Plans for the UT Cooling

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Overview

- **Cooling needs:**
  - On-detector (stave) cooling → **$C0_2$**
  - Cooling for PEPI electronics → **most likely chilled water**
  - OFF-detector cooling (LV regulators, Maratons, HV etc.) → **mixed water, as TT**

- **Gas needs:**
  - The detector has to be operated in a controlled environment with very low humidity → **dry air, as for TT**

On-detector Cooling (CO_2)

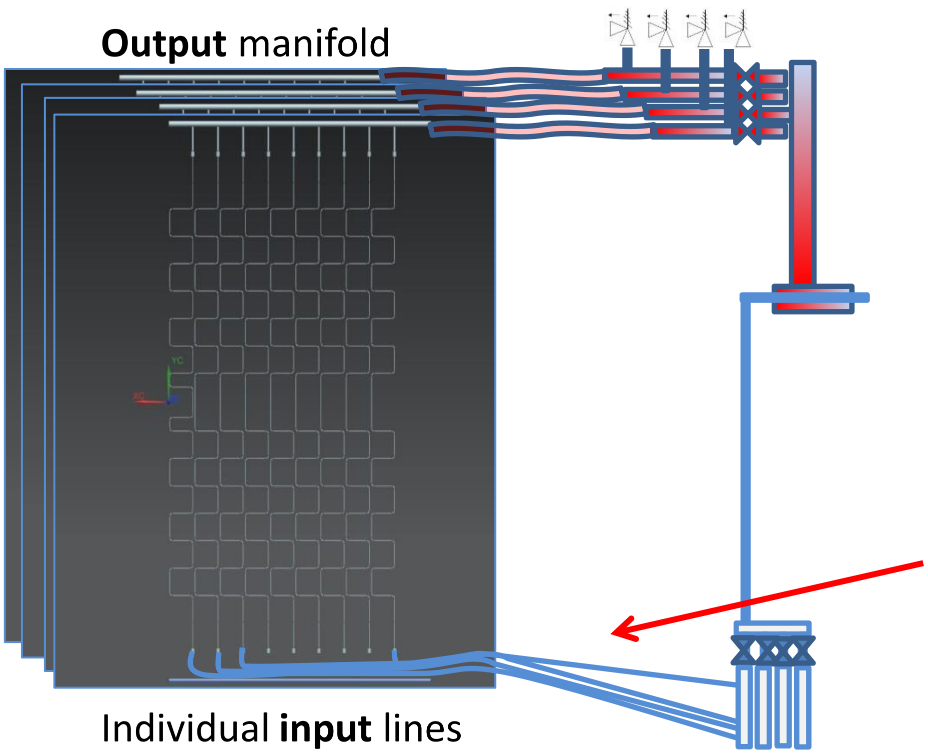
Cooling requirements (EDMS document in preparation):

UT NORMAL OPERATING MODE			*T_op = -30˚C*
Conditions: Box halves joined/sealed, electronics fully powered, full cooling (normal data-taking mode)			
SALT ASIC power	0.768	W/ASIC	assumption of 6 mW/ch
	761.9	W/plane	for each plane UTAX and UTAU
	847.9	W/plane	for each plane UTBX and UTBV
	3219.5	W/UT	
SENSOR self-heating	12.2	W/UT	worst case total, after 50 pb-1
DATA-FLEX power dissipation	323.2	W/UT	est., 10% of power carried
UT BOX load (est. convective, radiative)	100.0	W/UT	est. convective load from environment, assumed minimal, due to box insulation
BEAM-PIPE load (est. convective, radiative)	100.0	W/UT	est. convective load from beampipe heaters
TOTAL POWER LOAD	**3754.8**	**W/UT**	partial load
	4505.8	**W/UT**	with 20% margin
	5000.0	**W/UT**	est. max expected with all loads included

- Fluid filtration: accessible and replaceable in technical stop
- UPS: All control parts and part of the system
- Pressure parts: Max design Pressure: 100 bar
- On stave stability: 1-2 °C

Development and definition of the evaporator system

- **Design and test of the UT evaporator with vertical staves**
  - A basic design together with a test program exists

