

Dimensions, pressures and temperatures of cryogenic circuits for the SPL

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- **Introducing remarks**
- **Basics**
 - Basic parameters
 - Basic schemes
- **Design criteria**
 - He II cooling loop
 - Coupler cooling loop
 - Thermal shield cooling loop
- **Summary Table**

General note

- **As no in-depth study exists the actual “Baseline” concerning T and p values closely follows the design data of the ILC project**
- **Some of the choices presented here may be discussed and could be changed**
- **All dimensions given are:**
 - Depending on installed mass flow / cooling capacity
 - Intended to give an order of magnitude
i.e. not precise on the mm

Assumptions that are considered as decided

- **The following is considered as decided:**
 - Cooling of the cavities with helium II at ~ 2.0 K
 - Cavities inside the saturated bath
- **Anything else may be discussed / changed**
 - Examples
 - Cooling of the couplers :
5-8 K best compromise? (why not 4.5 K – 300 K e.g.)⁷
 - Cooling of the thermal shield:
40 – 80 K: typical choice by DESY; 50-75: typical choice by CERN

HP-SPL , LP-SPL

- **No decision is taken concerning the HP-SPL or LP-SPL option**
- **Both options are considered in this presentation**

Pressures and temperatures as proposed at the moment

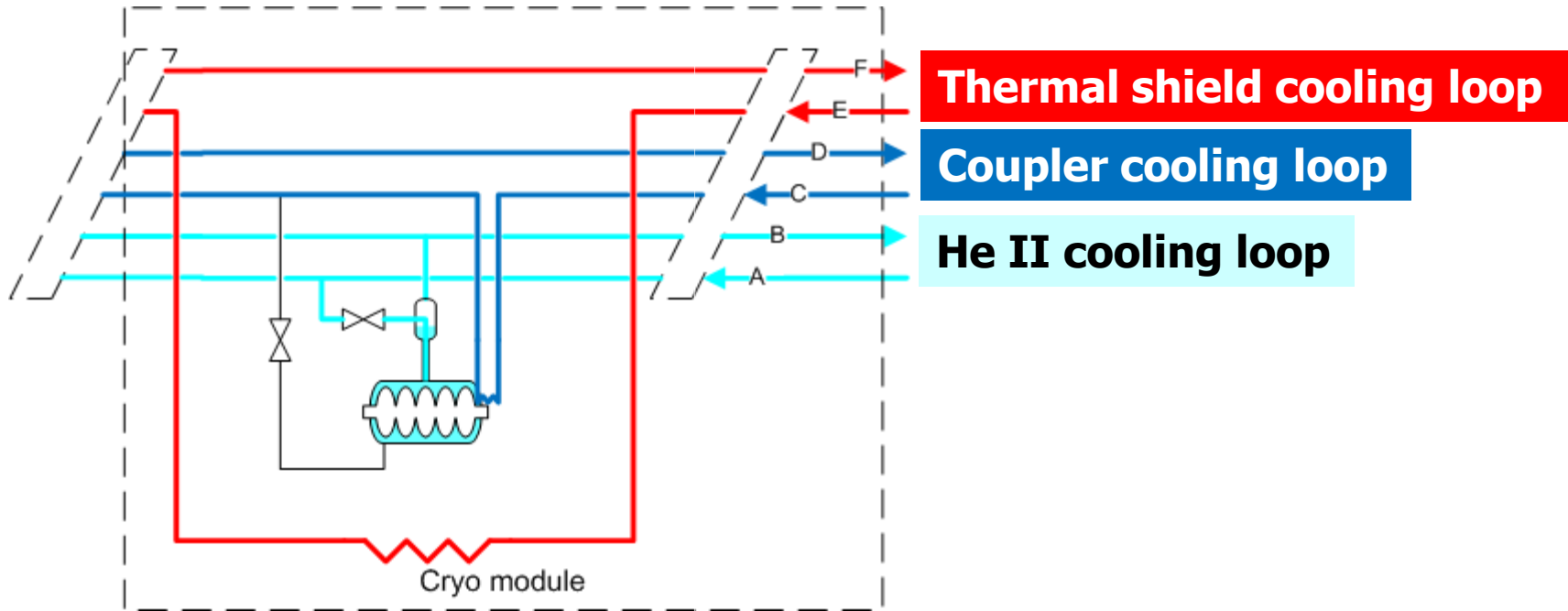
Line	Temperature	Pressure
Header A	2.2 K	0.3 MPa
Header B	2.0 K	3.1 kPa
Header C	5.0 K	0.55 MPa
Header D	8.0 K	0.50 MPa
Header E	50 K	1.8 MPa
Header F	75 K	1.7 MPa

