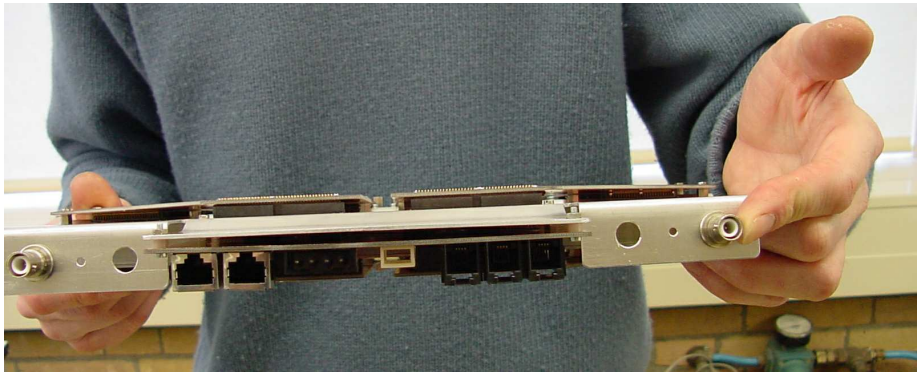
LHCb Outer Tracker
Services and Infrastructure

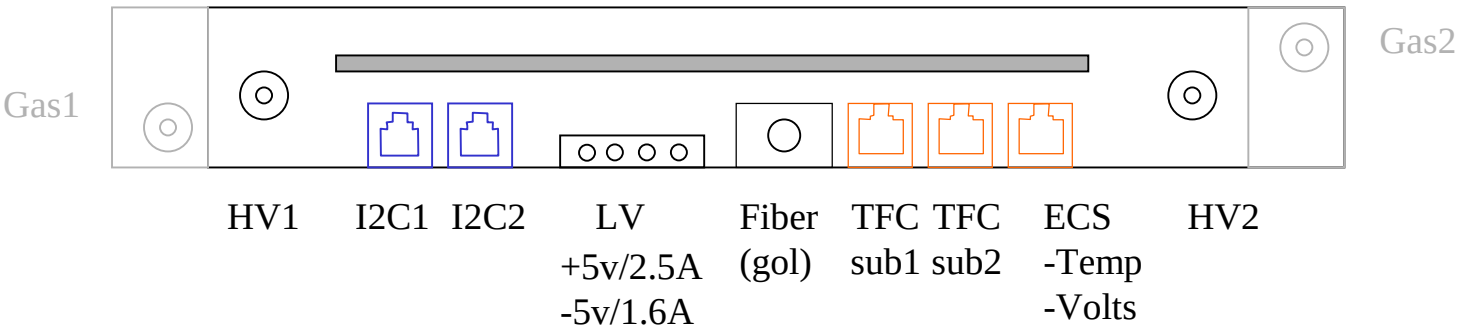
Service box / Patch panel

Cabling detector counting room

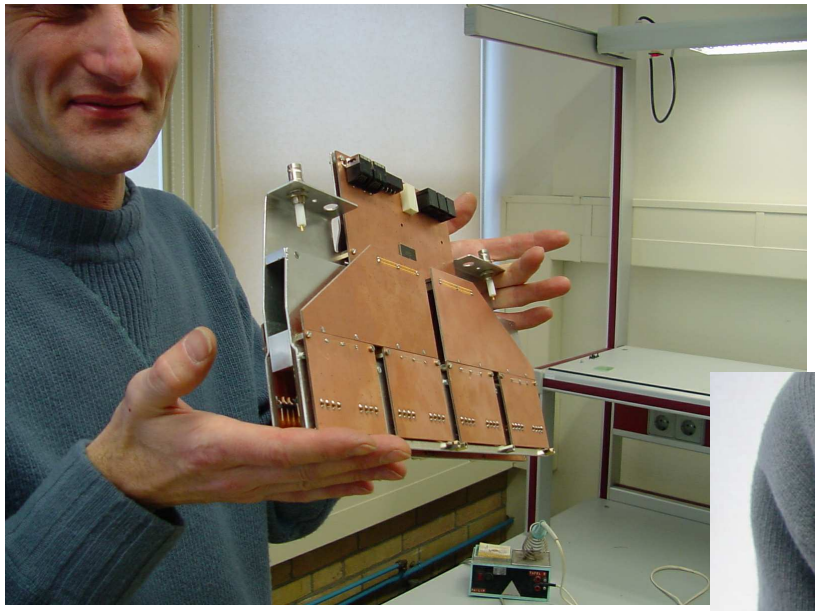
