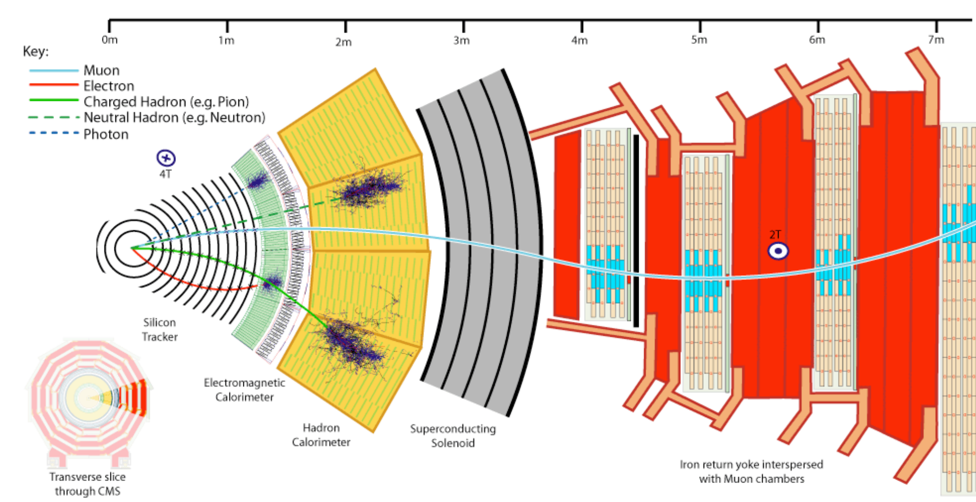
- Second Proton Beam - steering through IR in same beam pipe √
  (informal meeting on 5.October '10)
- Beam Separation Dipols - design H.Ten-Kate, A.Dudarev
- SR Calculations - N.Bernard, R. Appleby, E.Eroglu
- Beam Pipe - shape/thickness calculations - R.Veness, J.Bosch, M.Jimenez
- Solenoid(s) - design H.Ten-Kate, A.Dudarev
  - 1 or 2 magnets (2 magnets - no return yoke)?
  - CMS type Fe-yoke for 3.5T - needs ~10k tons steel, cost 5M$
  - 2 magnets - physics case: best muon measurement possible - needed?
  - cost estimate
  - drawbacks?
- Radiation background (Uludag Univ.)




RR-option - short dipoles
- dipole near to beam pipe - transparent?
- between tracker + calorimeter

2 x 9m dipole for the LR option?



