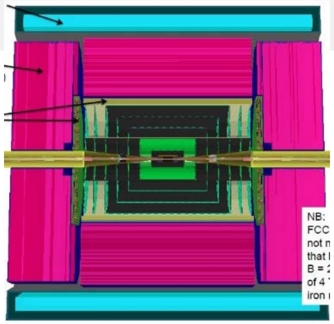
Detector Magnet & MDI issues
- conclusive statements -

Herman ten Kate, Erwin Bielert, Alexey Dudarev

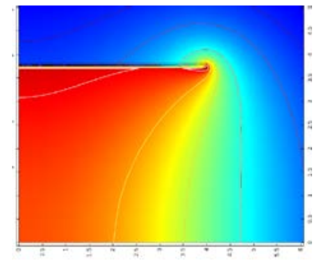
1. General comments
2. Detector magnets
3. IR magnets

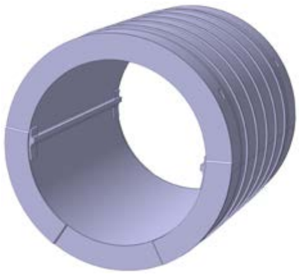
1) General



- We have to deliver in December 2018 a final CDR including a chapter on detector magnet and a chapter on MDI. To get focus it would be good to start with constructing the content of these chapters, assign editors and identify core writers.
- Also the level of detailing the various subsystems have to be agreed, and has to be in balance with FCCpp.
- There are only 18 months left between now and the delivery of the draft Detector chapter in the FCC CDR! Time is short, thus we urgently need a set of approved specifications of the baseline detector and the infrastructure needed to operate it.
- Only based on this we can start to make final drawings, pictures and tables describing the detector and its environment, and start drafting text.
- This includes an assembly and integration scenario of the detector determining cavern and shaft dimensions, infrastructure for services, crane loads etc. etc.
- Where are the draftsmen we need to make detector definition drawings in a coherent way?

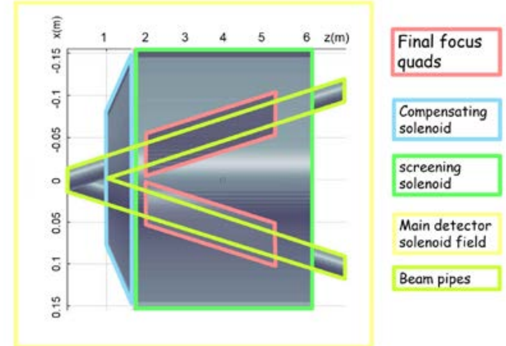
2) Detector magnets



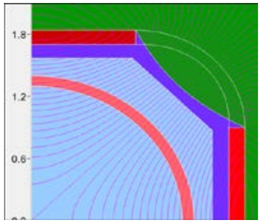


- A 2T/Ø6.6mx8m detector magnet, coil and cryostat, was dimensioned and costed.
- This is considered standard technology, very well doable and no risk.
- There is no yoke, so no shielding. Shielding where required has to be installed locally.
- **This is proposed to be the baseline detector magnet presented in the CDR.**
- As an option the ultra-thin&light 2T/Ø4mx6m solenoid inside E/HCAL (sizes still to be confirmed), will be described as well.
- **Can we approve this baseline? Then we can move on!**
- When approved we will continue to engineer the solenoid and its services in order to complete the specification, make 3D drawings of the system, develop production and assembly scenario, superconductor use, quench protection, cryogenic needs, layout and positioning in cavern of cryogenics, power, controls.
- What about the 0.5T/Ø16mx16m huge wide bore normal conducting solenoid requested for envetually a 2^{nd} dectector? Do we describe this option as well in the CDR (today I assume not but need a decision, confirmation).

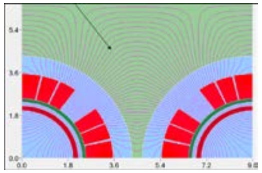
3) IR magnets



- Up to 2 weeks ago uniform 2T was assumed everywhere in stead of real detector magnet. Last 2 weeks the field gradient locally on the IR magnets was discussed and a 1st update on the magnet elements proposed. This needs to be redone carefully and cross checked.

