LARP CM12 Collaboration Meeting

April 9, 2009

Embassy Suites, Napa Valley

MULTIPACTORING ANALYSIS AND CRYOSTAT DESIGN

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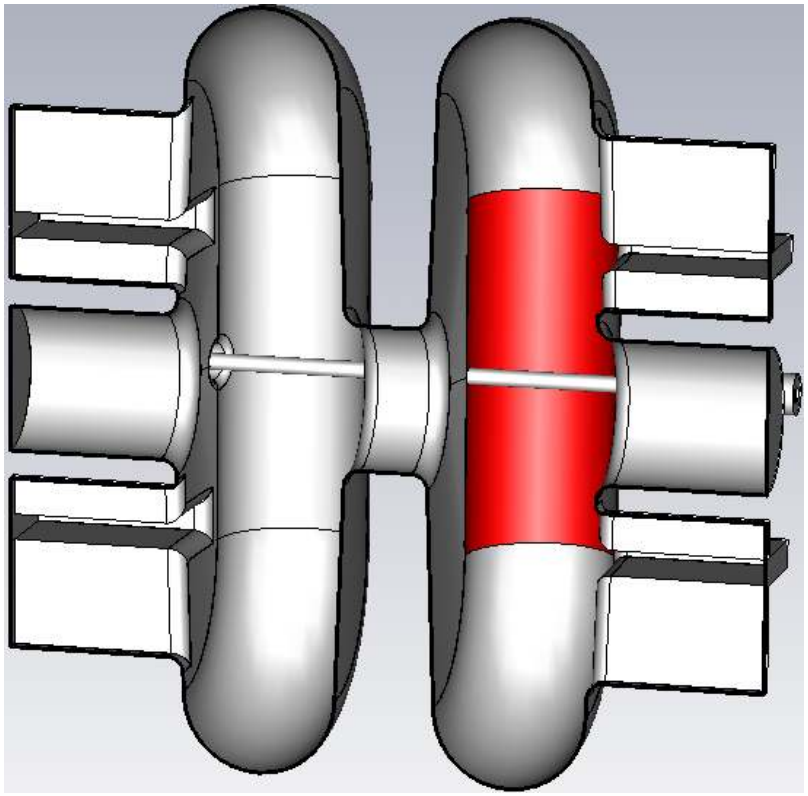
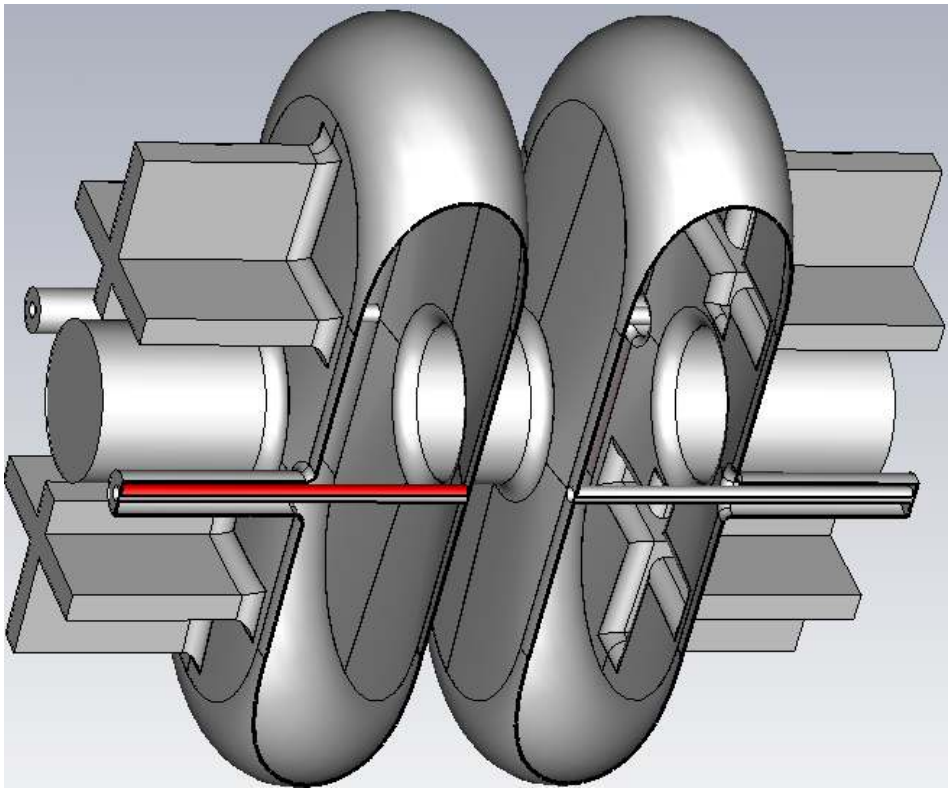
MP simulation in MWS (KEK-B cavity design)



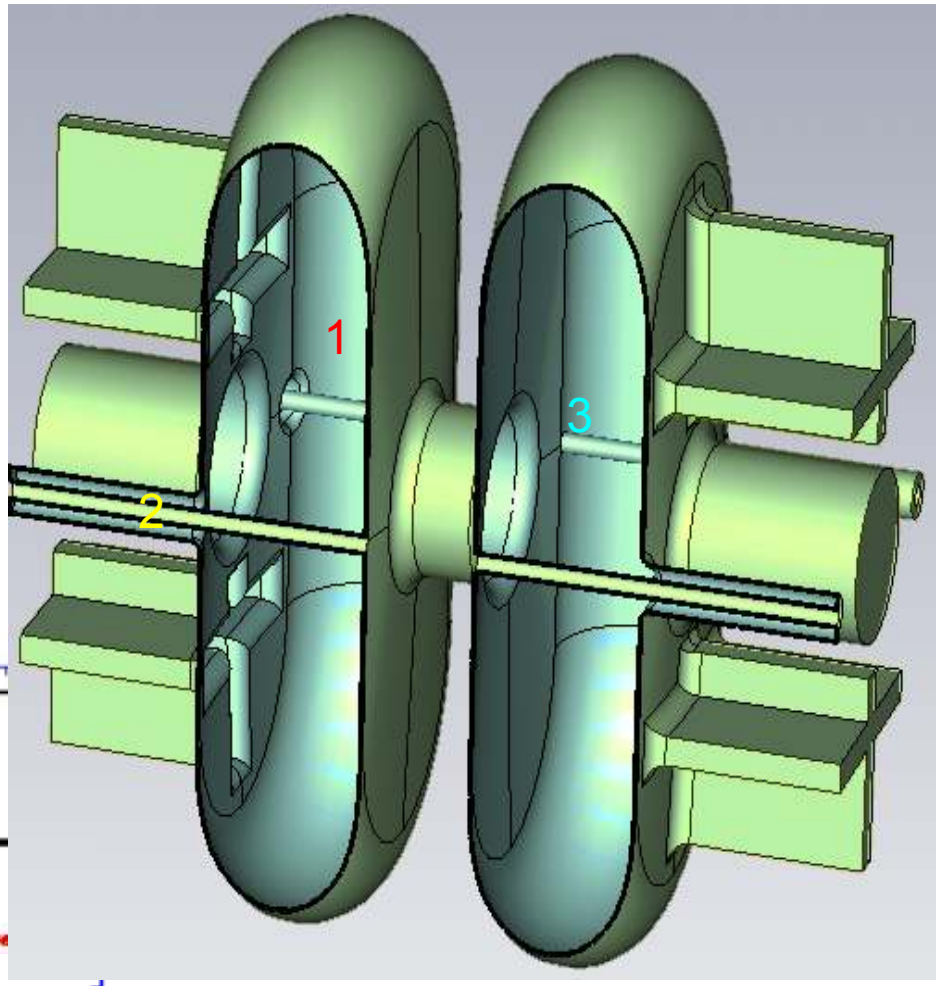


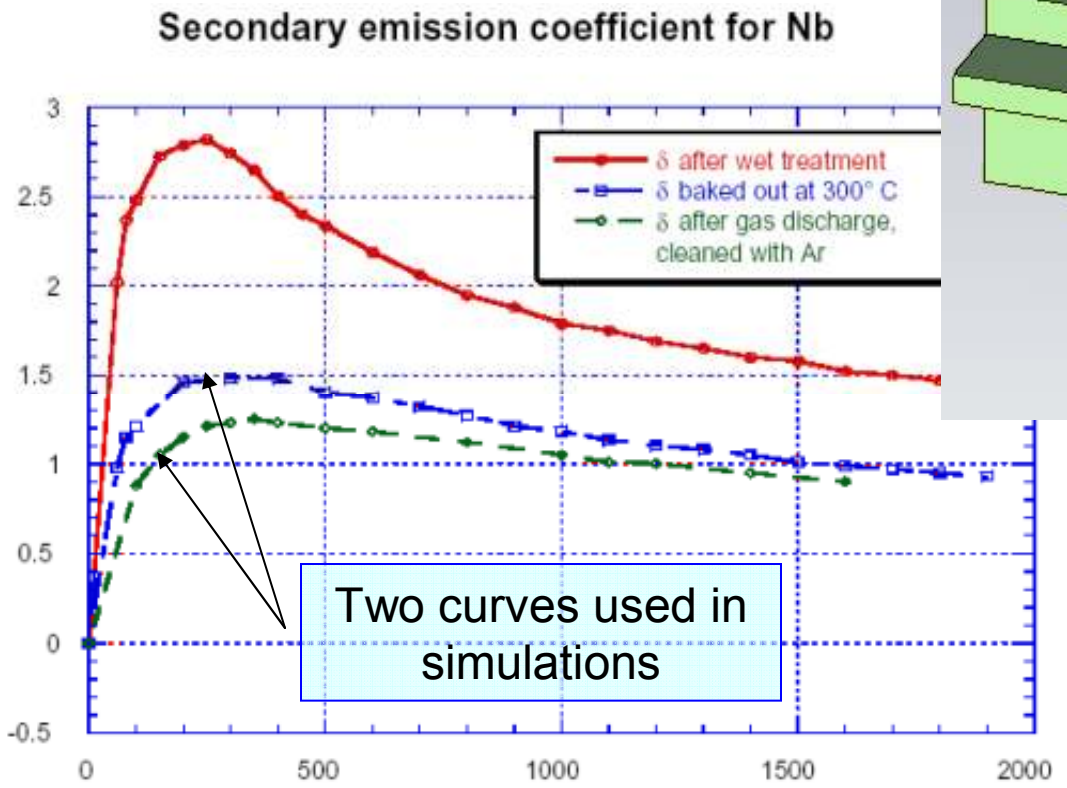
RED- surface where particles are emitted from

