MDI design integration

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Outline

Task 1: 3D engineering design of IR and MDI mechanical layout with integration

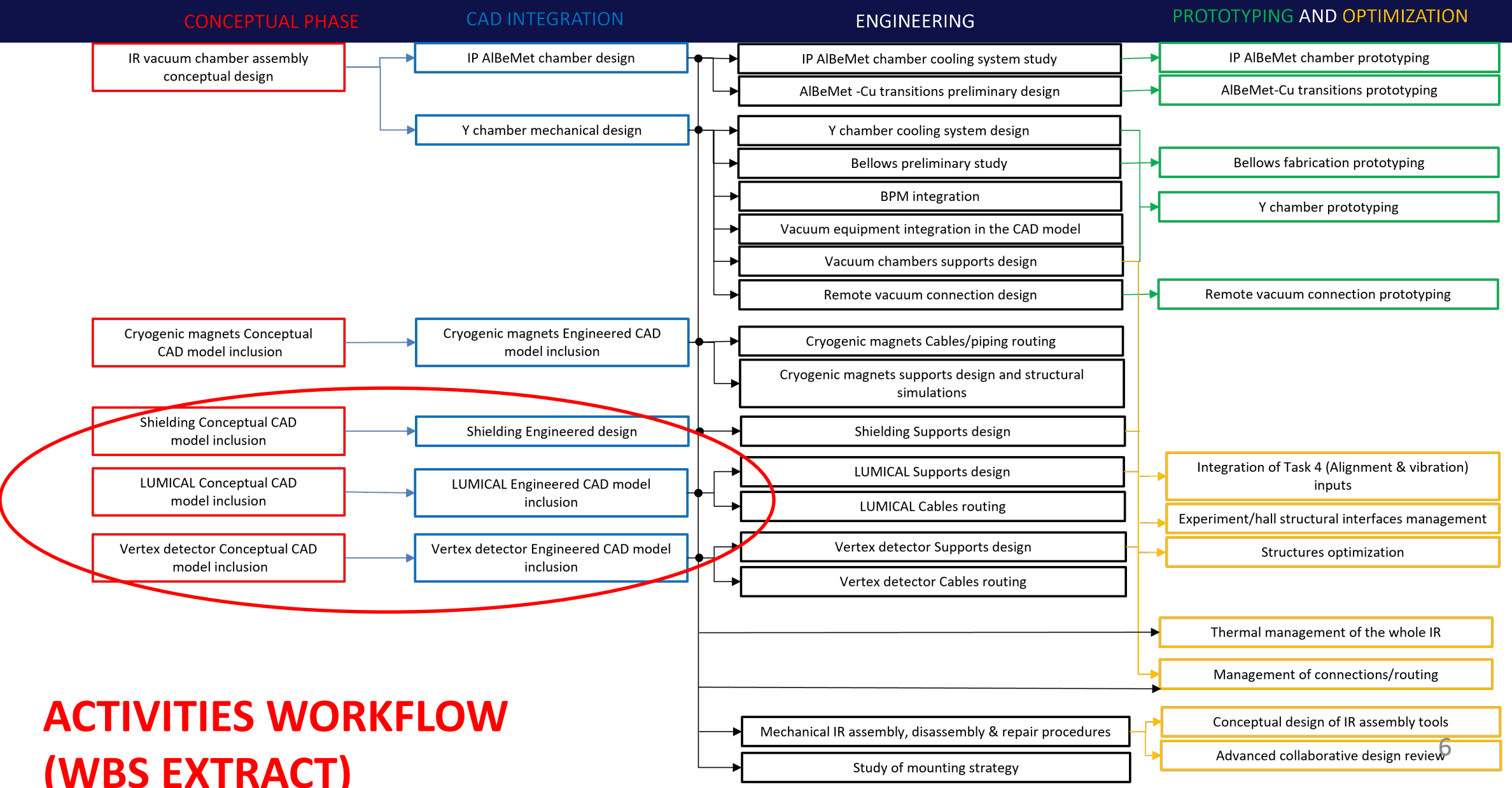
- Activity summary: PBS, WBS, REQUIREMENTS
- Organization: PDM, CAD SHARING AND COOPERATION
- WORK IN PROGRESS / STATUS
  - Preliminary 3DCAD drawing of the Interaction Region (IR)
  - Design of the beam pipe / cooling study
  - Ongoing/Starting collaborations
- Open points

Breakdown structure - PBS

1	**1**		**Beam pipe**
1	1	1	IP AlBeMet pipe
1	1	2	IP AlBeMet pipe cooling system
1	1	3	AlBeMet-copper transitions
1	1	4	Y pipe
1	1	5	Y pipe cooling system
1	1	5	Bellows
1	1	6	BPMs
1	1	7	Vacuum equipment (pumps, gauges)
1	1	8	Beam pipe supports
1	1	9	Remote vacuum connection
1	1	10	Pipe alignment system

