CRYOGENICS OPERATIONS 2008

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Organized by CERN

SPIRAL2 Cryogenic System

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Outline

- Spiral2 cryogenic installation
- Cryogenic design
- Control system
- Preliminary cryogenic tests

SPIRAL2 Accelerator

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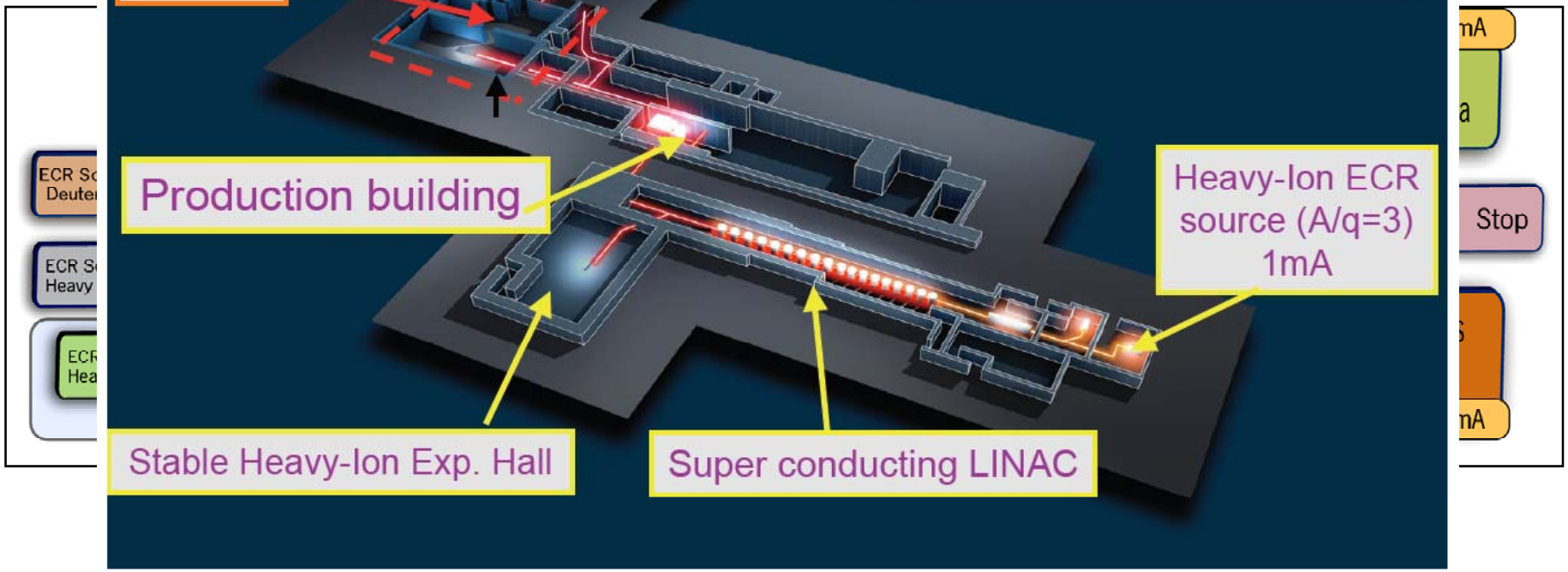

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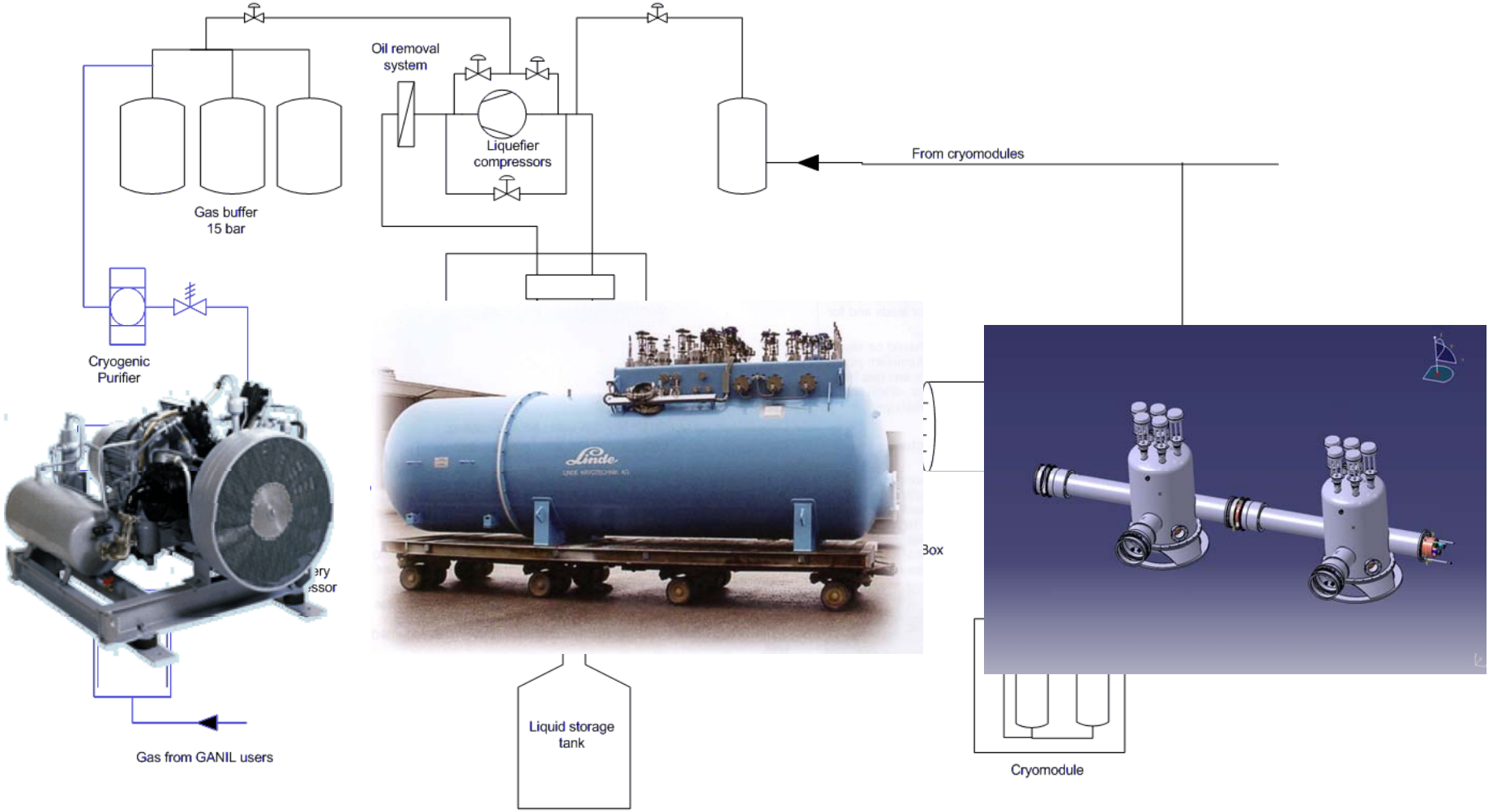
Cryogenic installation flow scheme