These values are fixed

The rest is for "orientation" only and may be modified

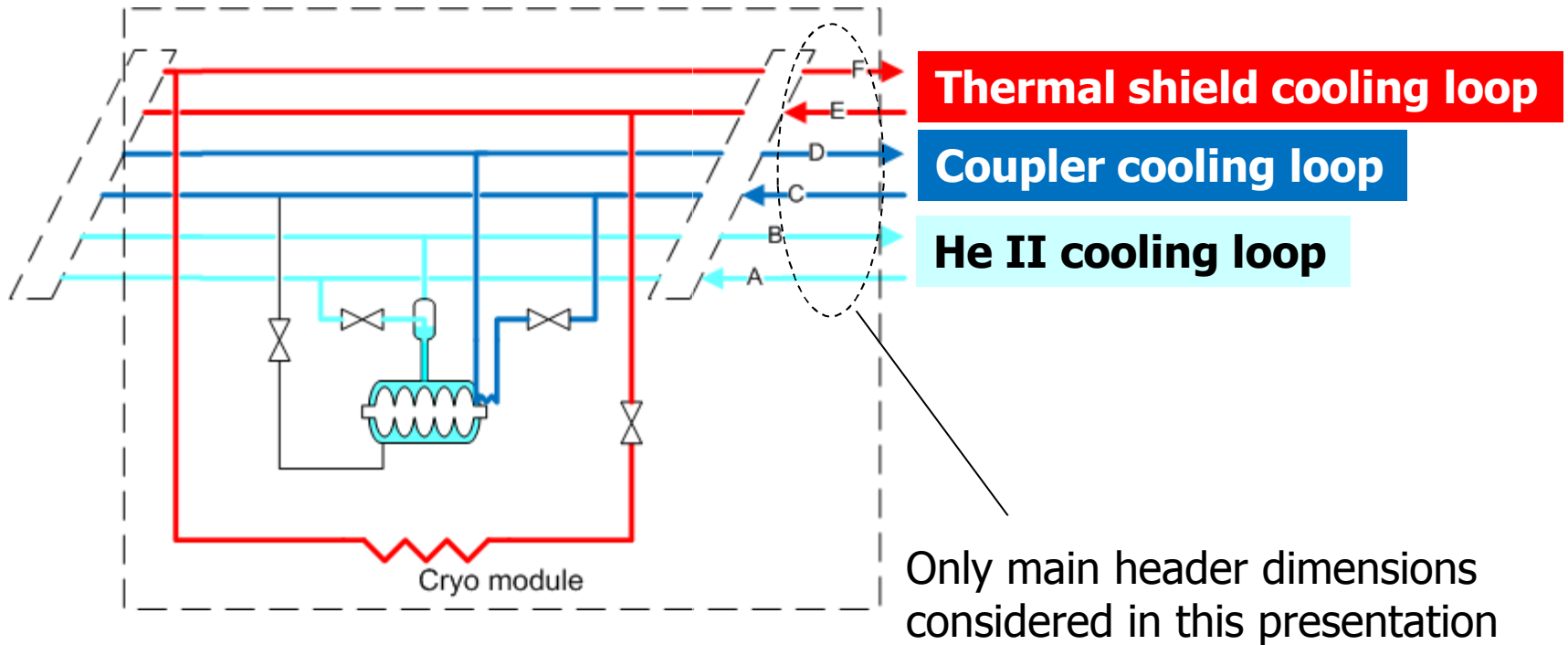
Cooling loops shown on a single cavity

Thermal shield and coupler cooling in "series"