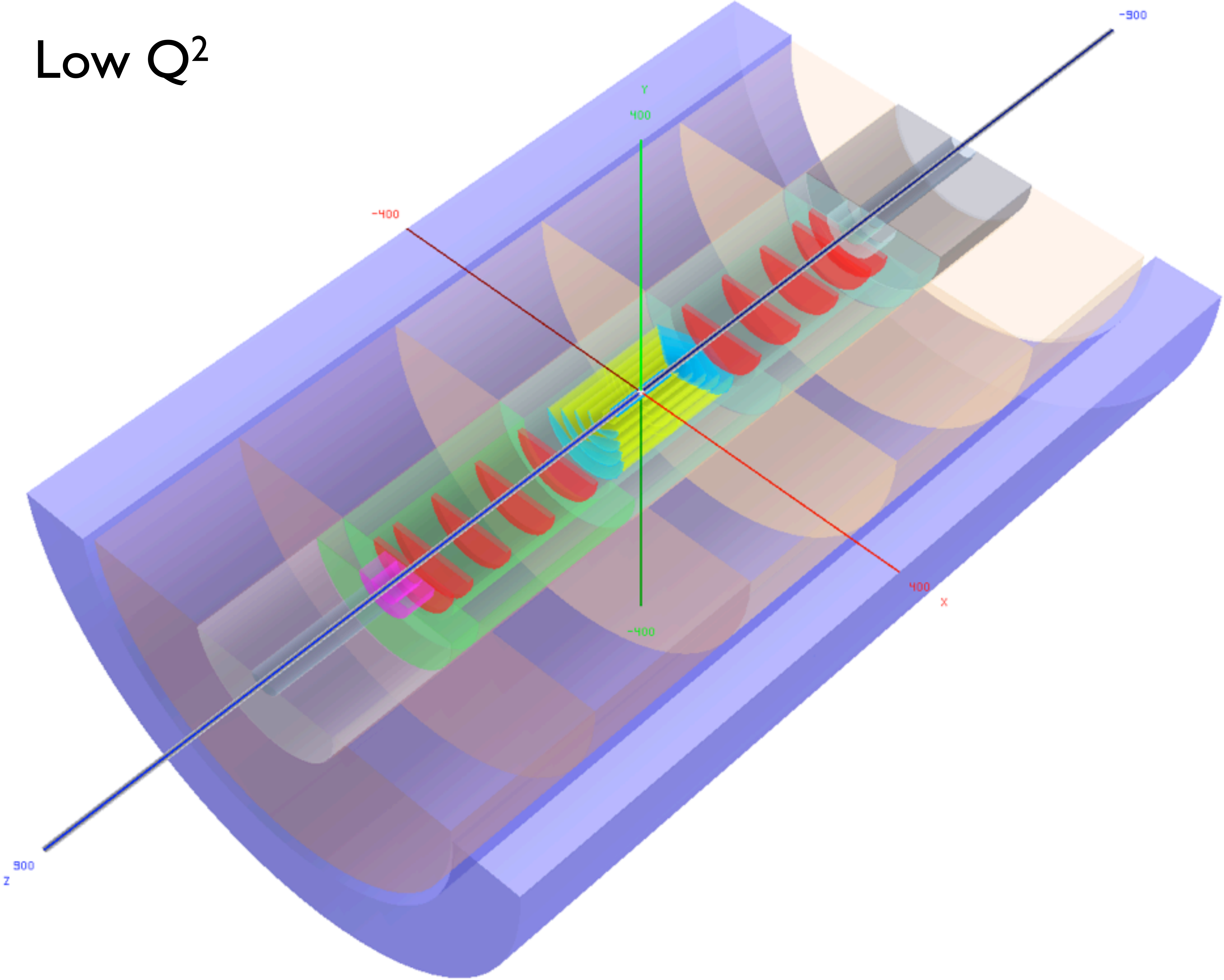
# Towards the CDR - Detector 2

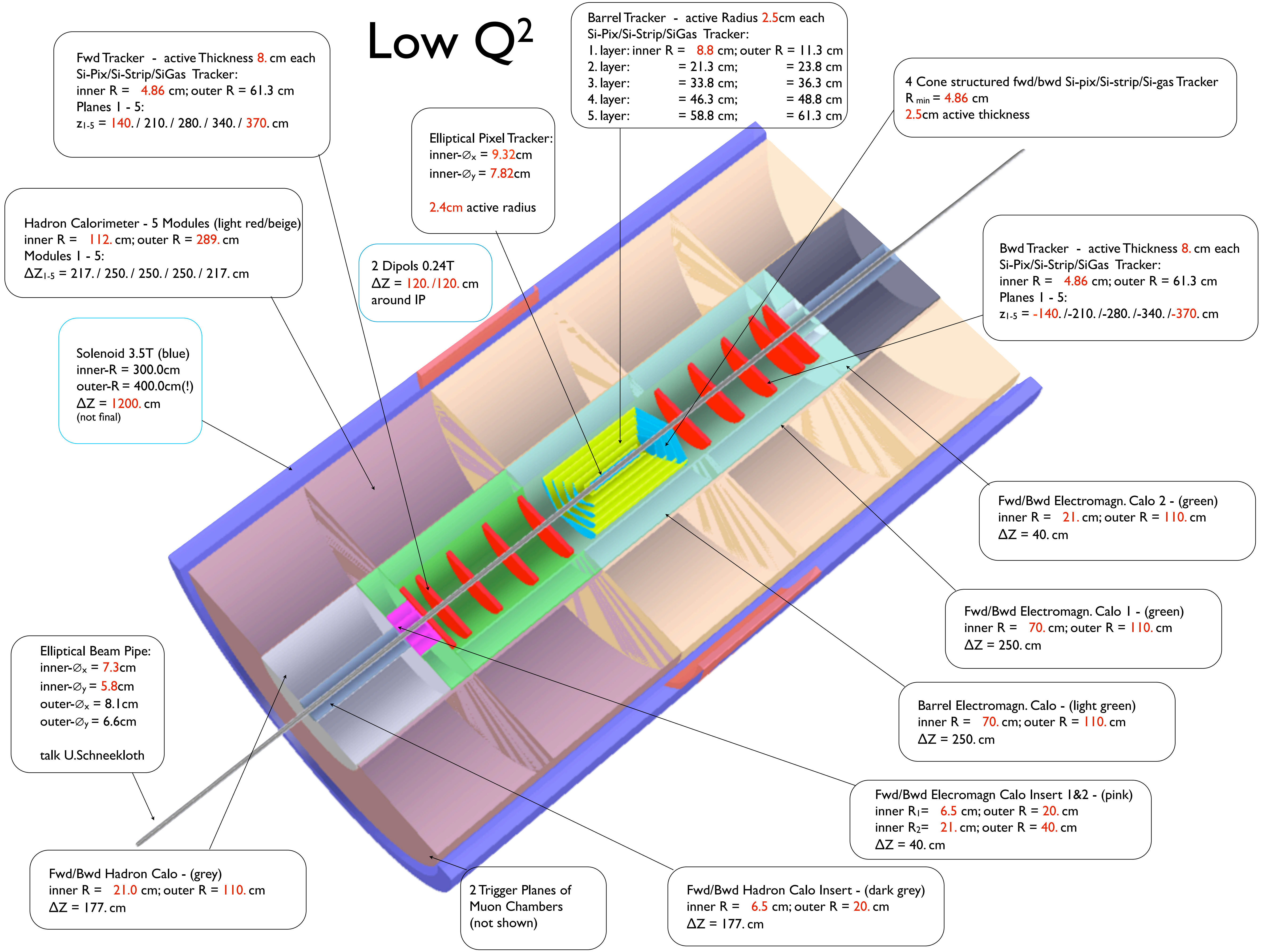
- Tracker - “conventional”: pixel, strip, pad
  multiple scattering! new development - thin Si-detectors
  few but accurate measuring points (designer wanted)
- Tracking - lightweight - SiGas (pixel, strip, pad - thin Si)
  Trigger capable, track segment definition (design: H. van der Graaf?)
- Warm Calorimeter - CMS inspired (contr. Uludag Univ. ?)
- Cold Calorimeter - H1/ATLAS (H.Oberlack ?)
- dedicated forward calorimeter (F.Simon, F.Sefkow ?)
- For many parts: consulting engineer wanted

