Cryo BLM meeting
Cold Masses and Cryostat layout

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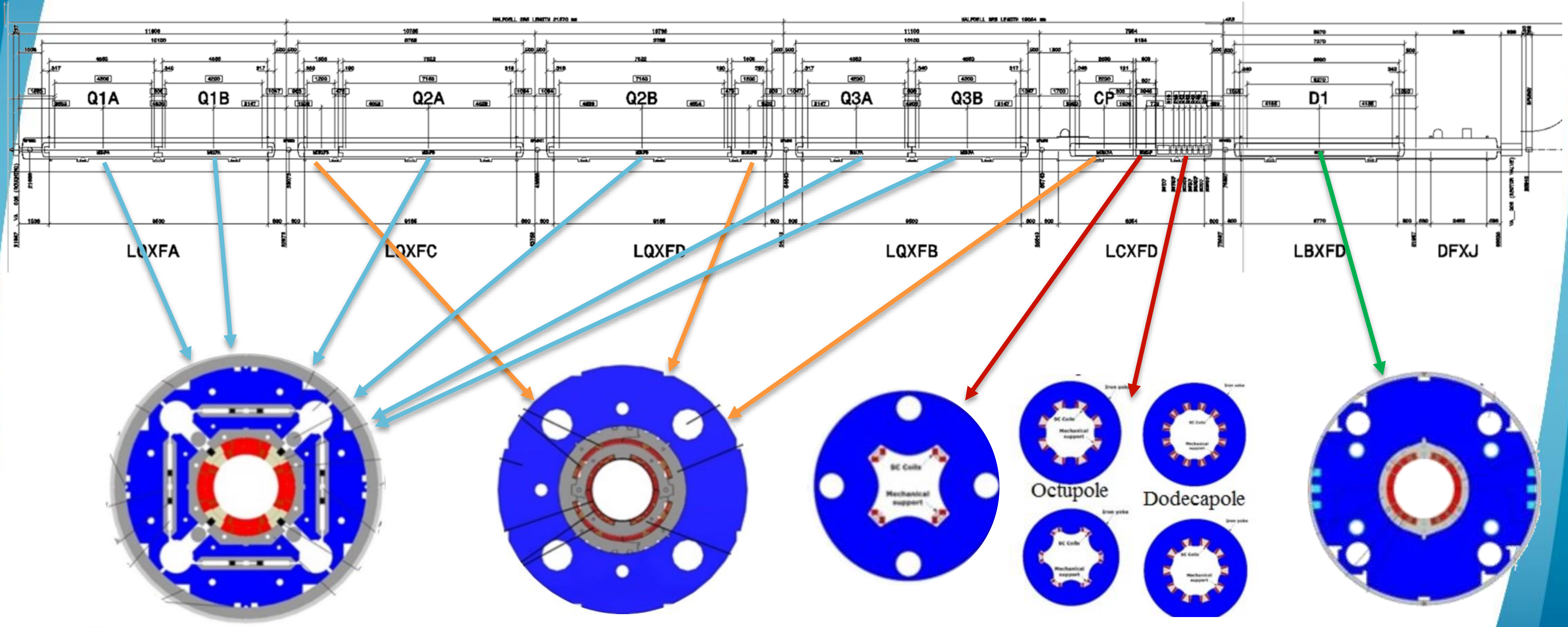
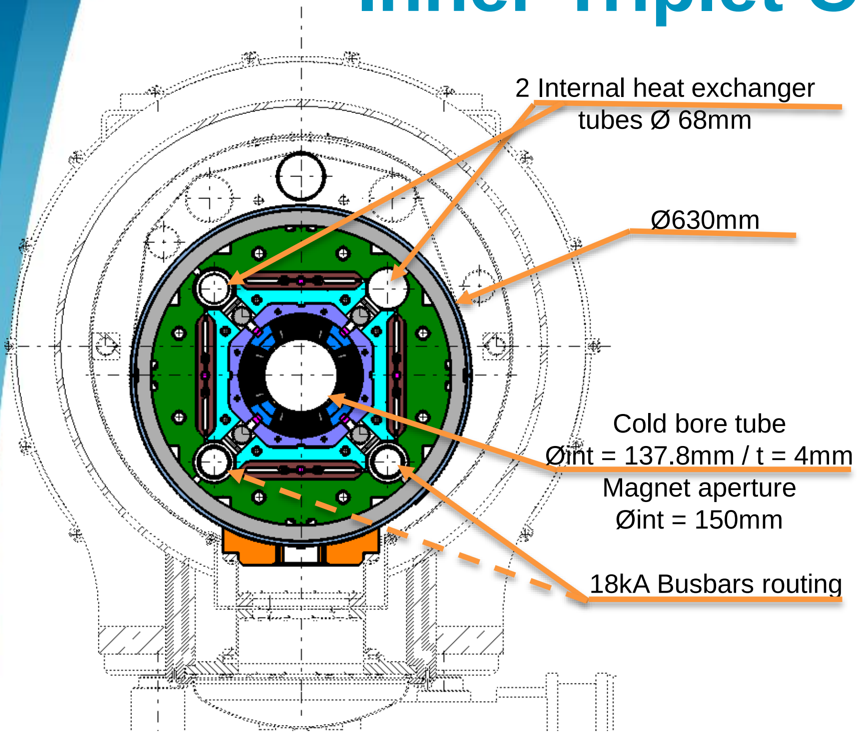
International Review of the Inner Triplet Quadruples (MQXF) for HL-LHC
CERN, Switzerland – 7th to 10th June, 2016