Cooling loops shown on a single cavity

Thermal shield and coupler cooling in “parallel”



Design criteria

- **Line A**

- Nominal conditions: $T = 2.2 \text{ K}$; $p = 3.0 \text{ bar}$ (my choice)

- Criteria:

- pressure drop during:

- Nominal operation

- Cool-down

- Warm-up



Conditions uncertain / may be done via Line C

- **Distribution baseline**

- Parallel cooling -> One HeII loop per module

Design criteria

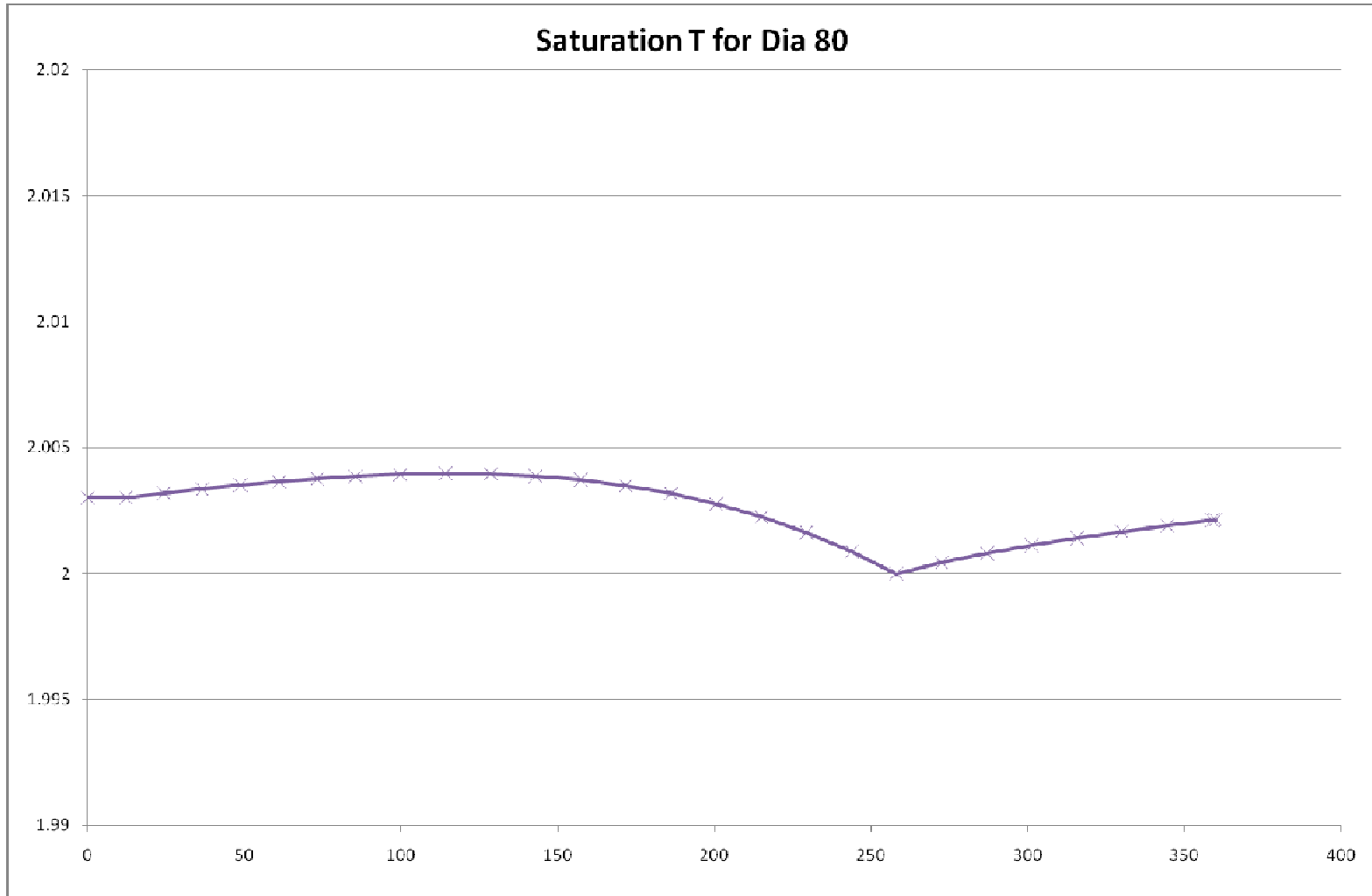
- **Line B**
 - Nominal conditions: $T = 2.0 \text{ K}$; $p = 31 \text{ mbar}$
 - Criteria:
 - Pressure distribution in line B in nominal operation
 - Chosen limit: $< \pm 10 \text{ mK}$ saturation temperature spread in bath
 - Line B may have a function as "quench buffer"
 - This is not considered for the moment
- **Distribution baseline**
 - Parallel cooling -> One HeII loop per module