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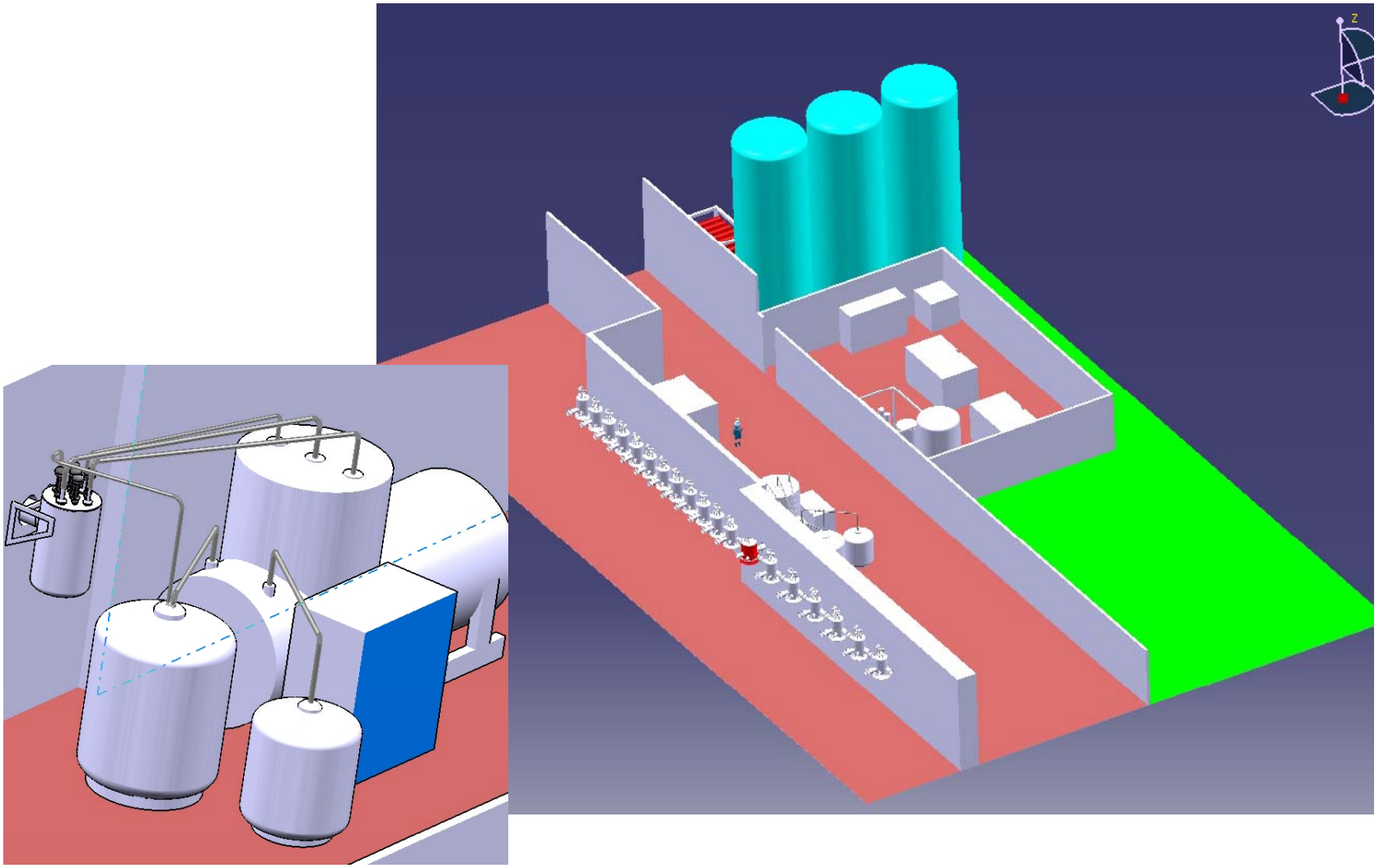
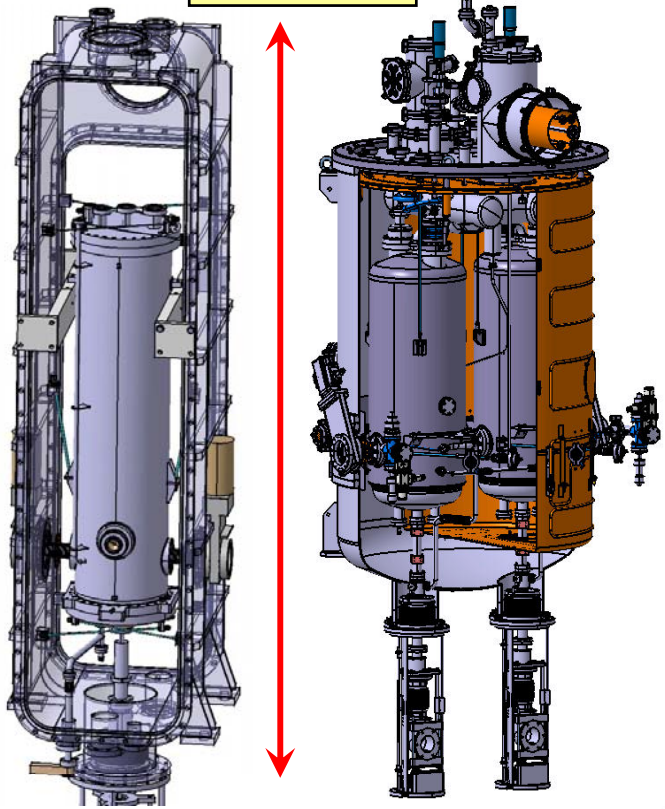
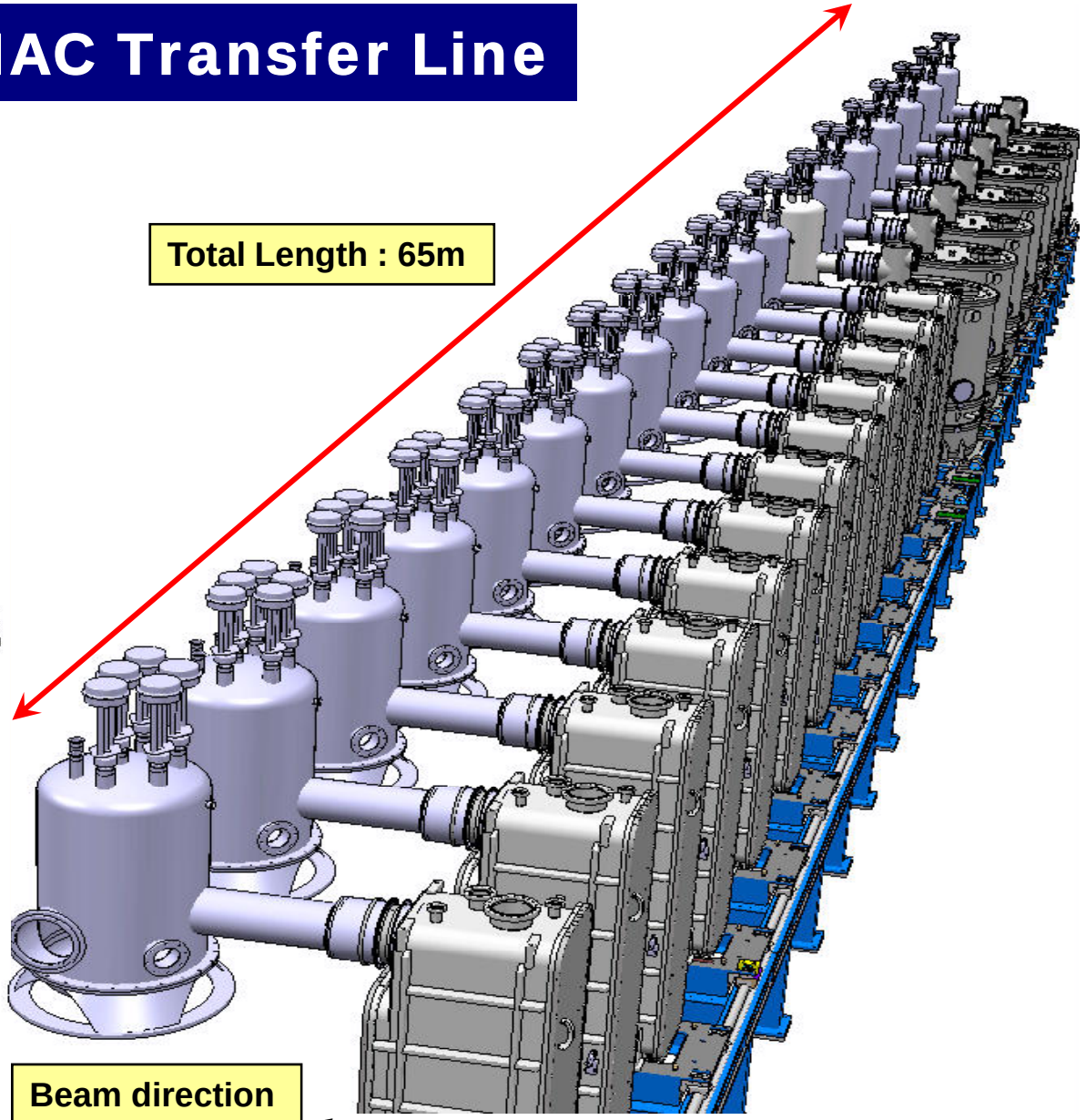
Cryogenic Plant