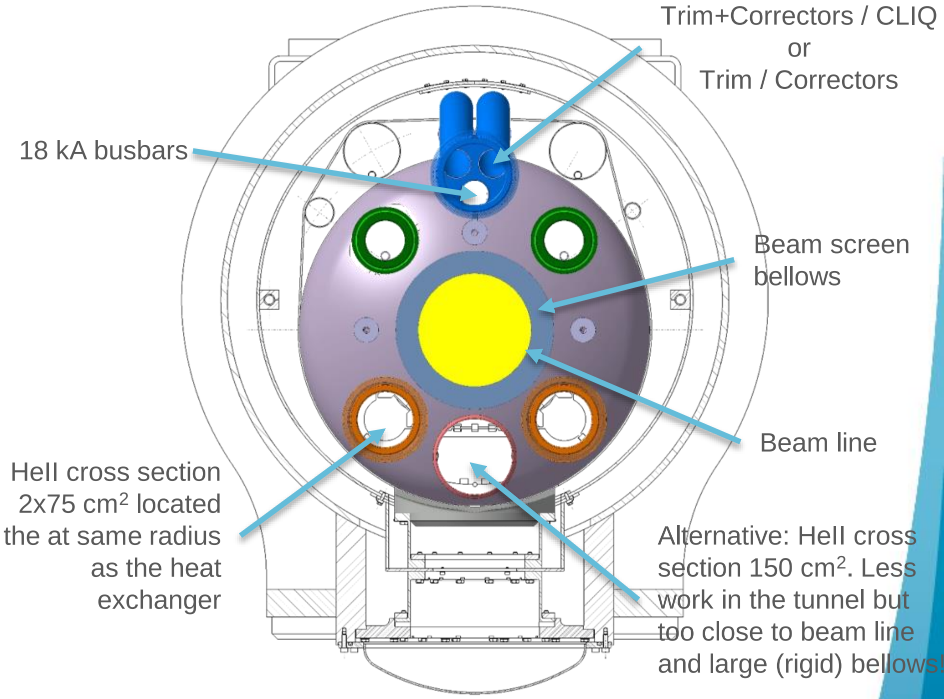
Inner Triplet String Layout
Magnets Cross Sections



Inner Triplet Cold Masses Layout



Cross section (along MQXF)