He II cooling loop

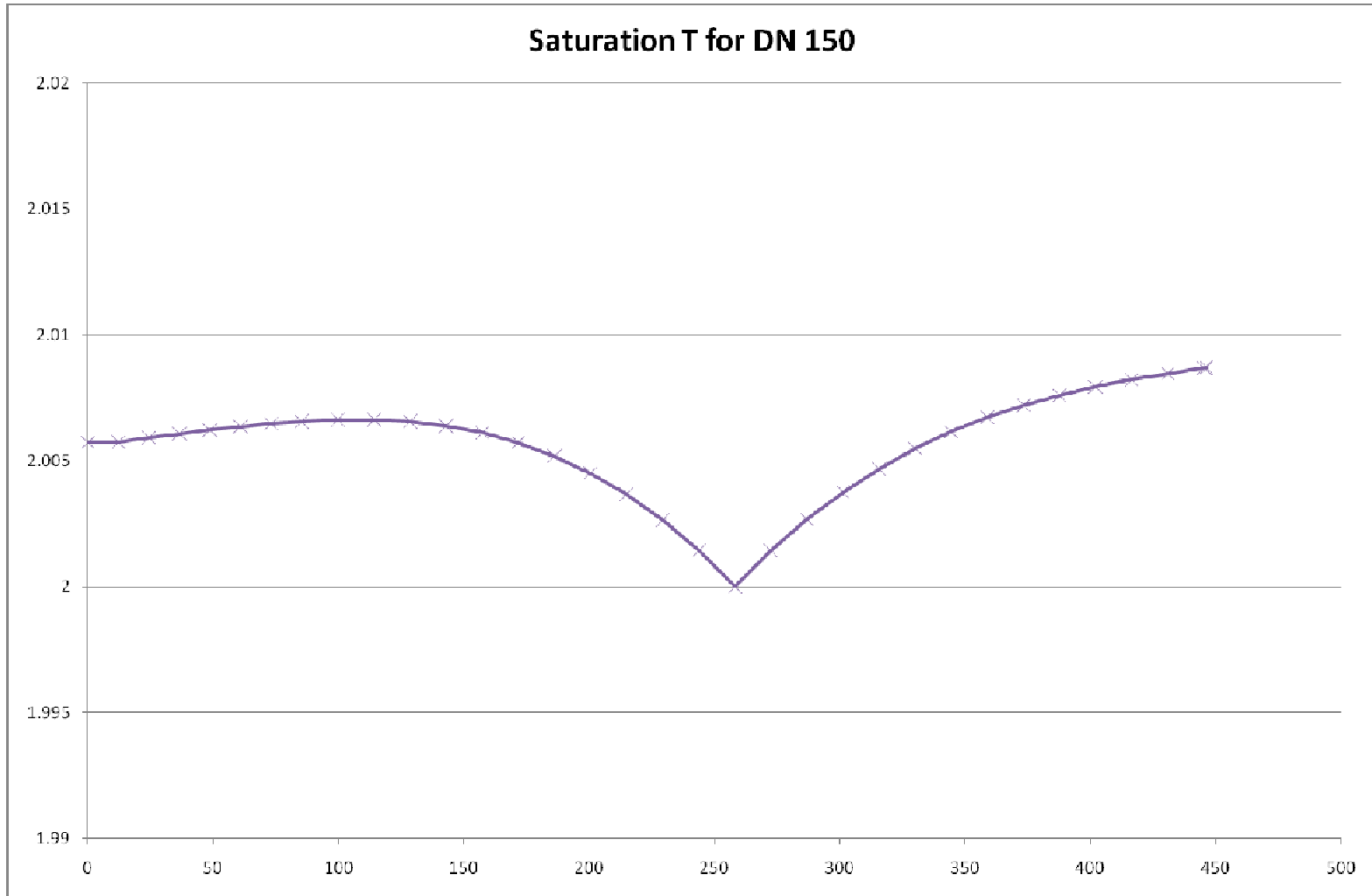
Design criteria, installed mass flow

	LP-SPL		HP-SPL	
	Low β	High β	Low β	High β
Flow / module [g/s]	1.4	2.0	5.5	9.3
Total flow [g/s]	50		271	

Diameter of the pumping line "Line B" LP-SPL



Diameter of the pumping line "Line B" HP-SPL



Design criteria

- **Line C and Line D**

- Nominal conditions: $T = 5.0 \text{ K to } 8.0 \text{ K}$; $p = 5.5 \text{ bar to } 5.0 \text{ bar}$

- Criteria:

- pressure drop during:
 - Nominal operation

- Line C only:

- Cool-down
- Warm-up

} Conditions uncertain / may be done via Line A

- **Distribution baseline**

- Series cooling -> full flow over full length

- Mass flow

- LP-SPL: 48 g/s ; HP-SPL: 57 g/s Conditions similar -> same size LP/HP

Design criteria

- **Line E and Line F**

- Nominal conditions: $T = 50 \text{ K to } 750 \text{ K}$; $p = 18 \text{ bar to } 17.5 \text{ bar}$
- Criteria:
 - pressure drop during:
 - Nominal operation **Cool-down / Warm-up not design criterion**