LINAC Transfer Line





Cryomodule A
Number : 12
CEA SACLAY

Cryomodule B
Number : 7
IPN ORSAY

Cryogenic Design

Cryomodule cooling system

- Liquid helium line 4.3K (in red)

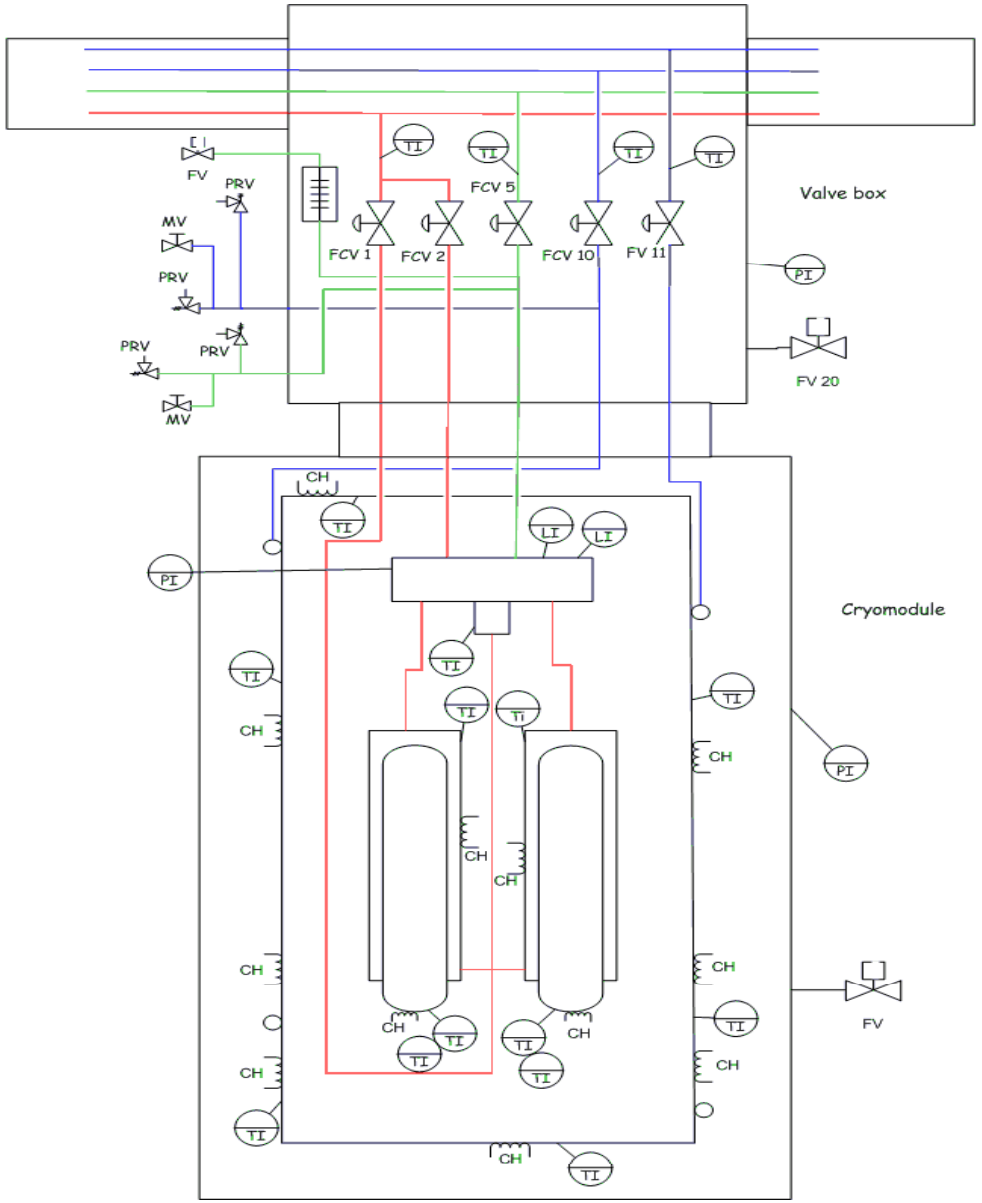
Depending of the working mode, FCV1 or FCV2 control the cryomodule liquid filling.

