Final Conclusions

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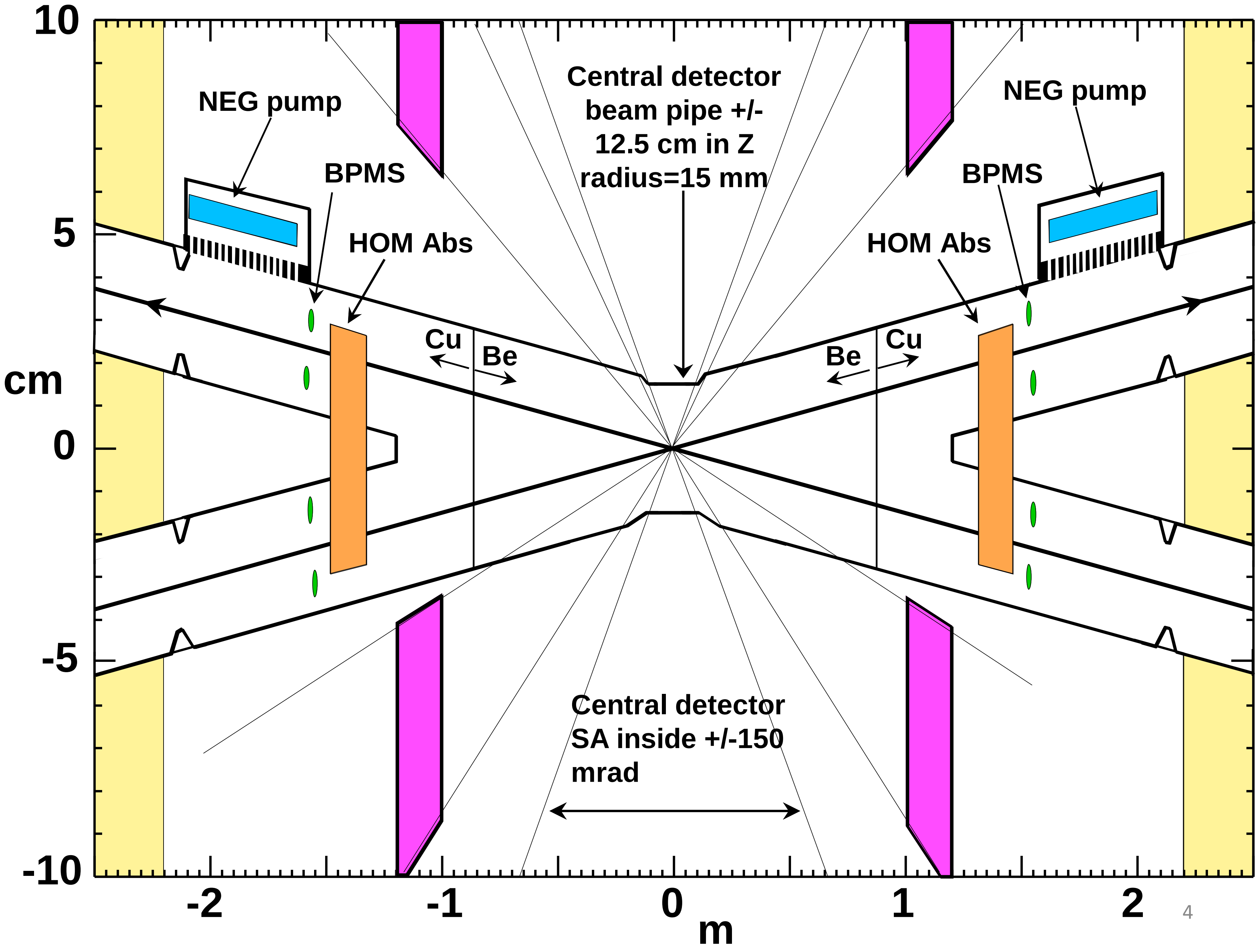
Main Topics discussed

