RICH Gas System
Design Parameters

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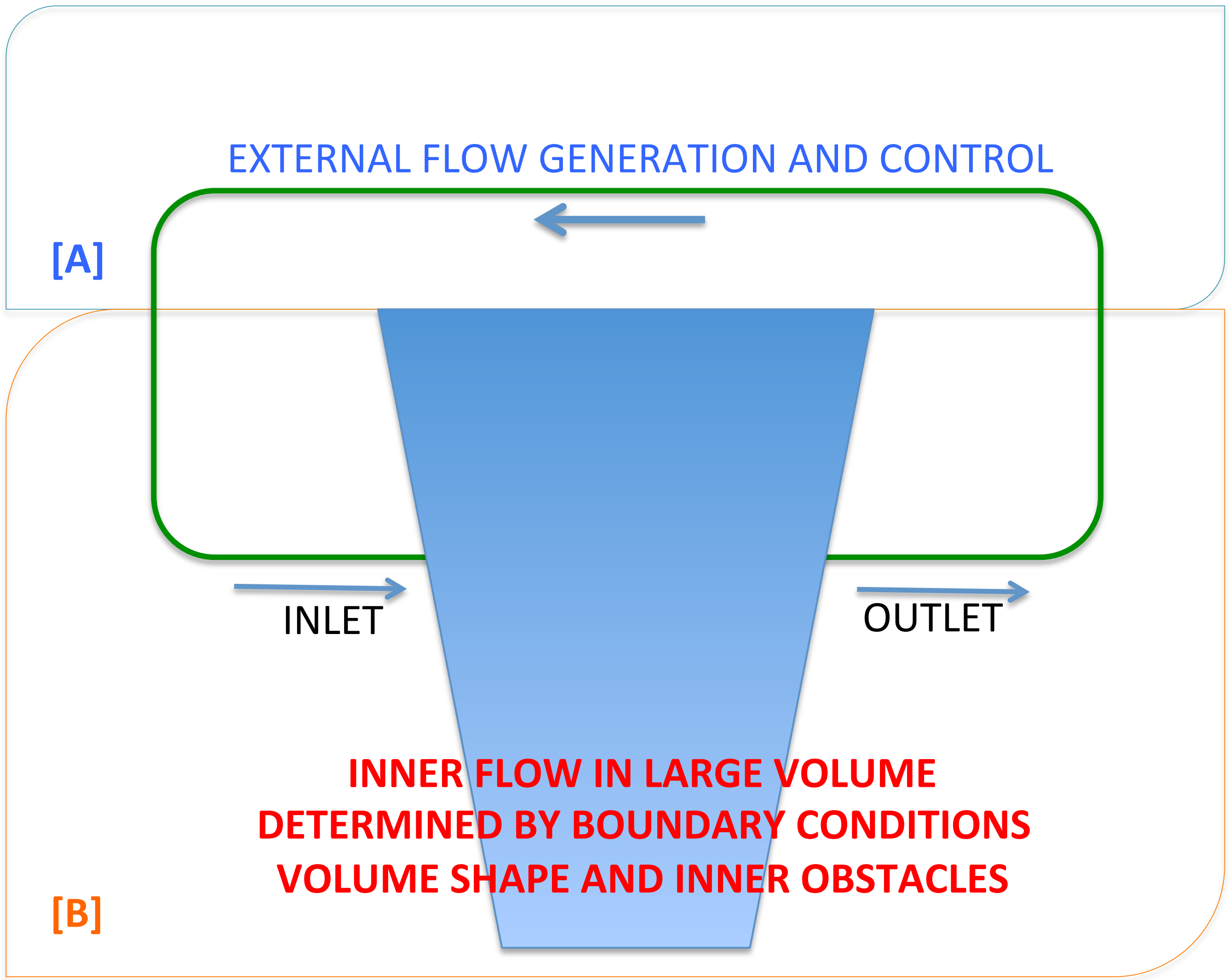
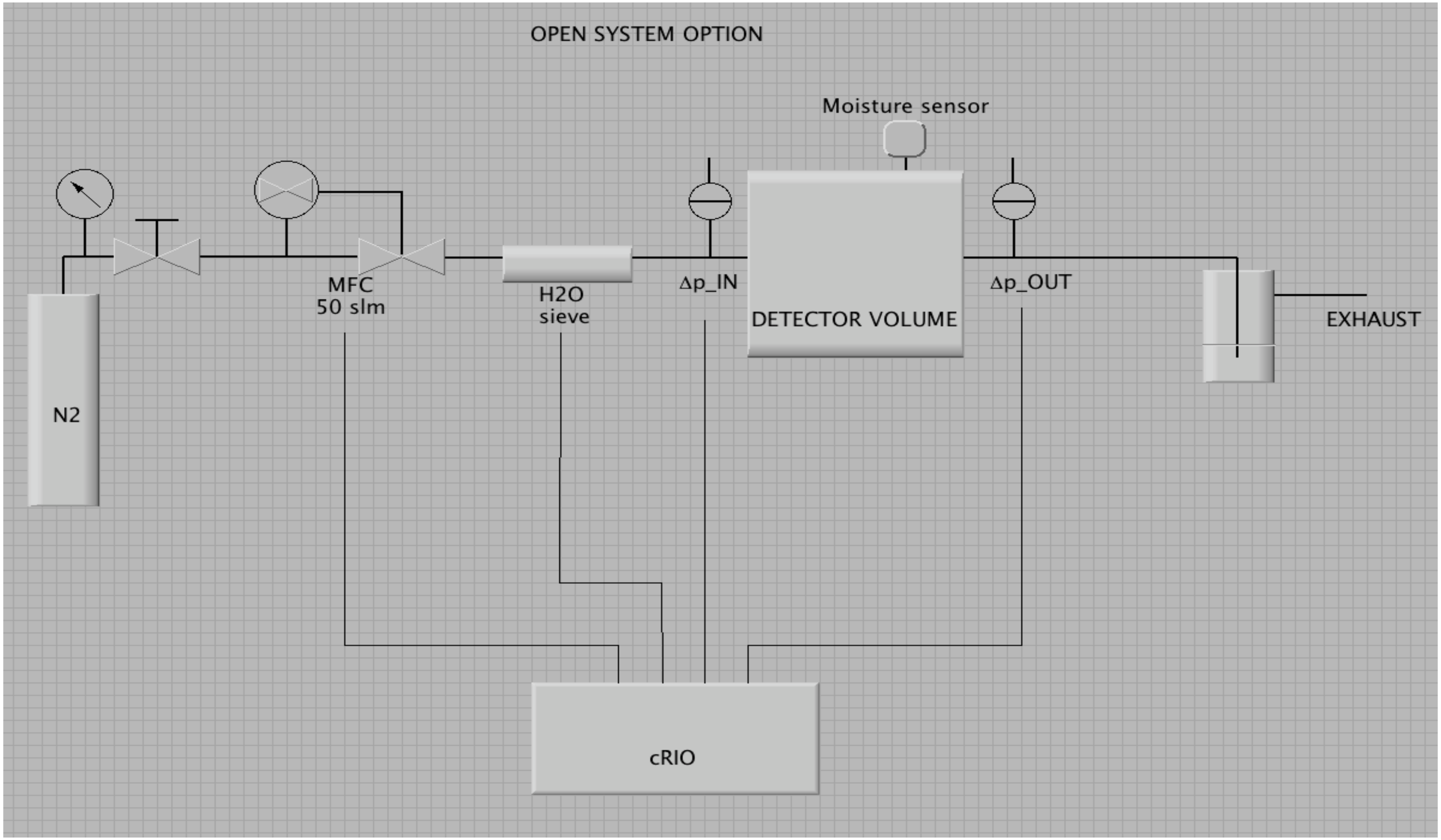
DRY GAS SYSTEM – GENERAL MODEL