- Gas helium line (in green)

The return gas goes back to the liquefier through FCV5

- Thermal shield circuit 60K (in blue)

Cryomodule inlet through FCV10 with control of outlet temperature.
Gas outlet through FV11



Control system

Working modes

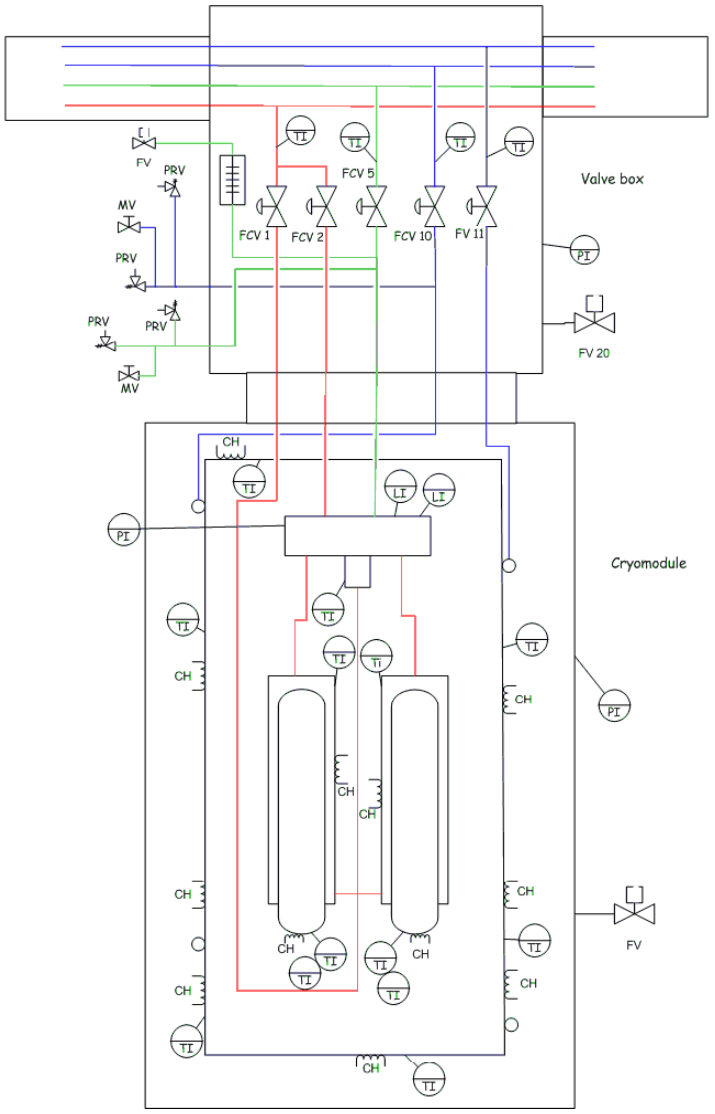
- **Cooldown**
  Used to control the cooling of the system from room temperature to cryogenic stable temperature.

- **Normal operation**
  When the system is in cryogenic stable operation with or without RF power.

- **Stand by mode**
  To keep the cavities below 50K with a limited helium consumption.

- **Heating**
  To reheat the system to room temperature

- **Security mode**
  When something goes wrong the system switch to this mode

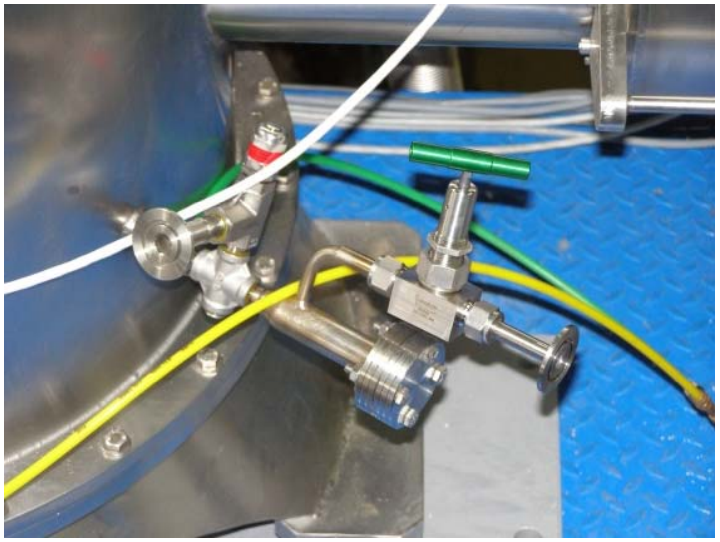


Cryogenic safety

Safety components

All cold circuits are protected by 2 components :

- One relief valve
- One burst disk



	Nominal Pressure	Relief valve	Burst Disk
			Pressure
4.3K circuit	1.02 bara	0.49 barg	0.75 barg
60K circuit	15 bara	17 barg	19 barg
Vacuum	vacuum		0.3 barg

Thermal loads

Element (Number)	T= 4.3 K (W)		T=60K (W)
	Static	Dynamic	
Cryomodules A (12), Cavity (12), Coupler (12)	7	10	40
Cryomodules B (8), Cavity (16), Coupler(16)	11	20	60
Valve boxes (20)	7	-	20
Transfer lines (1)	15	-	60

Liquefier specifications

	Loads (W)	
	4.3K	60K
Linac	643	1500
LHE (High Energy Line)	80	300
Total	723	1800
Liquefier request	1000	2400
External experiences (GANIL)	10 L/h	

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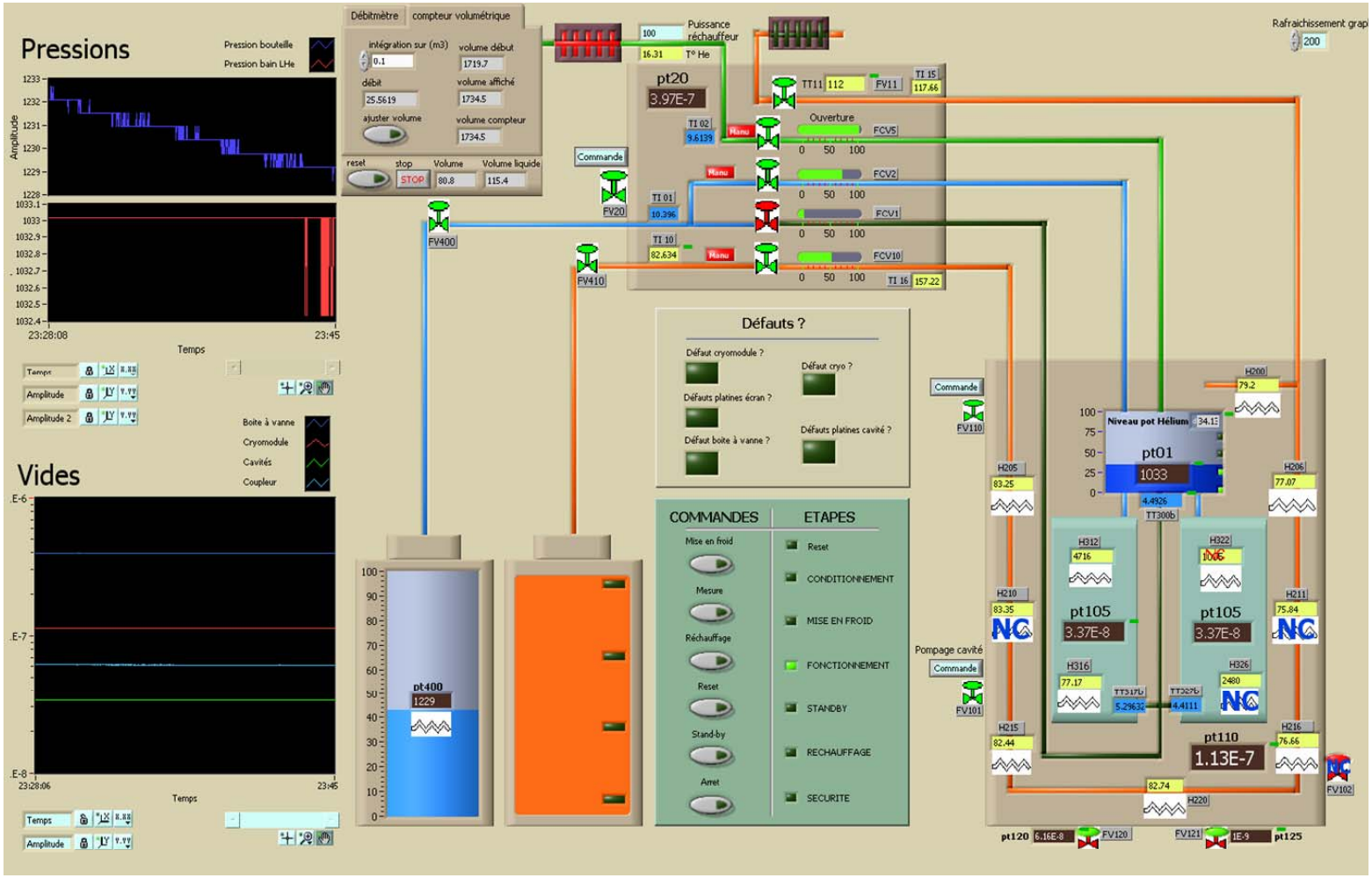
Cryomodule B tests at IPN ORSAY



