

SciFi Electronics Cooling

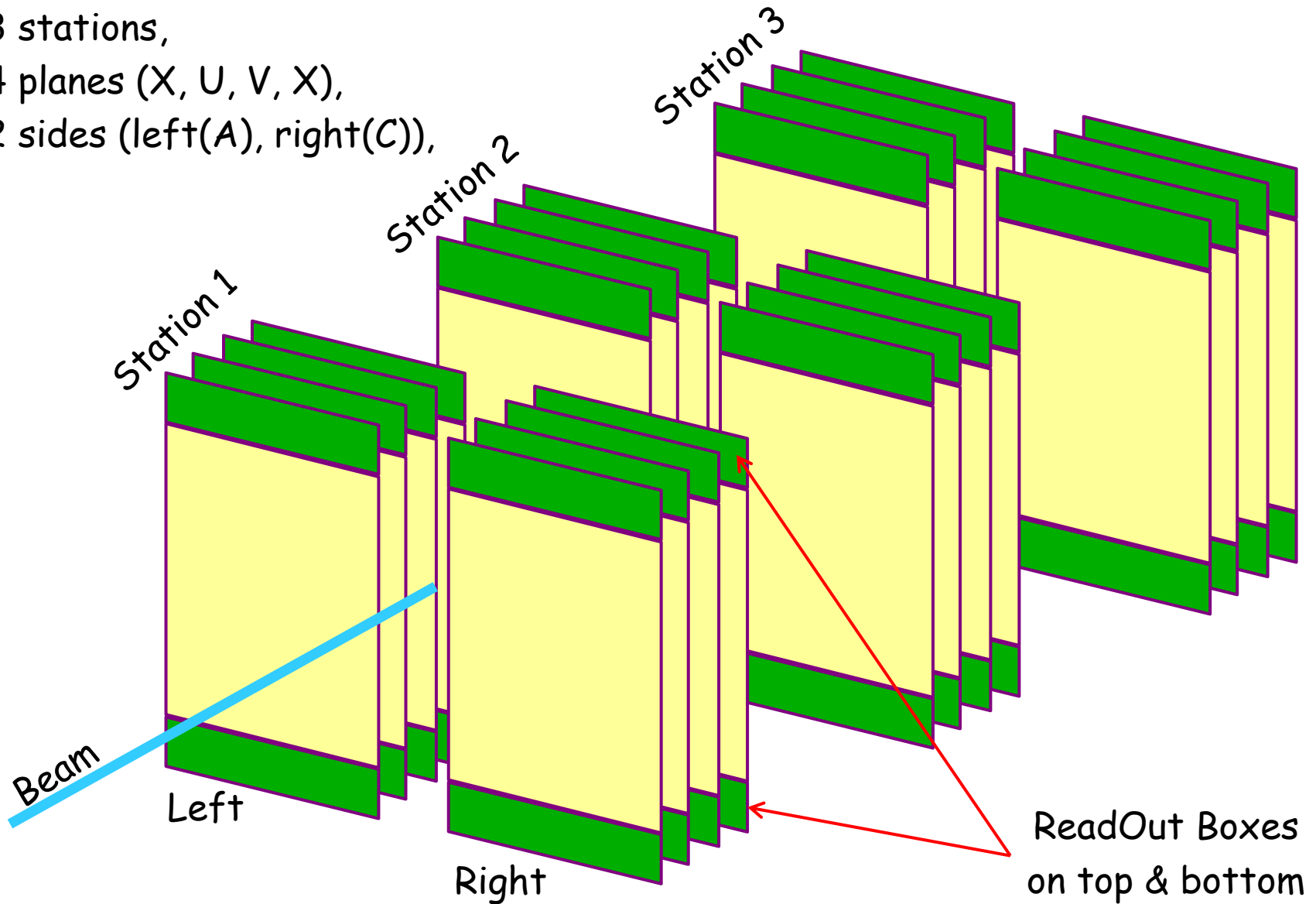
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LHCb Upgrade Electronics Meeting, October 8, 2015