1	**2**		**Cryogenic magnets**
1	2	1	Compensating solenoid left
1	2	2	Compensating solenoid right
1	2	3	Screening solenoid left
1	2	4	Screening solenoid right
1	2	5	Quadrupole 1.1, left
1	2	6	Quadrupole 1.2, left
1	2	7	Quadrupole 1.3, left
1	2	8	Quadrupole 1.1, right
1	2	9	Quadrupole 1.2, right
1	2	10	Quadrupole 1.3, right
1	2	11	Magnets power supply Cables
1	2	12	Magnets I/O Cables
1	2	13	Magnets alignment system
1	2	14	Magnets supports

~~1~~	**~~3~~**		**~~Cryostat~~**
1	3	0	(sub-task re-distributed: see above sub-tasks)
1	**~~4~~**		**Shielding**
1	4	1	Solenoid shielding
1	4	2	Tungsten shielding
1	4	3	Supports
1	**5**		**IP detectors**
1	5	1	Luminosity calorimeter
1	5	2	Vertex detector
1	5	3	Supports
1	5	4	Cables
1	**6**		**Main Supporting structures**
1	**7**		**Electrical and hydraulic connections main routes**
1	**8**		**Mechanical IR assembly tools**



ACTIVITIES WORKFLOW (WBS EXTRACT)

Work in progress

- Collecting components design, have and give feedbacks on them (status: updates needed)
- Design (CAD & thermo-mech simulation) of:
  - Paraffin cooled AlBeMet central chamber and Y chamber (status: advanced)
  - Bellows and Copper/AlBeMet transitions (status: good)
  - Supports (status: not yet started)
- Layout and space management (status: just started)
- Collaboration for low impedance design of the vacuum pipe and heat load assessment (w. A. Novokatsky) (status: advanced)
- Collaboration with LAPP (vibration issues) and CERN (alignment issues) (starting)
- Collaboration with Detector people on MDI (To be started asap)
- Prototyping proposal (1. Central IP chamber, 2. AlBeMet162-Cu transition with integrated bellow) (status: to be approved)