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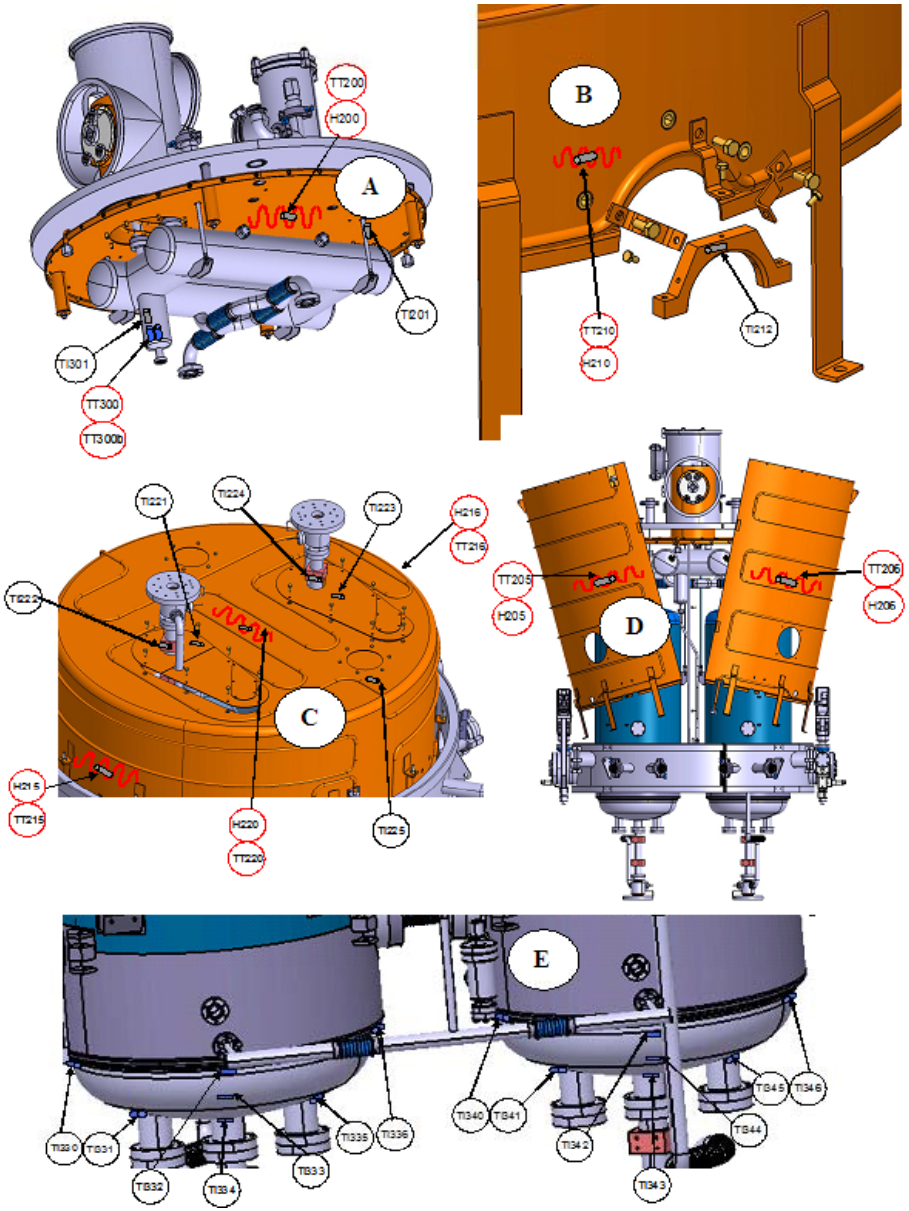
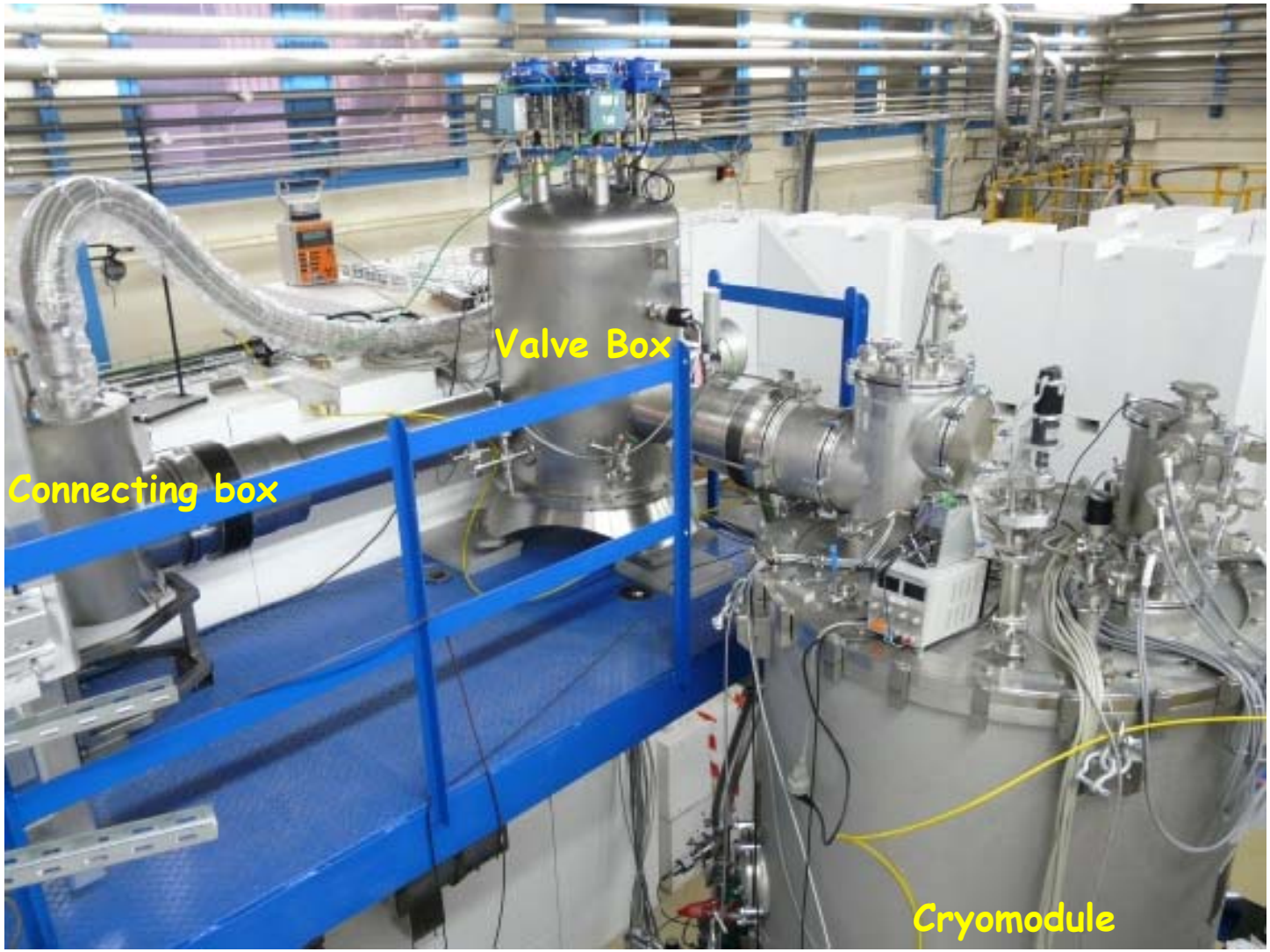
Sensors