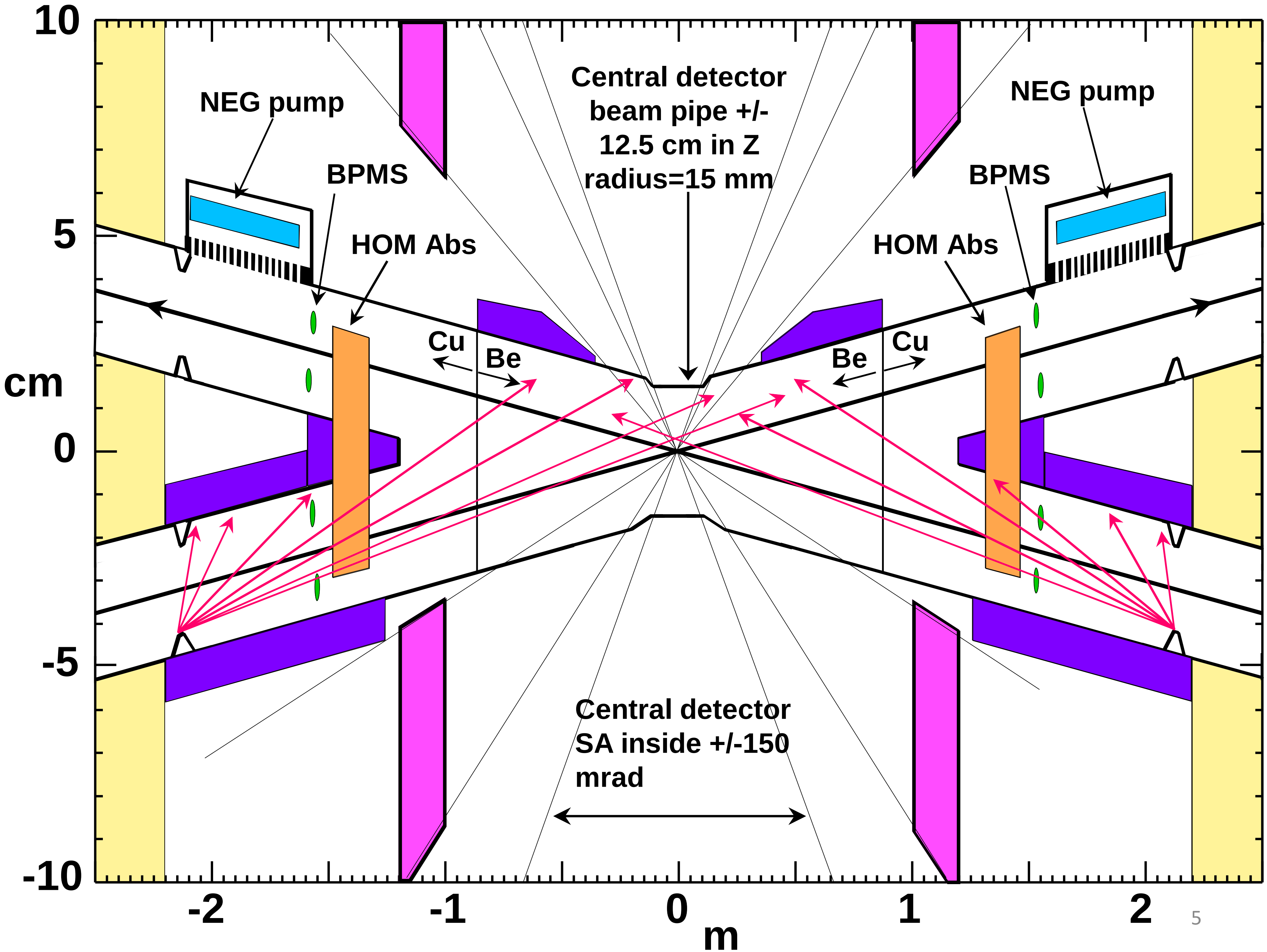
- Baseline KO optics with L* = 2.2 m
- IR Layout and many issues connected to it, like:
- beam pipe (shape, apertures, thickness, material)
- shieldings and masks (location, material, thickness)
- IR vacuum, water cooling, coating, HOM absorbers
- IR Trapped modes analyses for symmetric/asymmetric pipes
- Luminosity monitor design
- Solenoid compensation scheme
- Detector magnet integration
- IR quadrupole design
- IR collective effects, i.e. electron cloud, and mitigation

Outcome from discussion-1

- Present baseline **optics** works well for all the beam energies.
- **L*=2.2m** is confirmed to fulfill the requirements.
- A new improved **IR layout** has been developed.
- **Symmetric beam pipes** in the FF are confirmed as baseline option by first results of trapped modes analysis. Simulations are in progress to optimize this symmetric design.
- **HOM** analyses and estimate of the HOM power.
- A feasible **Lumical** design places it from 1m to 1.2m from the IP.
- **Compensating solenoid** in present design starts at 1.25 m. The corresponding ε_y blow-up is 0.3 pm rad. This is an acceptable value.