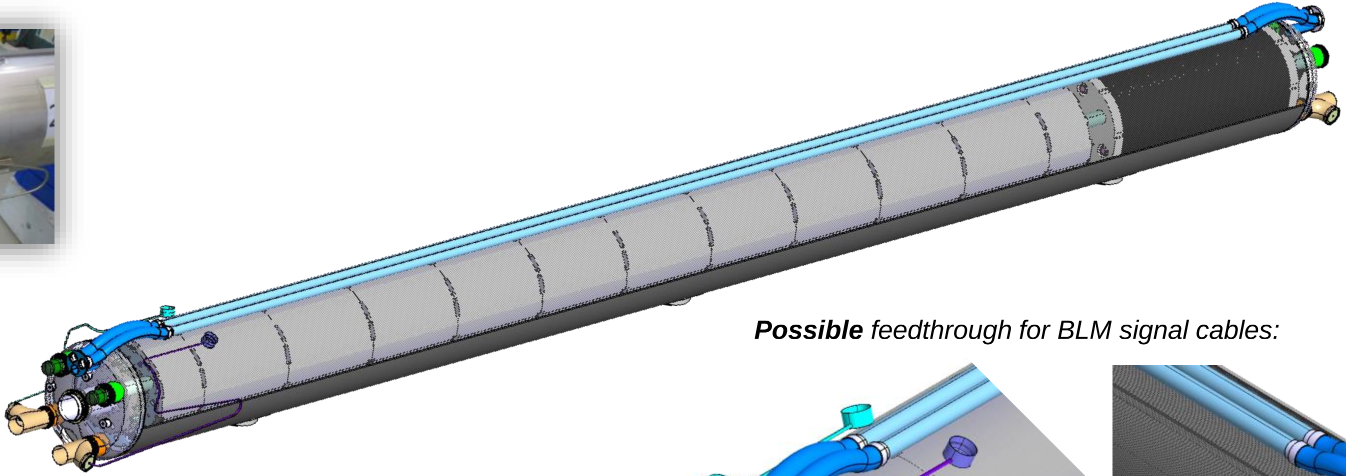


View from the extremity

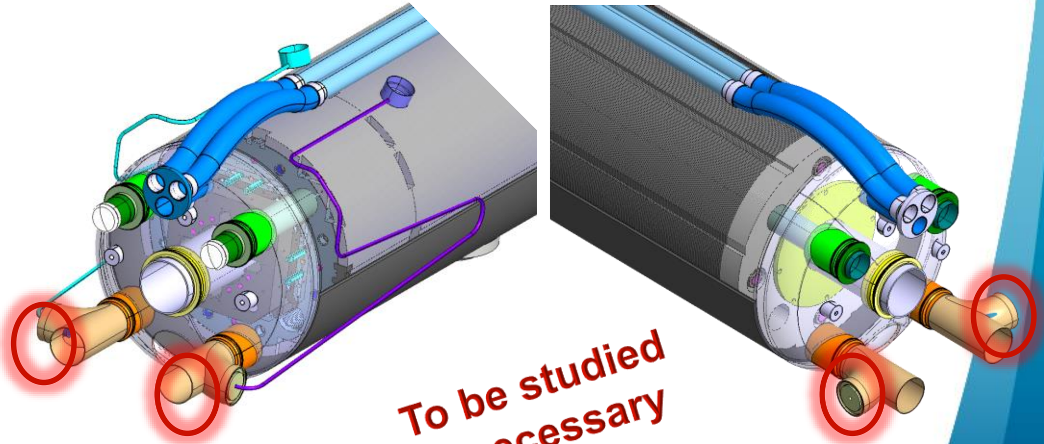
Inner Triplet Cold Mass Instrumentation feedthrough

MB IFS Capillary

Standard LHC Cover Flange on top of the cryostat surface



***Possible** feedthrough for BLM signal cables:*



Additional ports?

To be studied if necessary

***Instrumentation capillaries** housing ~120 cables:*

• *Voltage Taps*	*AWG26*
• *Quench heaters*	*AWG16*
• *CLIQ?*	*10mm^2*
• *Temperature sensors*	*AWG30*
• *Cryogenic resistance*	*AWG26*

*Maximum voltage during electrical tests can reach **3kV** (air @ RT)*

Cryoassembly

Radial gap at the top required for cryostating sledge

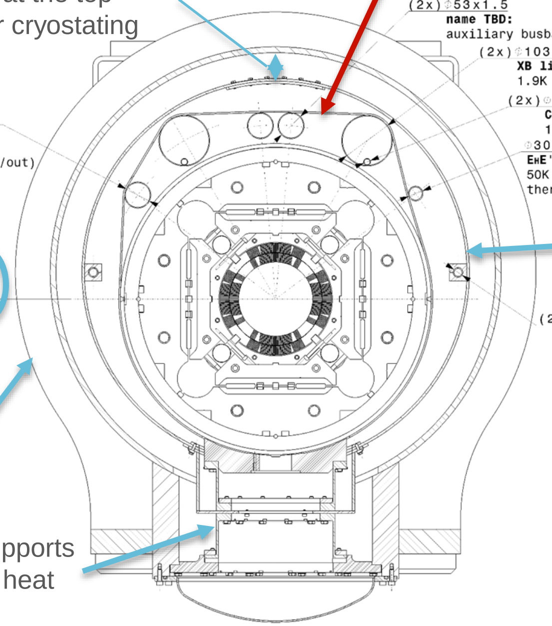
MLI (multi layer insulation)

