

COOLING & VENTILATION INFRASTRUCTURE

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Outline

1 – Present situation for CV systems

2 – Open issues and possible solutions

3 – Next steps

4 – Conclusions and discussion

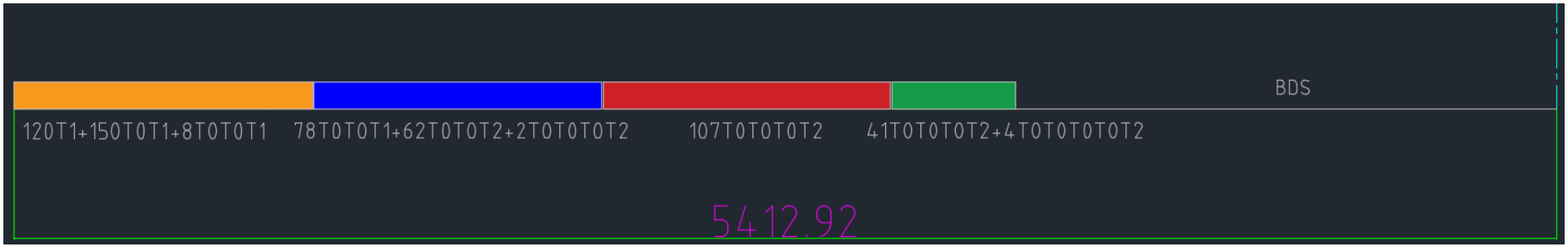
Defining the Problem - Layout

Work done until now

- Air Cooling and Ventilation for the 380 GeV option

Geometry definition:

- Length: 5413 m on each side
- 4 sequences of modules (foreseen to change in the future without affecting the overall length and heat loads)



Heat Transfer to Air

System	Elements	Heat/Element [W]	$T0$		$T1$		$T2$	
			# Elements	Air [W]	# Elements	Air [W]	# Elements	Air [W]
Alignment	Main B. Movers	0,6	3	1,8	6	3,6	6	3,6
	Drive B. Movers	0,6	3	1,8	3	1,8	3	1,8
	MBQ Movers	0,6	0	-	5	3,0	5	3,0
Beam Instru.	Main B. BPM	13,0	0	-	1	13,0	1	13,0
	Drive B. BPM	13,0	2	26,0	2	26,0	2	26,0
Vacuum System	Mini Pump Main	10,0	6	60,0	6	60,0	6	60,0
	Mini Pump Drive	12,5	2	25,0	2	25,0	2	25,0
	Penning G. Main	10,0	1	10,0	1	10,0	1	10,0
	Penning G. Drive	12,5	1	12,5	1	12,5	1	12,5
MQB Stabilization	Controller	80,0	0	-	1	80,0	1	80,0
	Seism./P Supp.	1,7	0	-	2	3,3	3	5,0
	Piezo	1,0	0	-	4	4,0	6	6,0
RF System	Eletronics	13,0	1	13,0	1	13,0	1	13,0
	Waveguides	11,3	4	45,2	3	33,9	2	22,6
-			Total [W]	195,3	Total [W]	289,1	Total [W]	281,5
			Total [W/m]	82,9	Total [W/m]	122,7	Total [W/m]	119,4

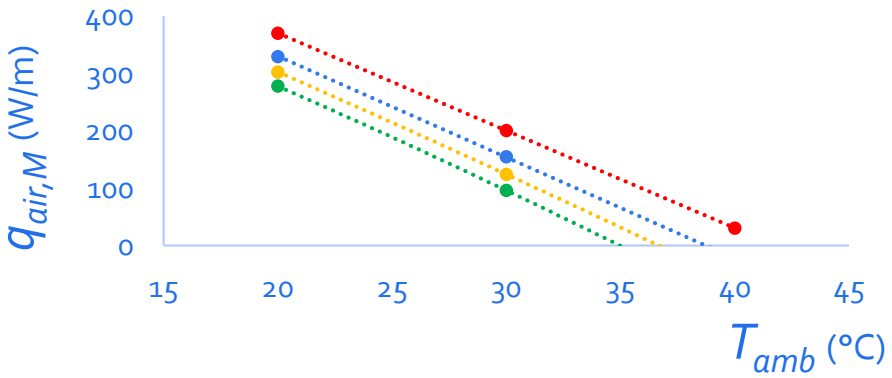
-	Components	Total [W]	Total [W/M]
Cables	Supply	Unknown	
	DBQ	68000	19,4
	MBQ	22000	6,3

Total [W/m]
124

Please confirm these values

Heat Transfer to Air and Water

-		Heat/Ele. [W]	$T0$			$T1$			$T2$		
			# Elements	Air [W]	Water [W]	# Elements	Air [W]	Water [W]	# Elements	Air [W]	Water [W]
Magnets	MBQ (Small)	1218,0	0	-	-	1	Unknown		0	-	-
	MBQ (Big)	2356,0	0	-	-	0	-	-	1	Unknown	
	DBQ	171,0	2	Curves - WIP		2	Curves - WIP		2	Curves - WIP	
RF System	AS	391,6	8			6			4		
	LOADS	168,4	16			12			8		
	PETS	88,0	4			3			2		