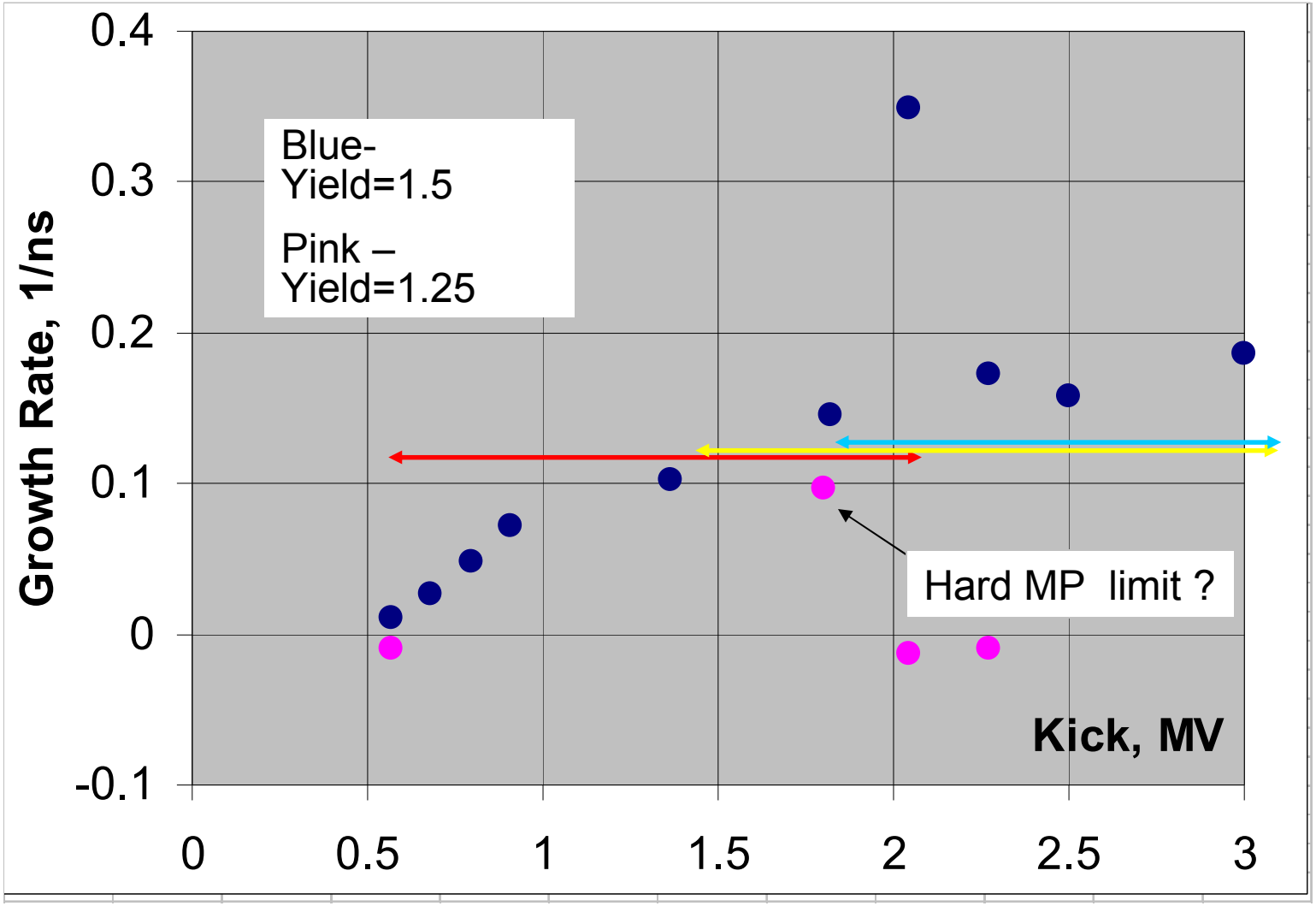
Is the Main coupler included in this model ?

CST Particle Studio defined 3 areas with multipactoring activity in KEK Crab cavity (where Growth rate is positive).

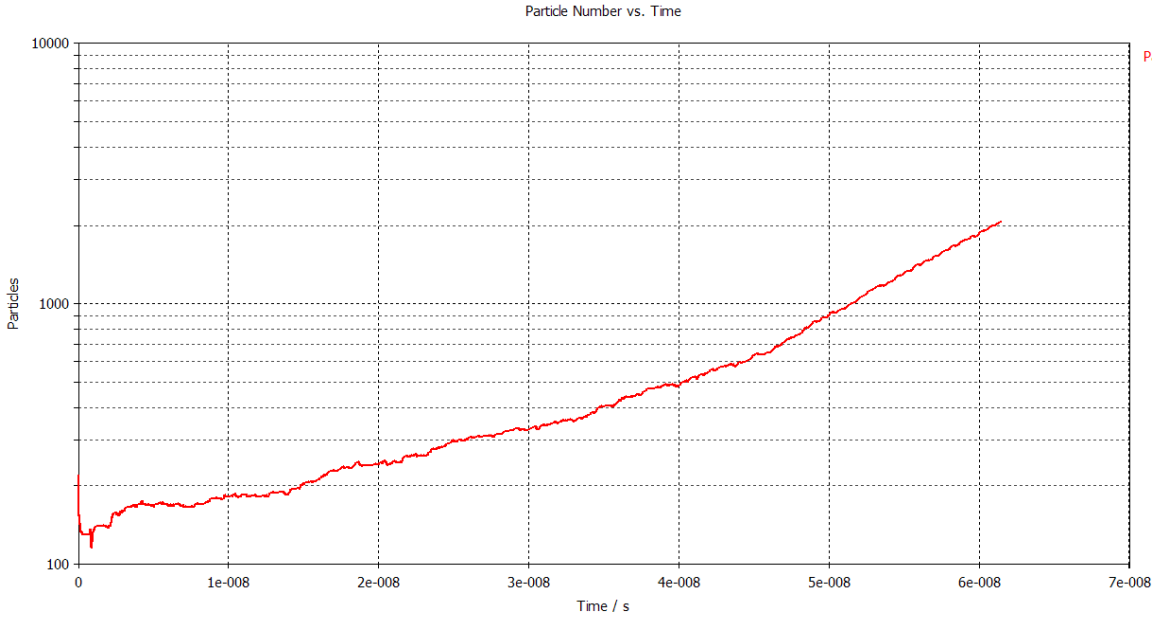
- 1 in long part of racetrack
- 2 in coaxial
- 3 In place of connection of coaxial to the cavity wall

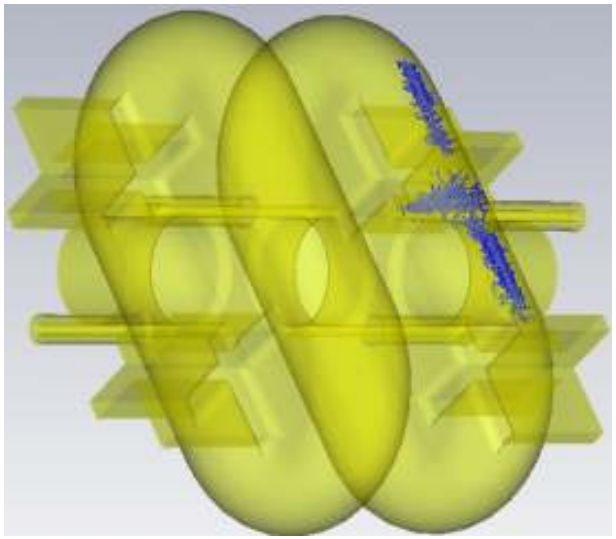






Growth rate vs Kick. Color arrows shows the range of MP taking place in 1 (side wall), 2(coaxial) and 3 (coaxial to wall connection) areas. Where the ranges are overlapped the MP in 3 area dominated.