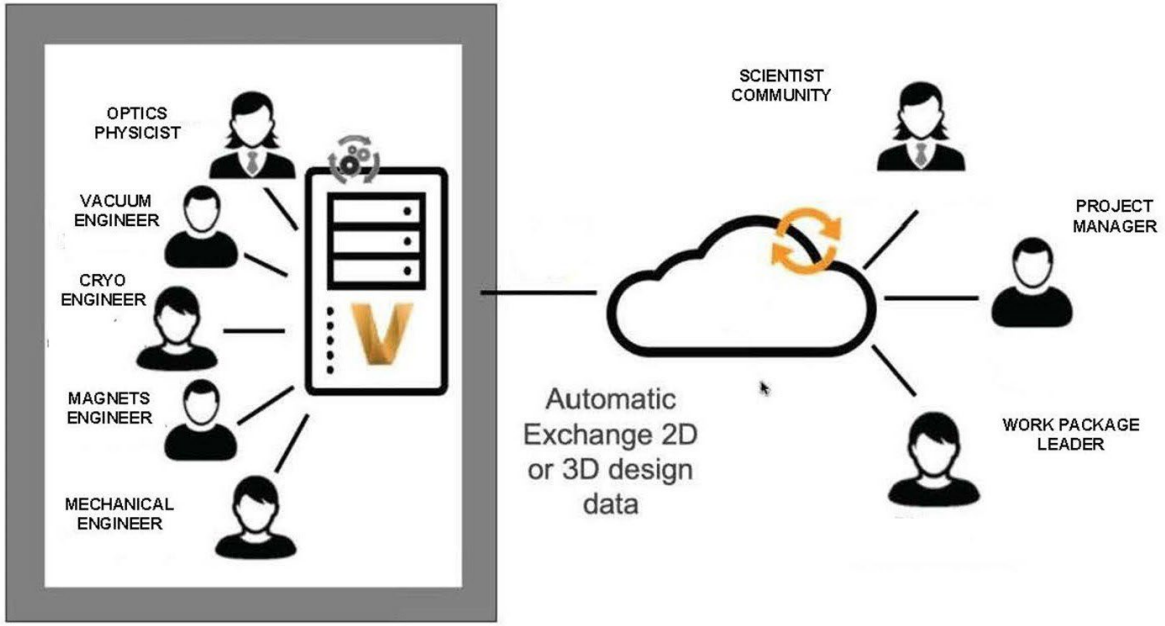
Requirements

(L. Pellegrino, F. Fransesini 16/11/2021, update 17/01/2022)		☑ =done		⚙ =work in progress					
Component	REQUIREMENTS FOR INTEGRATION								
	Conceptual/ preliminary drawing	Weight	Anchor points	I/O cabling	Power supply cabling	Cooling Piping	Thermal issues	Alignment issues	Engineered CAD model
Beam pipe	☑	⚙	⚙				⚙		⚙
SR absorbers/masks	☑						⚙		⚙
Vacuum equipment									
Compensation solenoid	☑								
Screening solenoid	☑								
Quadrupoles	☑								
Correctors									
Cryostats									
Alignment system									
LumiCal	☑								
Vertex detector									
BPMs									
Shieldings (solenoid)									
Shieldings (external)									
Bellows	☑								
Supports									

PDM, CAD sharing and cooperation

PRODUCT DESIGN MANAGEMENT tool:

- Engineering data management
- Web access for non-CAD users
- CAD cooperation
- Version control
- Change management



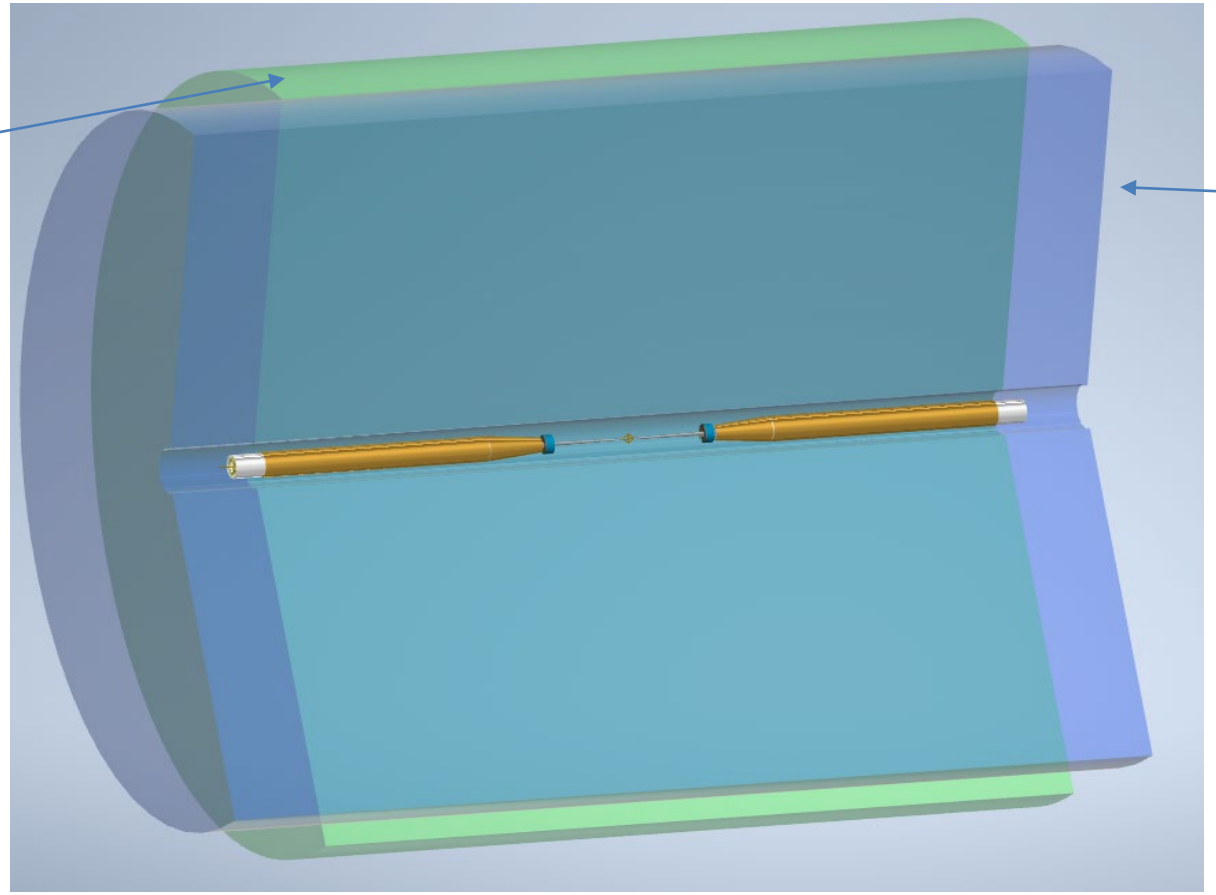
In Frascati we use:

- CAD: Autodesk INVENTOR Pro 2020 (INFN National License)
- PDM: Autodesk VAULT Pro 2020

(while waiting for a common design environment)