Offset creates space for piping inside the cryostat

Carbon steel vacuum vessel

GFRE column type supports (3x) with intermediate heat intercept

Aluminium thermal shield 40-60K

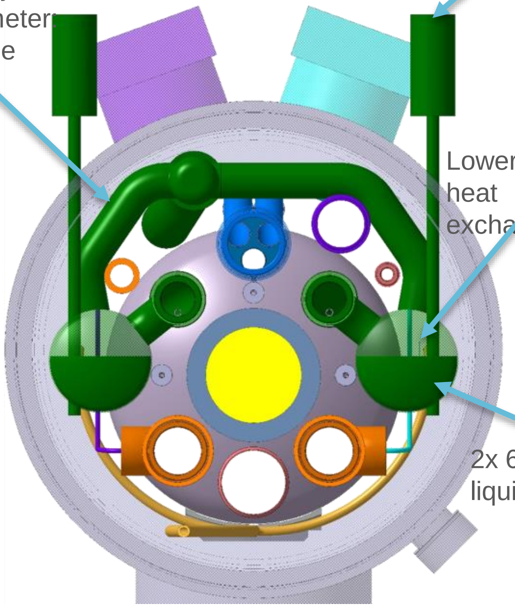


Pumping manifold requires locally enlarged diameter service module

Reservation for level gauge (if needed)

Lower than heat exchanger

2x 6.5 L of liquid volume



Cryo pipe diameters take into account cryo parameters and industrial availability

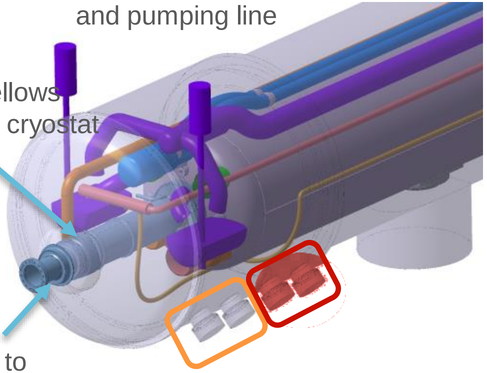
Sledge on rail cryostating method

Cryo-assemblies interconnections

Q1 IP side

Module required
for integration of
phase separators
and pumping line

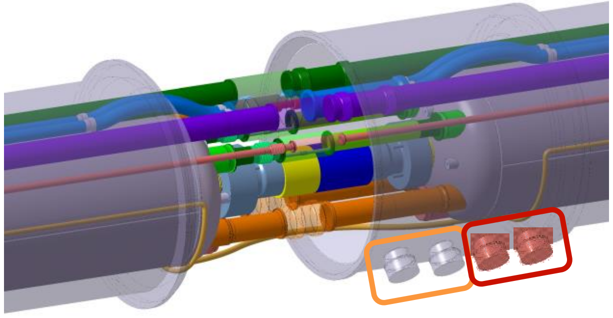
RF bellows
inside cryostat



Cold to
warm
transition

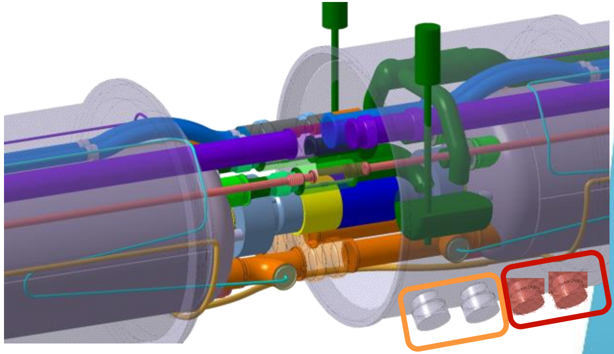
Q1 – Q2A
or Q2B – Q3

Service module



Q2A – Q2B

Service module



BPM feedthroughs

Possible BLM
feedthroughs

Internal volume already quite crowded !