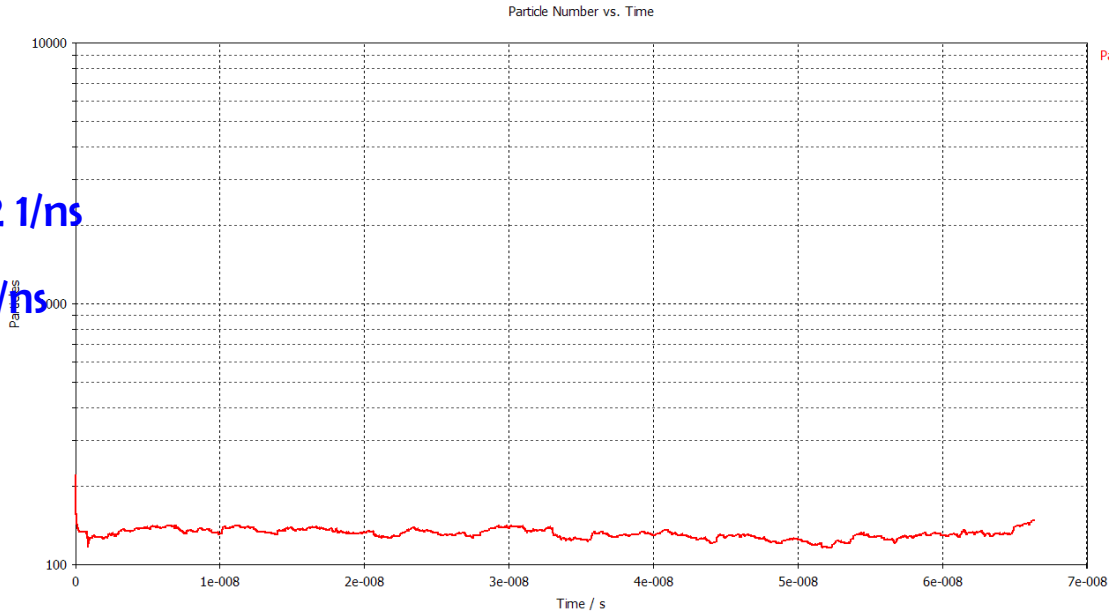


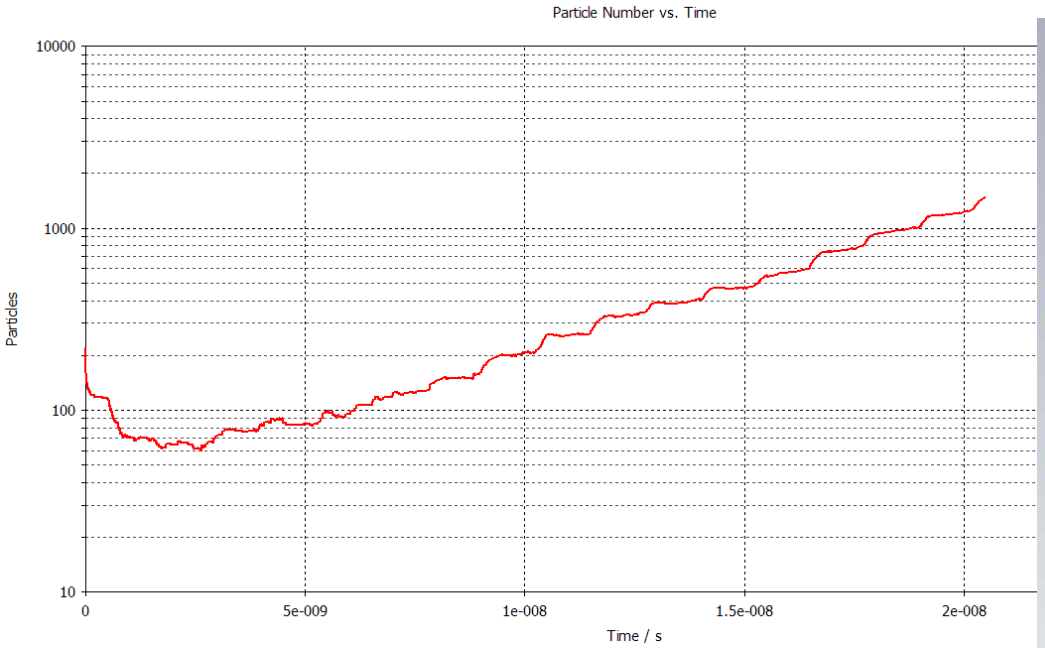


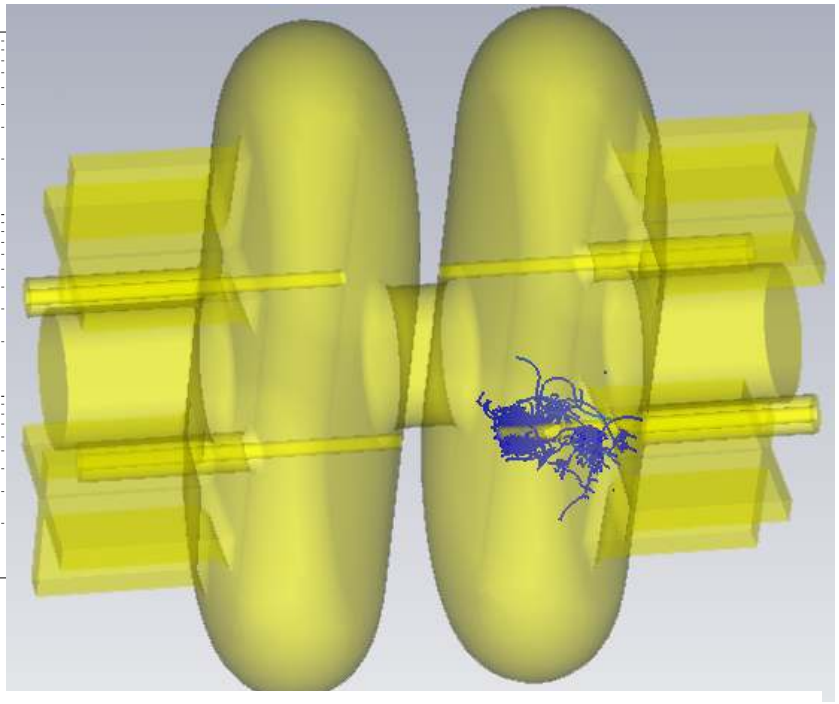
Kick=0.9 MV

Yield_max=1.5 Growth_rate=0.072 1/ns

Yield_max=1.25 Growth_rate~0 1/ns



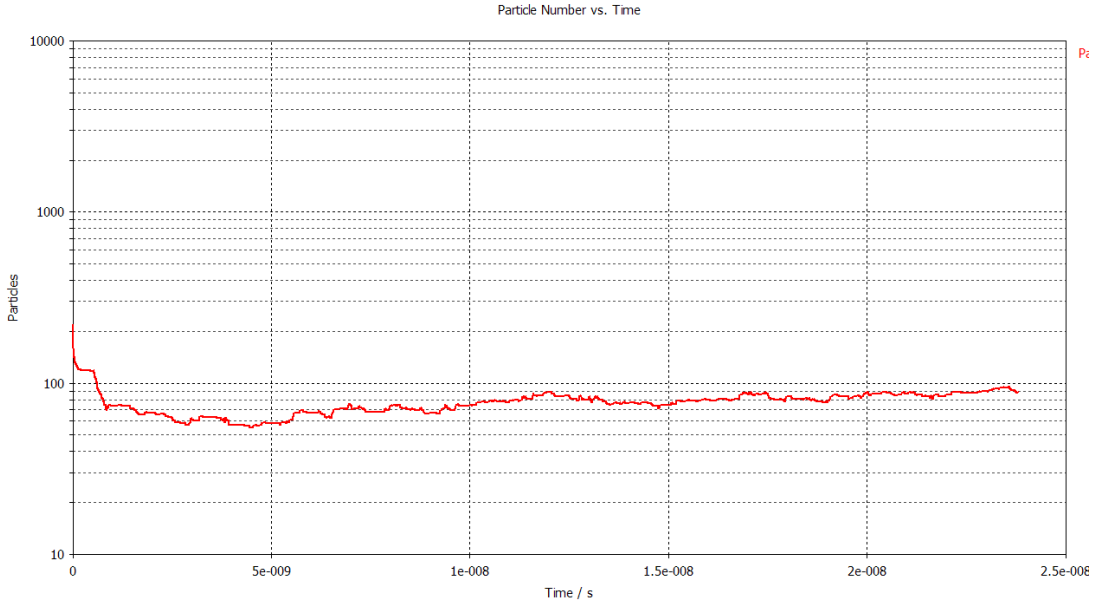




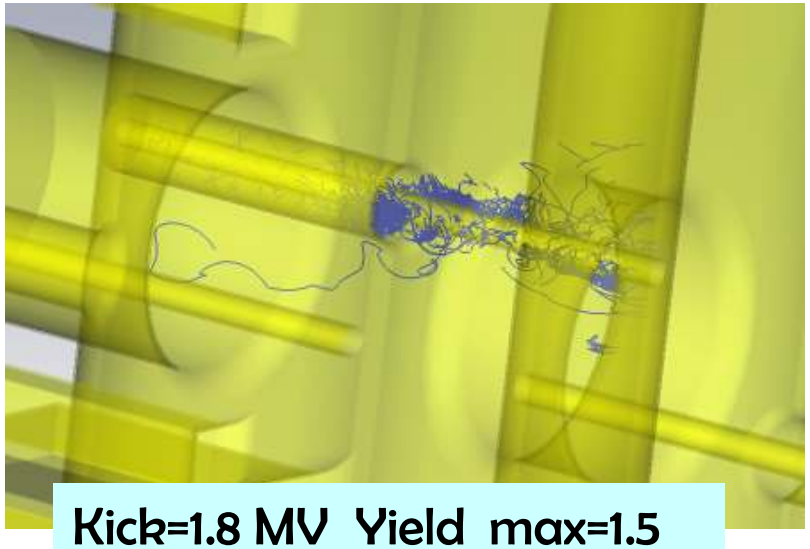
Kick=2.5 MV

Yield_max=1.5 Growth_rate=0.157 1/ns

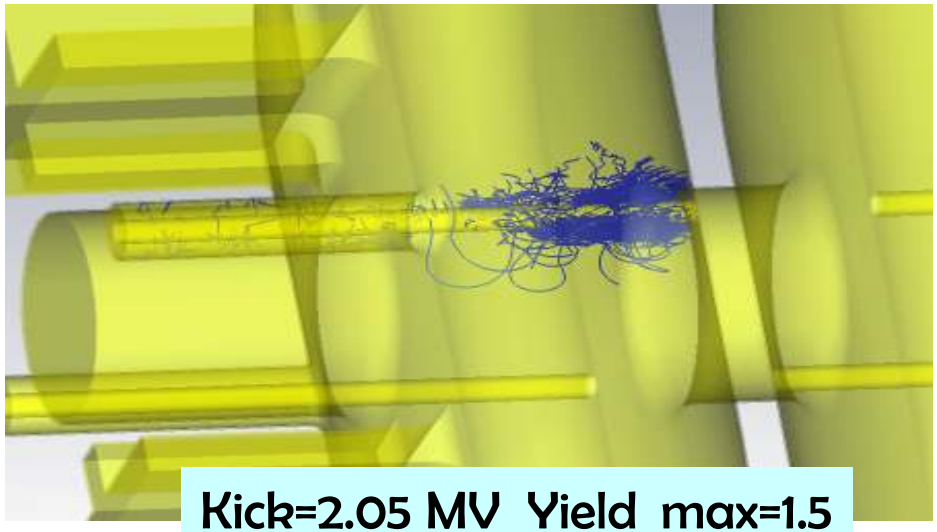
Yield_max=1.25 Growth_rate~0 1/ns



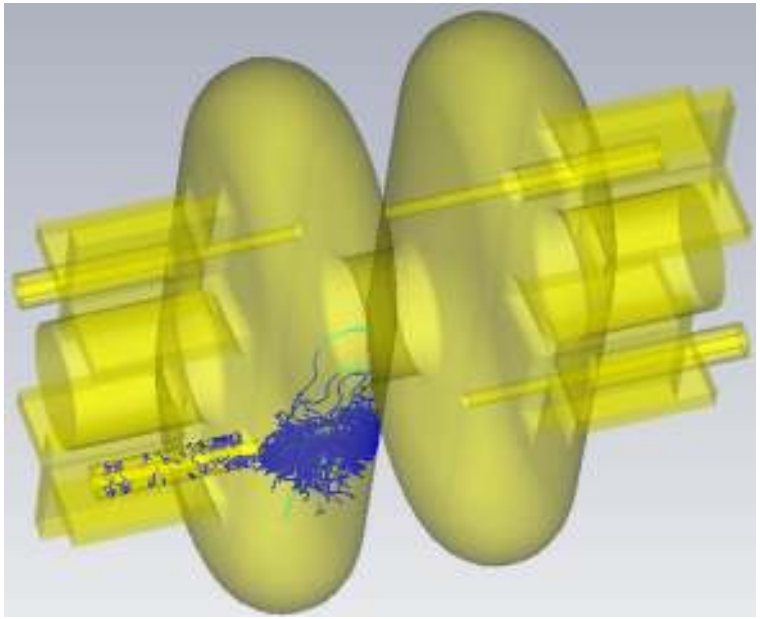
Emission from coaxial Line



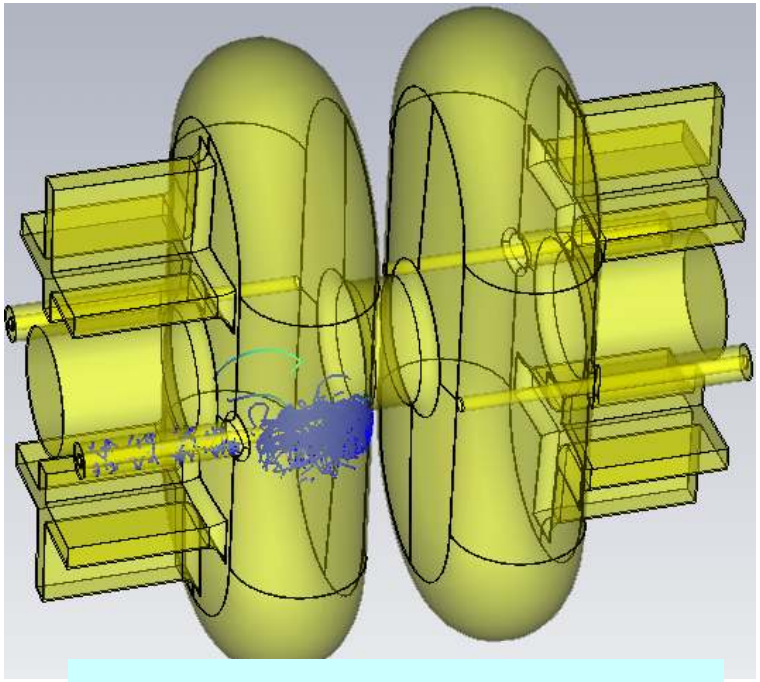