[TWO LOGICAL BLOCKS]



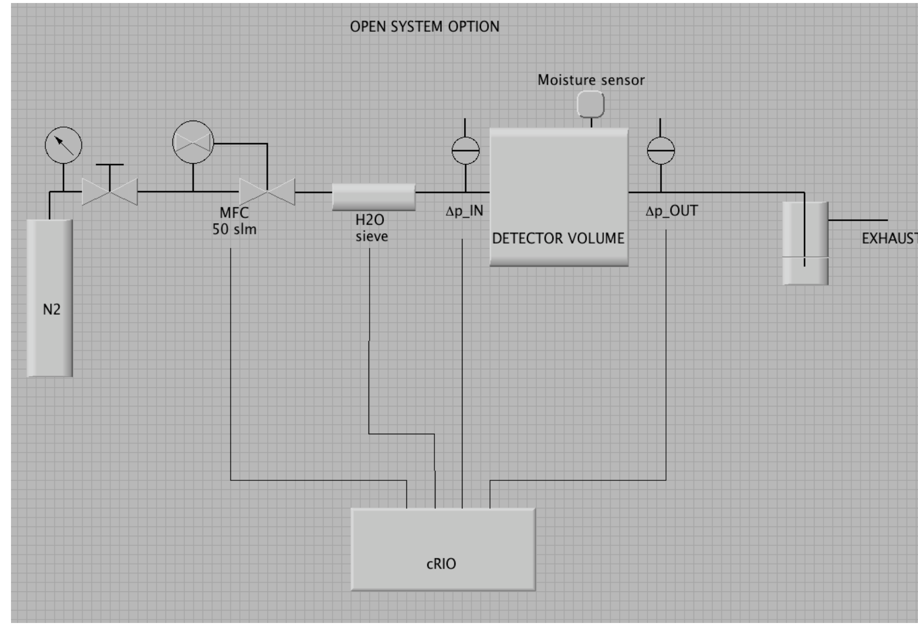
DRY GAS SYSTEM BASELINE LAYOUT

[A] FLOW GENERATION AND CONTROL IN OPEN CIRCULATION OPTION



System is flow-driven, i.e. the overpressure is determined by total impedance only.
Active controls regulate flow according to overpressure monitors.