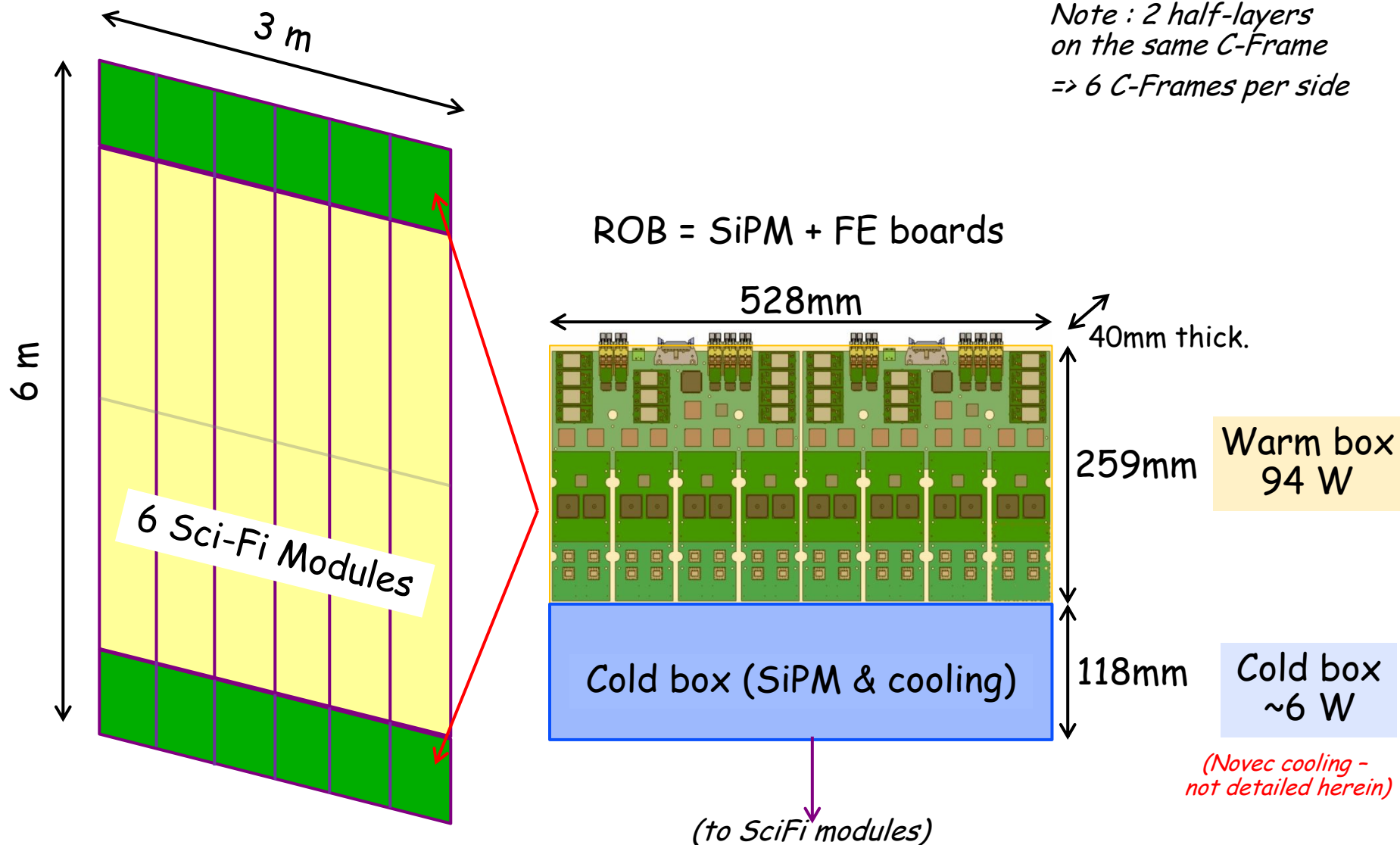
- o Introduction
- o FE Electronics design and power consumption
- o Cooling system specifications
- o Summary and Outlook