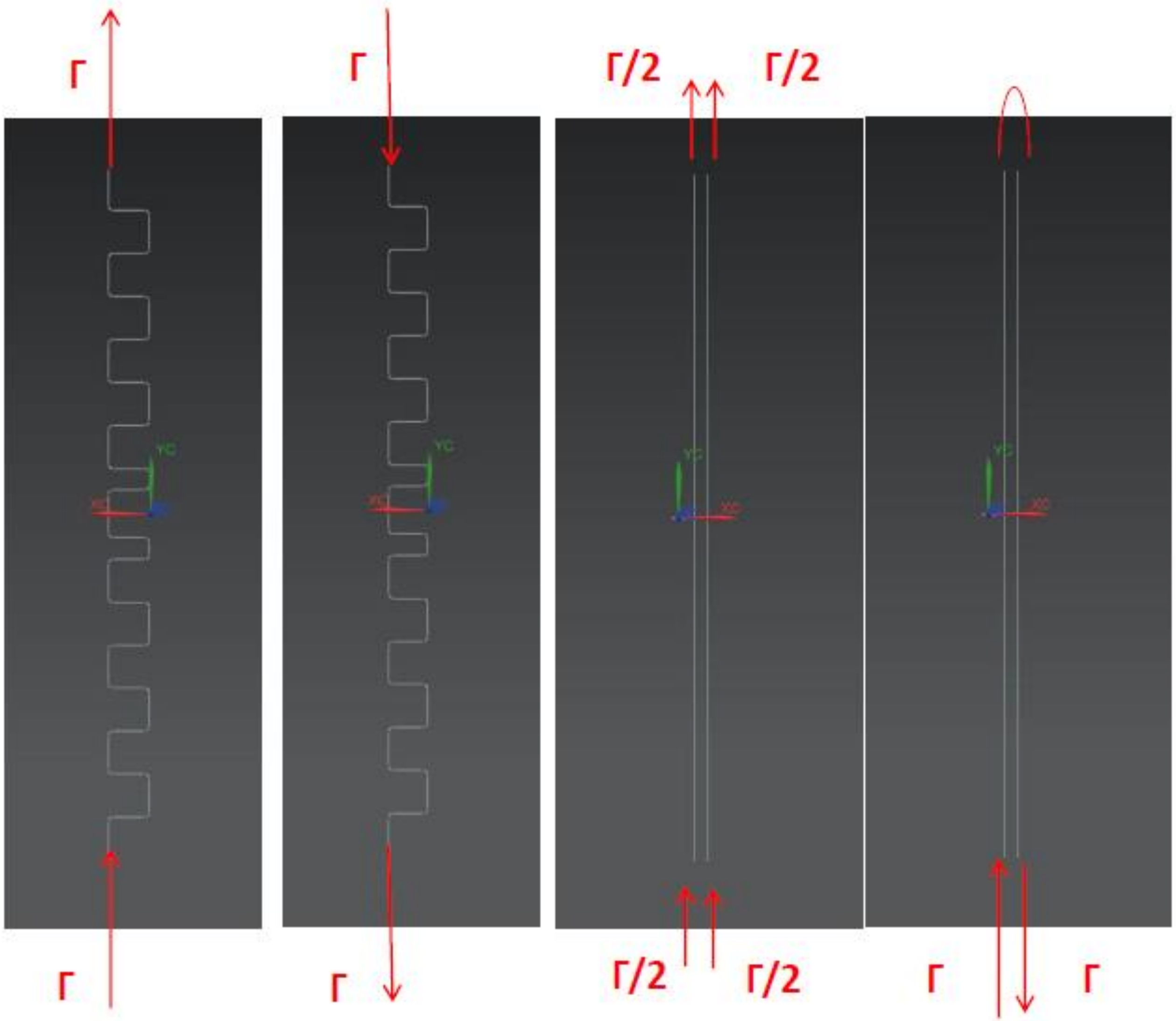


The goal for the cooling distribution is to give the correct flow, using balanced pressure drop in the circuit.

The degree of freedom in the design is in the **input** cooling line diameter and length

Cooling pipe and flow configurations

baseline



central stave

Q = 85 W
X = 30 %
H lv =280 kJ/kg

Coolant Mass flow rate always

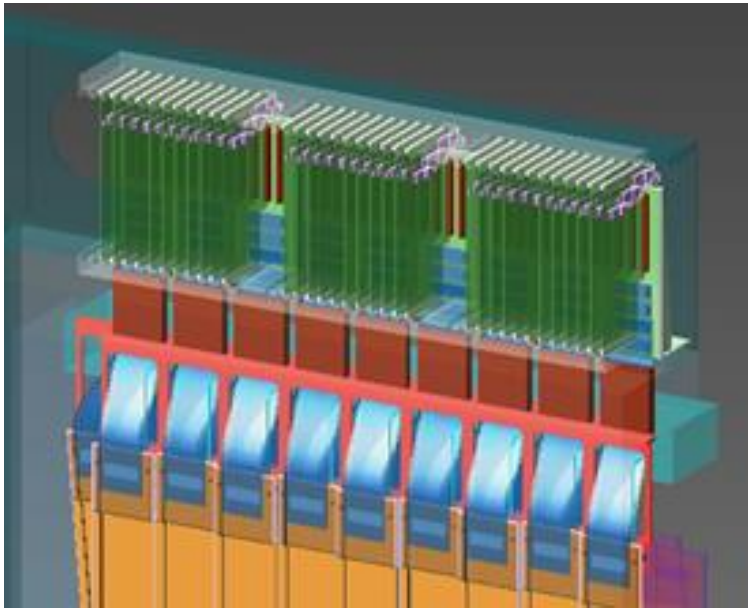
⇒ Γ = 1 g/s

Given the same boundary conditions

Cooling for Peripheral Electronics

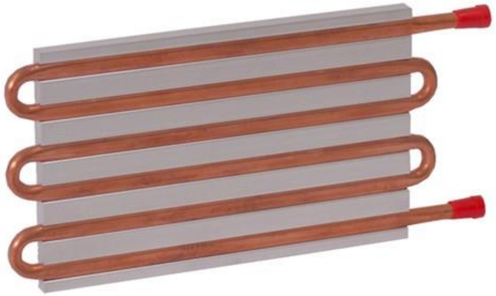
Power estimation:

- Total thermal load: **< 3 kW** distributed over 8 chassis.
- Max power per chassis: < 400 W
- Max power per DCB: < 15 W



Thermal management:

- Studies on thermal behaviour are planned this summer at Maryland:
  - evaluate the thermal resistances based on conduction cooled boards and wedge-locks



Present Plan:

- eliminate heat via coolant circulation, cold plates mechanically attached to the custom chassis sides with wedge lock guides

Conclusions

- Important studies on the thermal behaviour of the staves are planned for the coming months
  - They will allow us to finalize the design of the evaporator system
  - They form an important input to the Process and Instrumentation design (P&ID) of the cooling plant

- Studies are planned as well for the cooling of the peripheral electronics (PEPI)
  - They will have an impact on the integration of the PEPI system on the top and bottom of the detector