Kick=1.8 MV Yield_max=1.5



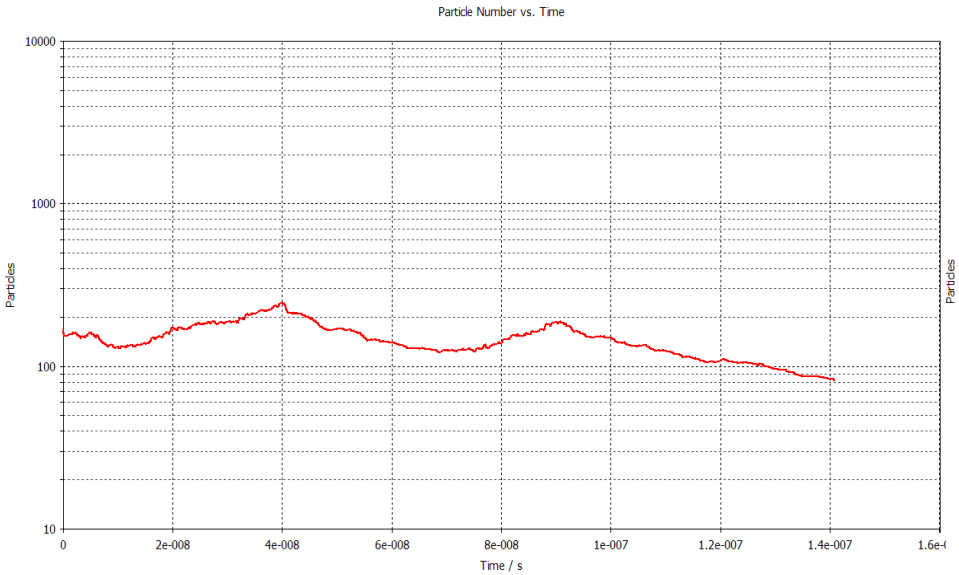
Kick=2.05 MV Yield_max=1.5



Kick=2.25 MV Yield_max=1.5

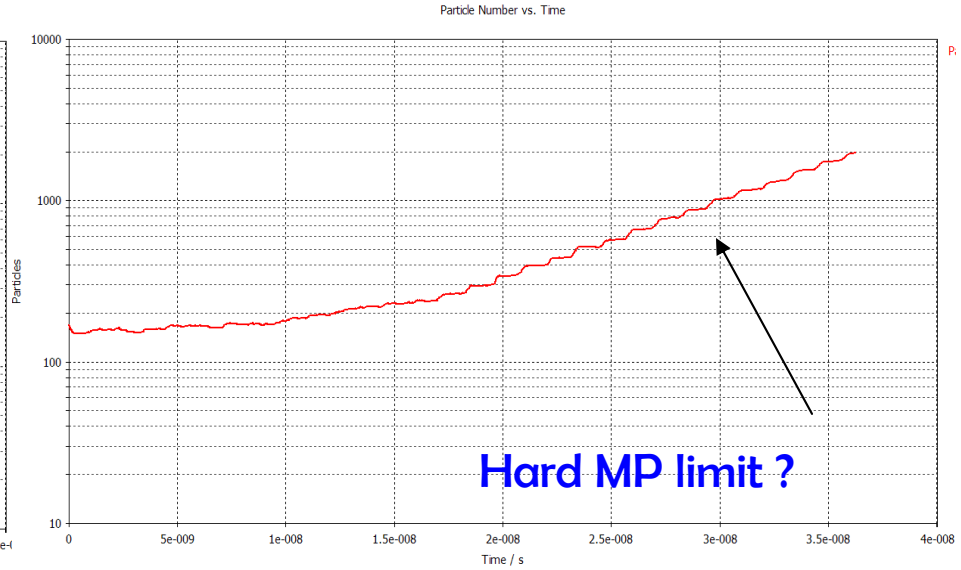


Kick=2.5 MV Yield_max=1.5



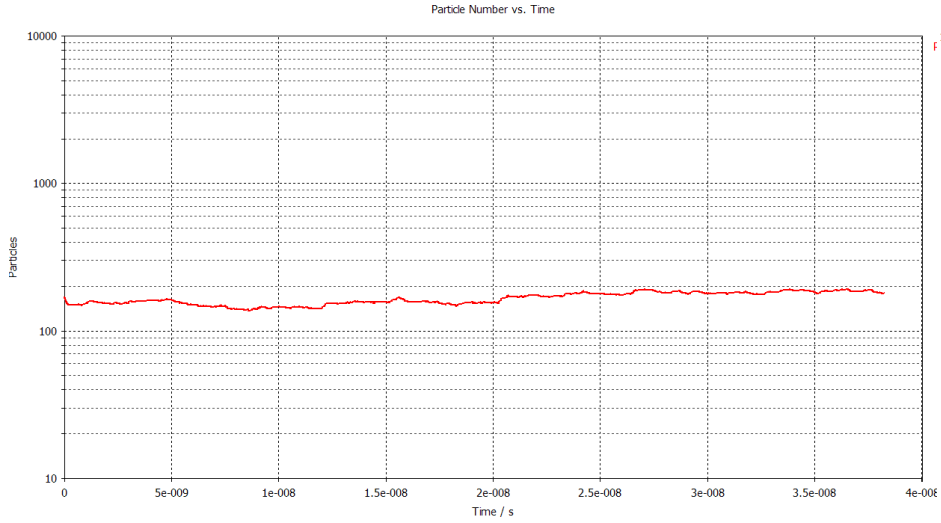
Kick=1.6 MV

Yield_max=1.25 Growth_rate=-0.009 1/ns



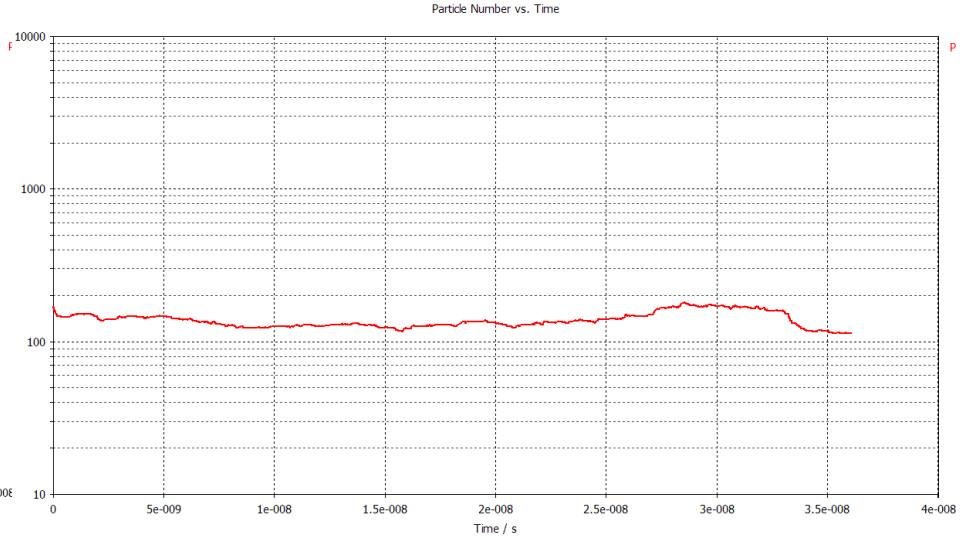
Kick=1.8 MV

Yield_max=1.25 Growth_rate=0.097 1/ns



Kick=2.25 MV

Yield_max=1.25 Growth_rate~0 1/ns



Kick=2.5 MV

Yield_max=1.25 Growth_rate~0 1/ns

Conclusions:

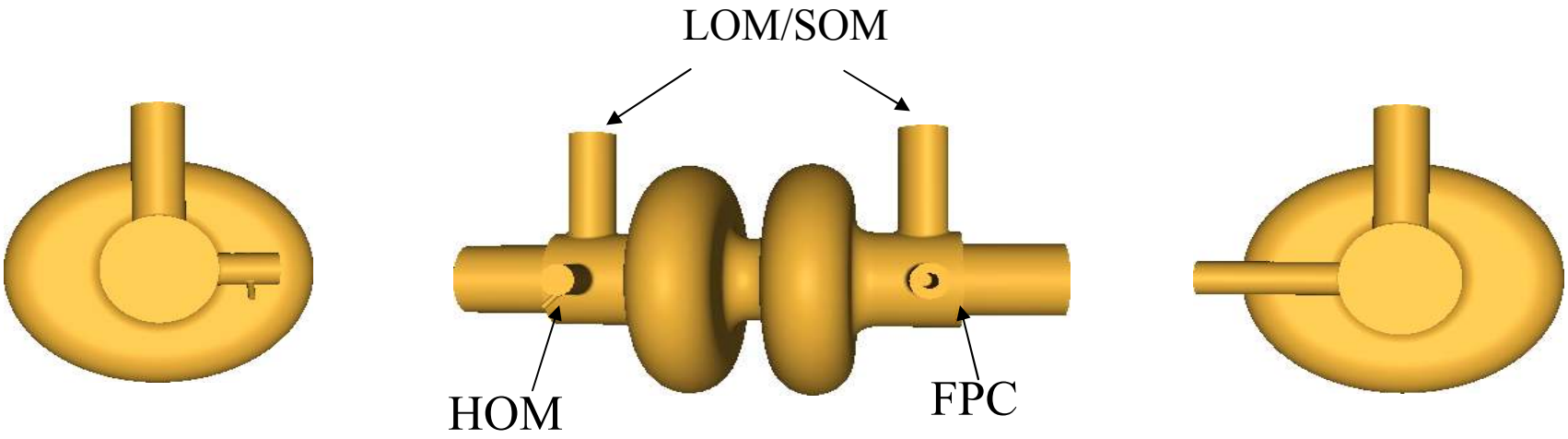
- According to the CST Particle Studio simulations, the resonance conditions for multipacting discharge take place in 3 places in different range including nominal Kick 2.5 MV ;

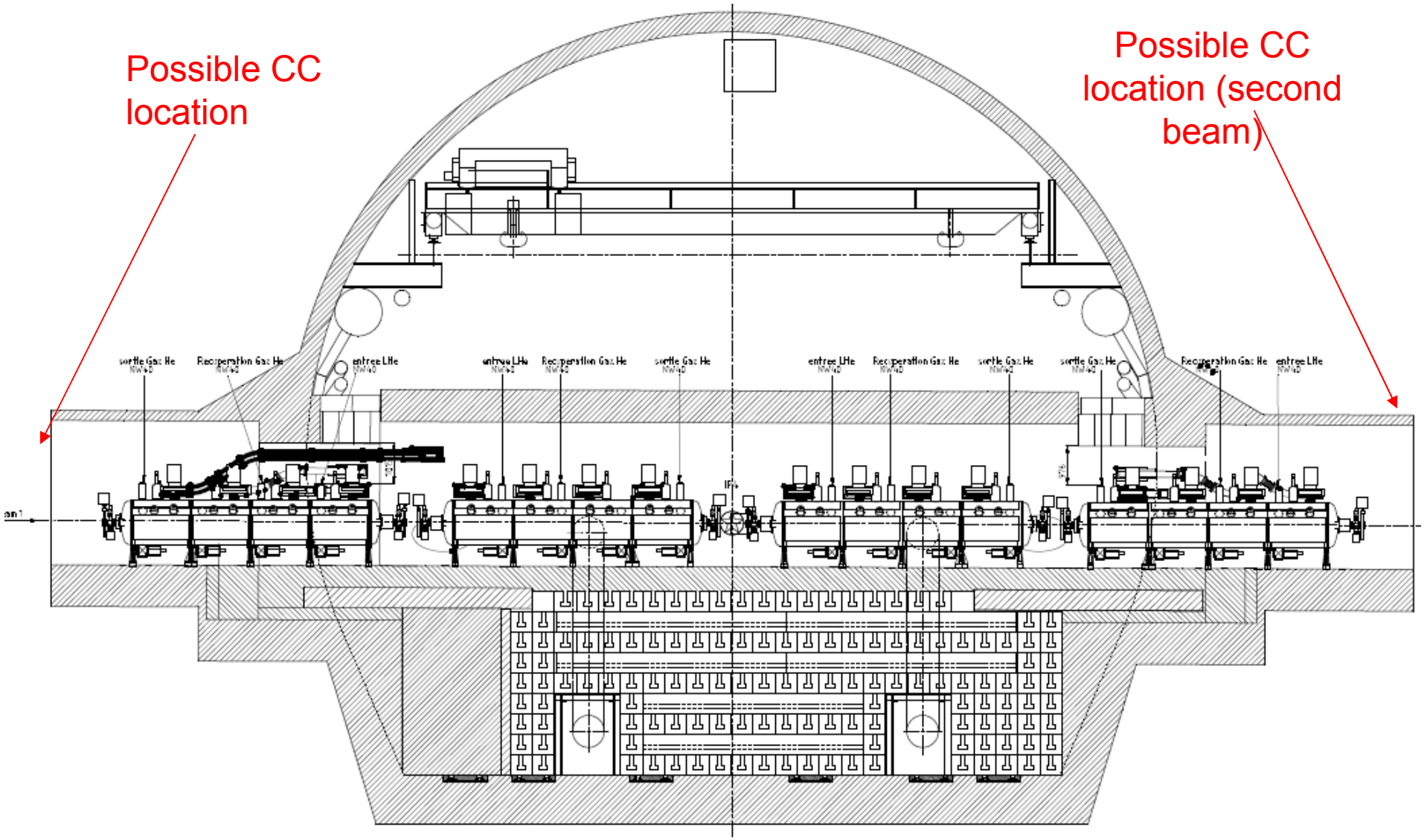
- The dominant MP take place in area of connection of internal road to cavity wall

- Calculation for smaller yield=1.25 max (Nb after RF power processing) shows possible hard MP limit near coaxial line at Kick 1.8 MV. Other MP zones may be qualified as Soft limit MP .

Status of the cryostat design

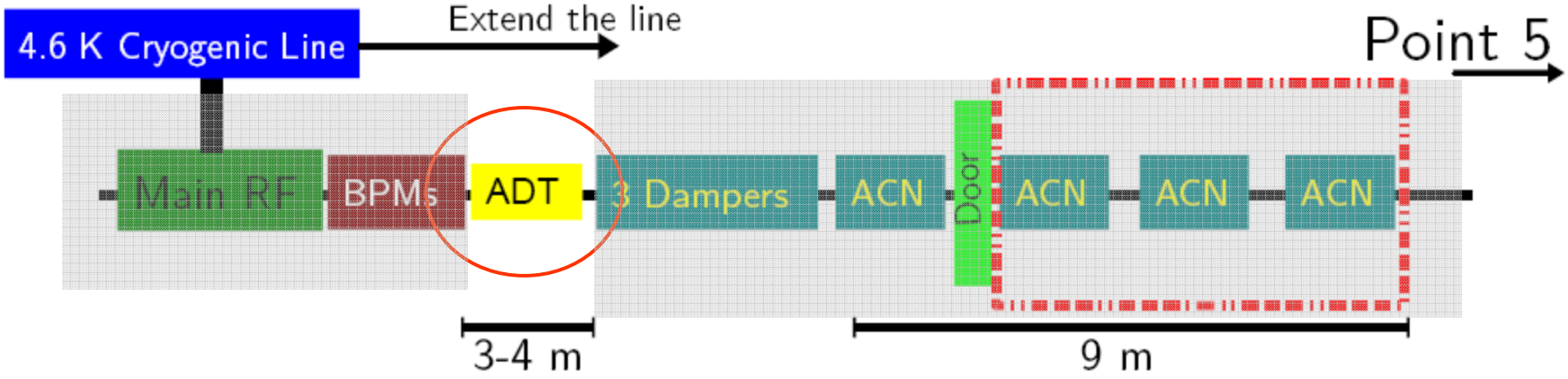
- Geometrical constrains for basic SLAC CC design (couplers);
- Start conceptual design



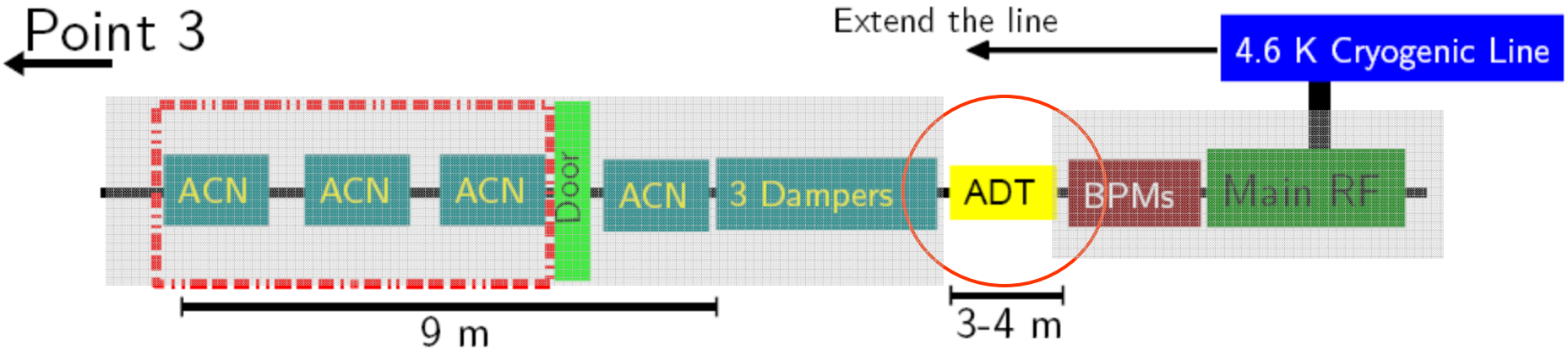


LHC IP4 location (RF)

