Cooling scheme for the cold powering system, WP9_Cryogenic_Aspects

Clarifications

S. Claudet (TE-CRG)

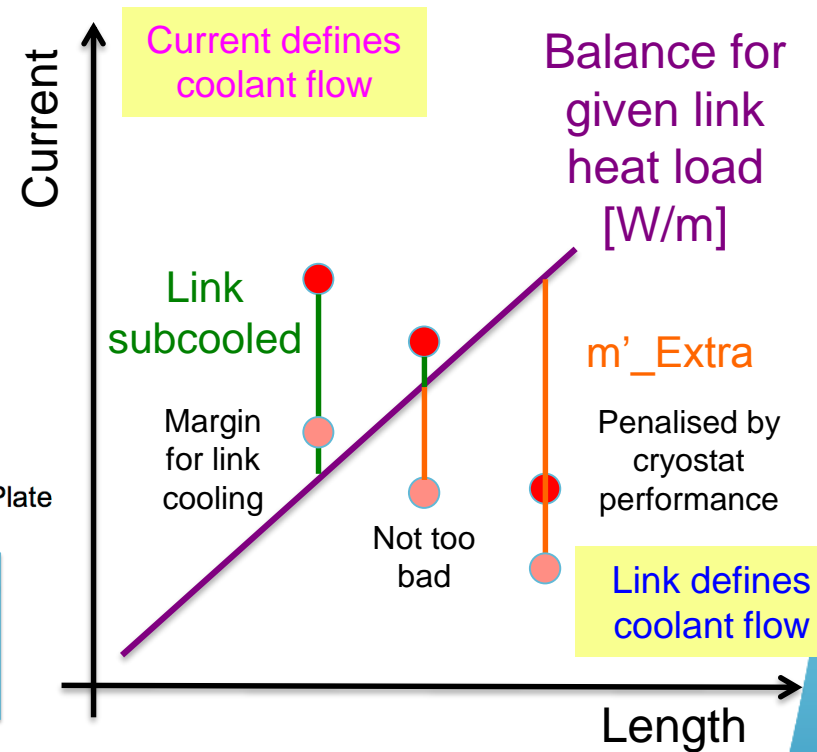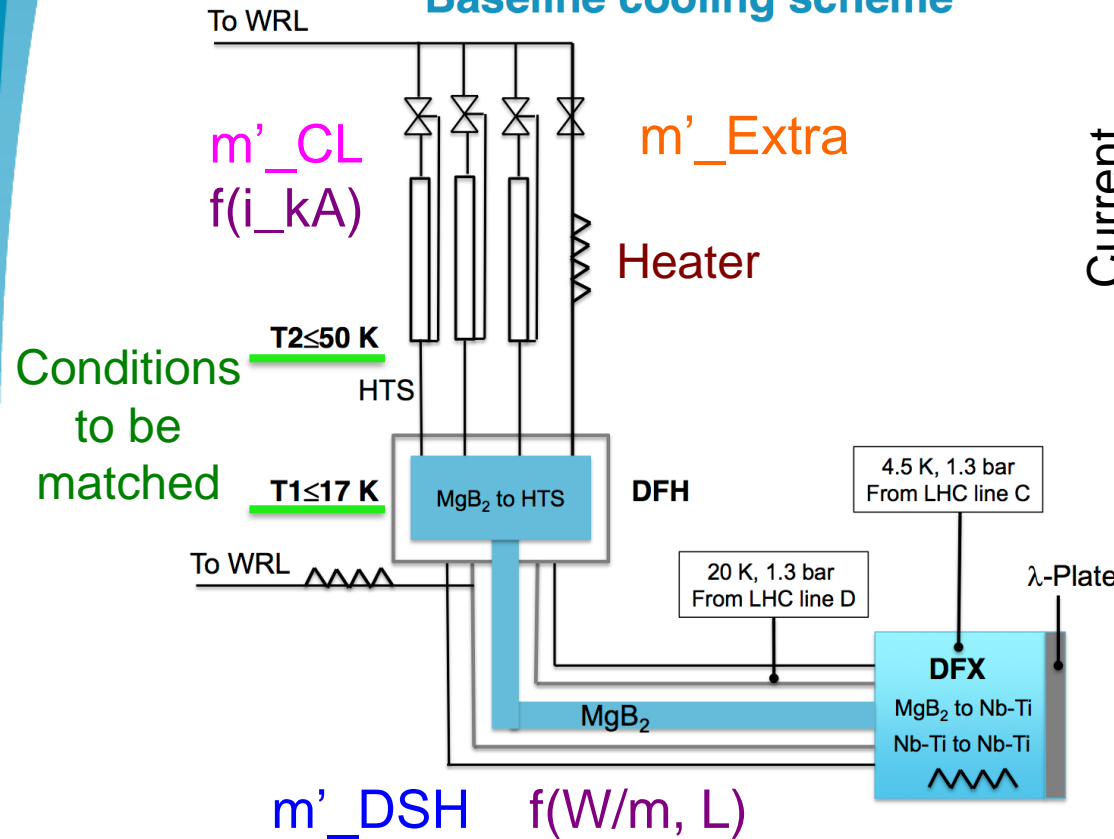*With the help of Daniel Berkowitz, Antonio Perin & Udo Wagner*