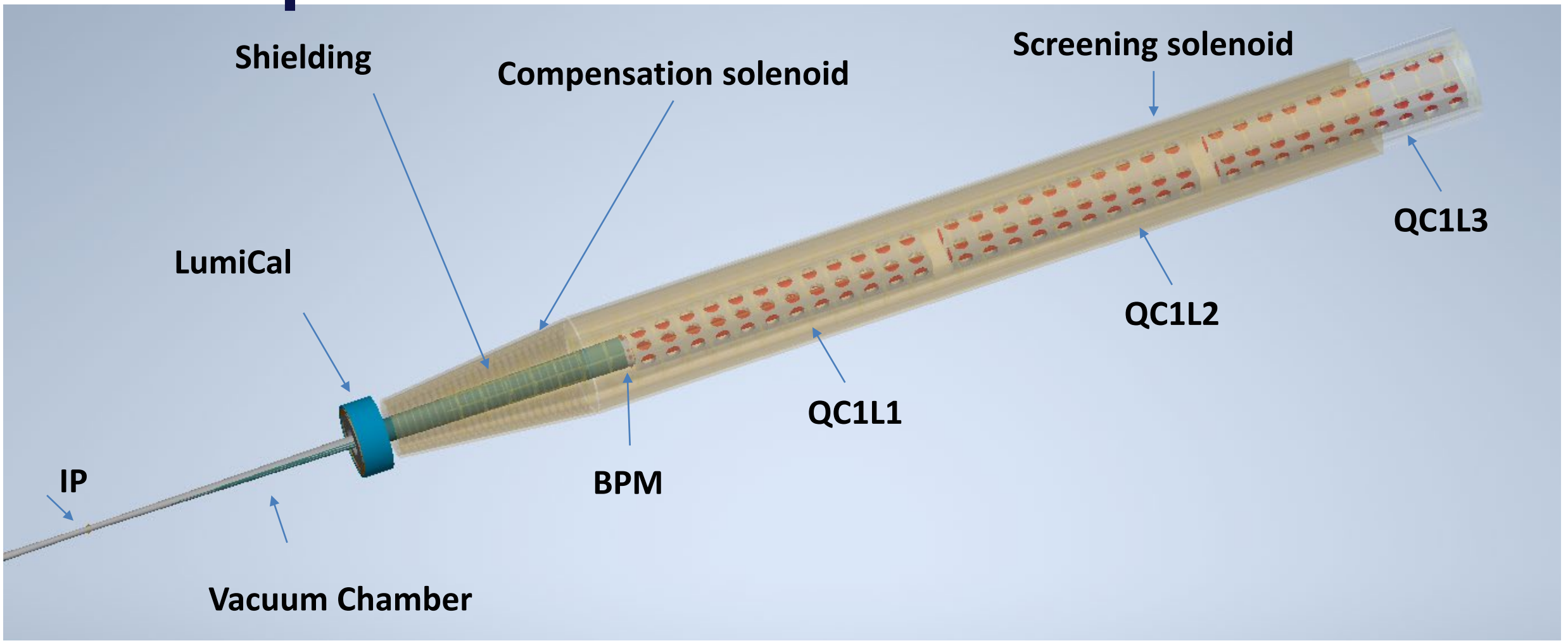
General view of the IR inside the Detector