Central detector
beam pipe +/-
12.5 cm in Z
radius=15 mm
NEG pump
NEG pump
BPMS
BPMS
HOM Abs
HOM Abs
Cu
Be
Cu
Be
Central detector
SA inside +/-150
mrad
cm
m
10
5
0
-5
-10
-2
-1
0
1
2


10
5
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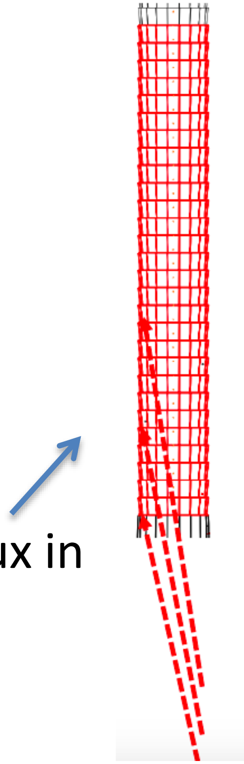
cm
-2
-1
0
1
2
m
NEG pump
BPMS
HOM Abs
Cu
Be
Central detector
beam pipe +/-
12.5 cm in Z
radius=15 mm
NEG pump
BPMS
HOM Abs
Be
Cu
Central detector
SA inside +/-150
mrad

Outcome from discussion-2

- **Beam pipe aperture:** now 30 mm everywhere
- **Beam pipe shape**:
  - circular at the quad
  - circular at the IP
  - need to join up -> vacuum engineer will be of great help for developing the design
- Beam pipe **material**:
  - **Be** central beam pipe from -0.8m to 0.8m (no window for lumical needed)
  - **Cu** (Be/Cu welding needs to be designed properly)
  - ridge/ sawtooth profile in the quad reduces to zero the photon flux in the Be pipe
- Warm beam pipe: water cooling needed



Cu preferred, for its superior qualities, with respect to aluminum: better conductivity, lower transparency to X-rays, lower outgassing yield and photoelectron emission.