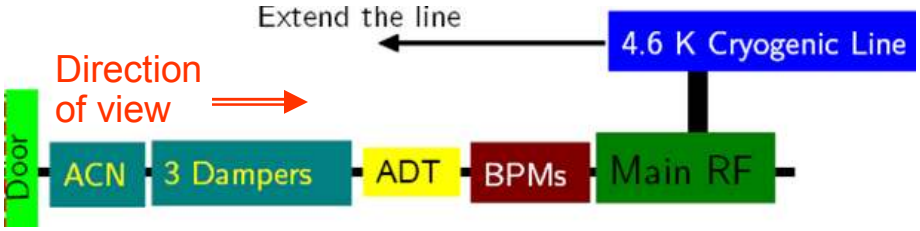
IR4 Layout

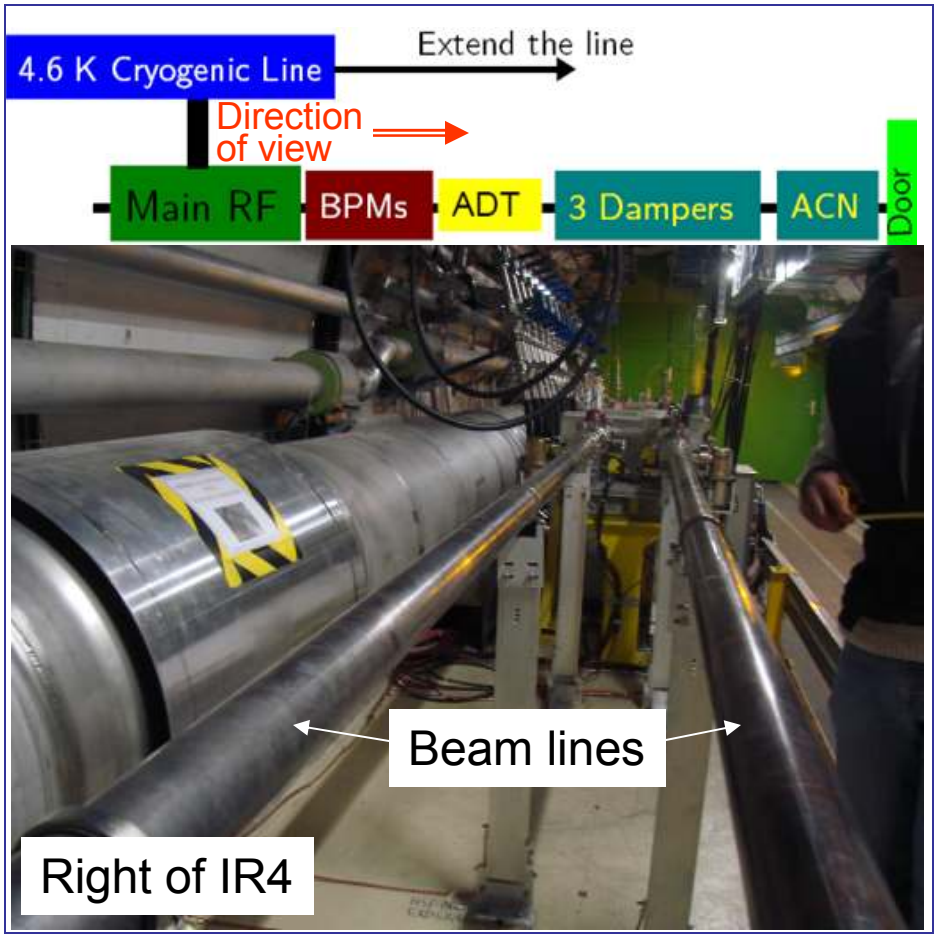


Max 3m longitudinally

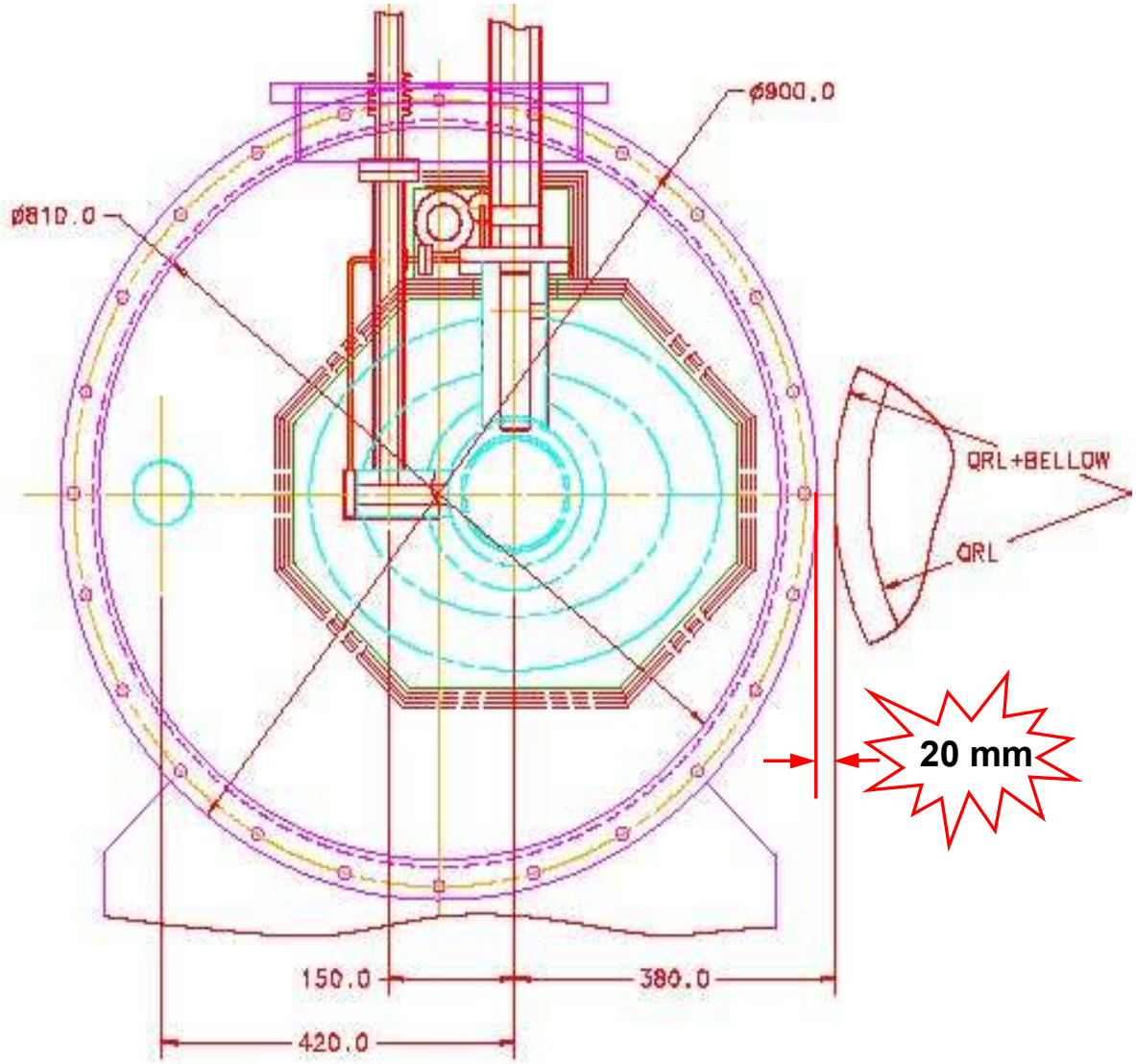


ADT Reserved Damper Space 3-4 m



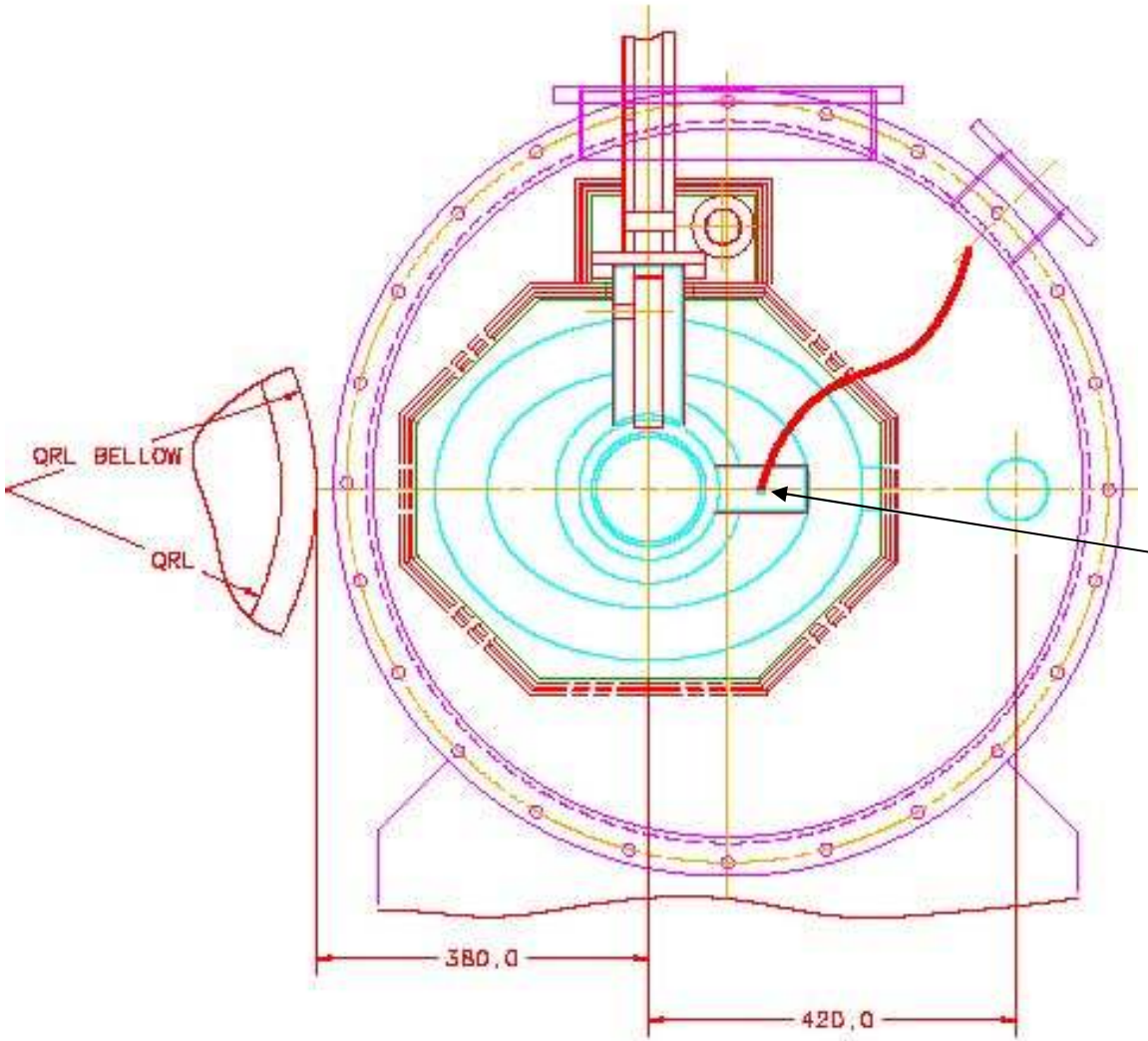


Left of IR4, ADT (View from the Door)