CLD



IDEA

IR components

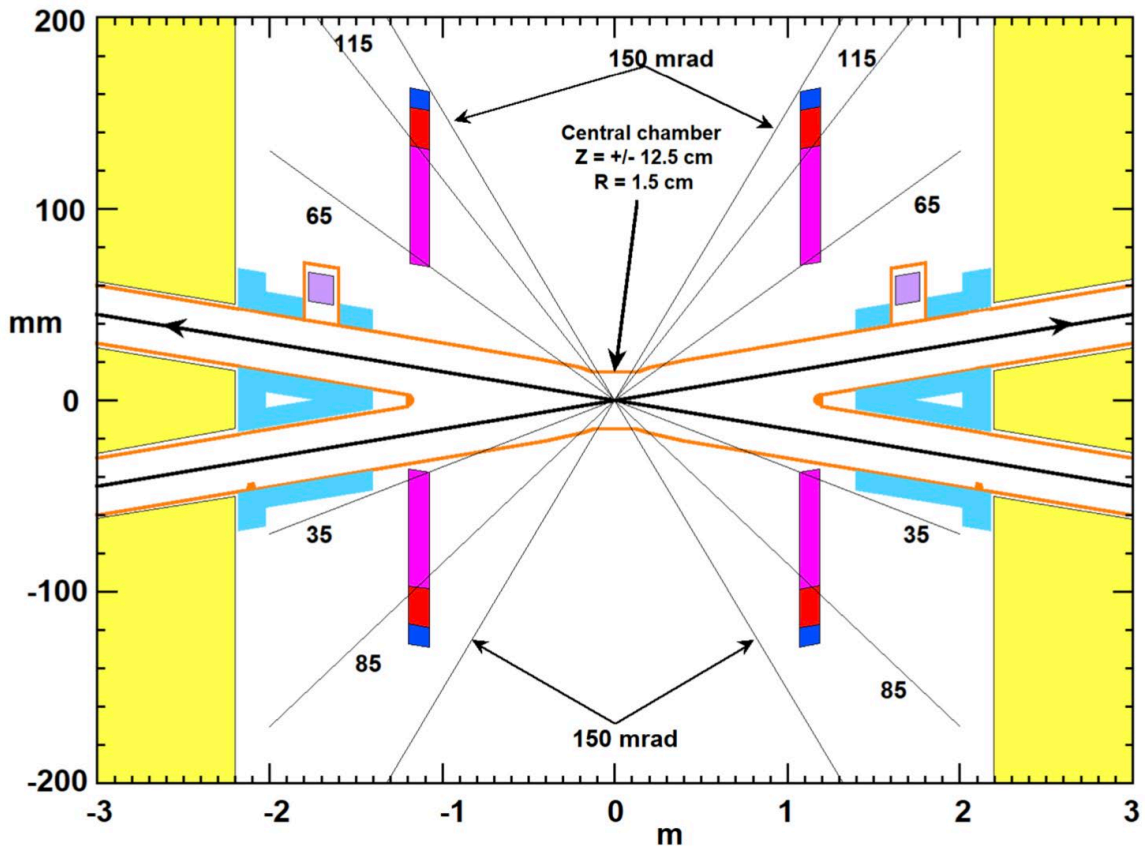


(Thanks to M. Koratzinos for the magnets CAD, to Mogens Dam for the LumiCal)

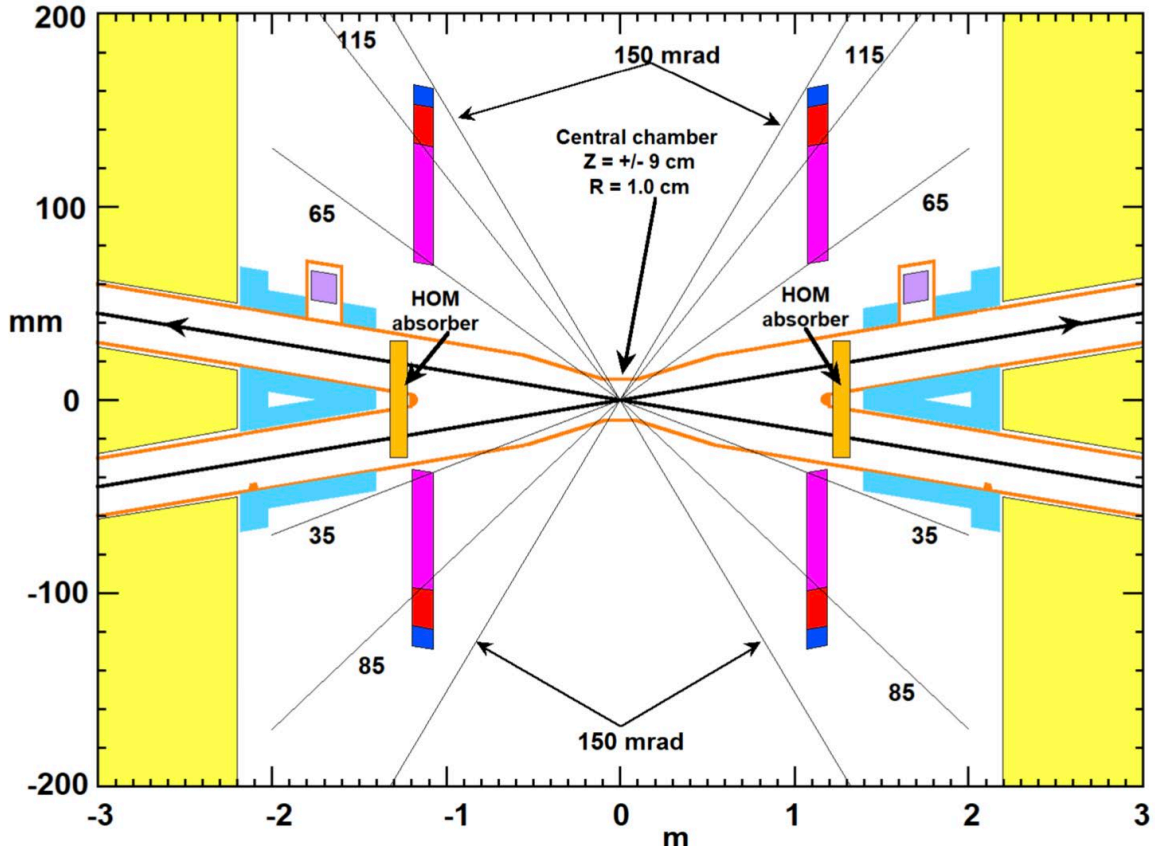
Diameter and length of the central beam pipe