DRY GAS SYSTEM BASELINE LAYOUT



requirements:

Volume of interest ~ 5 m^3

flow:
- dry N2 sufficient to keep H2O concentration below some prefixed level
- 10 nlm ~ 2 volumes/day

pressure:
wanted levels of ~30-40 mbar are not expected to affect mechanics significantly

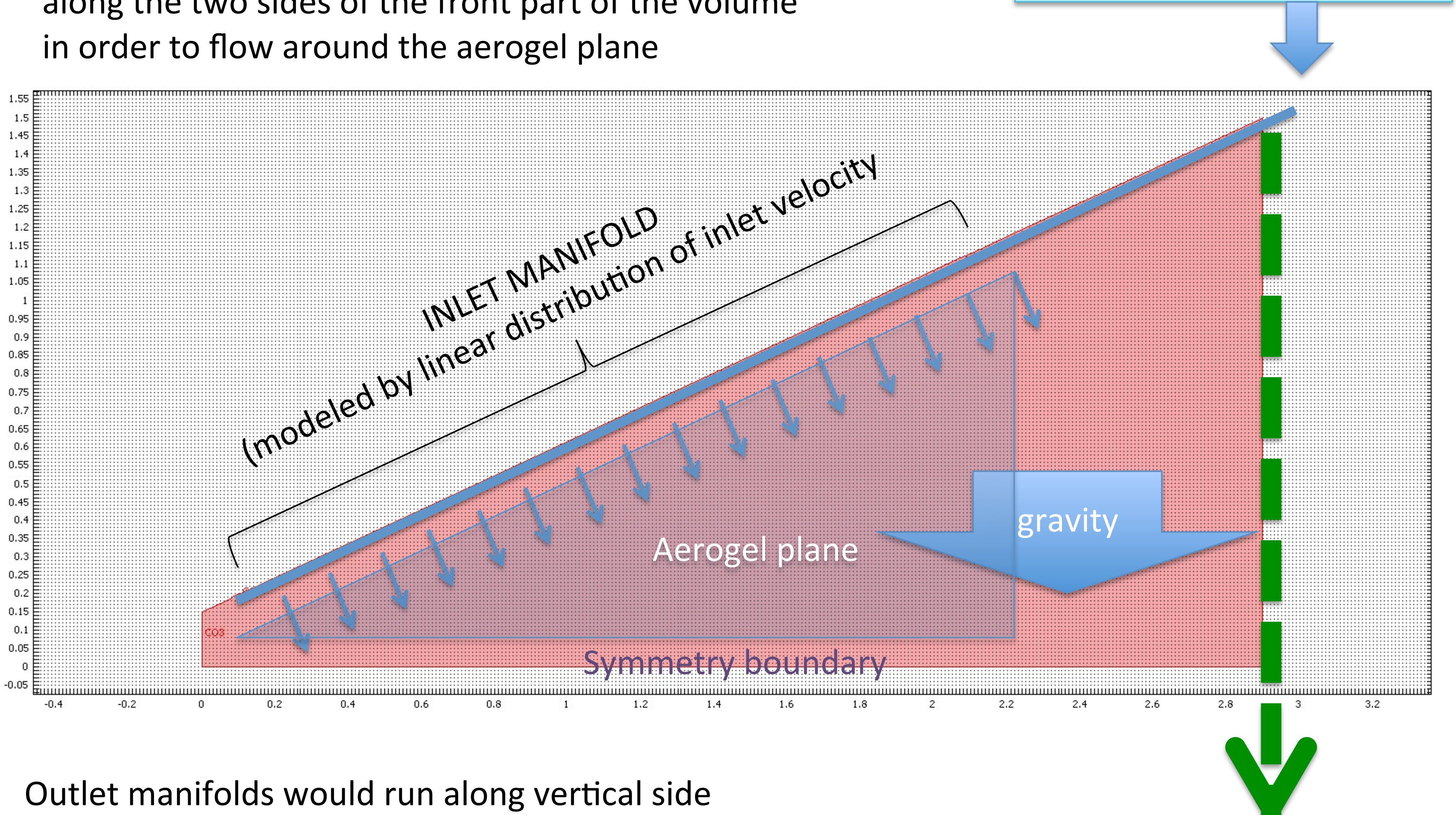
components:
[1] MFC e.g. 50 slm F.S.
[2] single inlets from two sides w/ internal manifolds
[2] single outlet from one side w/ internal low impedance manifold
[3] dP for overpressure measurement at chamber inlets and outlets
[4] H2O sensor(s) at inlets [0-100 PPM]
[5] Hydrosorb Molecular sieve(s) for H2O filtration