General Setup

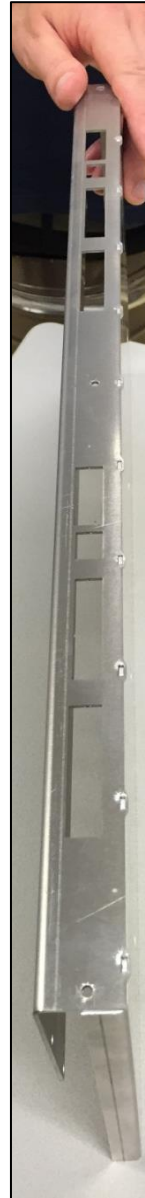
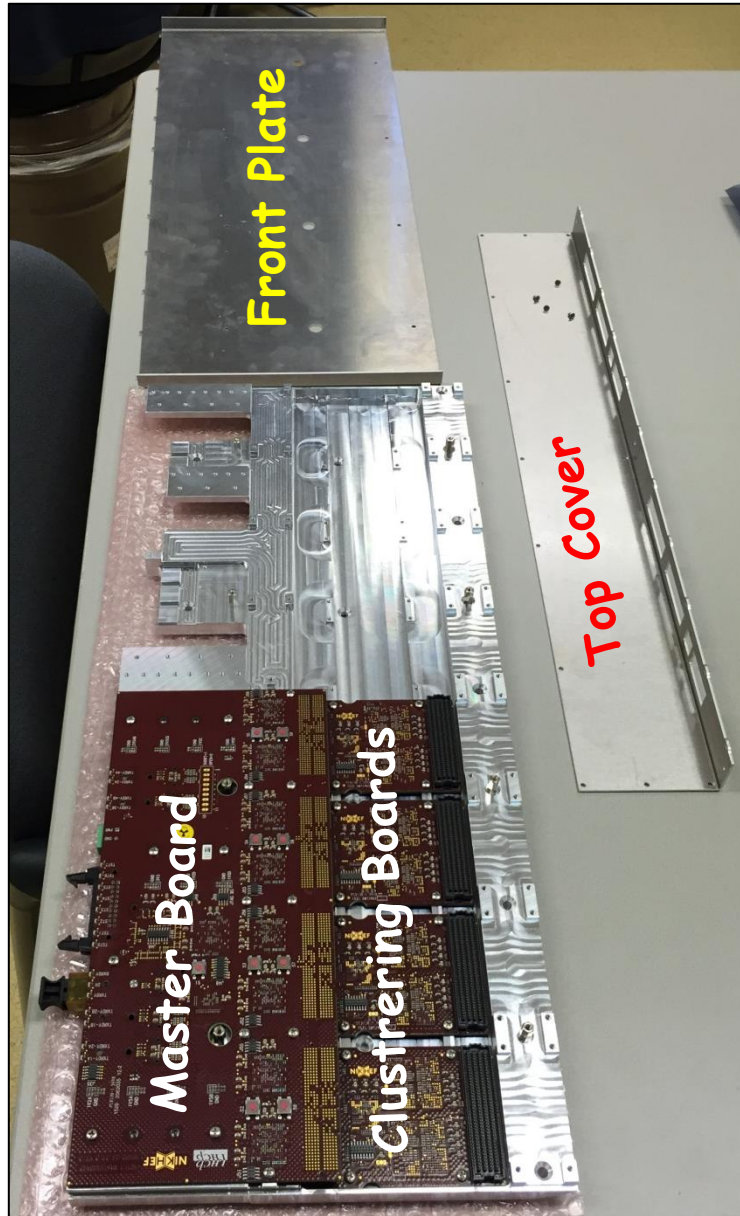
- 3 stations,
- 4 planes (X, U, V, X),
- 2 sides (left(A), right(C)),