	CDR	New values
Internal diameter of the central pipe	30 mm	**20 mm**
Length of the central pipe	125 mm	**90 mm**

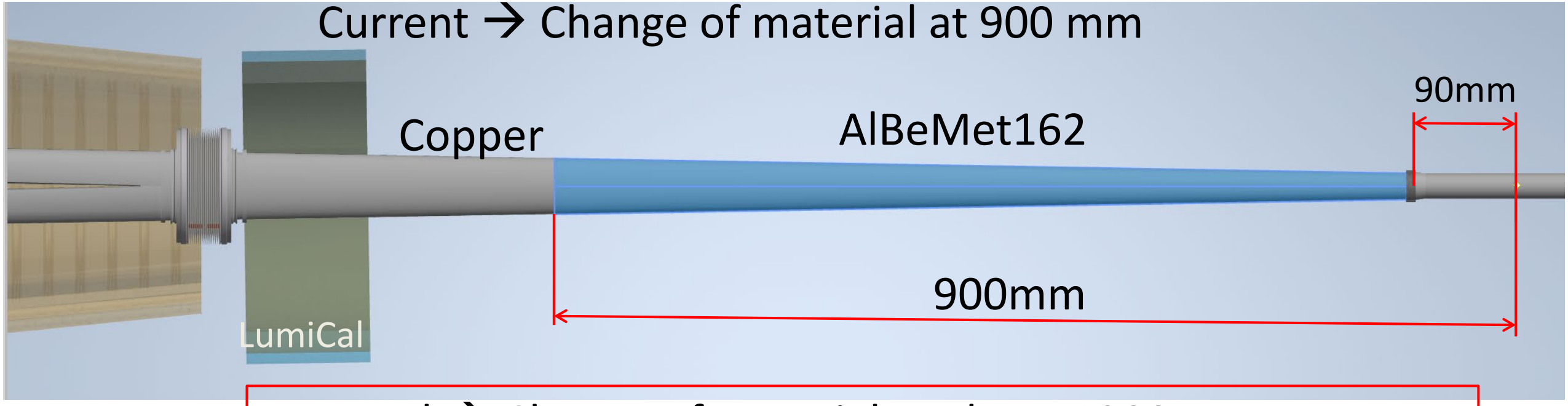
(M. Sullivan. FCC WEEK 2020)