Power supplies LV and HV

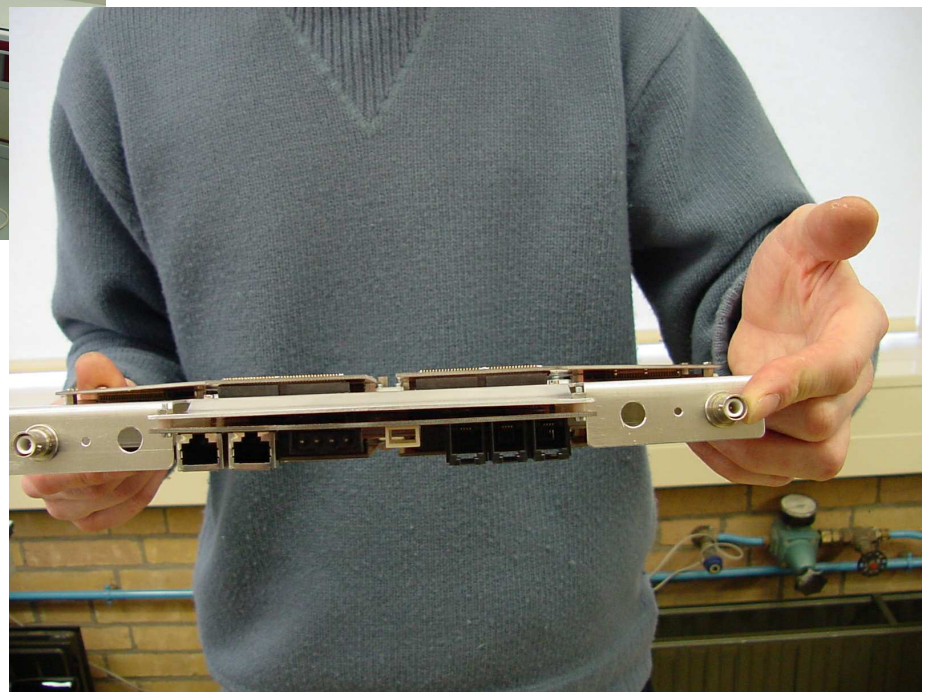
Module Electronics Box



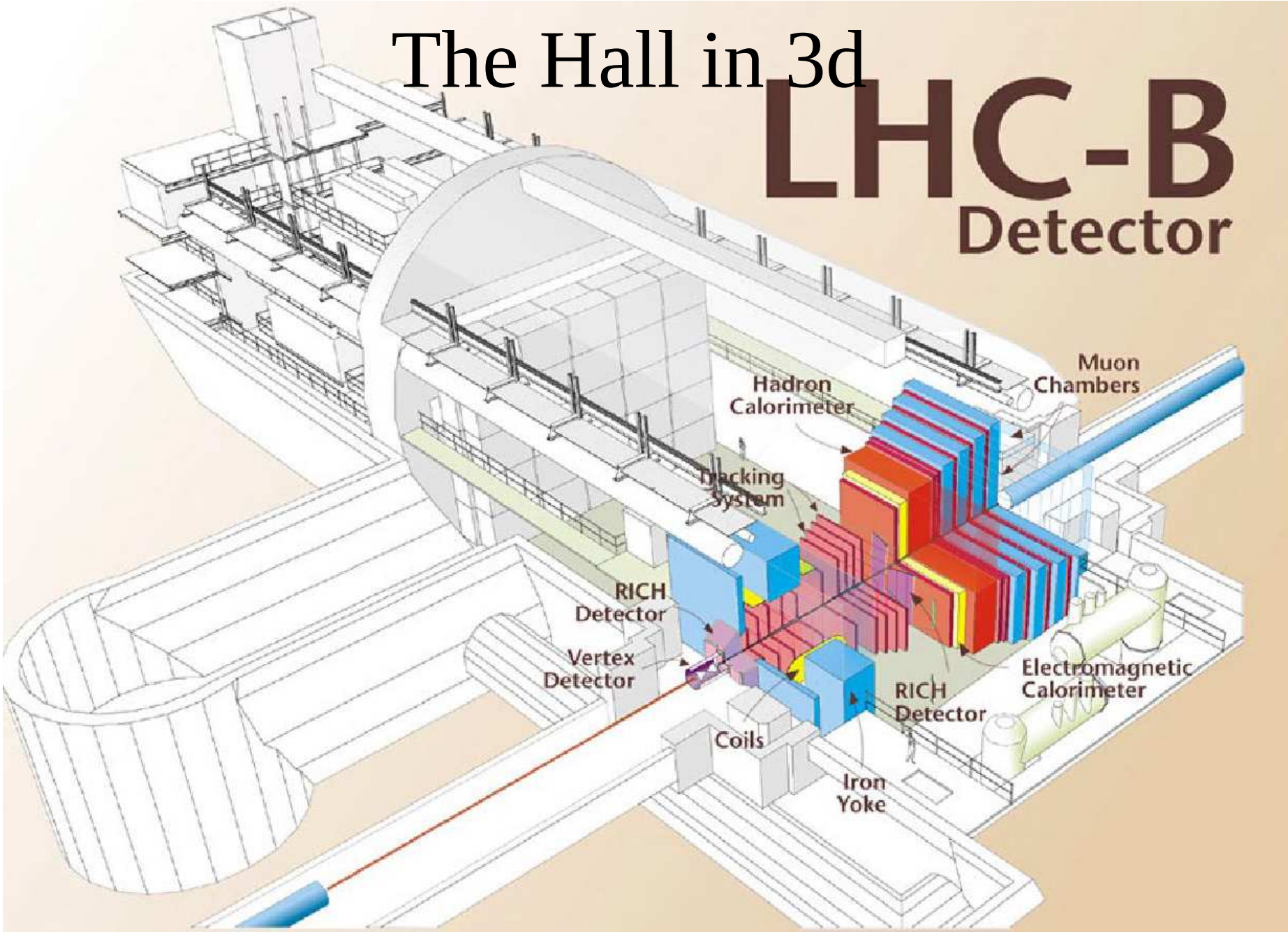


Module Electronics Box
without shielding box



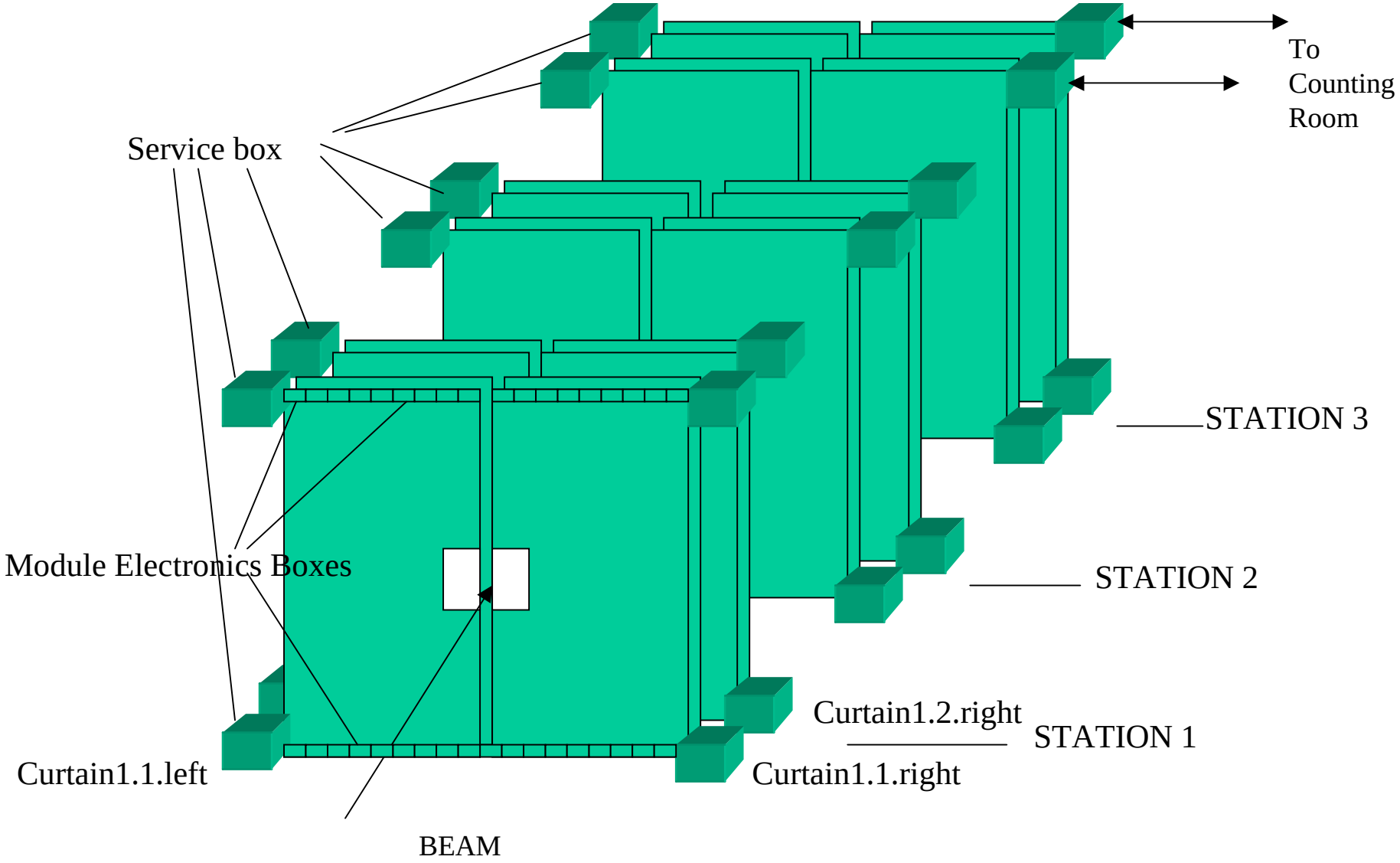