Half plane setup

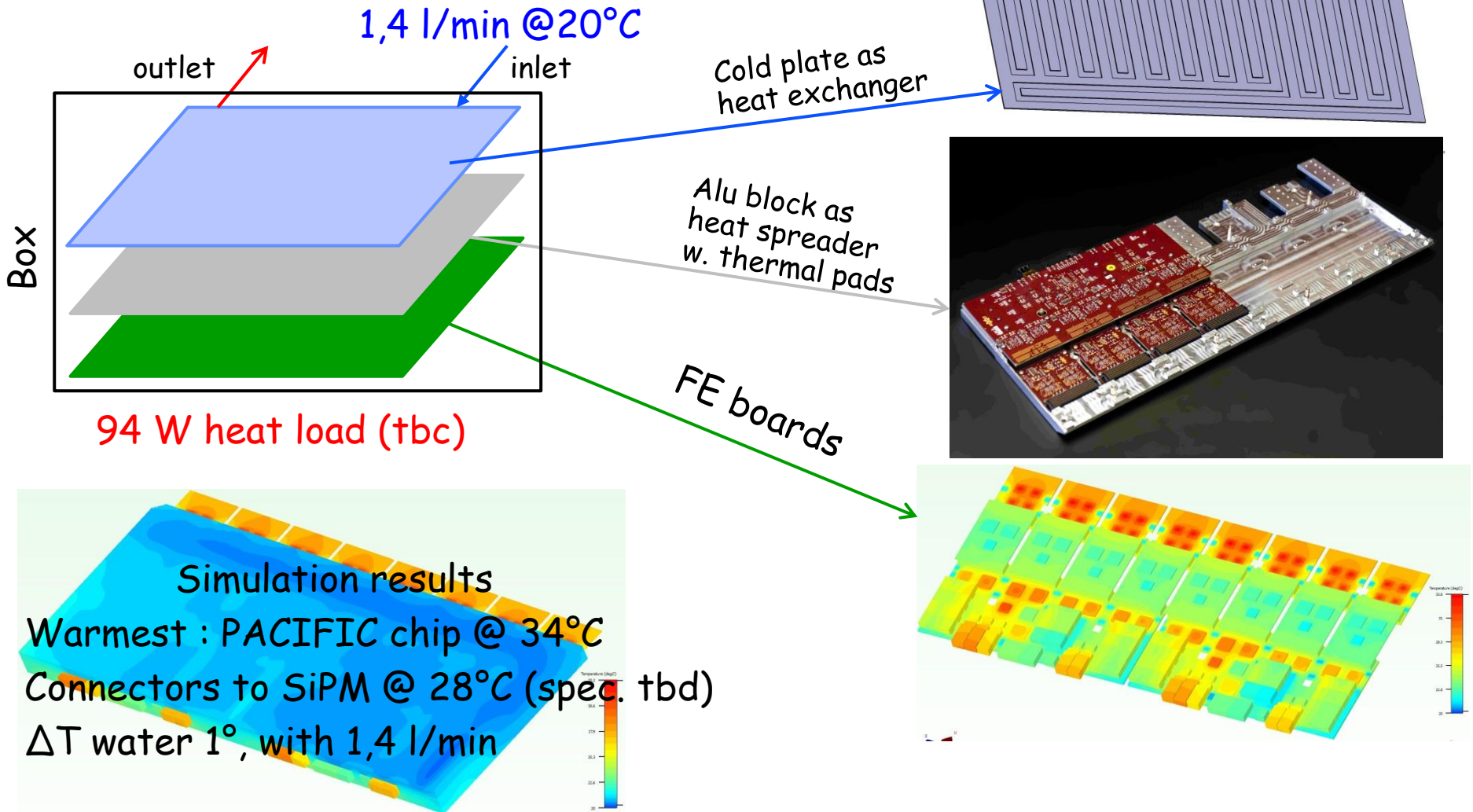


FE Box Prototypes @Nikhef

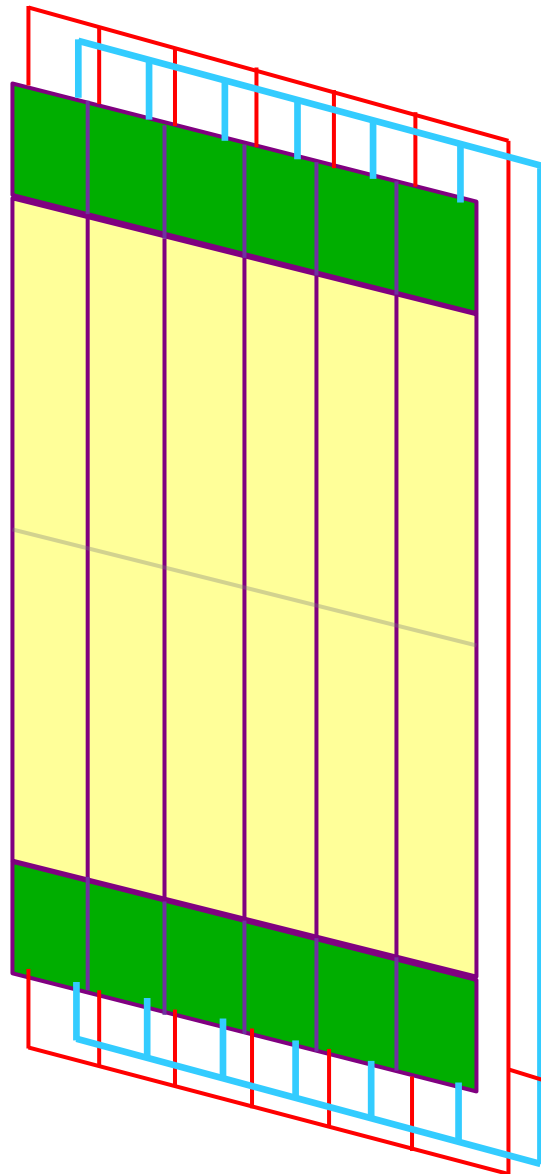


FE boards cooling simulations

Preliminary study based on prototype config.