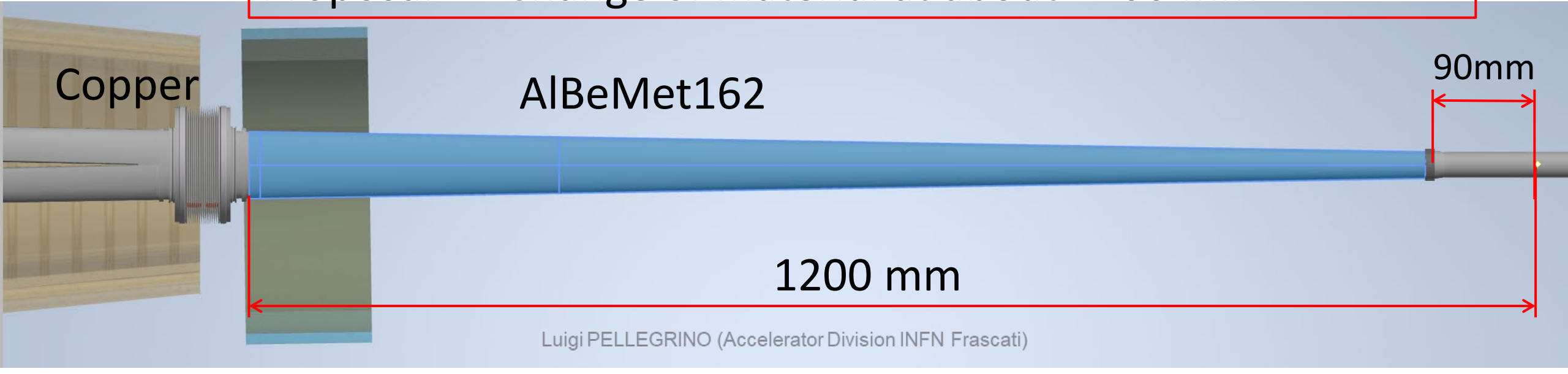
CDR



Current → Change of material at 900 mm

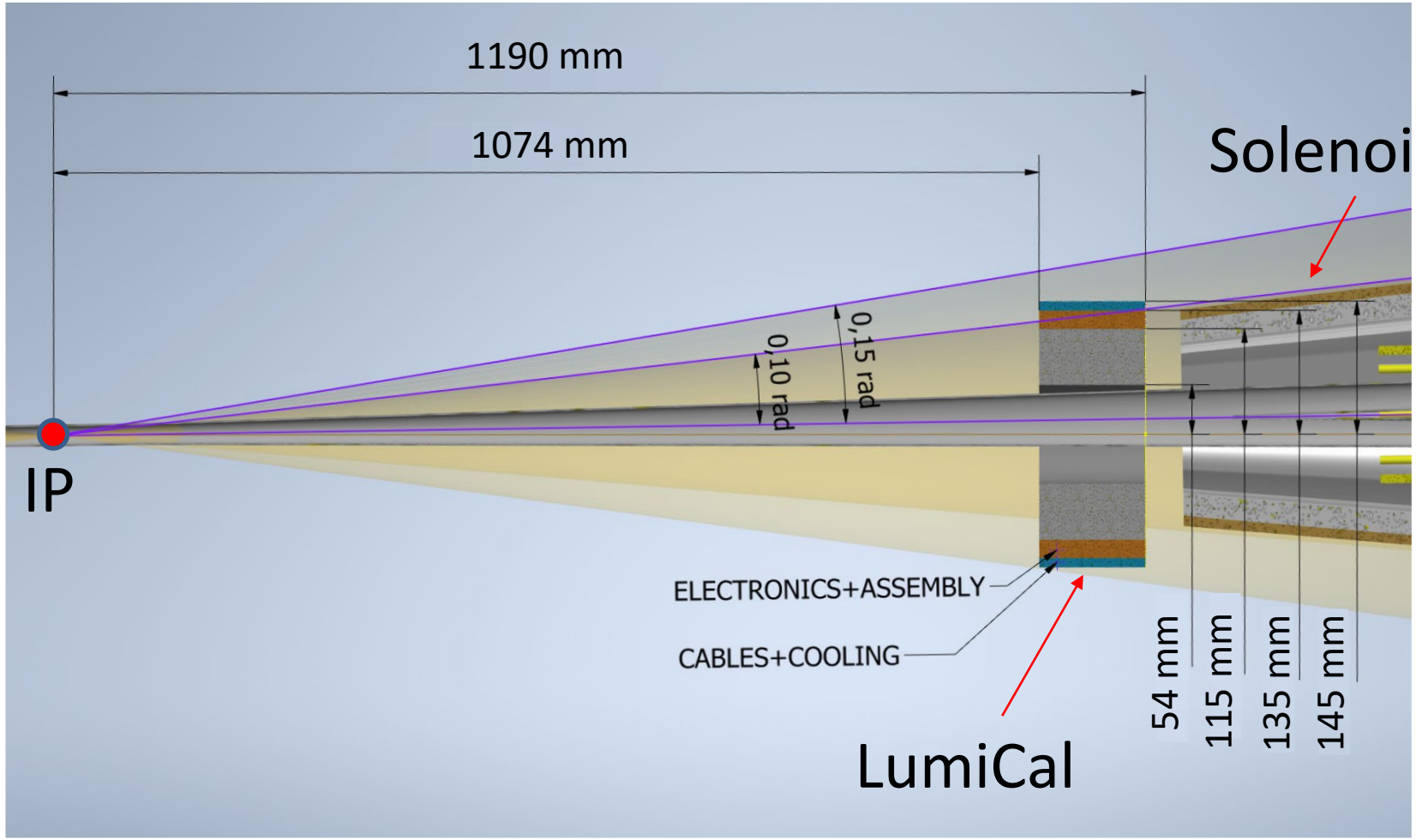


Proposal → Change of material at about 1200 mm

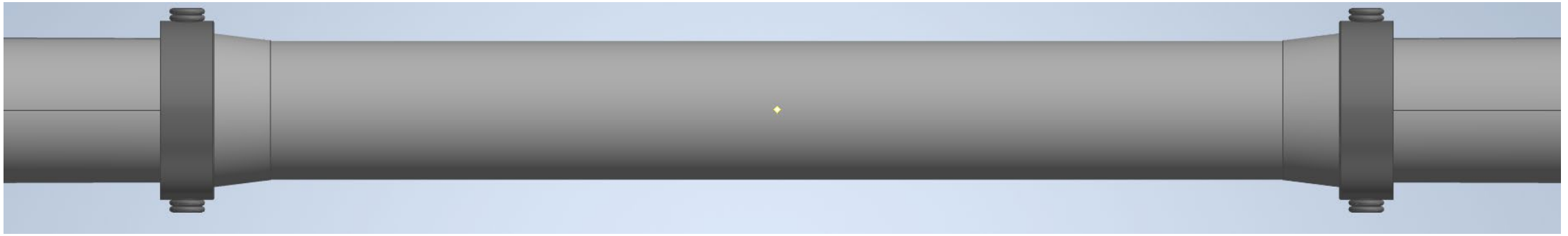


Highlight over the position of the LumiCal

- In the figure are shown the two cones of reference of the LumiCal, 100mrad and 150 mrad.
- According to the dimension given by Mogens Dam, the Lumical, with its cabling, cooling and electronics, is contained in 150mrad but not in 100mrad.



Paraffin cooled central chamber



Open points to be discussed with Detector people

- Interaction Region support system anchoring to (or outside to) the detector;
- IR insertion strategy (by one or two sides) – available room for mounting;
- Room allocation in the IR for auxiliaries;
- Is any further Detector components detail yet available (e.g.: geometry, weight, anchor points)?

INFN LNF

THANK YOU

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Activities - WBS

1	**1**			**Beam pipe design**
1	1	1		IR beam pipe assembly conceptual design
1	1	2		IP AlBeMet pipe design
1	1	3		IP AlBeMet pipe cooling system study
1	1	4		IP AlBeMet pipe prototyping
1	1	5		Pipes thermo-structural analysis
1	1	6		AlBeMet-copper transitions study
1	1	6	1	AlBeMet-copper transitions preliminary design
1	1	6	2	AlBeMet-copper transitions fabrication prototyping
1	1	7		Y pipe design
1	1	7	1	Y pipe mechanical design
1	1	7	2	Y pipe cooling system design
1	1	7	3	Y pipe prototyping
1	1	8		Bellows design
1	1	8	1	Bellows preliminary study
1	1	8	2	Bellows fabrication prototyping
1	1	9		BPM integration
1	1	10		Vacuum equipment integration in the CAD model
1	1	10	1	Vacuum pumps
1	1	10	2	Vacuum gauges
1	1	11		Vacuum chambers supports design
1	1	12		Remote vacuum connection design
1	1	13		Remote vacuum connection prototyping

1	**2**			**Cryogenic magnets integration**
1	2	1		Conceptual CAD model inclusion
1	2	2		Engineered CAD model inclusion