The Hall in 3d

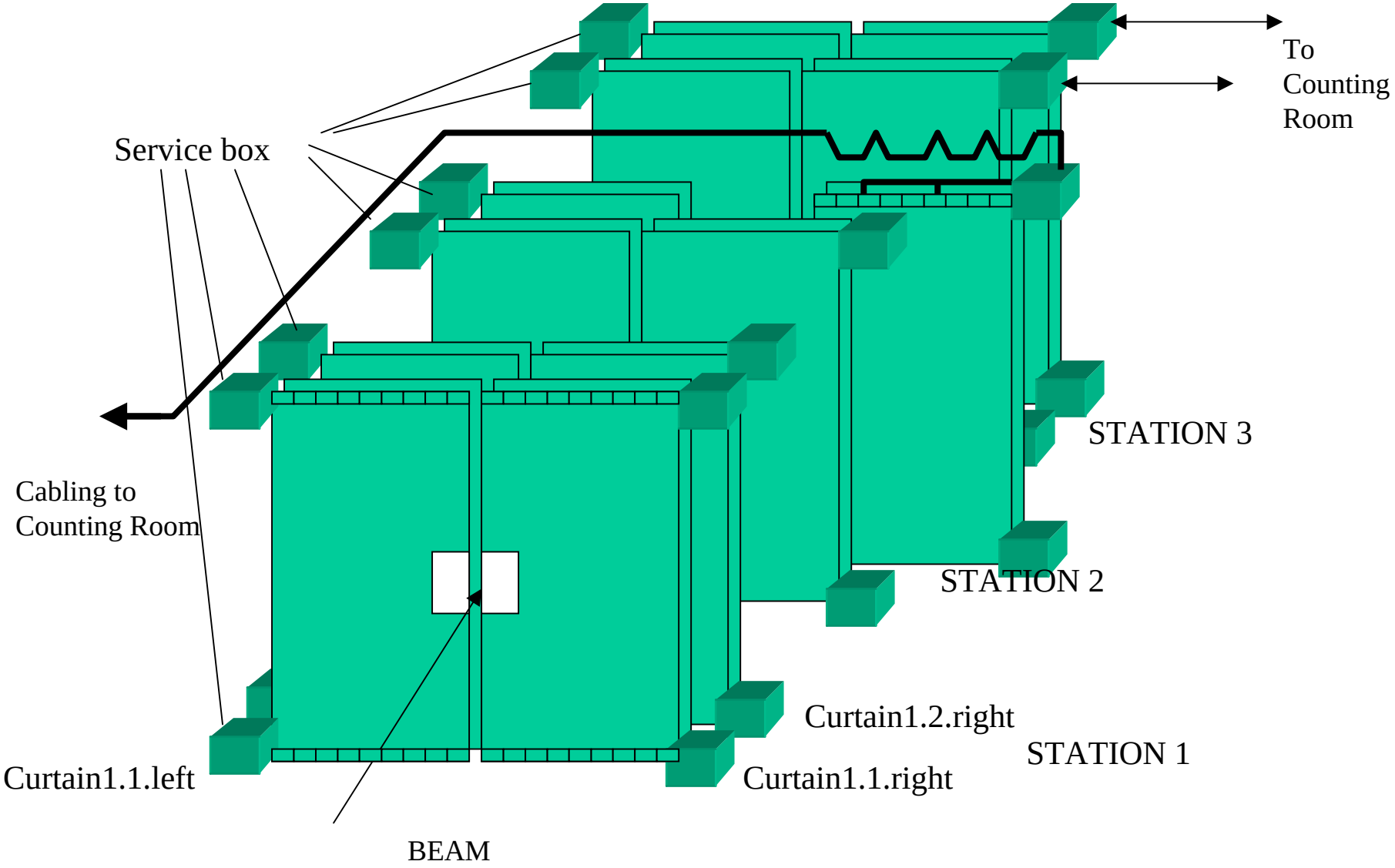


Outer Tracker with 3Stations and 24 Service Boxes

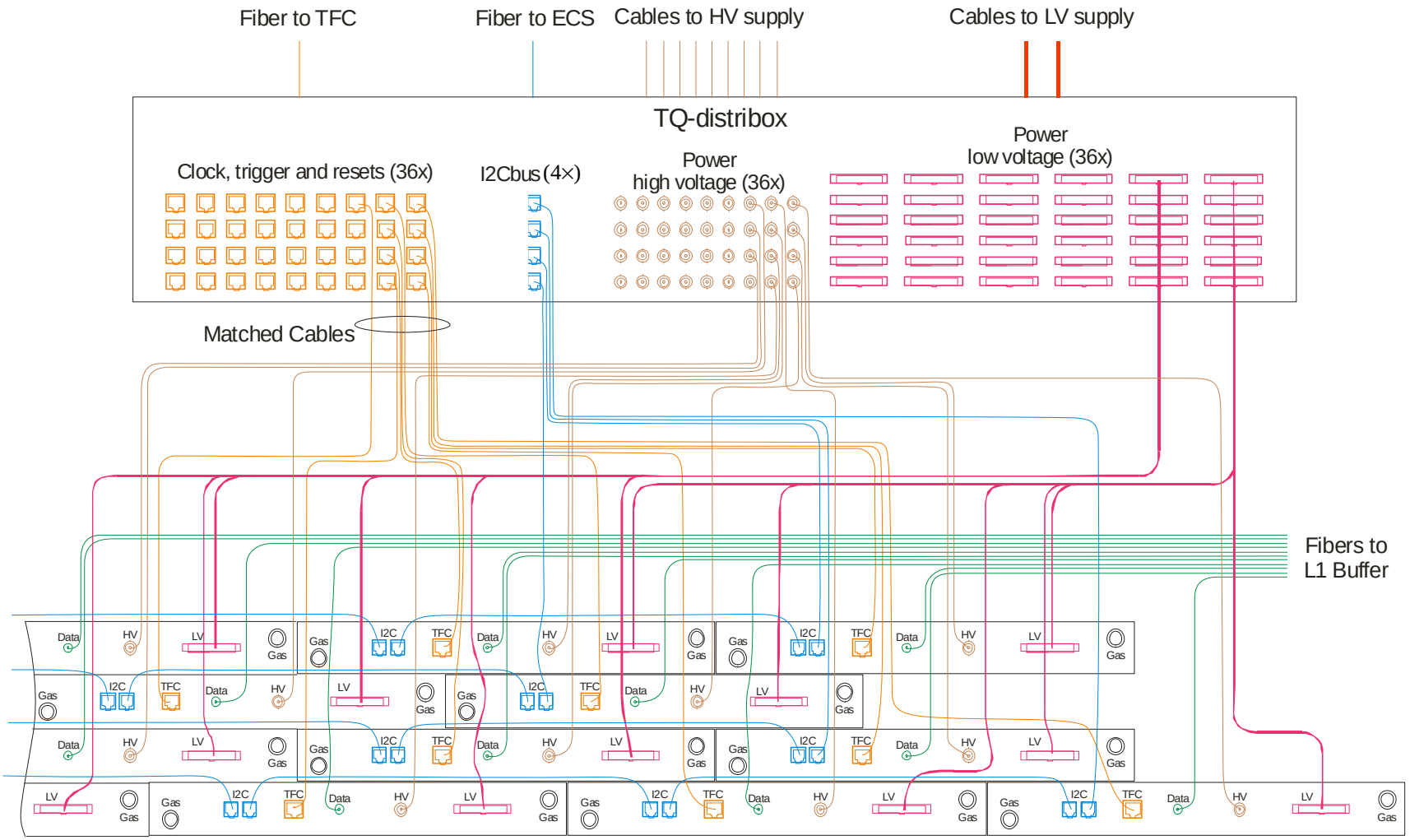
(status proposal still to be discussed, depending on mechanics)