$\uparrow T_{amb}$

$\downarrow q_{air}$

$$q_{air,M} + q_{water,M} = q_{Gen}$$

Solutions – Longitudinal Design

Length	Velocity	Free A	ΔT
5413 m	1 m/s	17 m²	10°C

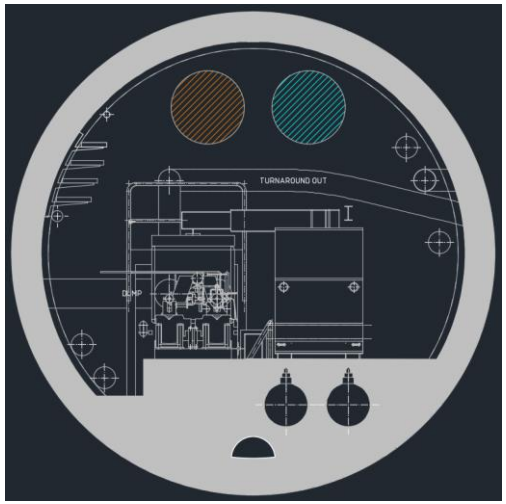
High ΔT &
Missing Modules

61 W/m < 124 W/m

Half of the required Power

Solutions – Transversal Design

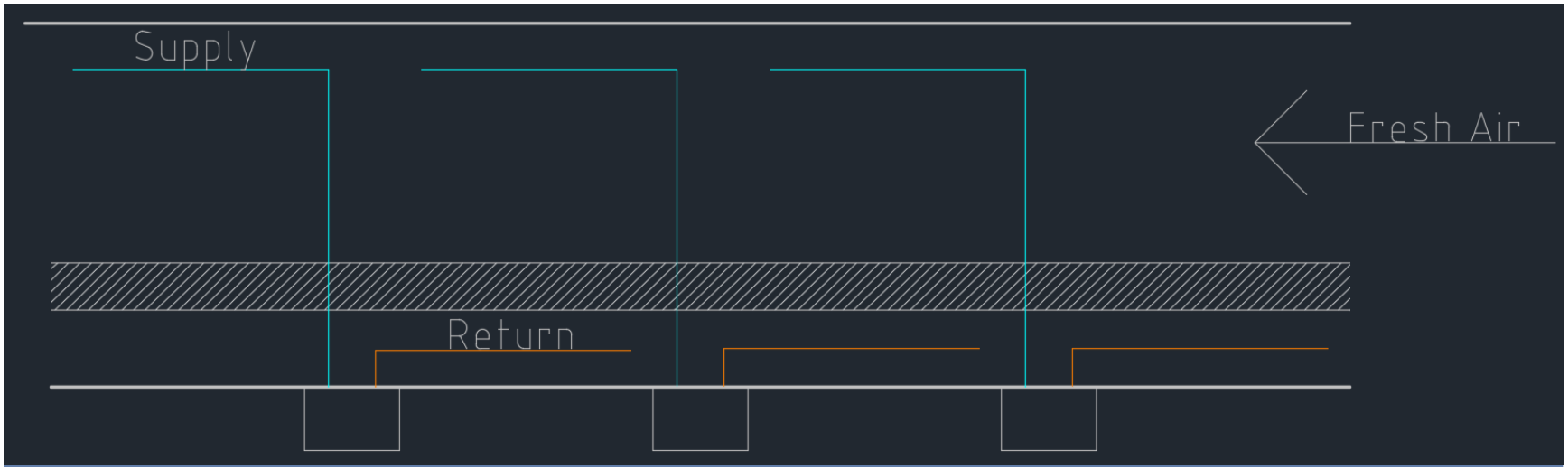
T_{amb}	Heat Load	ΔT	N	Flow Rate	D
25°C	324 W/m	5°C	19	36'000 m³/h	1 m



Large Number of Alcoves and AHU

Operational and scaling constraints

R2E validation



Future Work

Validation / Missing Heat Loads

- Tunnel and all other premises – Required to design the cooling towers

			Power (kW)
Sector 1			**198 960**
	a	Drive beam injectors building	142 560
	b	Drive beam injectors tunnel	15 840
	c	Frequency multiplication	15 581
	d	Transfer lines	8 028
	e	Chilled water production	16 951
Sector 2			**62 922**
	a	Main beam injectors building	14 215
	b	Main beam injectors tunnel	1 465
	c	Surface damping rings	21 634
	d	Tunnel damping rings	16 717
	e	Booster tunnel	1 066
	f	Booster building	5 364
	g	Chilled water production	2 461
Sector 3 (Drive Beam Machine)			**138 000**
	a	Tunnel e-	69 000
	b	Tunnel e+	69 000
Sector 4 (UTRs, dumps, loops,…)			**104 374**
	a	Tunnel e-	52 187
	b	Tunnel e+	52 187
Sector 5			**65 329**
	A	Detector premises	17 000
	B	Accelerator tunnel	41 760
	C	Chilled water production	6 569

3TeV CDR values

❖Preferably before the 15th of April

Future Work

Define a solution for the CV and design

Study specific solutions for complex / particular cases

Evaluate the impact on the cross section

Propose a global solution to present in the CDR

Future Work

Develop the klystron CV + other energy stages

While designing we have to consider safety requirements

- In case of fire - Smoke extraction, flow patterns, etc…
- Are we allowed to recycle air?

❖ We do not know these requirements yet

Conclusions

1) Traditional longitudinal ventilation is apparently not feasible

2) A transversal system might be the solution - several drawbacks

3) Missing / old information need serious attention

4) The CV solutions are highly dependent on that information

Questions and Remarks

Thank You for Your Attention