1	2	3		Cables/piping routing
1	2	4		EM forces data inclusion
1	2	5		Cryogenic magnets supports design and structural simulations
1	2	6		Mounting strategy definition
~~**1**~~	~~**3**~~			~~**Cryostat integration**~~
1	3	0		(sub-task re-distributed: see above sub-tasks)
1	**4**			**Shielding**
1	4	1		Conceptual CAD model inclusion
1	4	2		Engineered design
1	4	3		Supports design
1	**5**			**IP detectors integration**
1	5	1		Luminosity calorimeter
1	5	1	1	Conceptual CAD model inclusion
1	5	1	2	Engineered CAD model inclusion
1	5	1	3	Supports design
1	5	1	4	Cables routing
1	5	2		Vertex detector
1	5	2	1	Conceptual CAD model inclusion
1	5	2	2	Engineered CAD model inclusion
1	5	2	3	Supports design
1	5	2	4	Cables routing

1	**6**			**Vacuum system Integration**
1	6	0		(sub-task partially re-distributed: see above sub-tasks)
1	6	1		Integration of vacuum system (Task 1.6) inputs
1	6	1	1	Number, size and positions of pumps and gauges
1	6	1	2	Cables routing requirements
1	6	1	3	NEG coating definition
1	**7**			**Supporting structures**
1	7	0		(sub-task partially re-distributed: see above sub-tasks)
1	7	1		Integration of task 4 (alignment & vibration) inputs
1	7	2		Experiment and hall structural interfaces management
1	7	3		Structures optimization
1	**8**			**Thermal simulations**
1	8	0		(sub-task partially re-distributed: see above sub-tasks)
1	8	1		Thermal management of the whole IR, simulation included
1	**9**			**Management of electrical and hydraulic connections/routing**
1	9	0		(sub-task partially re-distributed: see above sub-tasks)
1	9	1		General routing plan
1	**10**			**Mechanical IR assembly, disassembly & repair procedures**
1	10	1		Study of mounting strategy
1	10	2		Conceptual design of IR assembly tools
1	10	3		Advanced collaborative design review
1	**11**			**Project Design Management (Task 1)**
1	11	1		PDM tool definition
1	11	2		PDM tool settings
1	11	3		PDM users management
1	11	3		PDM tool maintenance