MDI Studies toward CDR

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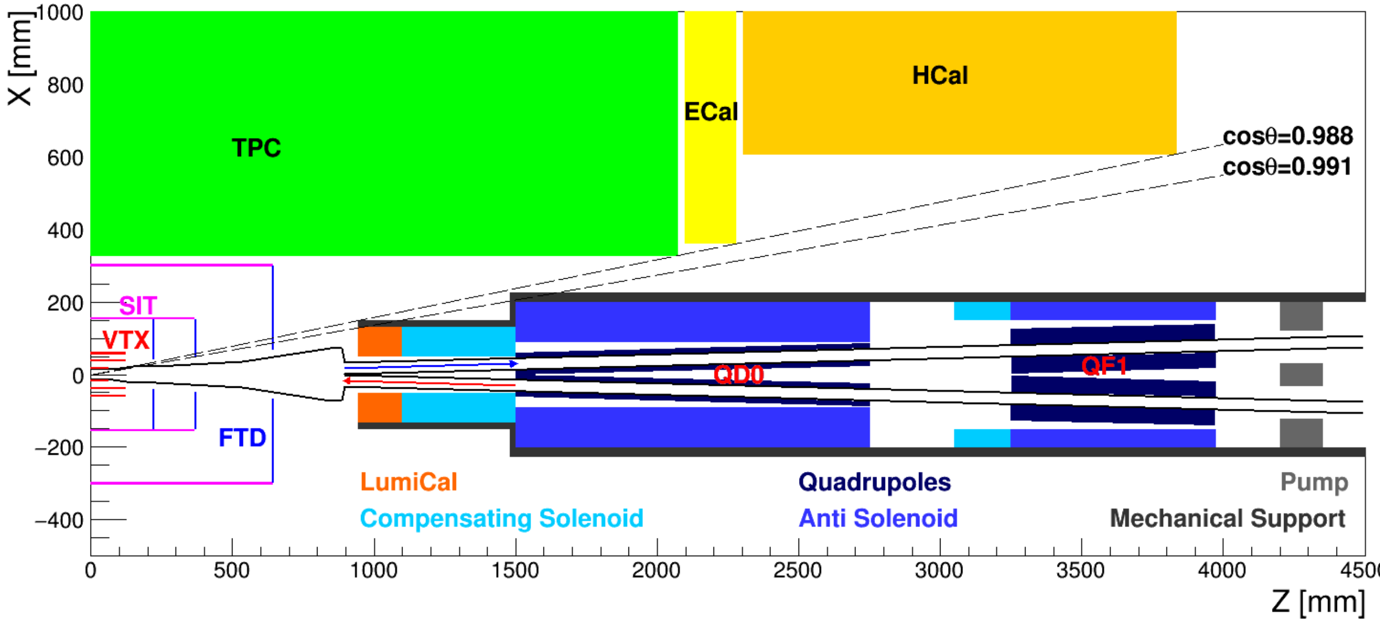
Research Topics

- Interaction Region layout design
- Radiation background estimation
- Collimator and shielding design
- Final focusing magnets design
- Luminosity Calorimeter design
- Supporting structure

Interaction Region

S. Bai, Q. Xiu & H. Zhu

- Require comprehensive understanding of both machine and detector → identify critical elements and optimize the overall performance



- *To deliver*: updated version with more reasonable layout of the machine and detector elements

Q. Xiu + student

Radiation Background Estimation

- Sources of radiation backgrounds: beamstrahlung, radiative Bhabha scattering, synchrotron radiation, gas scattering … for the baseline machine design and interaction region layout
  - Radiation tolerance requirements on silicon devices → design parameters for sub-detectors

- Complete the generic software framework for background estimation – basic structure in place, functionality to be extended

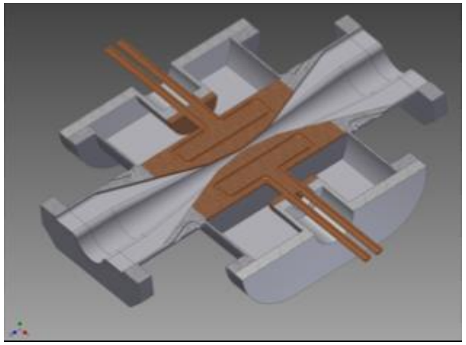
- Provide guideline for collimator and shielding design and estimate their effectiveness of mitigating backgrounds → iterative studies

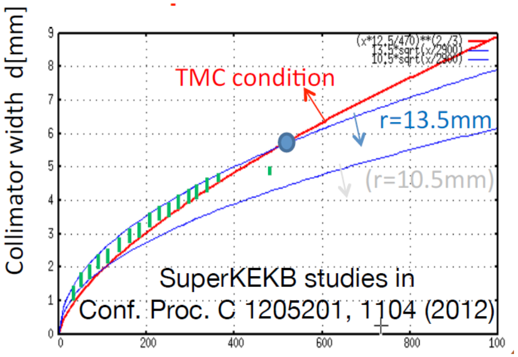
- *To deliver*: estimate of radiation backgrounds for the baseline design