Water cooling distribution



Baseline : cooling 2x6 ROBOT in parallel (tbc)
2 half-layers per C-frame

Total heat load : 27 kW

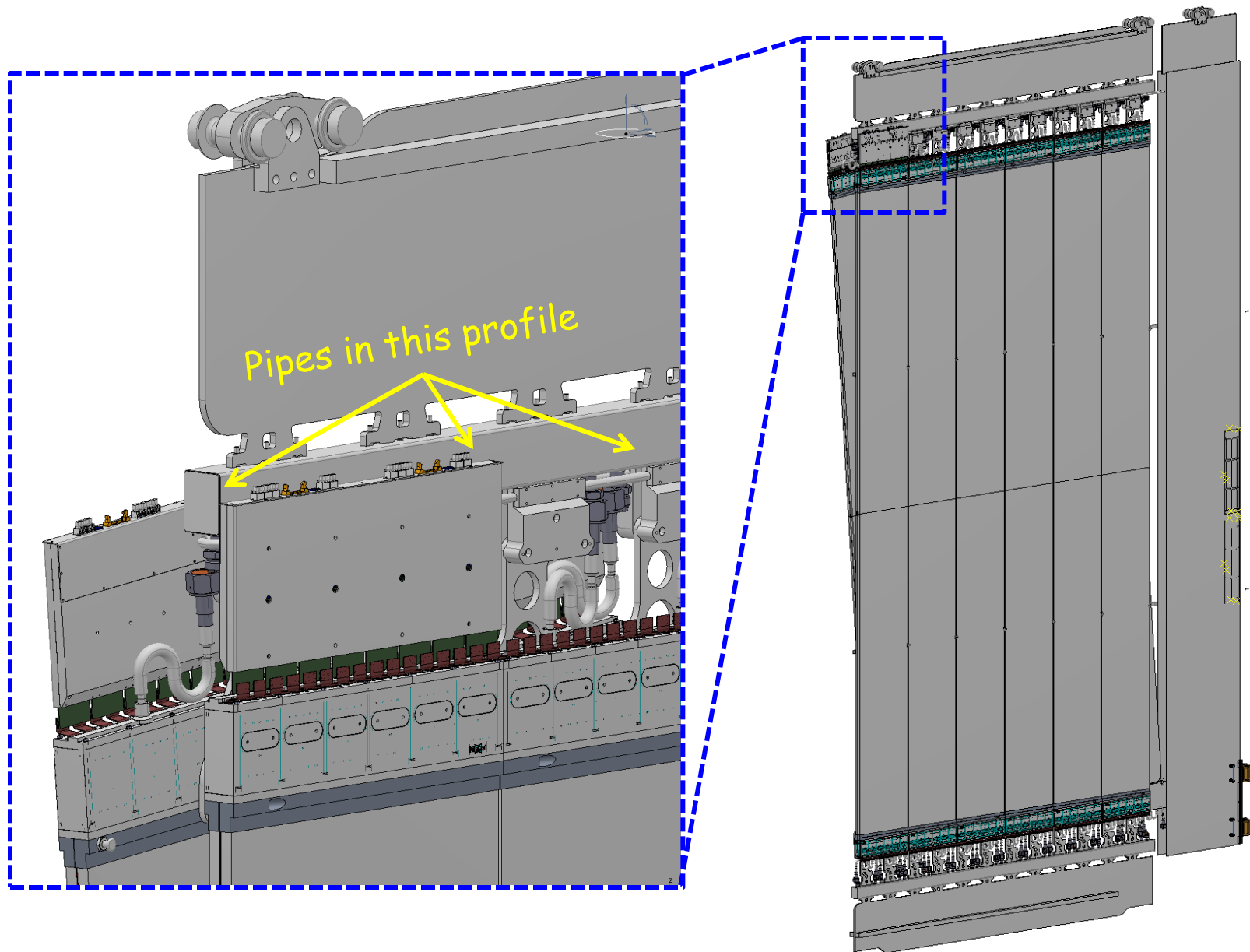
Total vol. flow : 403.2 l/min (24.2 m³/h)