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Cooling principle and governing parameters

- A cryogenically optimised sc-link system (flow in series) should not take more mass flow than the one required by the current leads
- Alternative: Separate feeding of the link cryostat (shielded) allowing to cool the leads at a higher temperature that is less "costly" (exergetic) as equivalent load (not HL baseline)

Baseline cooling scheme

To WRL

m'_CL
f(i_kA)

m'_Extra

Heater

Conditions to be matched

T2≤50 K

HTS

T1≤17 K

MgB$_2$ to HTS

DFH

4.5 K, 1.3 bar
From LHC line C

λ-Plate

To WRL

20 K, 1.3 bar
From LHC line D

MgB$_2$

DFX
MgB$_2$ to Nb-Ti
Nb-Ti to Nb-Ti

m'_DSH   f(W/m, L)

Current

Current defines coolant flow

Balance for given link heat load [W/m]

Link subcooled

Margin for link cooling

Not too bad

m'_Extra

Penalised by cryostat performance
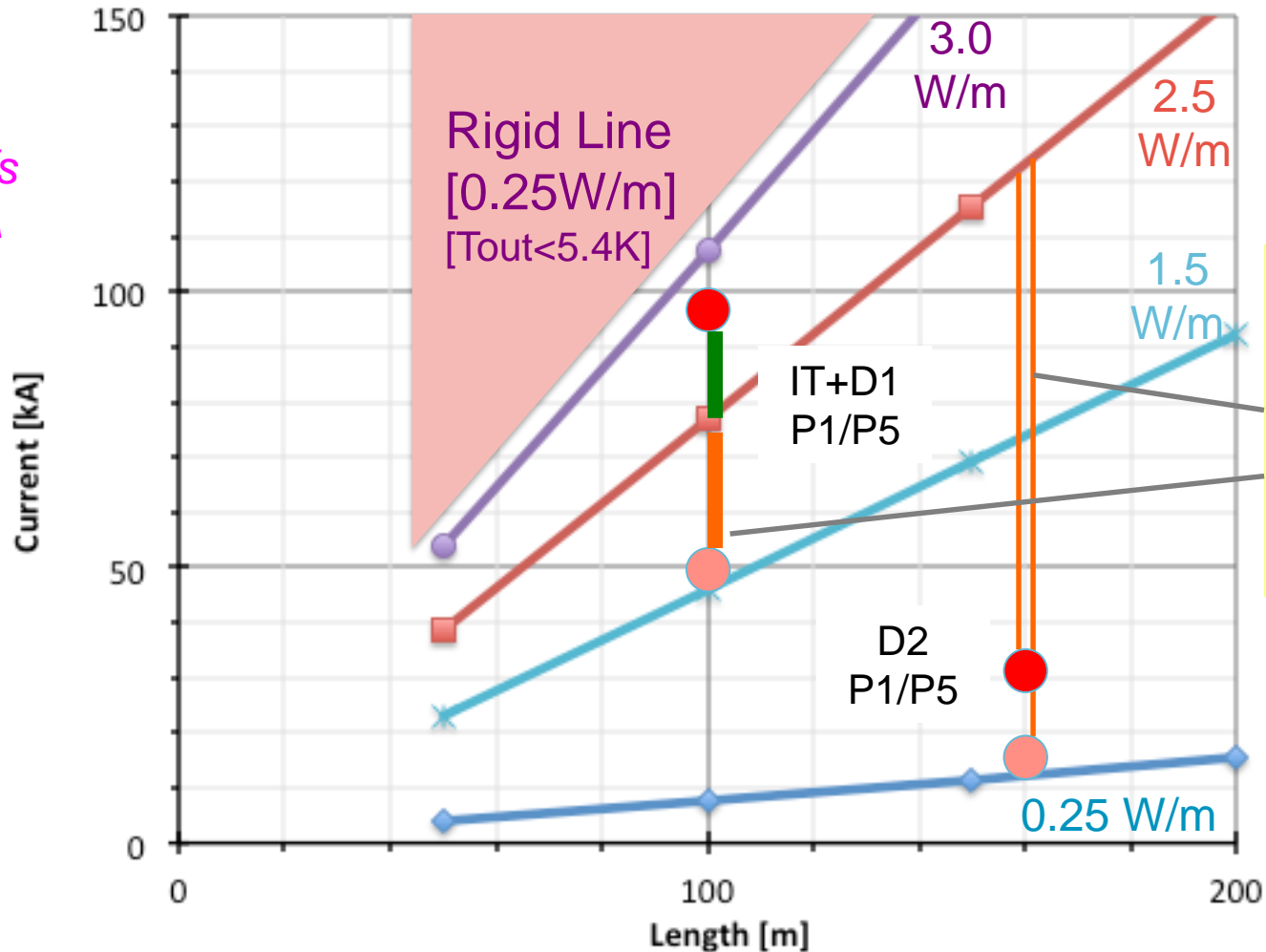
Link defines coolant flow