Sensors	Use	Number
Temperature		
platinium	process	14
cernox	process	8
platinium	measure	11
cernox	measure	13
Carbon	measure	14
Pressure		
fluid	process	2
Vacuum	process	5
Level		
continous	process	2
position	process	2
Flow	measure	2



Cryogenic tests



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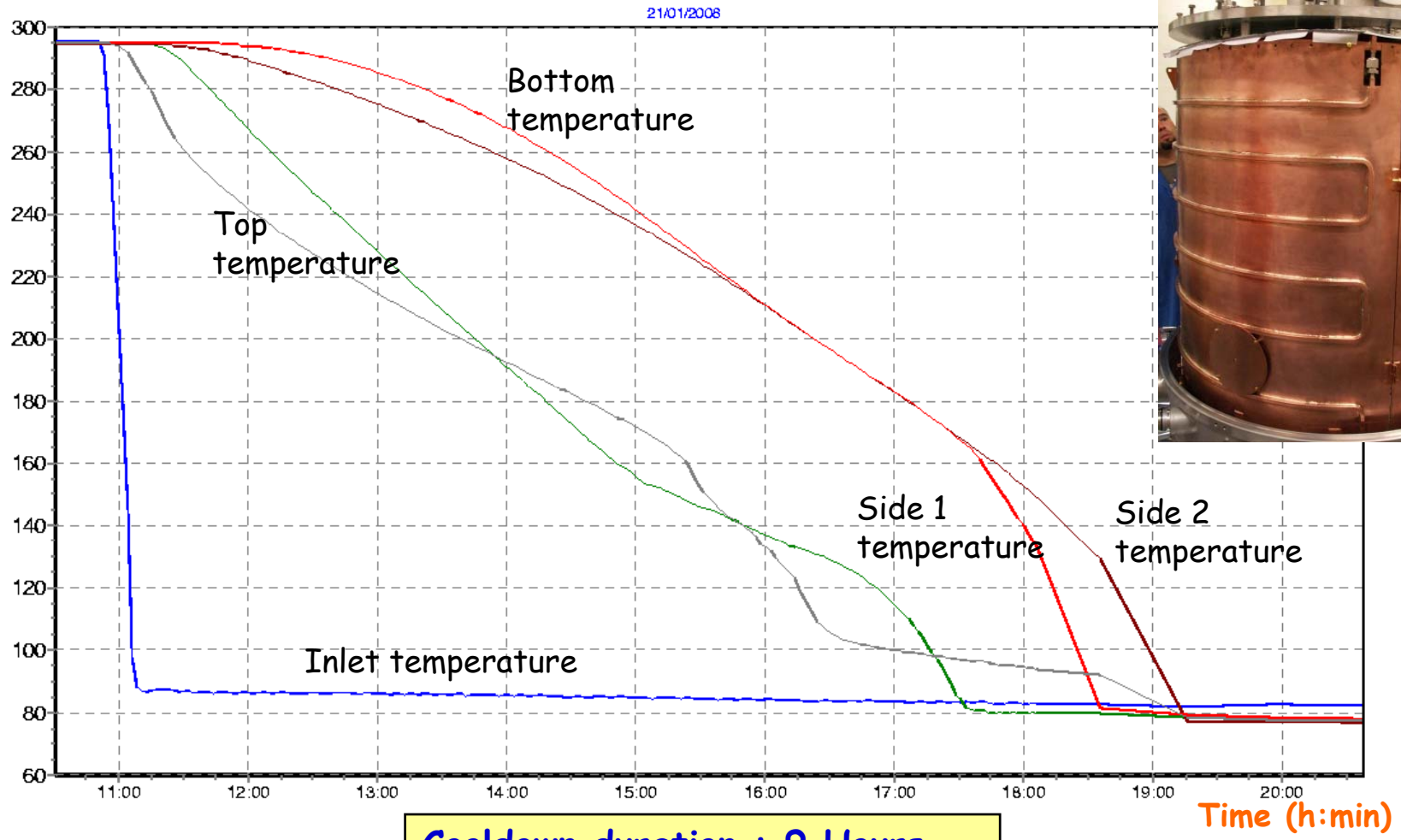
Thermal shield cooldown