- **Distribution baseline**

- Series cooling -> full flow over full length
 - Mass flow
 - LP-SPL: 82 g/s; HP-SPL: 98 g/s **Conditions similar -> same size LP/HP**

- **We like to avoid opening of cold safety valves**
- **Design pressure for cryogenic helium circuits PN25**
 - Where possible
i.e. all lines except Line B
- **Line B design pressure to be defined**
 - Proposal 6 bar or 3 bar



Summary Table LP-SPL



Present proposal as working basis

	Line A	Line B	Line C	Line D	Line E	Line F
Nominal T [K]	2.2	2.0	5.0	8.0	50	75
Nominal p [Mpa]	0.3	0.003	0.55	0.5	1.8	1.75
Design Pressure	PN 25	PN 6	PN 25	PN 25	PN 25	PN 25
Min. Di [mm]	30	70	30	30	50	50



Summary Table HP-SPL



Present proposal as working basis

	Line A	Line B	Line C	Line D	Line E	Line F
Nominal T [K]	2.2	2.0	5.0	8.0	50	75
Nominal p [Mpa]	0.3	0.003	0.55	0.5	1.8	1.75
Design Pressure	PN 25	PN 6	PN 25	PN 25	PN 25	PN 25
Min. Di [mm]	30	150	30	30	50	50



Thank you for your attention