Collimator and Shielding Design

S. Bai +

- Collimator to stop electrons/positrons deviating from the orbit after loosing energy due to radiative Bhabha scattering → critical measure to suppress the radiative Bhabha scattering induced backgrounds
  - *To deliver*: conceptual design (shape and location optimization)





- Shielding to prevent particles directly penetrating or backscattering into the detector volume, *to deliver:*
  - Collimator/masks to suppress SR photons
  - Shielding structure (material option + thickness) outside of the QD0

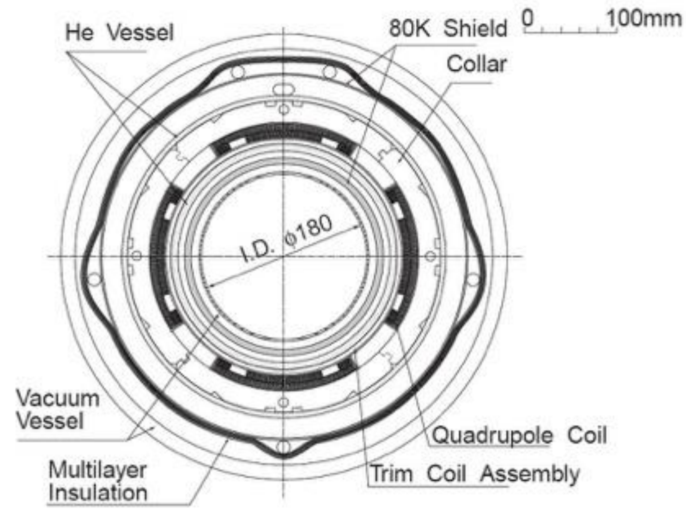
Y. Zhu & W. Yao

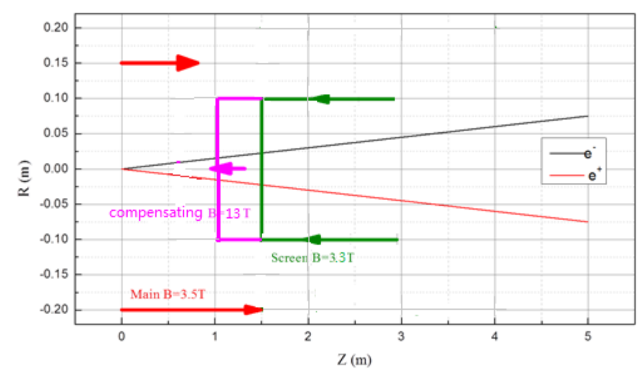
Final Focusing Magnets Design

- *To deliver*: conceptual design (mechanical structure, prototype?) of the final focusing magnets

- Screening magnet to cancel out the detector solenoid → to be integrated into the final focusing magnet (possible common mechanics and cryogenics)

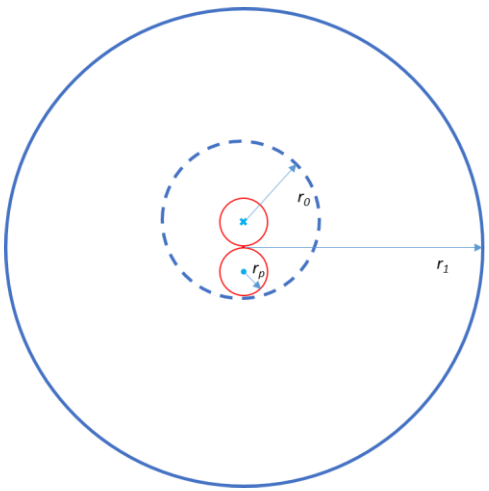
- Critical issues related to the compensating magnet → B×L
  - Conflicting between magnetic field strength and space in front of QD0
  - Shall consider lowering down the detector solenoid without not too much performance loss



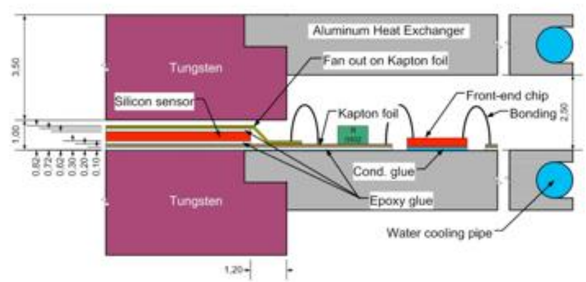


Luminosity Calorimeter

K. Zhu



- Limited space for luminosity calorimeter → estimate the acceptance of the radiative Bhabha scattering events with different configurations of inner and outer radius, starting and ending z-axis positions
  - Calculation on-going, overall performance in simulation