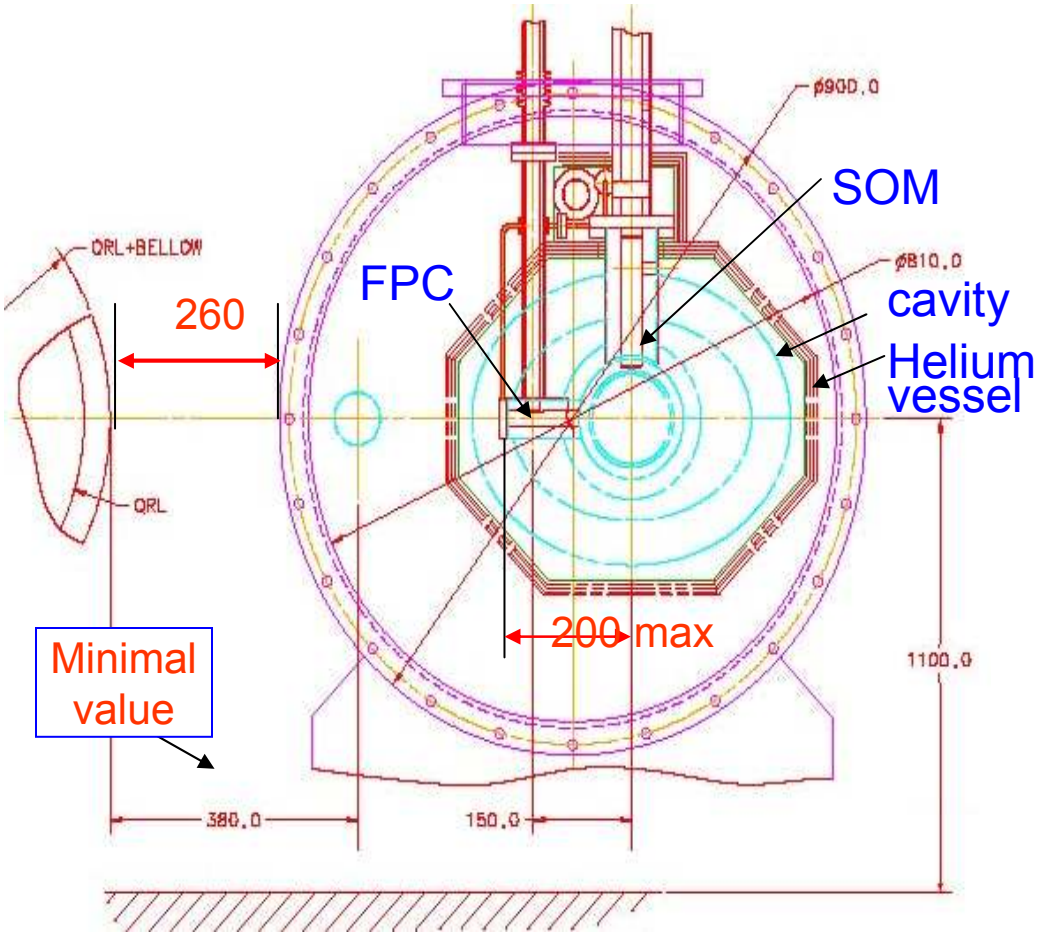
- Diameter of CM is ~ 900mm
- Very limited space between Helium vessel and cryostat wall (QRL position vs. beam)
- No way for horizontal main coupler output (limits from both sides).
- Design of the main coupler with vertical output is required. Horizontal part of the coupler is limited (< 15cm)
- LOM and SOM couplers are already in vertical plane, HOM coupler is connected by cable
- Cavity position in the cryostat is asymmetric. It will probably complicate alignment, which is more severe than for accelerating cavity

Left of IR4, ADT (View towards the Door)



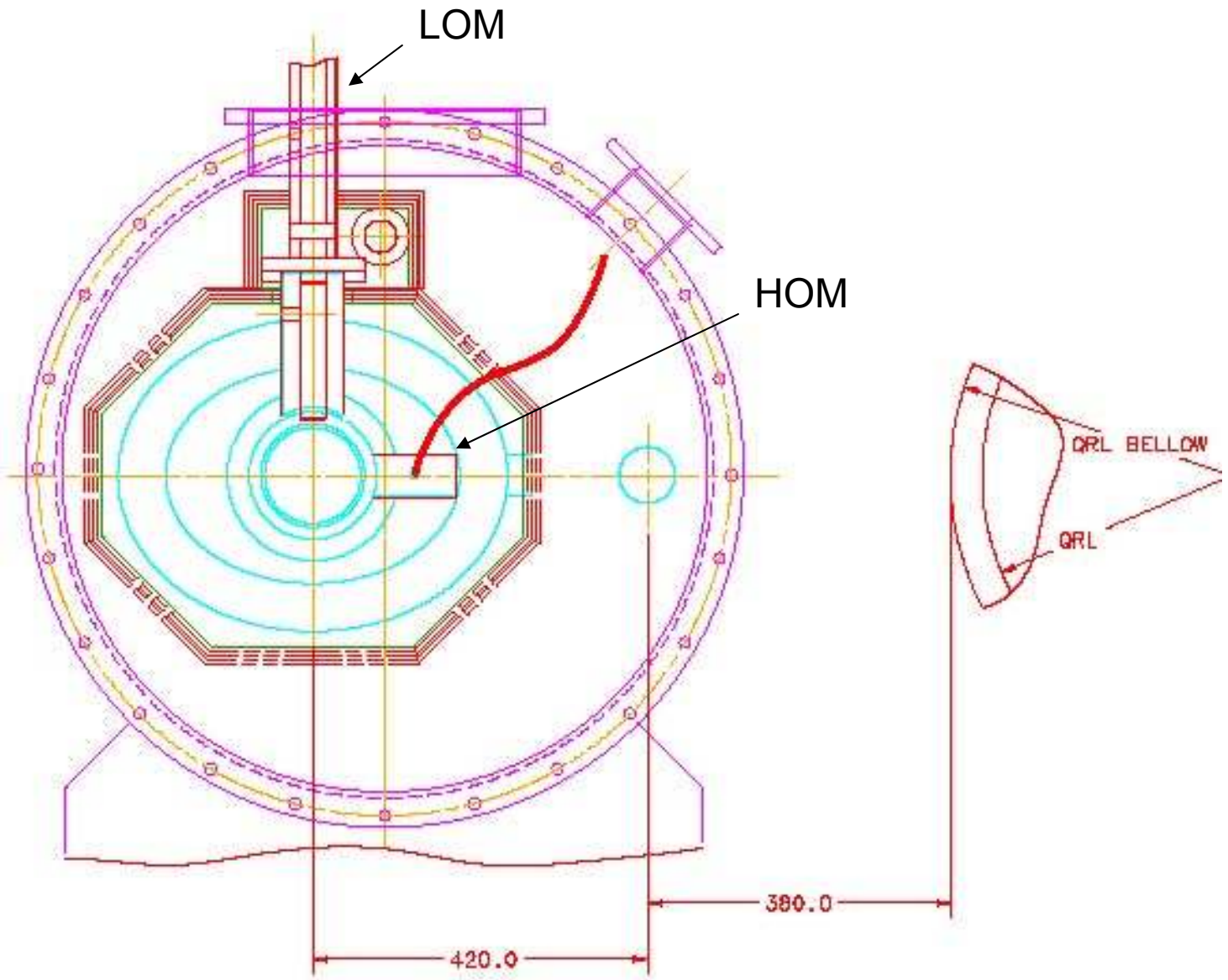
- LOM (High power) and HOM coupler are in the same side of the cavity
- HOM coupler → cable connected, port location is not limited

Right of IR4, ADT (View towards the Door)

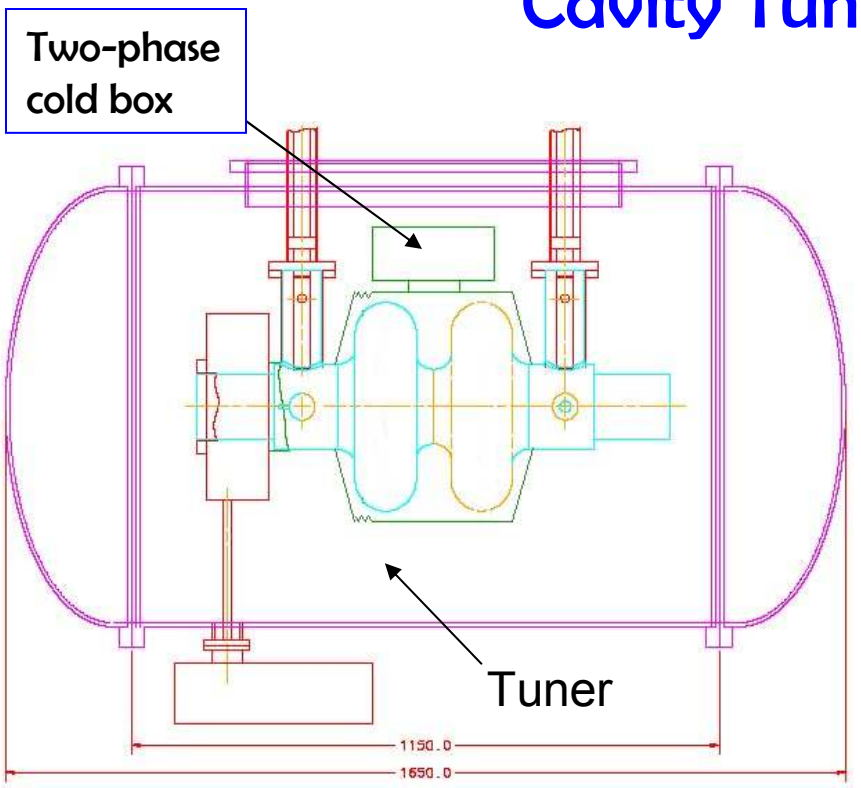


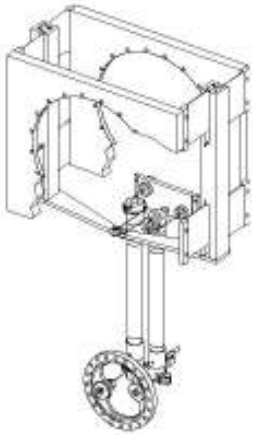
- In this location more room from left side (If needed)
- Horizontal FPC output even in this case is problematic (limited from aisle side - transportation)