A Curtain move out to reach electronics easily

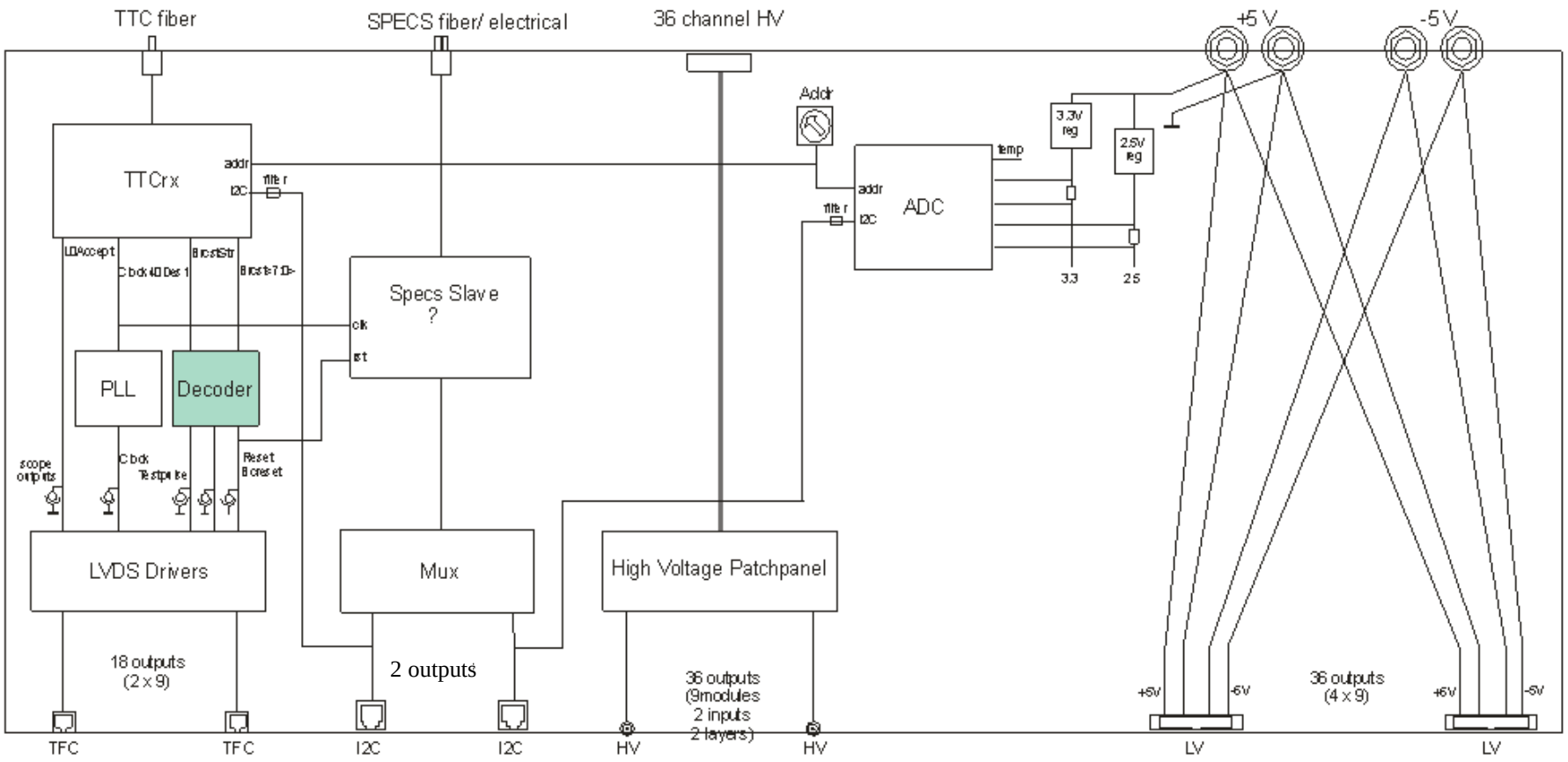


Old type Service box for 2 curtains



Top view of a part of the Tracker Quadrant

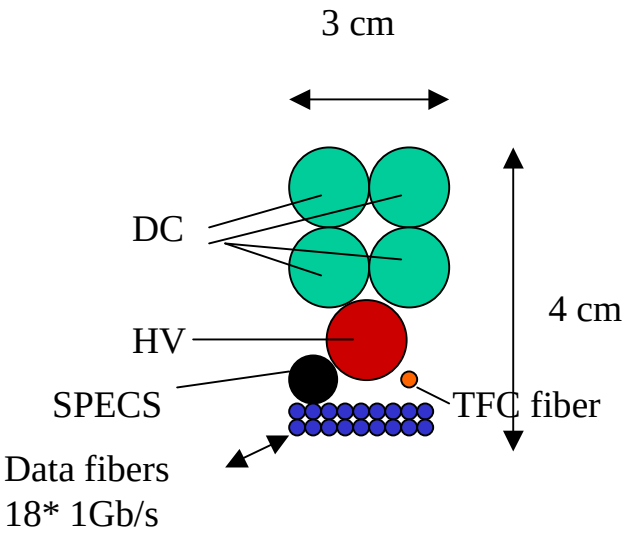
A Service Box for 1 Curtain



Detector Electronics Service Box

2003-03-31/TS

The Cables of 1 Service Box going to counting room



DC +5V /50A 12mmdiam
DC 0/50A 12mm diam
DC-5V 40A 12mm diam
DC 0 40A 12mm diam

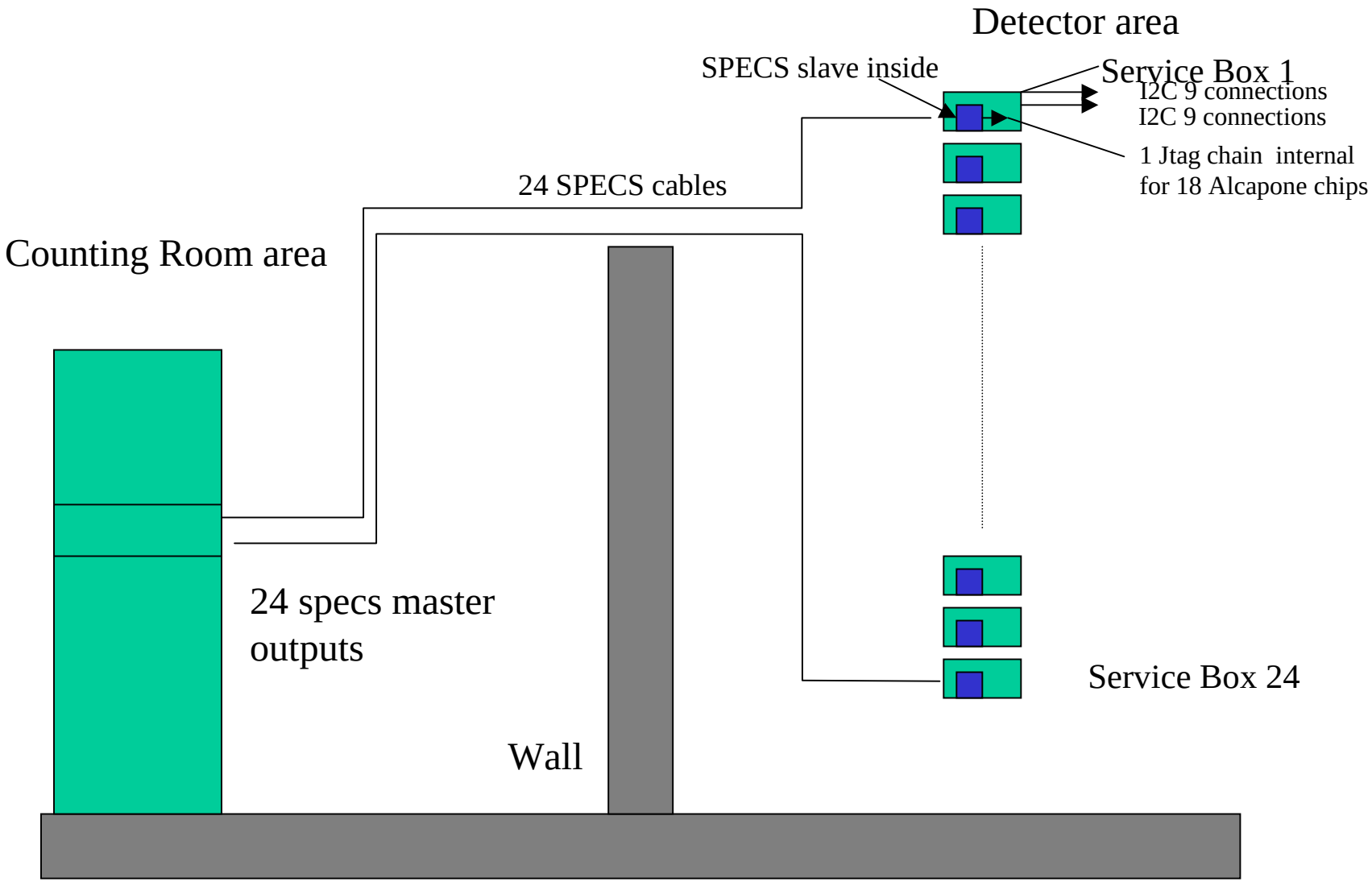
HV 36/52* 2.5KV , 15mm diam

SPECS STP 4pairs 5 mm diam.