- R/O DAQ - B.Melado expressed interest

- Software: on lxplus @ CERN - dedicated lhec installations

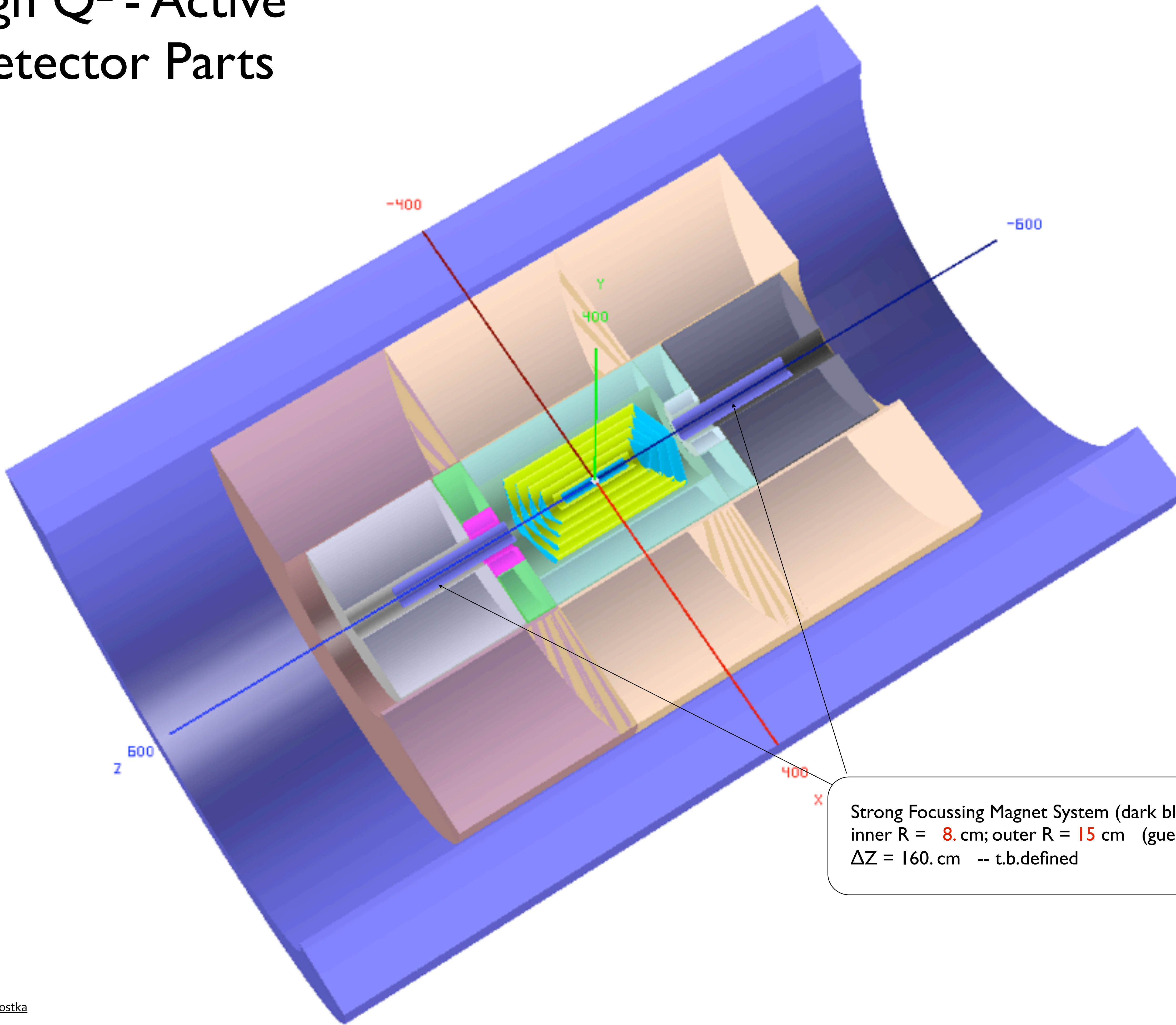
# Low $Q^2$





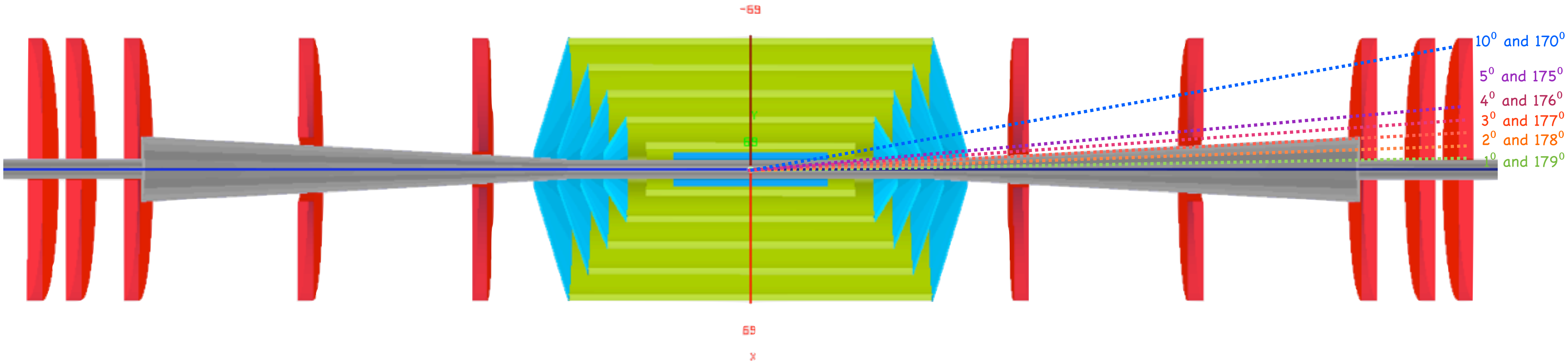
Low Q²
Fwd Tracker - active Thickness 8. cm each
Si-Pix/Si-Strip/SiGas Tracker:
inner R = 4.86 cm; outer R = 61.3 cm
Planes 1 - 5:
z1-5 = 140. / 210. / 280. / 340. / 370. cm
Elliptical Pixel Tracker:
inner-Øx = 9.32cm
inner-Øy = 7.82cm
2.4cm active radius
Barrel Tracker - active Radius 2.5cm each
Si-Pix/Si-Strip/SiGas Tracker:
1. layer: inner R = 8.8 cm; outer R = 11.3 cm
2. layer: = 21.3 cm; = 23.8 cm
3. layer: = 33.8 cm; = 36.3 cm
4. layer: = 46.3 cm; = 48.8 cm
5. layer: = 58.8 cm; = 61.3 cm
4 Cone structured fwd/bwd Si-pix/Si-strip/Si-gas Tracker
R min = 4.86 cm
2.5cm active thickness
Hadron Calorimeter - 5 Modules (light red/beige)
inner R = 112. cm; outer R = 289. cm
Modules 1 - 5:
ΔZ1-5 = 217. / 250. / 250. / 250. / 217. cm
2 Dipols 0.24T
ΔZ = 120. /120. cm