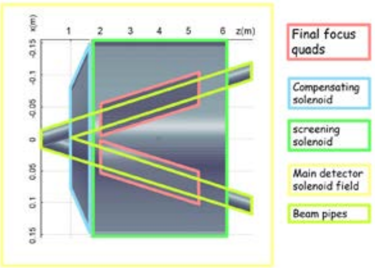


- Quads coil technology
  - We have seen BINP specific design with thin iron decoupling both quads, not requiring compensation. Gradient can be easily attained, and short demo coil produced. Looks simple and straightforward. A good baseline design to be approved.
  - Alternatively a no-yoke CCT design was proposed (M.K), yet to be demonstrated that dimensions can be equal or smaller and compensation for coupling can be implemented (to do).
  - For FF quads classical coils are proposed, not demonstrated for FCCee but reference is made to LHC standards.
  - Since from a coil point of view nothing is critical full size demonstration coils are not needed for the CDR (but short version recommended for CCT).



3) IR magnets

- Shielding Solenoid
  - No 2T static anymore, thus has to compensate the gradient, multi-sectional, graded coil needed, easy to do, no problems expected.
  - No yoke, so shielding of quads may need to be extended over the outer sections as well, to be studied in detail.

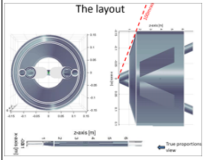


- Compensation Solenoid. Is a high field coil, tapered, about 6T, can be done with NbTi with some care.

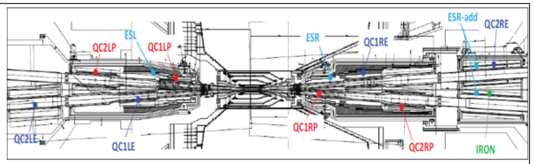
- Positioning of the coils. So far only coil dimensions shown, cryostats and warm beam pipes not yet shown, not taken into account! The final positioning in z very much depends on a realistic design of the cryostat with two warm bore requiring proper thermal shielding and gaps between the shells at various temperatures.

- Cryostat and supporting structures design missing! This is high priority, result required for confirmation of z positioning of the coils!

- SuperKEKB experience is a very goof reference and can be used as guideline. Urgently need a cryostat designer!

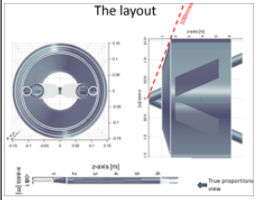


FCCee IR magnet sketch.

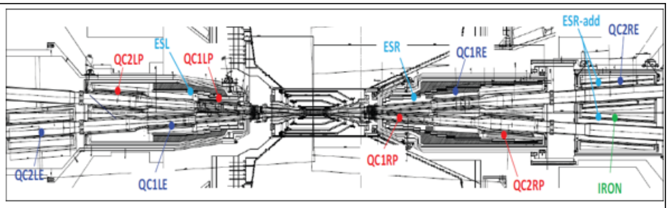


Example: SuperKEKB drawing of IR

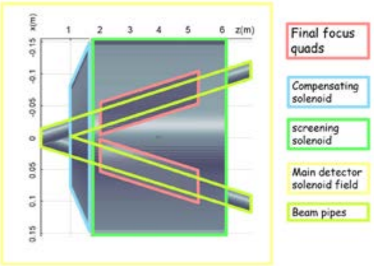
3) IR magnets



FCCee IR magnet sketch.



Example: SuperKEKB drawing of IR



- SuperKEKB experience is a very good reference and can be used as guideline.
- Urgently need a cryostat designer to detail the IR and magnets region !
- All IR solenoids have to be detailed to some level in order to present them properly in the CDR, thus a magnet designer has to go over the designs again after the coil dimensions have been finalized based on field requirements.
- This includes the analysis of forces and support structures needed.
- As well as a thermal analysis of all coils to confirm the coil safety margins and settle the cryogenic requirements.
- And we need a cost estimate for the complete IR magnet system including its structures, cryogenics and other services.

- **Next 18 months are challenging to solve all this and get it on paper……….**