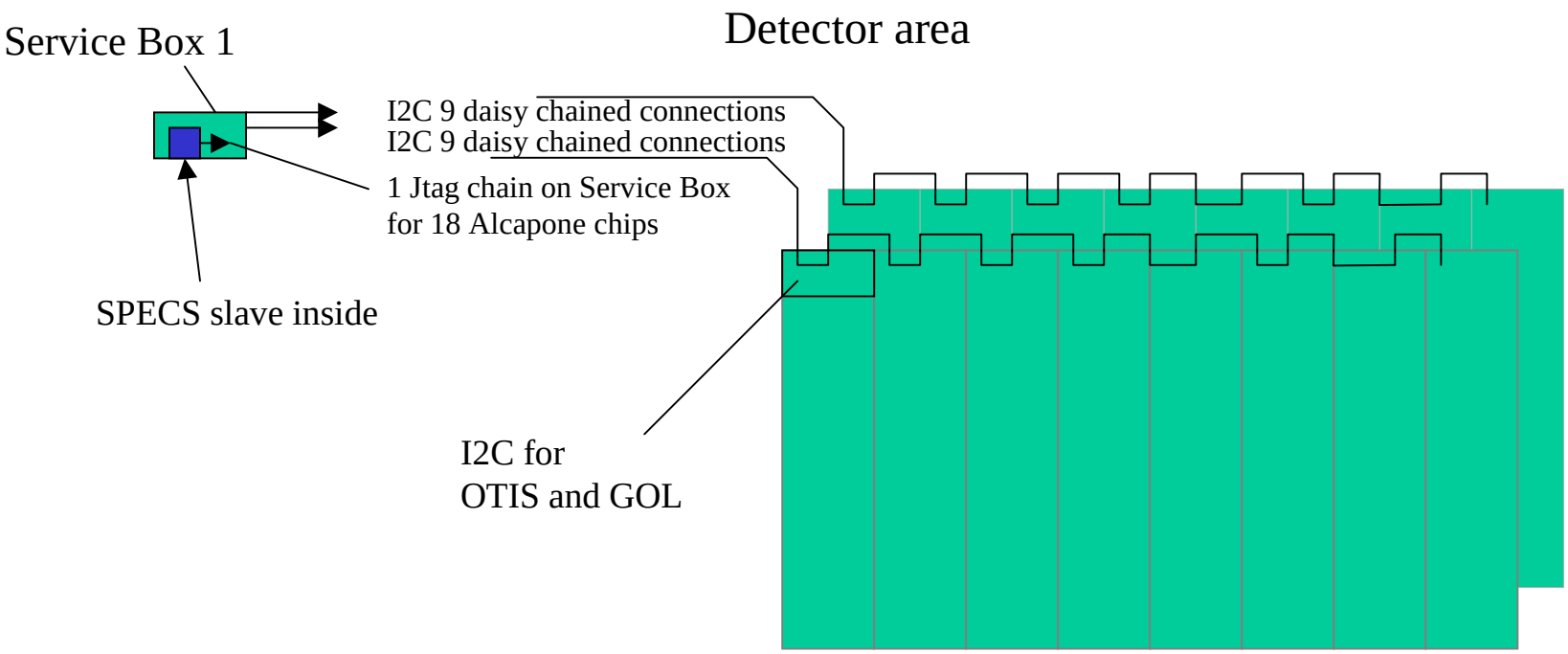
TFC 1 optical fiber 3 mm diam

Data fiber 18 * 3mm diam

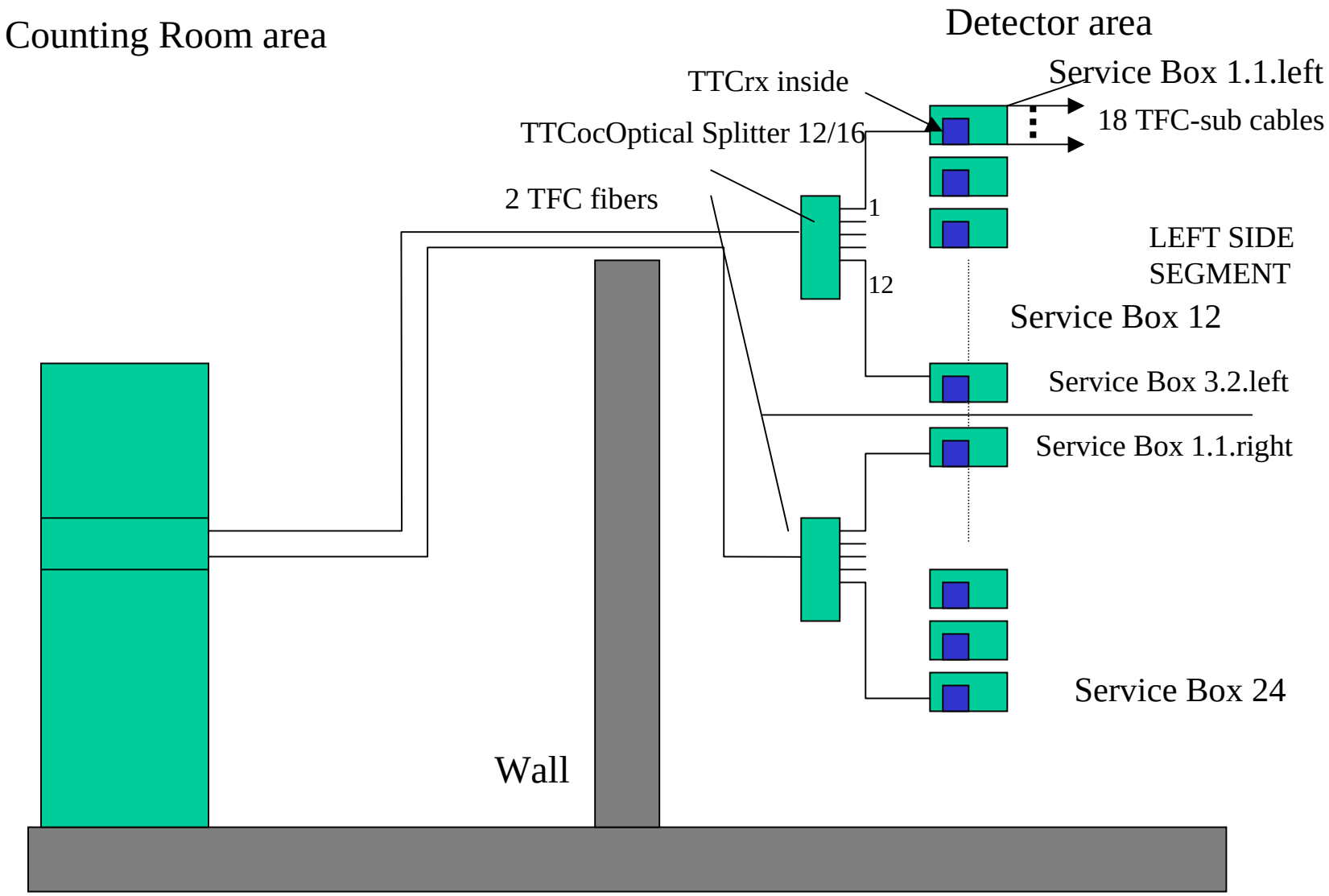
Interface to ECS



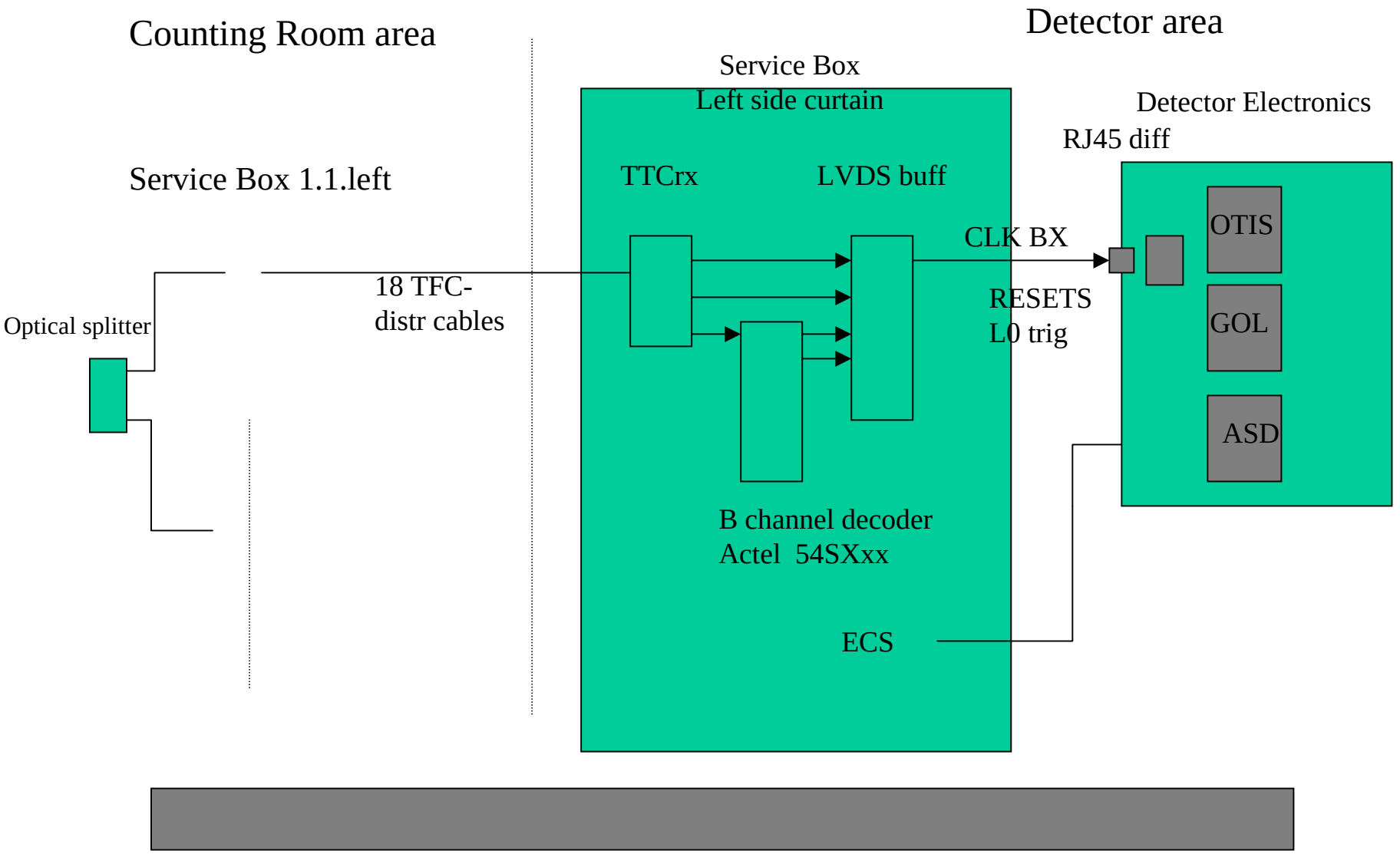
Interface to ECS 2



Interface to TFC 1



Interface to TFC 2

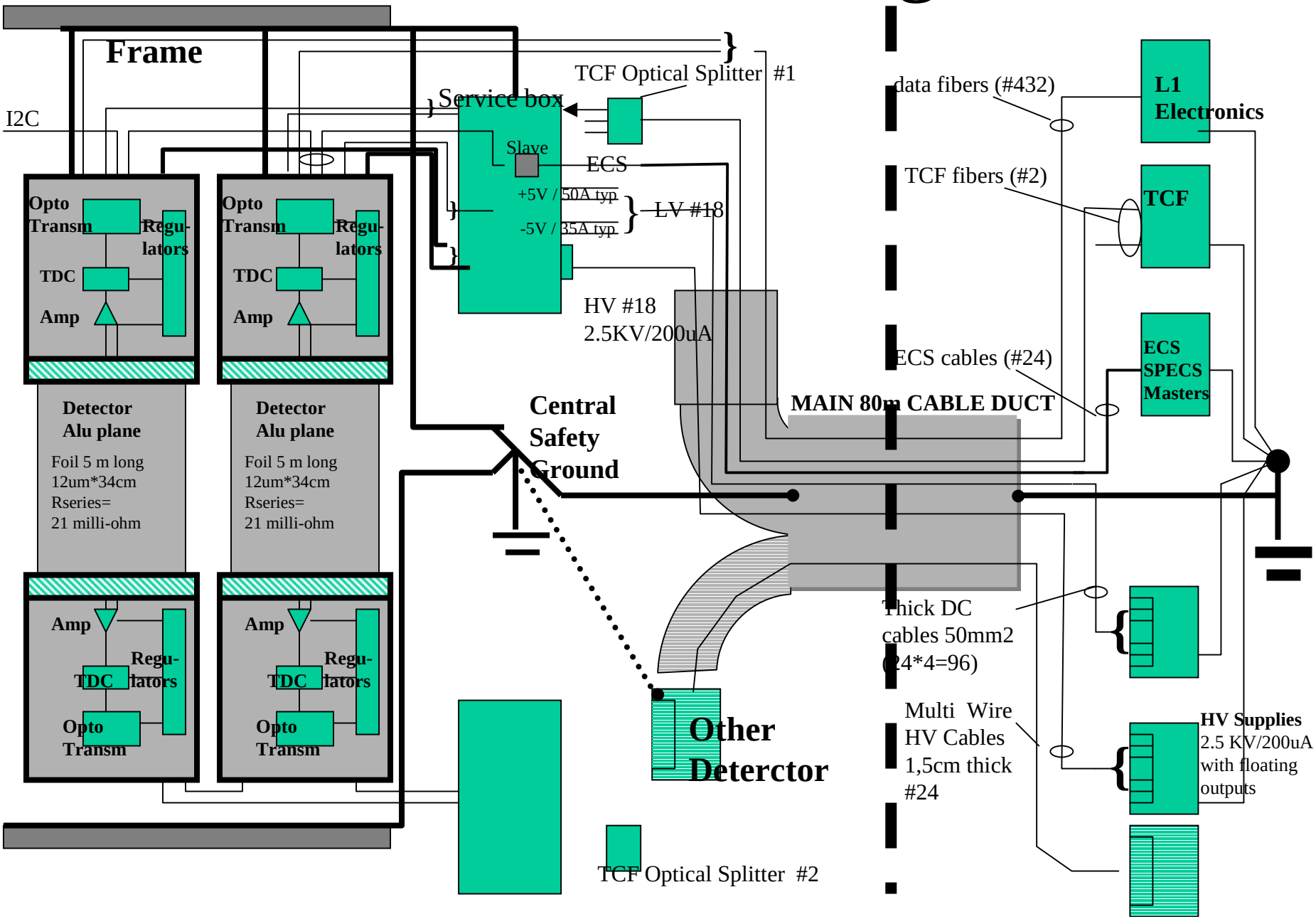


Detector cabling and grounds

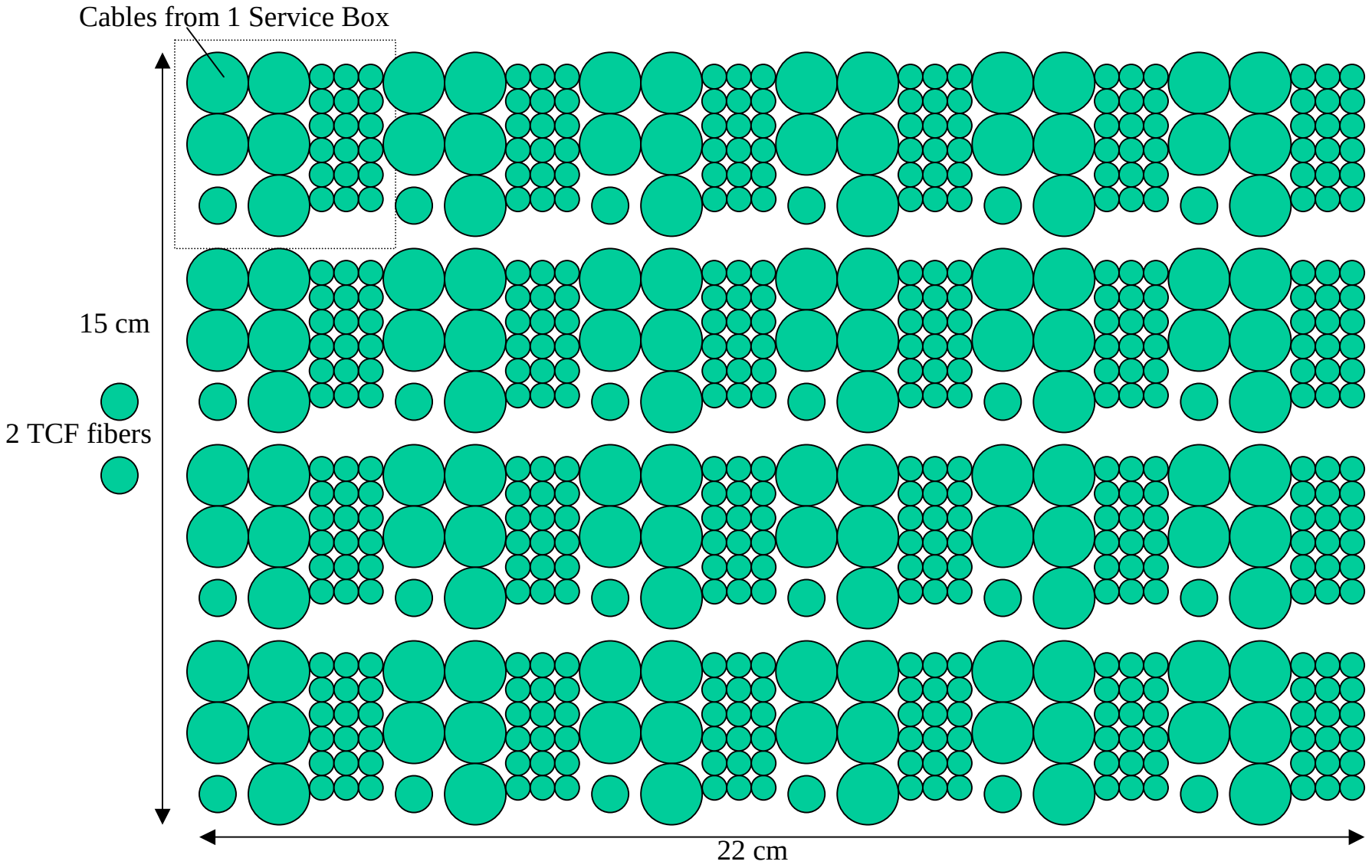
Which ground connections do we have

- Signal ground
- Safety ground, Frames
- Supply grounds
- Connection to Counting room
- Connection to Other Detectors

Detector Cabling



The Cables of OT in the 100m Cable Duct
(total 24 Service Boxes, about Realistic Size on A4)



LV supplies / Patch Panel

Each MODULE ELECTRONICS BOX needs +3V/1.6A, -3V/1.6A , +2.5V /~1A
Too critical to supply remotely (deviation <+0.1/-0.1V)
Radiation Hard Regulators from CERN used.

Remote Supply 5V on detector (Regulators need extra voltage)

Corners of the Detector have 18 Module Electronics Boxes to feed.
So +5V/ ~50A typical , -5V / 40A typical (->50A)
THE SERVICE BOX SERVES AS PATCH PANEL

Cables 4 * ~50mm2 50A, 1.7V drop over 100 m

LV Supplies in Counting room for each of the 24 Service Boxes with
24 times +5V/50A and
24 times +5V/ 40A
Plus and Minus have separate ground cables, not combined !
Outputs are “Floating”, Grounded ON DETECTOR

Patch panels on Service Boxes

HV supplies / patch panels

Module needs 2.5KV, 200uA max for 128 channels. (typical; 1.5KV / 10uA)
Current limiting without damage of detector (0-200uA levels ok)

Ground On Detector, HV Supplies semi floating. (safety rules respected)

First fan out on Service Box (patch panel 1)

Multi Wire HV Shielded Cable (2*18=36 wires) to Counting Room supplies

Patch Panel2 in Counting Room
Used for further combining of module layers(also used for fuse handling)