Central controller: e.g. NI-cRIO

2D idealized model: boundary conditions

Concept is that flow is provided by an inlet tube running along the two sides of the front part of the volume in order to flow around the aerogel plane

FRESH DRY N2 FLOW INLET

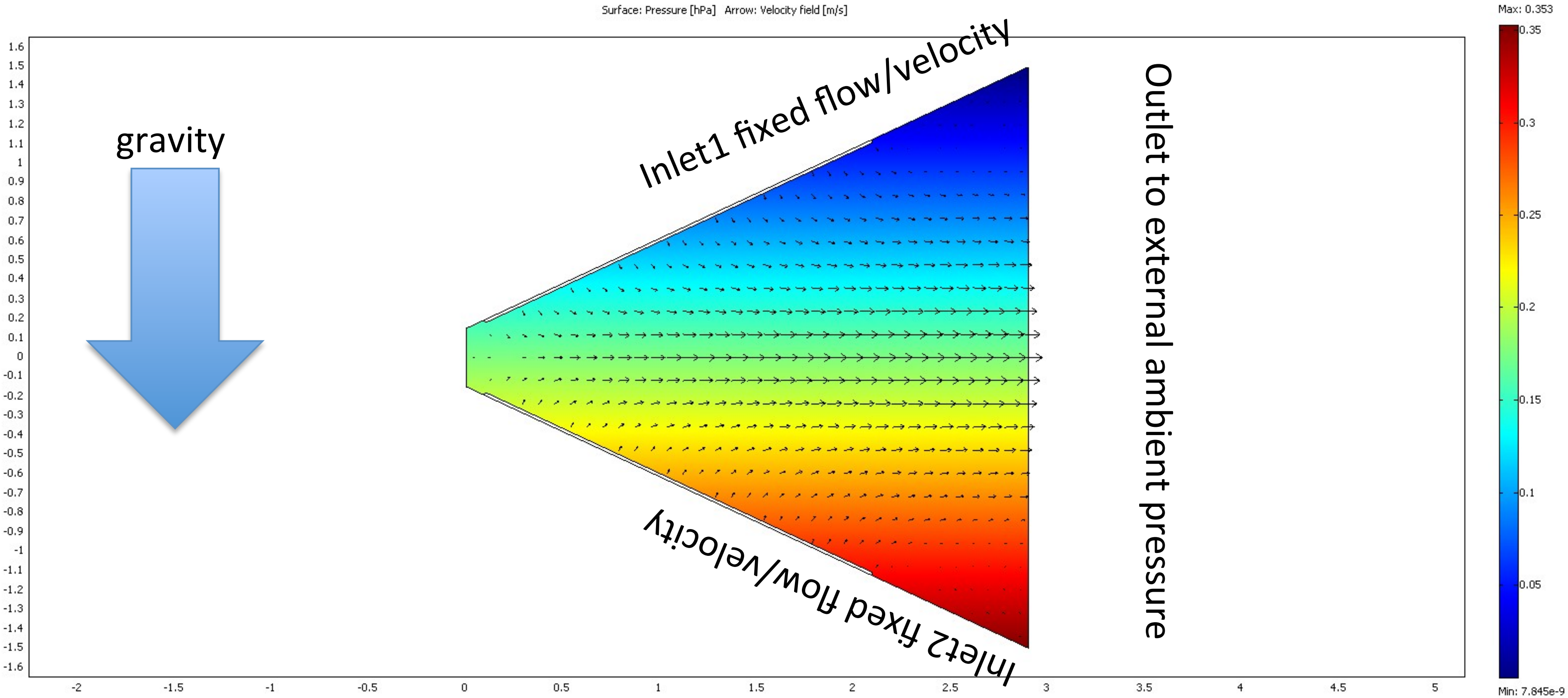


Outlet manifolds would run along vertical side collecting the flow streamlines to the outside hall (impedances are considered negligible at this stage)

OUTLET MANIFOLD
(modeled by continuous boundary towards outer hydrostatic pressure)

2D idealized model

> inlets linearly distributed along two sides
> outlet linearly distributed along one side