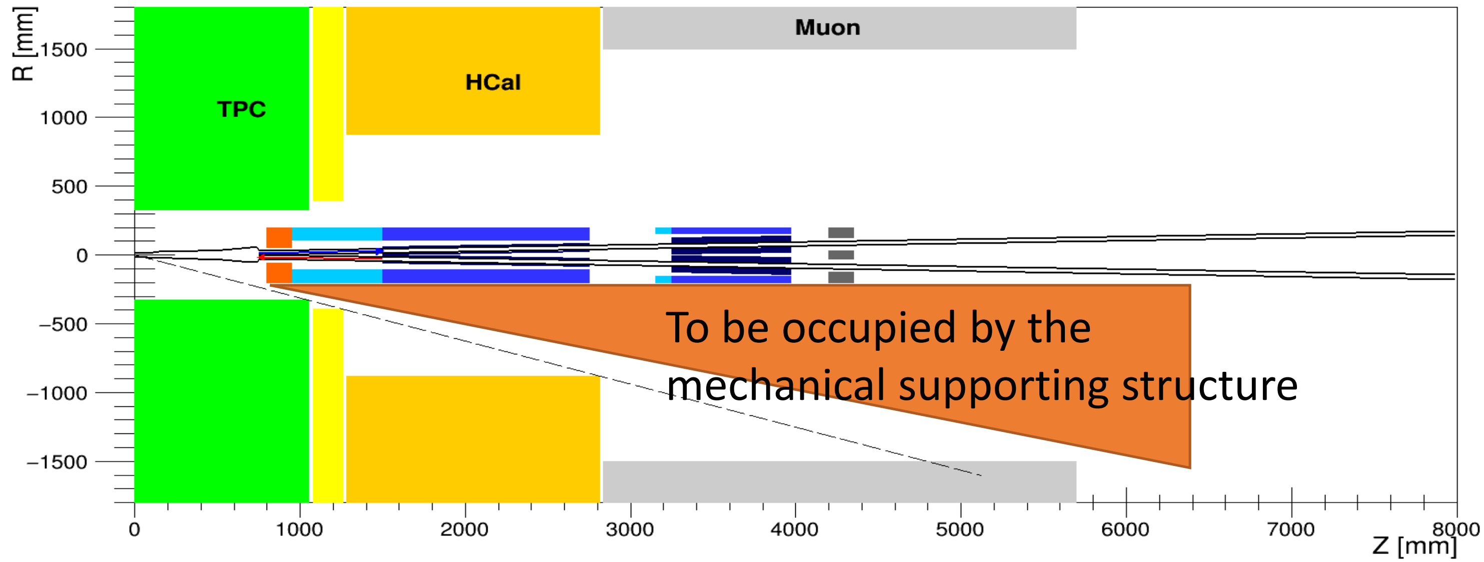
- Conceptual design with reasonable choice of detector structure and sensor options, and mechanical constraints

- *To deliver:* layout of the luminosity calorimeter and sensible detector structure

Mechanical Structure

H. Qu

- Request sent to the accelerator mechanics group and contact person identified → first iteration to understand the general requirements and rough estimate of the total weight to be supported



- On going feasibility studies on stress, deformation and vibration
- ***To deliver:*** conceptual design of the mechanical structure

Timescale and Manpower

- Timescale highly depending on the machine baseline design progress
  - *Critical*: no workable lattice yet for the (partial) double ring → cannot evaluate the radiation backgrounds from radiative Bhabha or synchrotron radiation; collimator/shielding design; software almost ready and not difficult to produce results
  - Studies on luminosity calorimeter and mechanical supporting structure started recently → will take time to make real progress
  - Compensating magnet design depends on detector solenoid

- Manpower just fine to perform general studies but difficult to bring the studies to higher levels without real expertise injected
  - More and regular exchanges with SuperKEKB and FCC-ee

From the IAC Recommendation

So far at least 4 schemes (Pretzel, Partial Double Ring, Advanced Partial Double Ring, and Full Double Ring) have been considered as the candidates for the CEPC machine. The CDR may contain all these options with comparisons in the performance and the cost, together with variations in the circumference. The IAC recommends that the team investigate areas which can differentiate one scheme from another and perform a rough but consistent cost estimation for each scheme. The CEPC MDI (machine detector interface) team needs further technical investigation on the layout, magnetic field design, synchrotron radiation background, collimation, etc. The MDI part may have strong similarities to FCC-ee or SuperKEKB. Similarities with FCC-ee are increasing, which is good, in view of potential cooperation and cross-checks between two projects. International efforts will be crucial for some areas in the accelerator R&D, including the final focus magnets. While a goal of 20 T is fine, the achievement of such a working field is currently too speculative to give as a design parameter. The field should be given as in the range of 15 – 20 T.

- *Discussed and to be addressed*