Length

Cooling principle and governing parameters

Basic application to HiLumi, to be completed with splices and other singularities

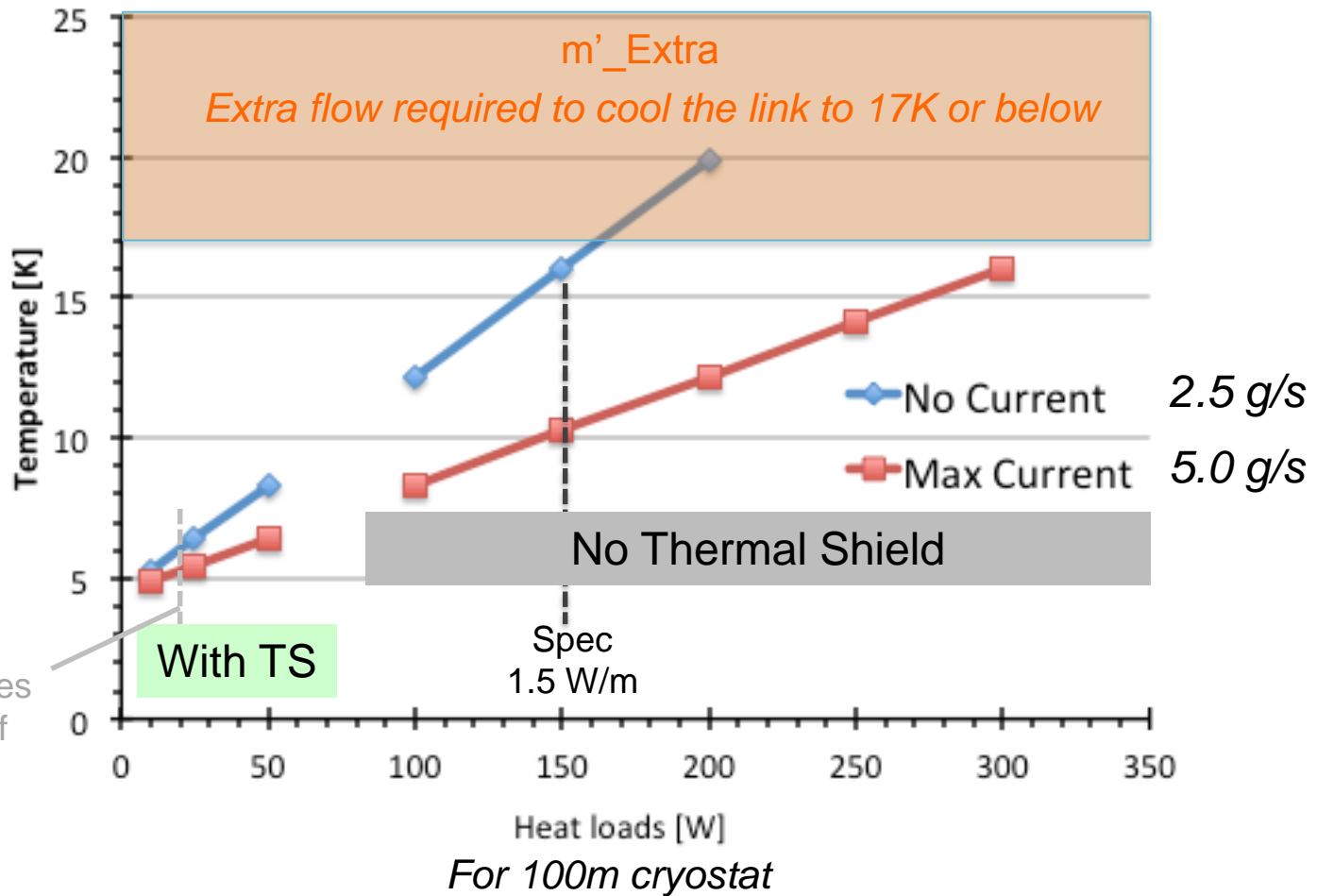Lines for optimised links (defined before) for a T_out of 17K

50 mg/s per kA

Rigid Line [0.25W/m] [Tout<5.4K]

3.0 W/m

2.5 W/m

1.5 W/m

IT+D1 P1/P5

D2 P1/P5

0.25 W/m

Definitely worth recovering extra flow at low temperature

Current [kA]

Length [m]

Temperature at outlet of link

For 100m cryostat