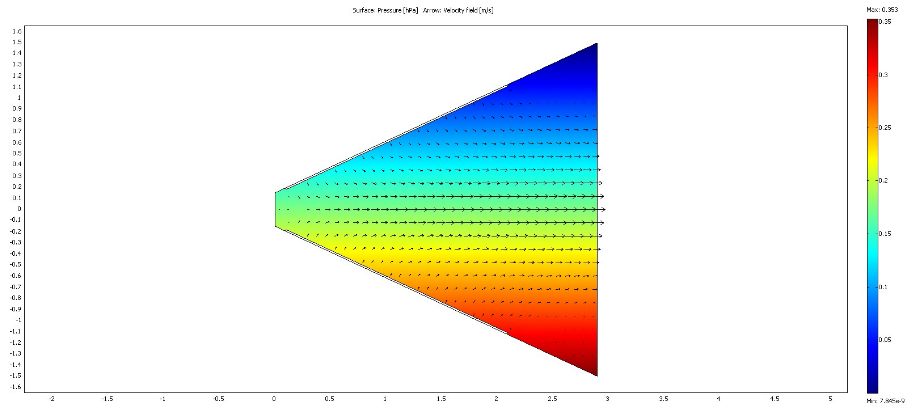
Model is extremely simplified:

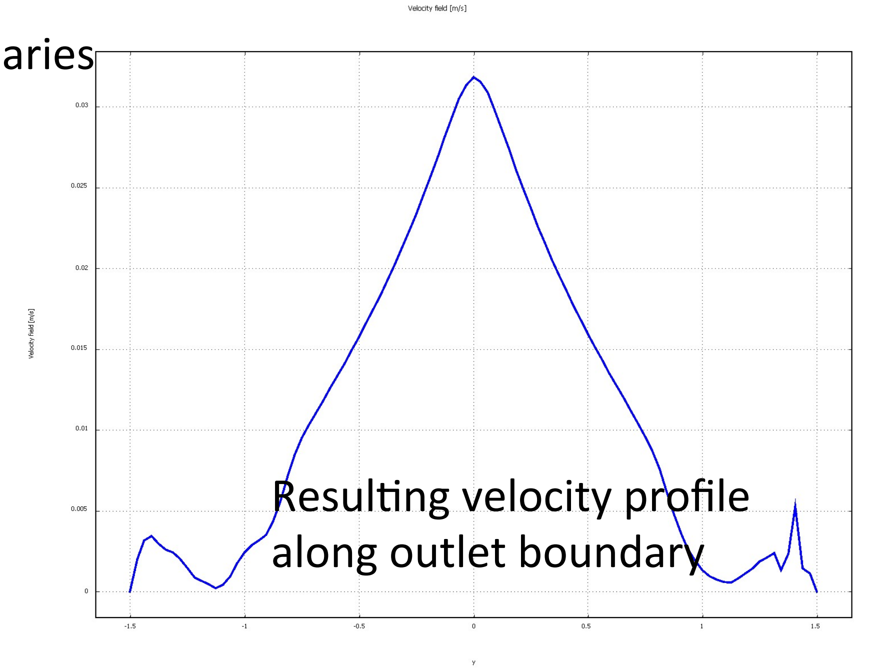
inlets are very close to reality (two long inward manifolds)

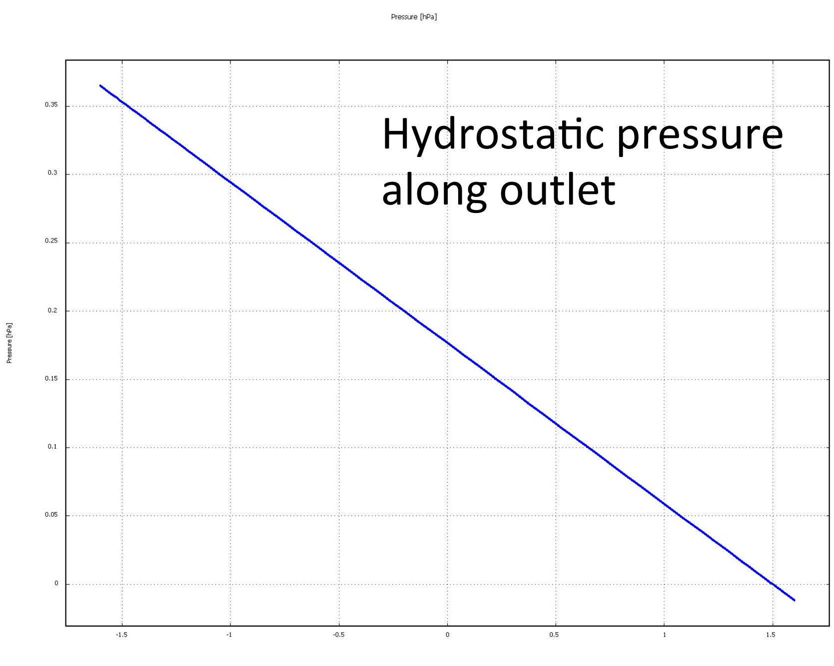
outlet is to be improved with impedance in order to get realistic inner pressure rise