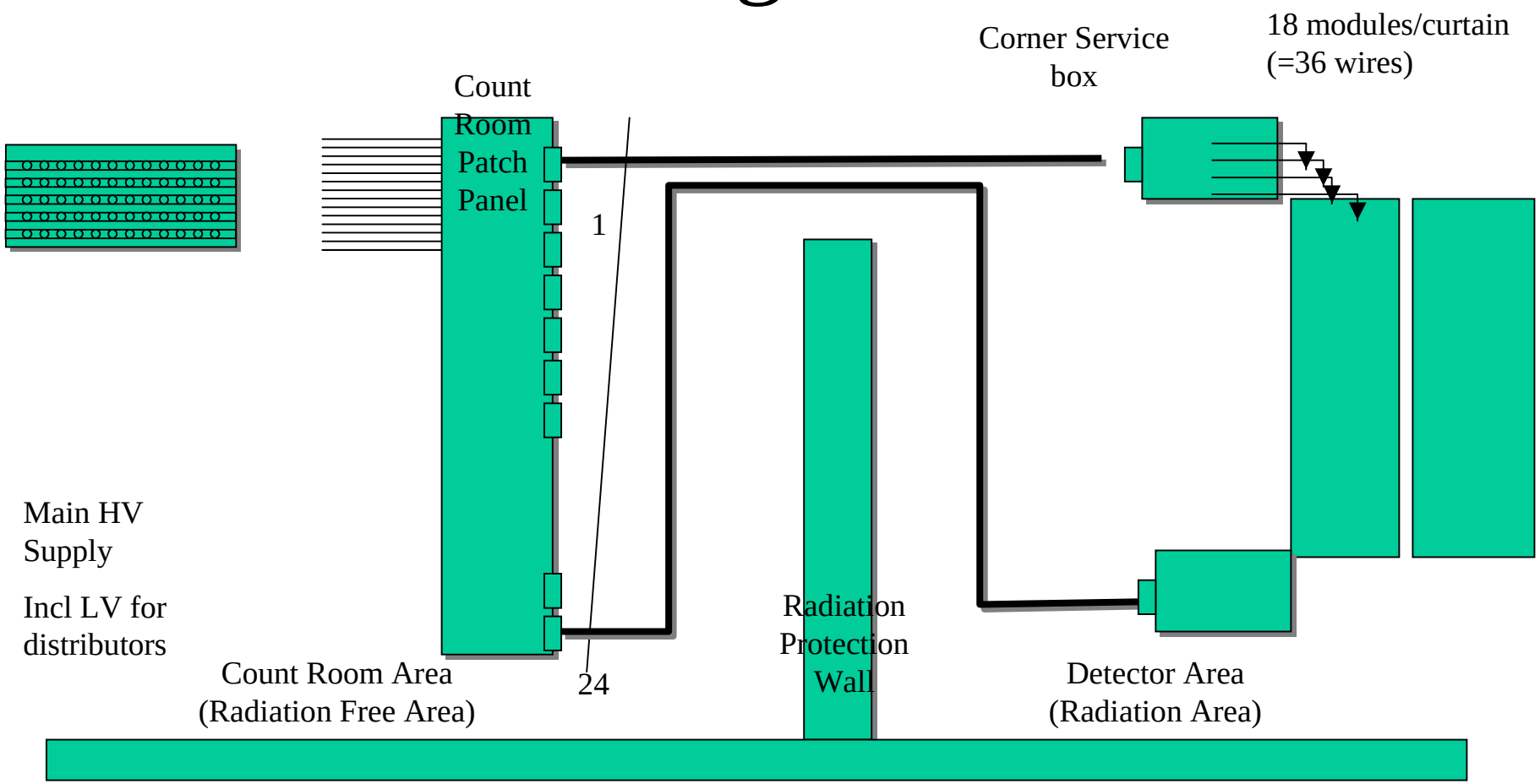
HV supplies in Counting Room
proposed 432 (+spare) outputs for 0-2.5KV/ 200uA in about 3 crates
ECS prepared (for instance CAEN 1527 equipped with modules)

DETAILS OF DESIGN

2 layers of module each have own connector.
But are combined with 1other layer

HV Fuses would need “extra local supply of 1.5KV 2mA”

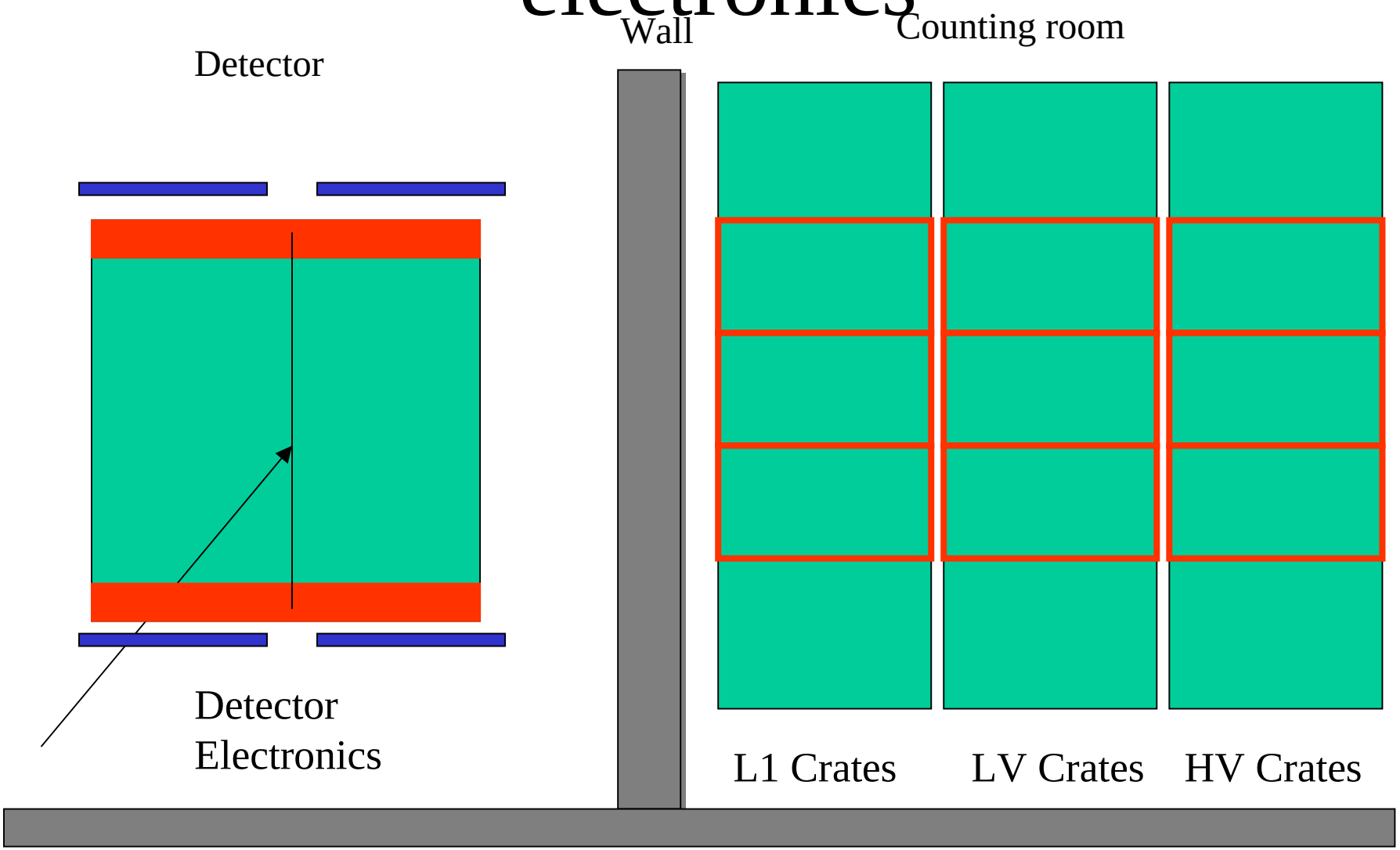
HV cabling schematic



Cooling……

- No Heat dump in Hall , Hall- air conditioner can handle 80KW total
- Mixed water for : no condensation on HV parts 19C = above dew point
- Module Electronics needs to be cooled also in view of high packing density
- Counting Room Crates cooled by LHCb standards, “intercoolers” etc.

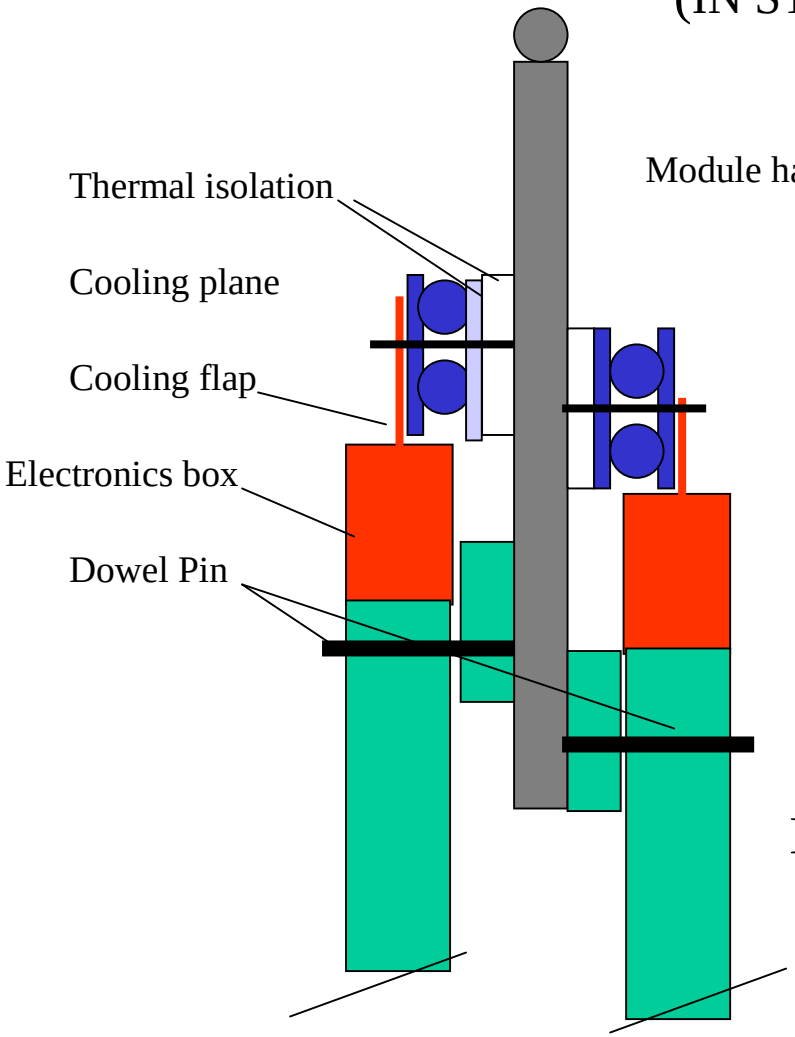
Cooling the LHCb Outer Tracker electronics