- 6 distribution points on each side of detector
- Use flexible hose between distribution and detector to allow C-frame opening without disconnecting (cooling in open position too)

Inlet 16.8 l/min

Outlet 1.2 kW

How it could actually look like *(prelim.)*



Water cooling supply

Current features of water cooling station for Outer Tracker:

[see <http://www.nikhef.nl/pub/experiments/bfys/lhcb/outerTracker/Cooling>]

- ❖ Cooling capacity = 23 kW [15 kW × 1.5 safety factor]
- ❖ Flow rate = 10 m³/h
- ❖ Inlet temperature in detector = 19°C
- ❖ Demineralized water (conductivity < 1 μS/cm)
- ❖ Typical pressure at detector inlet ~1 bar

Specifications evaluated for SciFi electronics cooling :

- ❑ Coolant = demineralized water
- ❑ Water temperature : det. inlet = 20°C (*simu*) / det. outlet = 21°C (*simu*)
- ❑ Maximum ΔT inlet = +/- 1°C
- ❑ Flow rate for entire detector = 24,2 m³/h (if parallel config. validated)
- ❑ Water pressure inlet of detector = tbd (work underpressure preferred)
- ❑ Cooling capacity = 30 kW (10% margin included)
- Can the current cooling station be upgraded ?
- When can we begin study in details in collaboration with EN/CV ?

Summary & Outlook

- ❑ SciFi Electronics cooling studied with simulation
- ❑ First Electronics prototypes produced and available @ Nikhef
- ❑ Tests on Electronics performance have begun and tests on thermal behaviour is foreseen in near future :
 - Actual power consumption and temperature measurements possible once FE prototypes can be fully configured (soon)
 - Setup with Master and cluster boards + alu. block + cold plate for heat load and temperatures validation
 - Complete FE prototypes with Pacific boards (and later chip-to-SiPM flex)
- ❑ Results expected in 6 months before Electronics EDR
- ❑ In the mean time, can start discussion about cooling plant
 - Stay with present (OT/PS) demi-water plant (closed circuit, excellent water quality, never had problems with impurities, filters, etc.)
 - Design upgrade to higher cooling power