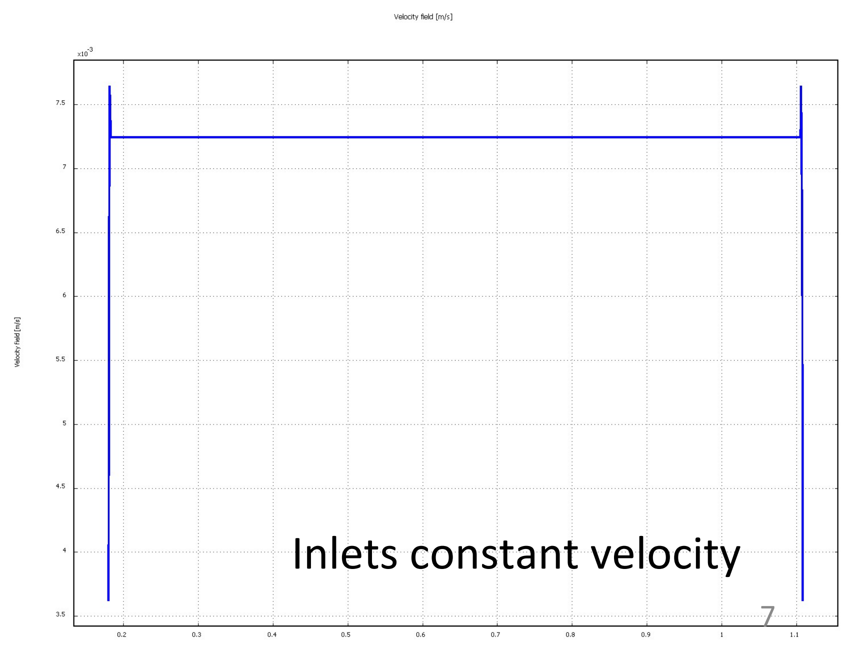
Overall solution features are realistic and ensure expected outward gas flow