Feb 2003/TS

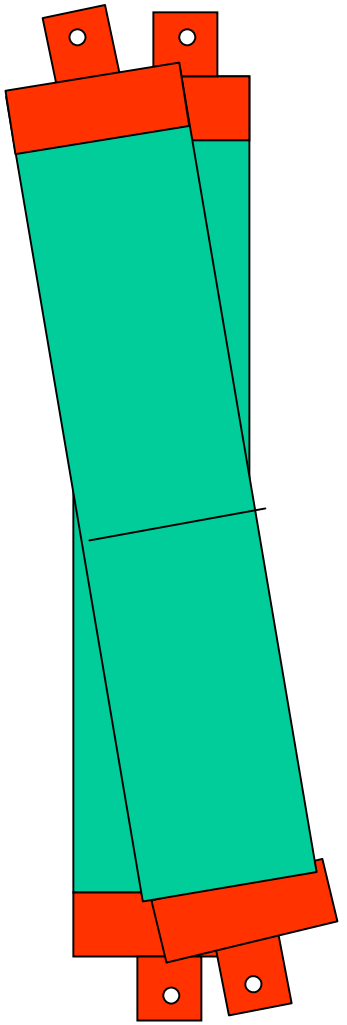
Detector Electronics Cooling Possibility

(IN STUDY)



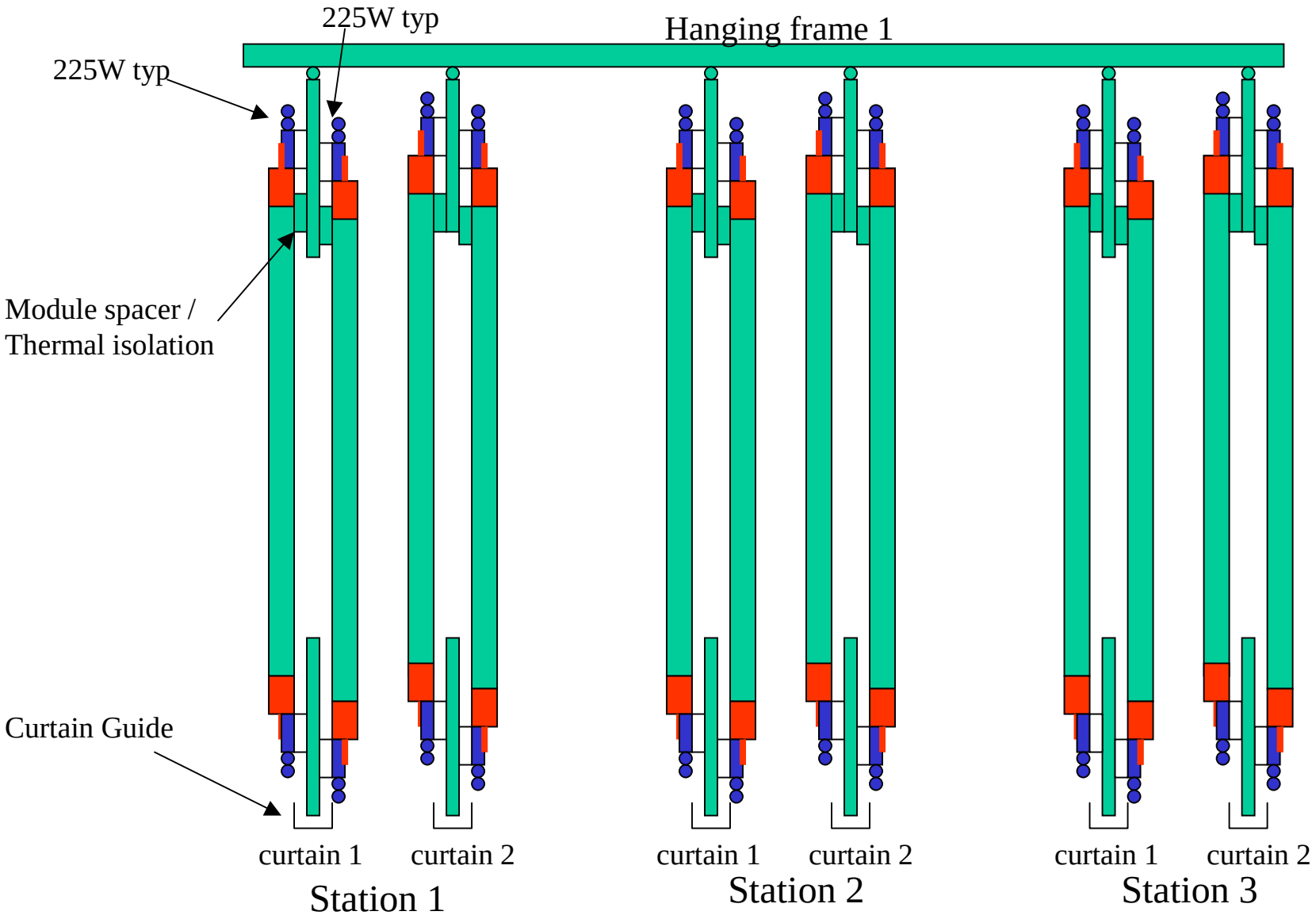
Enlarged module ends
side view

Module with straws



Rotated modules
front view

Possible Cooling of Detector Electronics for OT stations



Cooling capacity needed

1 module 25W typical
9 modules in a layer= 225W
2 layers in a curtain, (separate cooling tubes) = 450W

2 curtains in a station = 900W at the top corner
Also 900W at the bottom corner

This means 1800W per station left, and 1800W per station right. = 3600W/station

3 stations = 10800W typical power capacity needed.

We need to move the curtains 2.5 to 3 meters,

This needs Flexible hoses,

Cooling wish-list:

”Mixed water” from O.T regulated circuit 19 degree C

Flow and pipe diameters to be determined

Closing valves at each station manifold

Radiation Tolerance1

- Expected 10 KRAD
- Rad Tolerant components used
  - On Detector Electronics:
    - HV board 32 ceramic HV capacitors, 32 resistors, 32 springs
    - Preamp board ASDBLR + resistors, capacitors, protection diodes (like atlas TRT, 1Mrad)
    - TDC board : OTIS 0.25um, rad-hard lib
    - Optical transmitter + auxillary board:
      - 1 GOL CERN Rad hard, 1 optical transmitter (VCSEL)
      - 4 Voltage Reg. Rad Hard
      - TFC trig, clk, resets LVDS input from distribution box
      - I2C in/out OTIS

Radiation Tolerance2

- Expected 10 KRAD
- Rad Tolerant components used
  - On Detector Electronics 2:
    - Distribution box
      - Alcapone gate all around, also adc,
        - » Alcapone from alice 4 ch 8 bits 0.25um, rad tol, rad hard lib, jtag readout/control
        - » *Power up reset needed for ADC … out of SPECS slave*
      - TTCrx + lvds+ decoder in atmel antifuse, triple vote…… still in study
      - Specs Slave 10KRad with I2C buffer and Jtag lvds buffer ….. Saclay Perhaps combine with Specs slave with TTC decoder in Atmel.

Conclusion

Infrastructure concept in proposal stage based on LHCb- light

Number of cables (even curtains) not fixed yet due to mechanic construction uncertainties

Talks with ECS / SPECS and TCF for consensus have to start.

Some Problems to Solve ……..

1 When do we install cables, who does it

2 Need for Rad. Tol. lvds buffers, (QPLL, and Antifuse logic) etc.

3 Radiation Tolerant Supplies cheaper? (reduced cabling and installation)

4. SPECS grounding currents ?
   safety grounds potential difference between detector and Counting Room
   garanteed to be < 100mV??