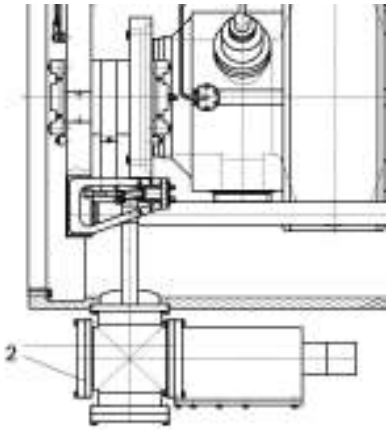
Right of IR4, ADT (View from the Door)



Cavity Tuning Concepts



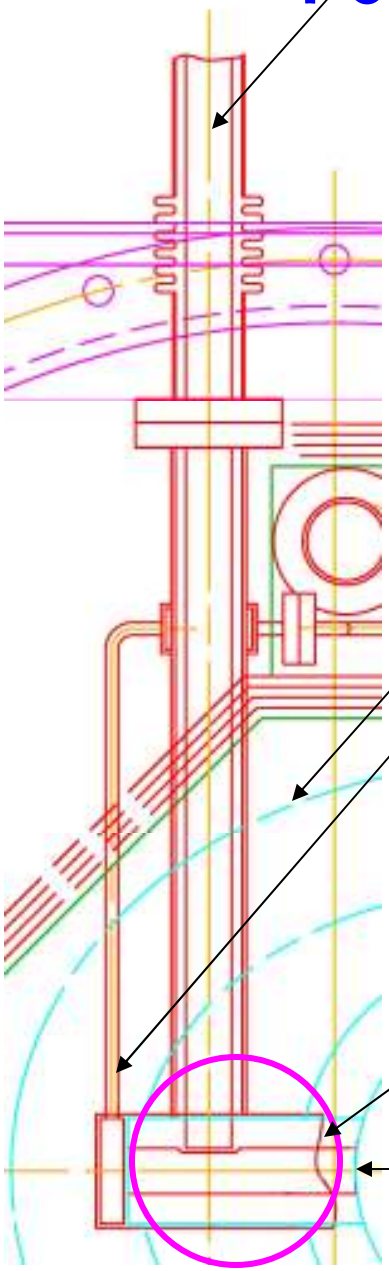


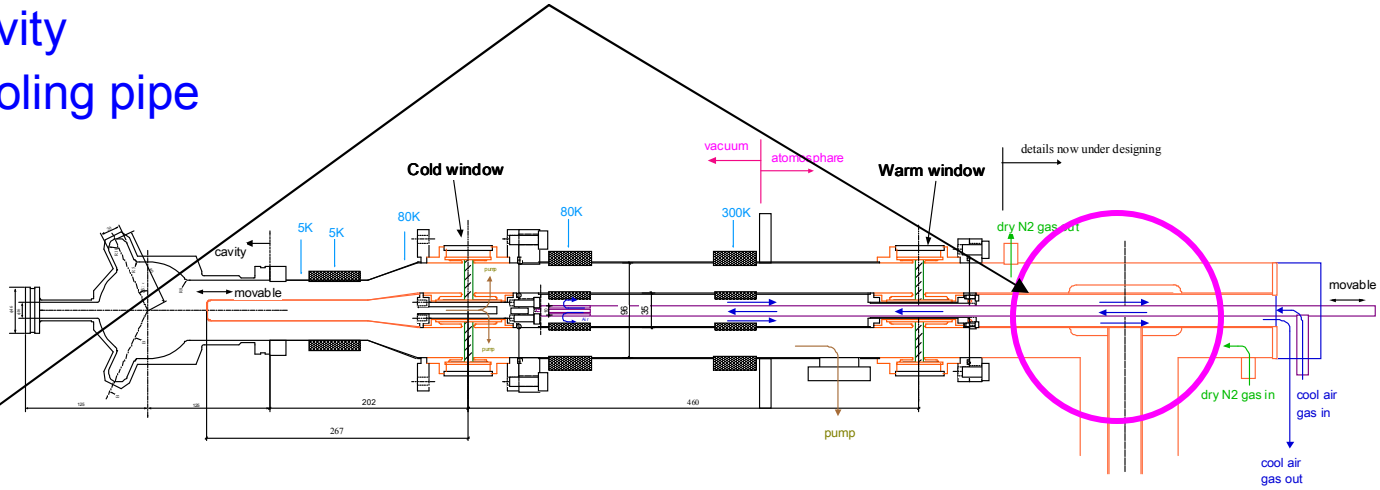


- Try to use CERN design with minimum modifications.
- Specifications for cavity tuning not defined (tuning range, forces, deformations of each cavity, field stability, etc ...)
- Mechanical analysis (stress, forces and deformation) of the cavity tuning. Analysis should include helium vessel and couplers.
- Helium vessel is part of cavity design, not part of cryostat design (but they should be matched)

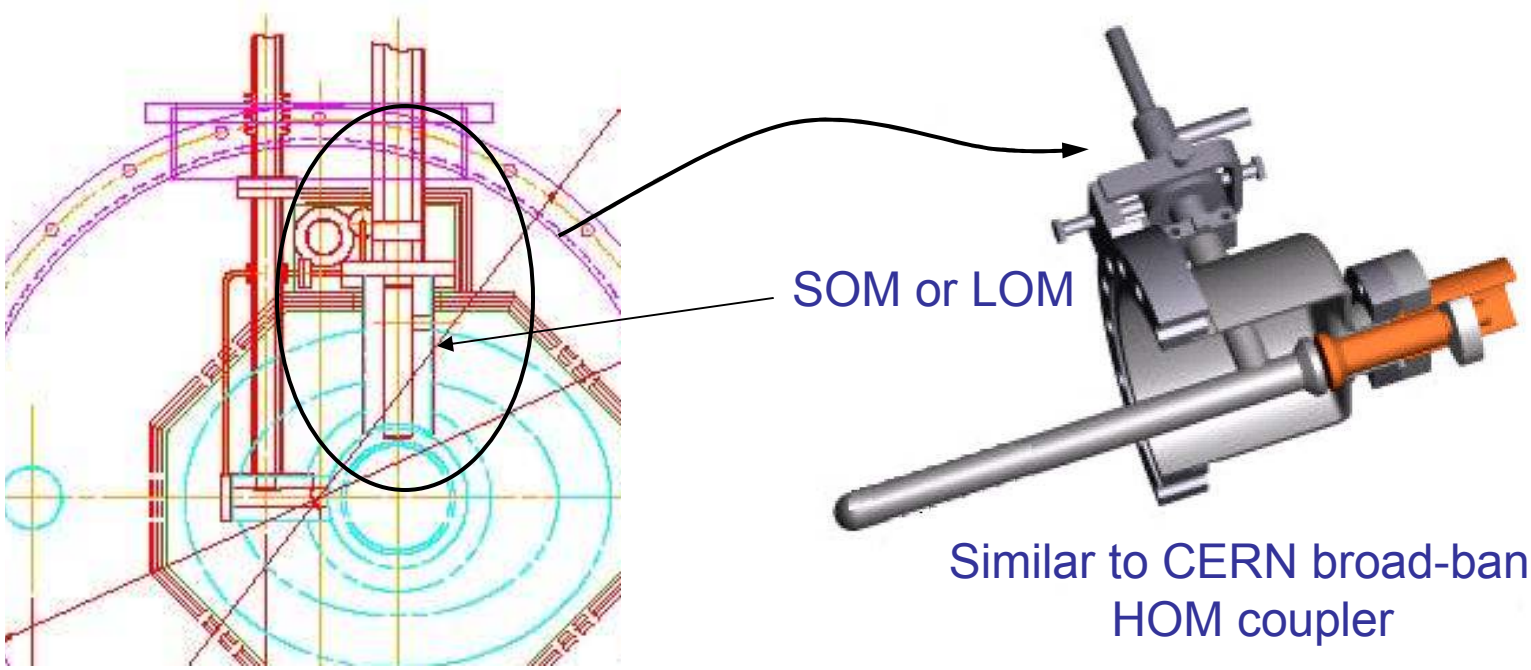
Possible design of the FPC coupler that fits the geometrical constrains

- No room for FPC in horizontal direction;
- Central electrode of FPC is to be cooled; No concept design of the coupler with cooling yet.
- Do we need adjustable power coupler ?
- Possible solution: T-connection like in KEK Tristan-type ERL coupler





Possible design of the LOM/SOM coupler



- Need realistic concept of all couplers (level of details enough for CM design, see example of CERN coupler), that includes:
  - How to assemble
  - Assembly tolerances
  - Cooling scheme

Summary:

- The work on the cryostat mechanical design is started
- The details of the cryostat position and distances to the critical elements of the environment are to be clarified;
- More detailed cavity package design is required:
  - Specification (cooling, tuning, forces, etc...) and mechanical/alignment tolerances
  - Real design of the couplers (FPC, LOM, SOM. HOM) - cooling, supports, assembly.
  - Helium vessel