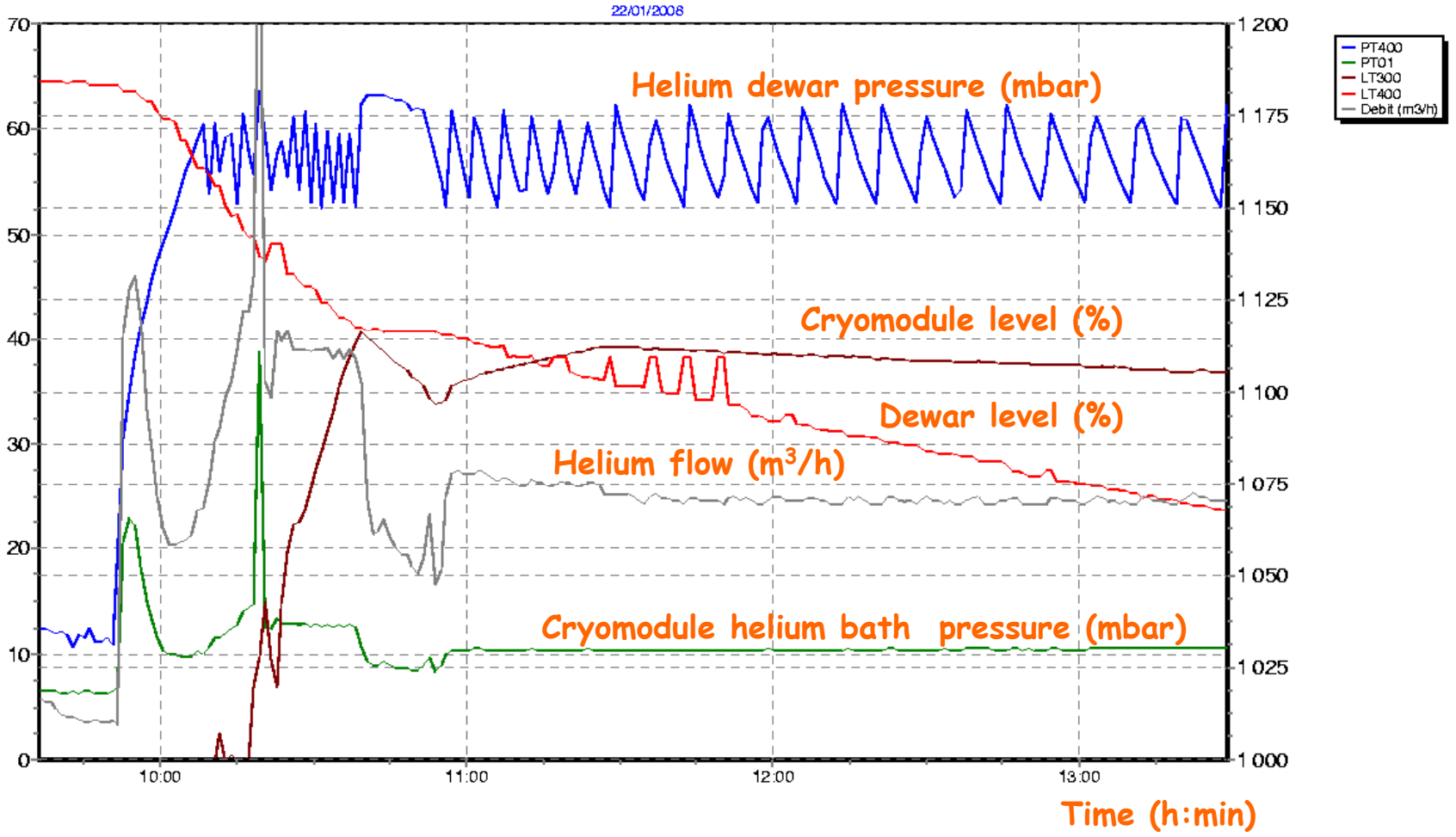
Cooldown duration : 9 Hours

Helium cooldown

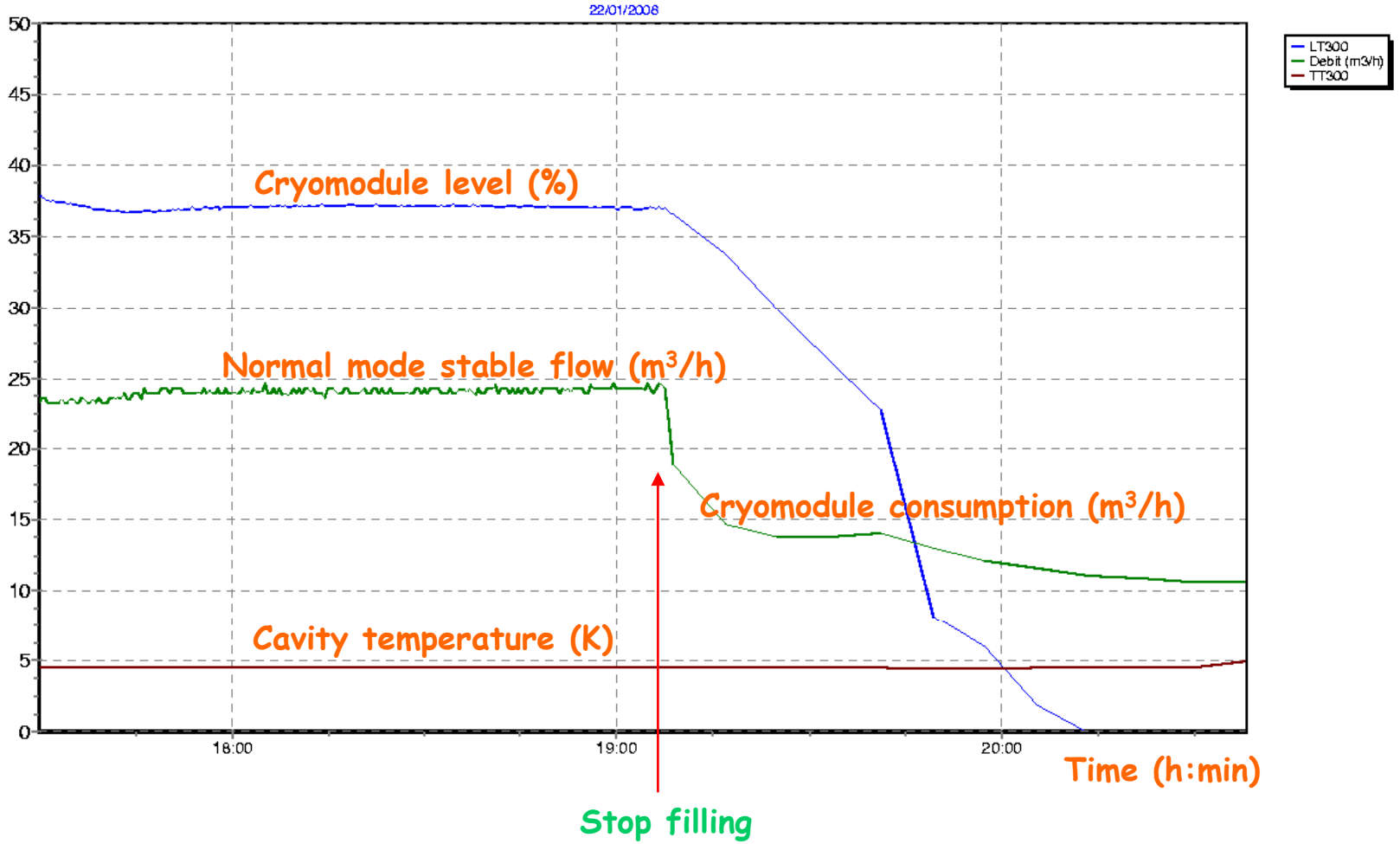
Cooldown duration : 4 hours

Helium consumption : 500 liters

Cryomodule helium filling



Cryomodule helium stop filling



4.3K Results

Measured helium flow

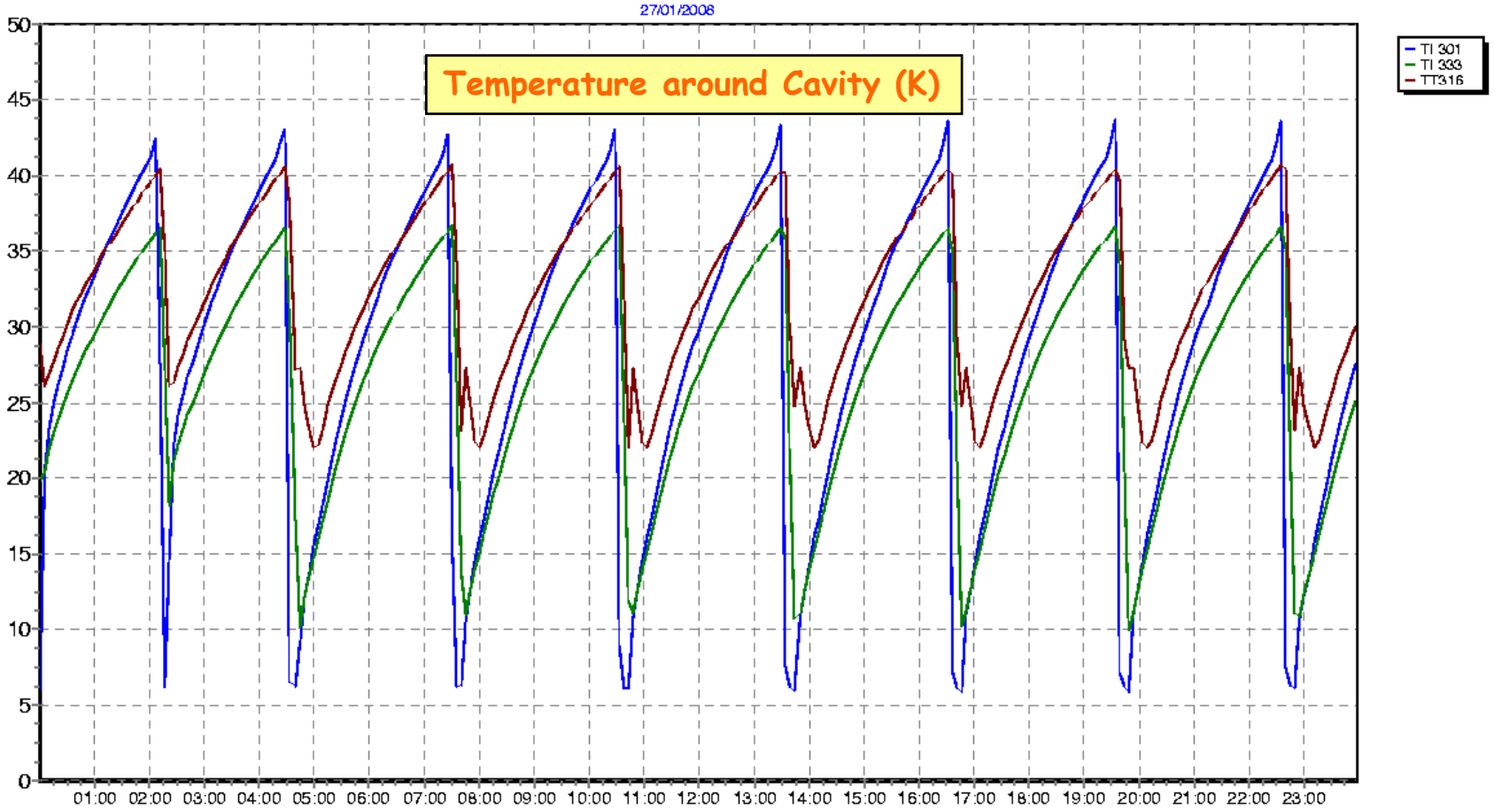
25 m^3/h in stable conditions without RF power