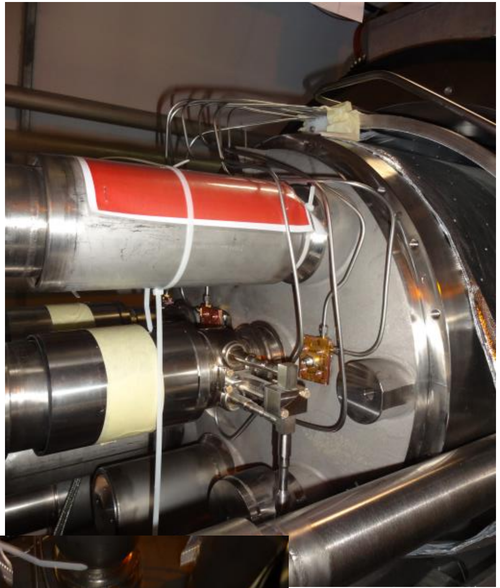
BLM Implementation within the Cold Mass or the Cryostat

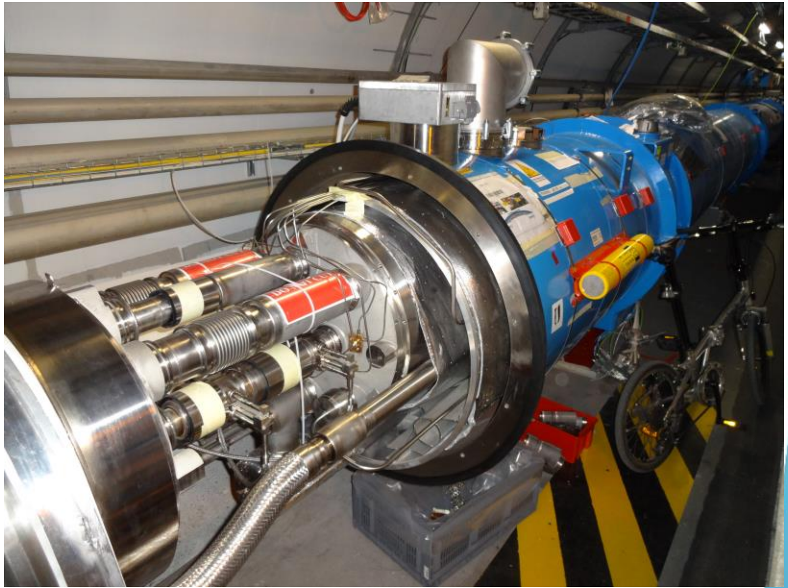
Questions and Remarks

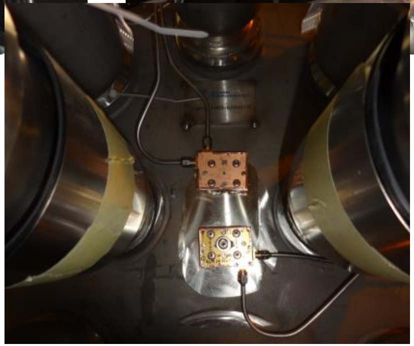
- ***BLM volume*** *and* ***quantity*** *to be integrated?*
- ***Cable type*** *and* ***quantity*** *to routed out?*
- ***I*** *and* ***V range*** *during operation?*
- ***Dielectric tests*** *conditions?*
  - *In case of a insulation fault, BLM circuits can see up to 3kV ⇨ leave the BLM cables floating or connect them to ground during the tests?*
- *Simple or double* ***leak tight feedthroughs*** *system for the cables ?*
  - *HeII ⇨ Insulation Vacuum ⇨ Air*
  - *HeII ⇨ Air*
- *BLM* ***reliability****?*

- ***No Maintenance or consolidation*** *within the cold mass or along the cryostat without very heavy operations (cryo-assembly removal, decryostating, cold mass opening…)*
- *BLM exchange in the interconnects require at least the inner triplet* ***string warm up***
- ***Leak tight feedthroughs*** *and* ***shielded cables*** *could be tricky (risk of leaks, dielectric properties under vacuum)*
- *Cable feedthroughs have to integrated in the* ***service module*** *(close to the interconnections)*
- *High current* ***busbars proximity*** *(up to 18kA)*
- ***Thermal loads*** *to be assessed*
- ***Thermal contractions*** *between the cold mass and its cryostat to be taken into account in the cable routing*
- ***Design is most probably not the last iteration***

Cryo BLM installed by SIT during LS1 on the cold masses end covers in QBBI.9R7 and QBQI.9L5







Courtesy of N. Bourcey