around IP
Bwd Tracker - active Thickness 8. cm each
Si-Pix/Si-Strip/SiGas Tracker:
inner R = 4.86 cm; outer R = 61.3 cm
Planes 1 - 5:
z1-5 = -140. /-210. /-280. /-340. /-370. cm
Solenoid 3.5T (blue)
inner-R = 300.0cm
outer-R = 400.0cm(!)
ΔZ = 1200. cm
(not final)
Fwd/Bwd Electromagn. Calo 2 - (green)
inner R = 21. cm; outer R = 110. cm
ΔZ = 40. cm
Fwd/Bwd Electromagn. Calo 1 - (green)
inner R = 70. cm; outer R = 110. cm
ΔZ = 250. cm
Elliptical Beam Pipe:
inner-Øx = 7.3cm
inner-Øy = 5.8cm
outer-Øx = 8.1cm
outer-Øy = 6.6cm
talk U.Schneekloth
Barrel Electromagn. Calo - (light green)
inner R = 70. cm; outer R = 110. cm
ΔZ = 250. cm
Fwd/Bwd Elecromagn Calo Insert 1&2 - (pink)
inner R1= 6.5 cm; outer R = 20. cm
inner R2= 21. cm; outer R = 40. cm
ΔZ = 40. cm
Fwd/Bwd Hadron Calo - (grey)
inner R = 21.0 cm; outer R = 110. cm
ΔZ = 177. cm
2 Trigger Planes of
Muon Chambers
(not shown)
Fwd/Bwd Hadron Calo Insert - (dark grey)
inner R = 6.5 cm; outer R = 20. cm
ΔZ = 177. cm