Component	Calculated values	Measured values	Difference
Cryomodule	10 W	13 W	3 W
Valve Box	5 W	12 W	2 W
Connecting box	3 W		
Single line	2 W		
Total	**20 W**	**25 W**	**5 W**

Modification to improve the static losses :

- **Cryomodule**
- **Valve box**

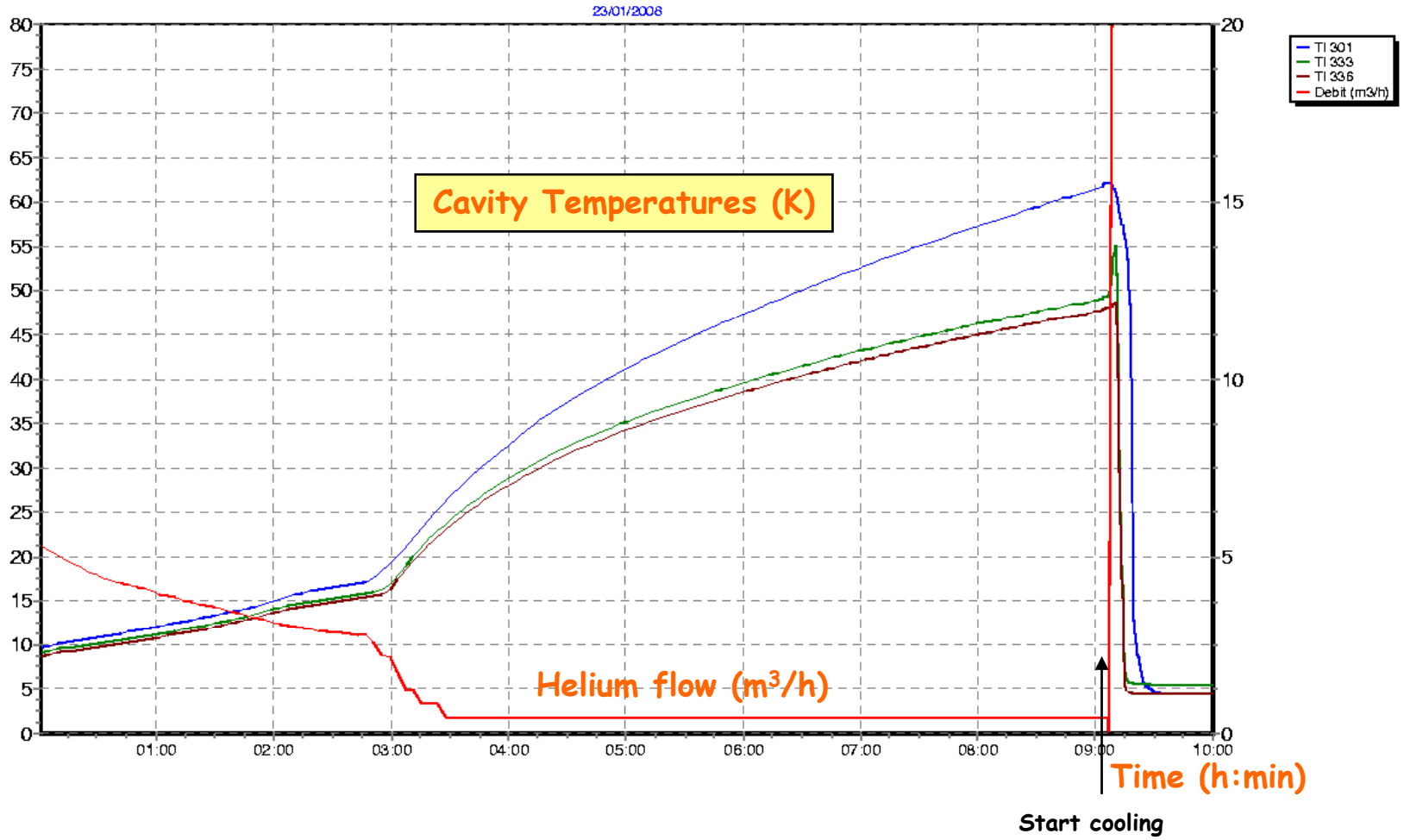
Stand-by mode test



Cycle period : 3h

Mean helium consumption : 6.5 L/h

Heating over night



Thanks for your attention