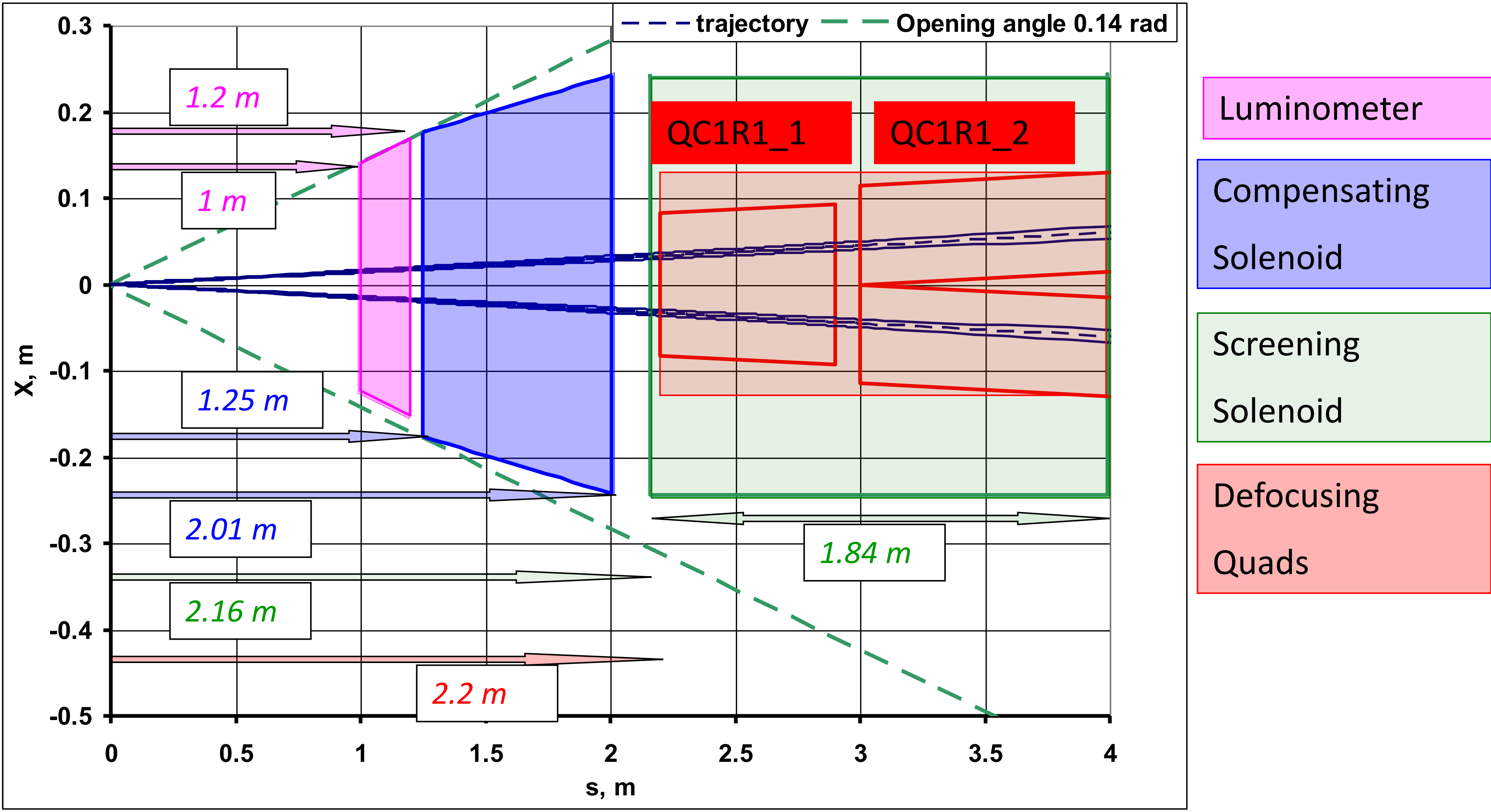
Outcome from discussion-3

- **Pumping:** Distributed pumping along the chambers would be a major asset. NEG coating is the obvious choice (it's applicability to FCC-ee needs to obtain the green light from the impedance experts).
  - The most stringent pumping requirements refer to the **Z**-pole machine: **Pavg<1.0E-9 mbar** only if **200~500 l/s pumps** are placed at a distance < **3~4 m** from each other.
- **Electron cloud instability:** to reduce the SEY we must look for the possibility of using either **thin-films (e.g. titanium nitride, NEG-coating, amorphous carbon) or laser-ablated surface structures.**

Outcome from discussion-4

- **Detector magnet** design, integration issues addressed.
- **IR quadrupole design**: it will not be a single quad, but split in two (or three) magnets
  - QD0-1: modified Panofsky type quad proposed, no critical issues found (no correction coils needed)
  - QD0-2: two designs possible, conventional *cosine-theta* design or *canted-cosine-theta* (CCT) design (correction coils must be added here).
  - Interesting presentation of the Superkekb SC IR magnets
- **Diagnostics** at IR:
  - BPM innerside of first quad
  - Beamstrahlung monitor (as for Superkekb)
  - fast luminosity monitor for machine tuning? (especially for bunch-by-bunch luminosity feedback)

Layout



QC1R1_1: L= 0.7 m, K1=-75 / -75 T/m, R = 0.015 m

- QC1R1_2: L= 1.4 m, K1=-173 / -166 T/m, R = 0.0175 m

On-going/Next steps-1

- On-going investigation for reduction of β_x*
- **SR** simulations with new layout (photon flux)
- SR **masks & shielding** refinement for the different beam energies.
- IR electron cloud simulations (need iteration?)
- Which **correctors** are needed in the IR? (Optics with impact in the IR design)
- **Detector background (beam-gas):** realistic vacuum profile around the IP foreseen once the geometry of the vacuum chambers will be finalised (important because it drives the amount of off-momentum particles scattered off the residual gas and end up in the detector due to the strong FF quads)
  - for IR vacuum requirement
  - for off-momentum particles rates estimate into the lumical

On-going/Next steps-2

- Mechanical CAD design of the IR vacuum chamber will start soon.
- New IR computer model designs and CST or HFSS calculations .
- A HOM water cooled absorber design.
- Final IR geometry including a Lumi monitor and an absorber.
- Impedance budget estimate.
- IR quadrupole design: 3D study foreseen for QD0-1
- Non-linear terms needed in the IR, to be added as correction coils in the quads, have not been determined yet.
- A full 3D design of QD0-2 will then be possible.
- For the CDR which level of detail is required? Prototype?Measurements?

On-going/Next steps-3

- Continue the interaction with the **MDI detector study group** to check, validate and optimize present design also considering Geant4 simulations into detector (for example central beam pipe thickness, off-momentum particles rates into the lumical, SR photons into the detector, …)

Conclusions

- It is has been a very productive workshop!
- We propose to repeat this experience, we found it effective!

THANK YOU!