Boundary conditions and resulting fields at boundaries

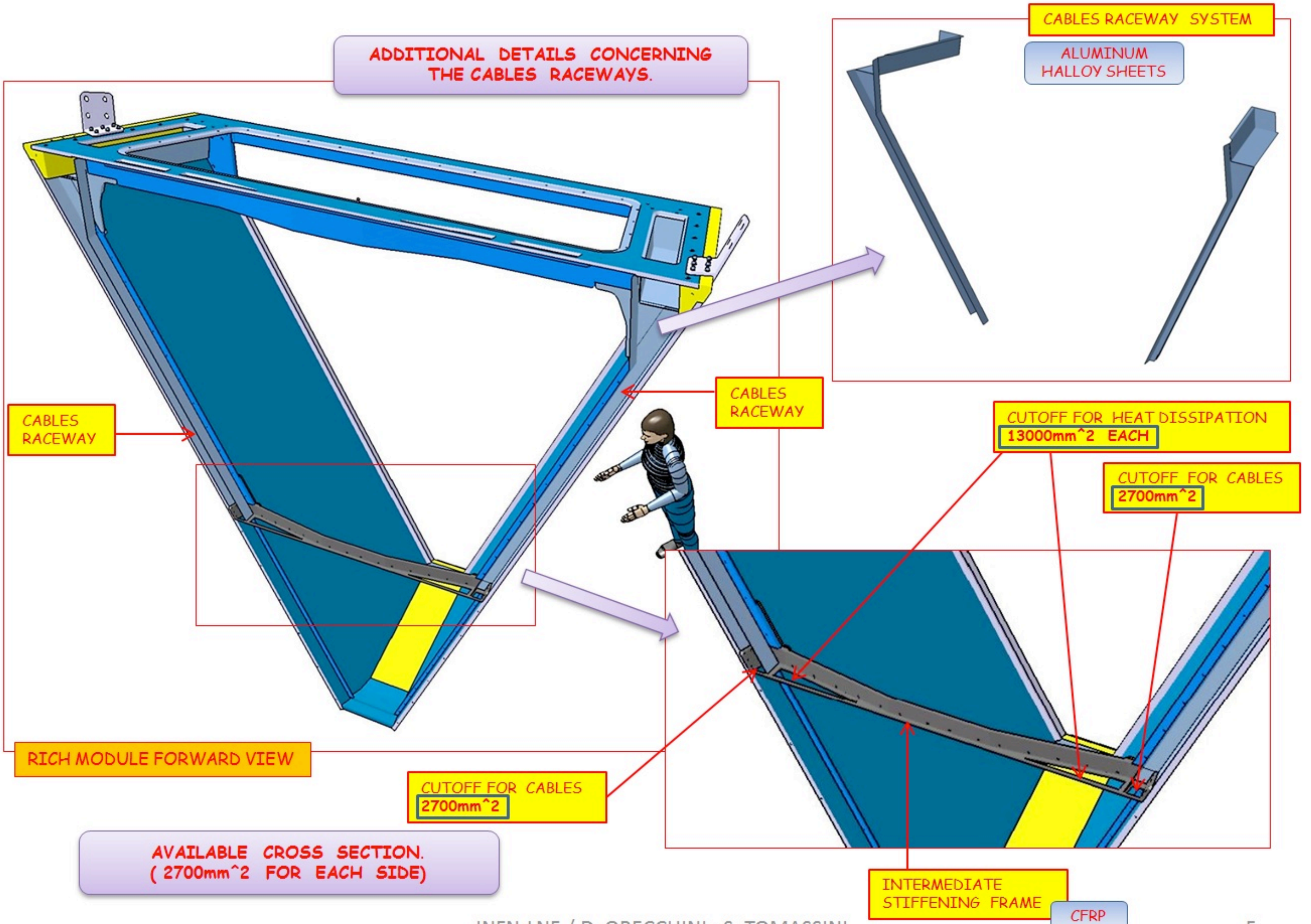








THE RICH Module: *Cables Raceways System Details.*



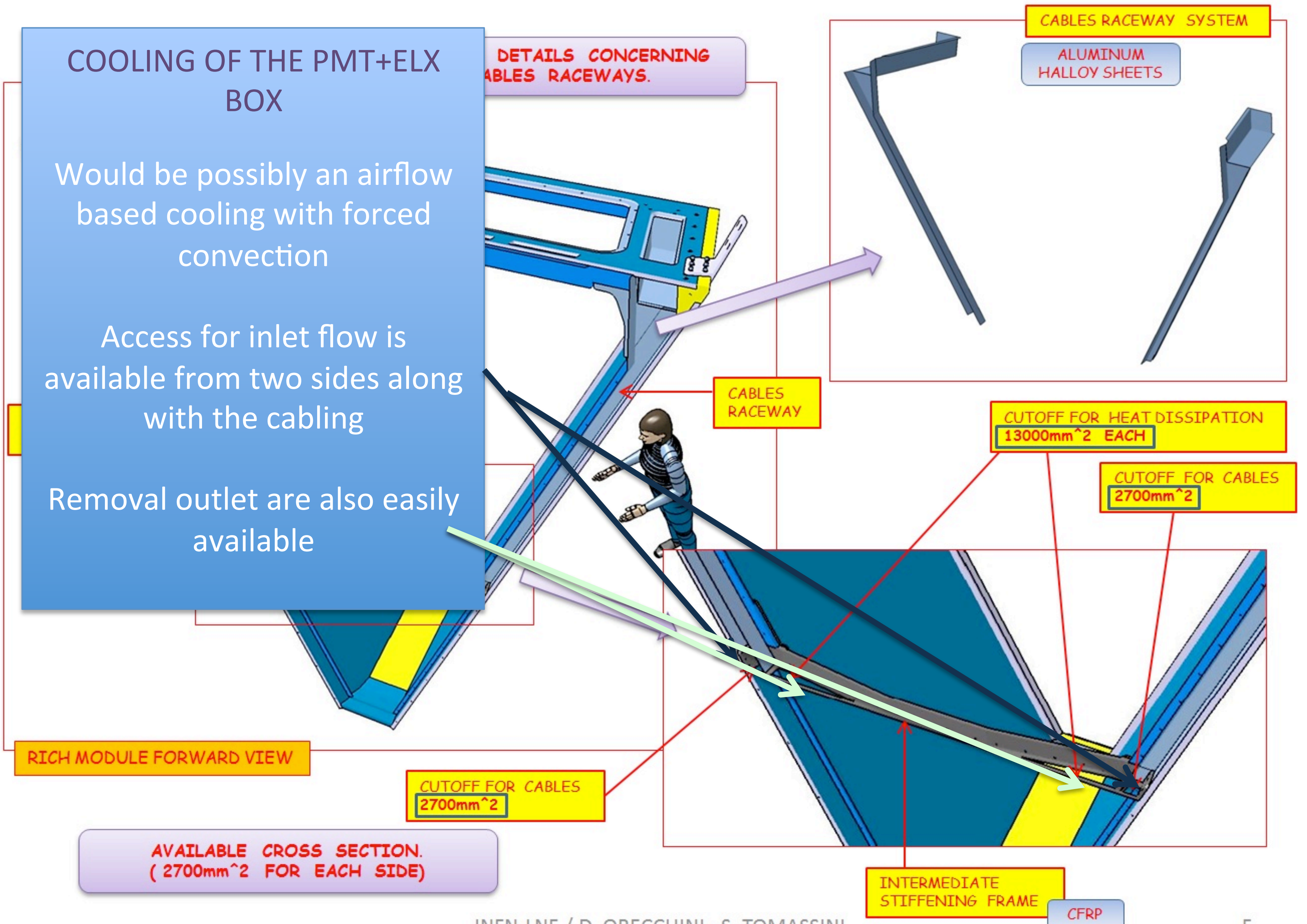
THE RICH Module: *Cables Raceways System Details.*

COOLING OF THE PMT+ELX BOX

Would be possibly an airflow based cooling with forced convection

Access for inlet flow is available from two sides along with the cabling

Removal outlet are also easily available



Preliminary general physics shows a temperature of ~40 degC would be kept by a steady 5 degC airflow of ~600 nlm