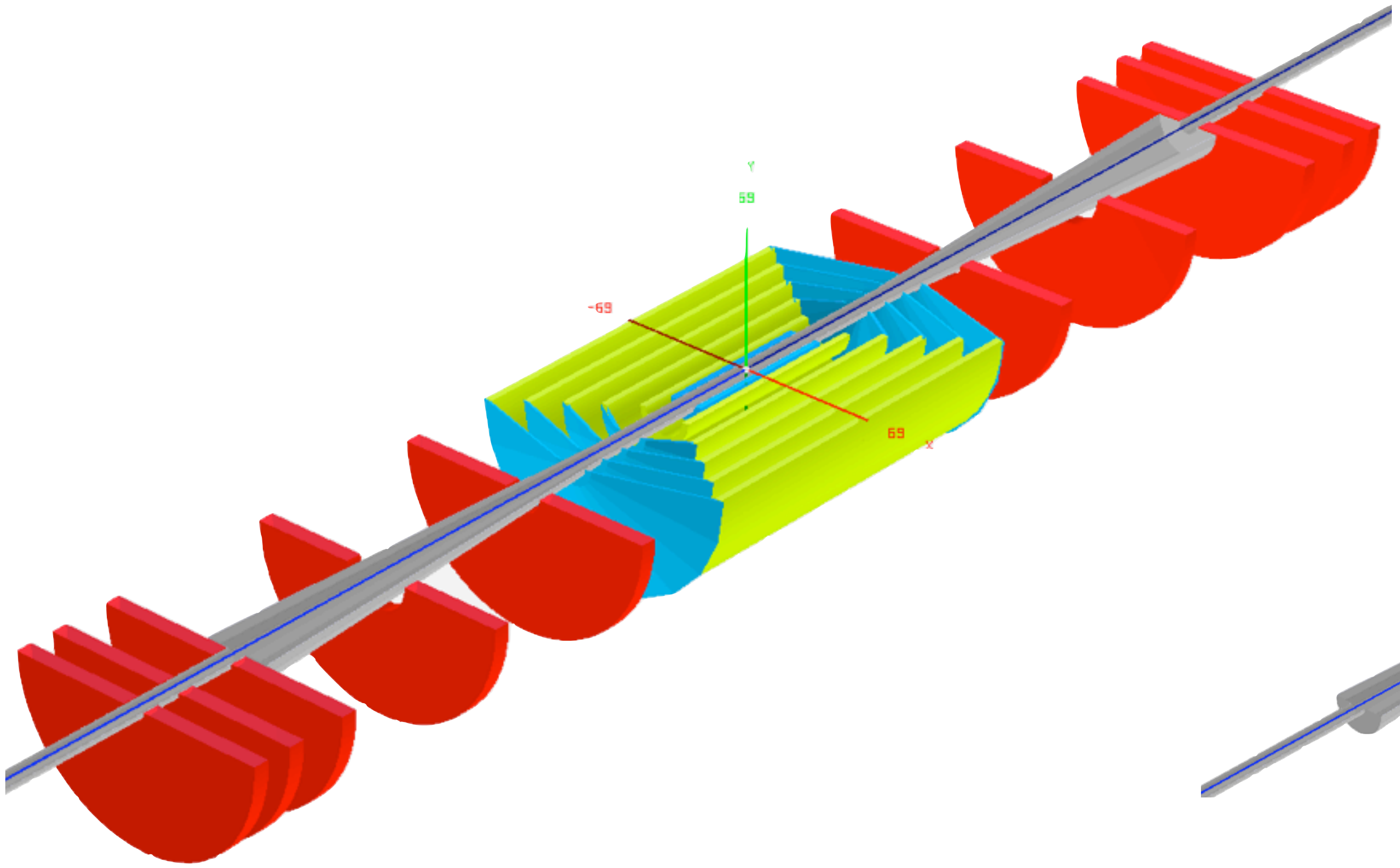
# High $Q^2$ - Active Detector Parts

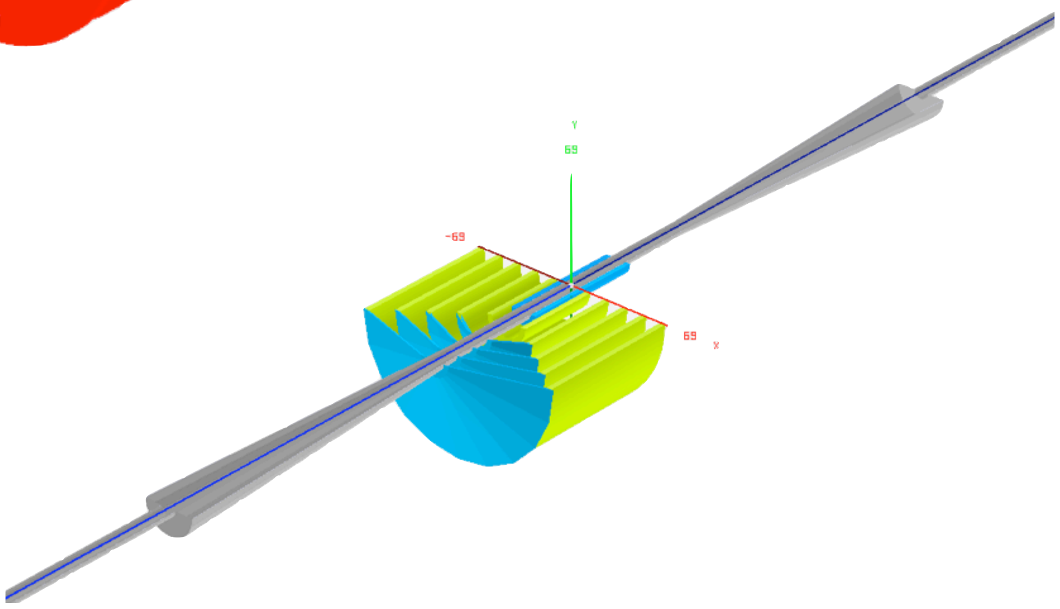



Strong Focussing Magnet System (dark blue)
inner R = 8. cm; outer R = 15 cm (guess)
ΔZ = 160. cm -- t.b.defined

# Fwd. / Central / Bwd. Tracker



# Behind Schedule

# Detector Requirements and Design

## 5.1 Design Description

### 5.1.1 Requirements on the Detector

- The LHeC experiment has to be operated in parallel to the other LHC experiments and has to be set up in accordance to all regulations.
- The not interacting proton/ion beam has to bypass the IP region guided through the same beam pipe housing the electron and interacting proton/ion beam. That needs timing as well as angle adjustment - chapter[].
- The detector has to be operated in a high luminosity environment $L$. High $L_{average}$ is anticipated with small beam spot sizes ($\sigma_x \approx 30\mu m$, $\sigma_y \approx 16\mu m$), small $\beta^*$ and relatively large IP angles (see acc. part). On the other hand $\beta^*$ has to be chosen to eliminate effects of parasitic bunch crossings. The machine and detector needs near the IP is a difficult optimization problem.
- Good vertex resolution for decay particle secondary vertex tagging is required, which implies a small radius, thin beampipe optimized in view of synchrotron radiation and background production from the machine side - chapter[].
- The detector will have one (or two) solenoid(s) building a homogenous field in the tracking area of 3.5T extending over $\pm 6m$.
- The tracking and calorimetry in forward and backward direction have to be set up such that the extreme asymmetry of the production kinematics are taken into account by layout and choice of technology for the detector design and ensure high efficiency measurements.
- Very forward/backward detectors have to be set up to access the diffractive produced events and measuring the luminosity with high precision, respectively.
- The detector must experience acceptable backgrounds. The design has to be background insensitive as far as possible and the machine has to incorporate masks, shielding's and an appropriate optics design that minimizes background sources and impacts and a vacuum profile that reduces backgrounds.
- It might be necessary to have insertable/removable shielding protecting the detector against injection and poor machine performance.
- The detector should be flexible to accommodate for the high acceptance as well as for the high luminosity running foreseen for the two main physics programs. The flexibility should accommodate for reducing/enhancing the energy asymmetry of the beams.
- Special Interaction Region instrumentation for tuning of the machine with respect to background and luminosity is needed. Radiation detectors e.g. near mask and tight apertures are useful for fast identification of background sources. Fast bunch related informations are useful for beam optimization in that context.

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