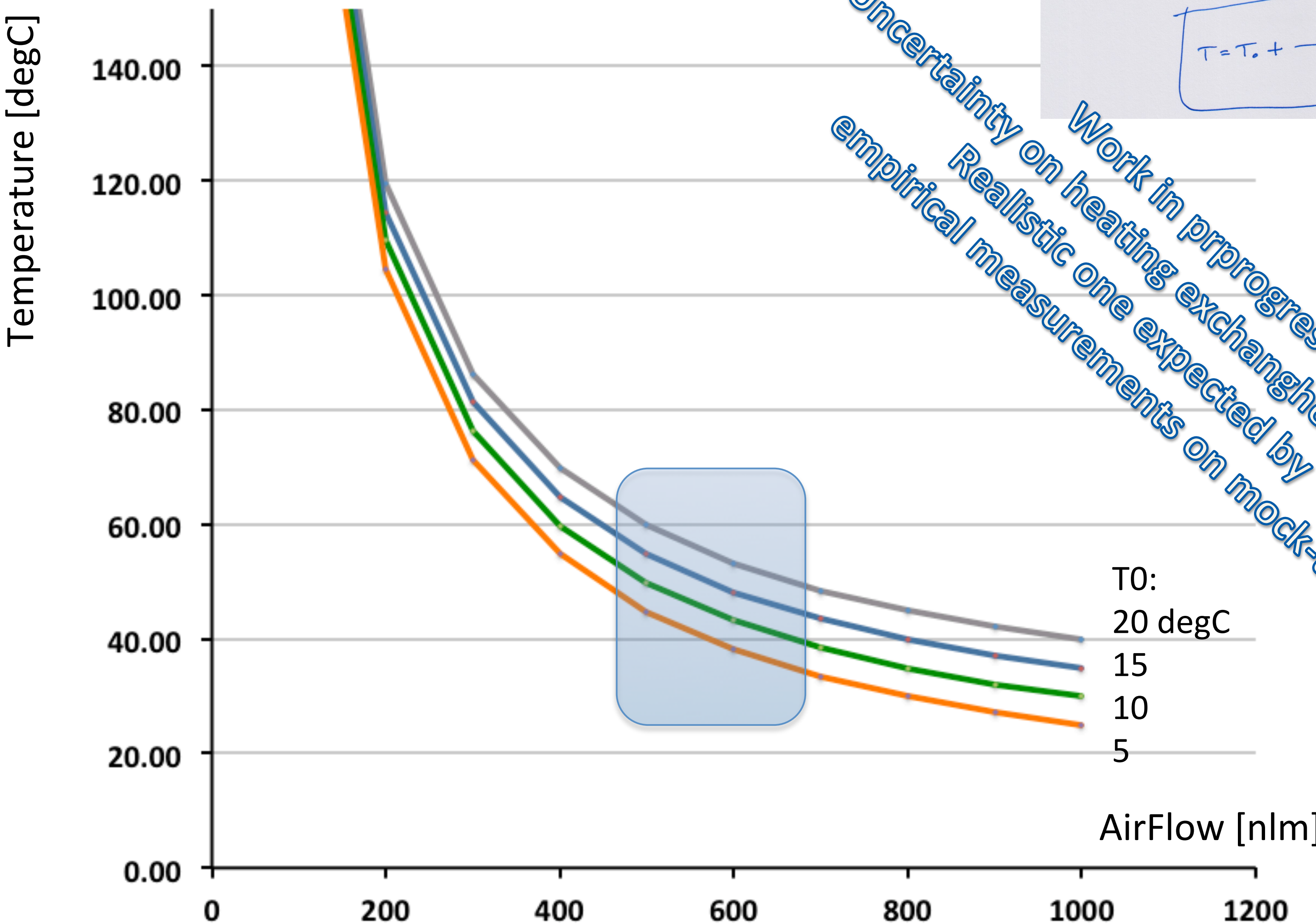
A more relaxed condition of ~60 degC (if acceptable) would be more easily achieved by 20 degC ~500 nlm airflow, certainly avoiding additional technological costs

$$\frac{dQ}{dt} = C_p \frac{dm}{dt} (T - T_0)$$

$$\frac{dQ}{dt} = C_p \underbrace{\frac{dm}{dV}}_{\rho} \underbrace{\frac{dV}{dt}}_{\Phi_0} (T - T_0) = C_p \rho \Phi_0 (T - T_0)$$

$$\boxed{\Phi_0 = \frac{dQ/dt}{C_p \rho (T - T_0)}}$$

$$\boxed{T = T_0 + \frac{dQ/dt}{C_p \rho \Phi_0}}$$



Work in prprogress

Uncertainty on heating exchanghe coefficient

Realistic one expected by empirical measurements on mock-up