



# SiW Ecal and AHCAL Off-detector services

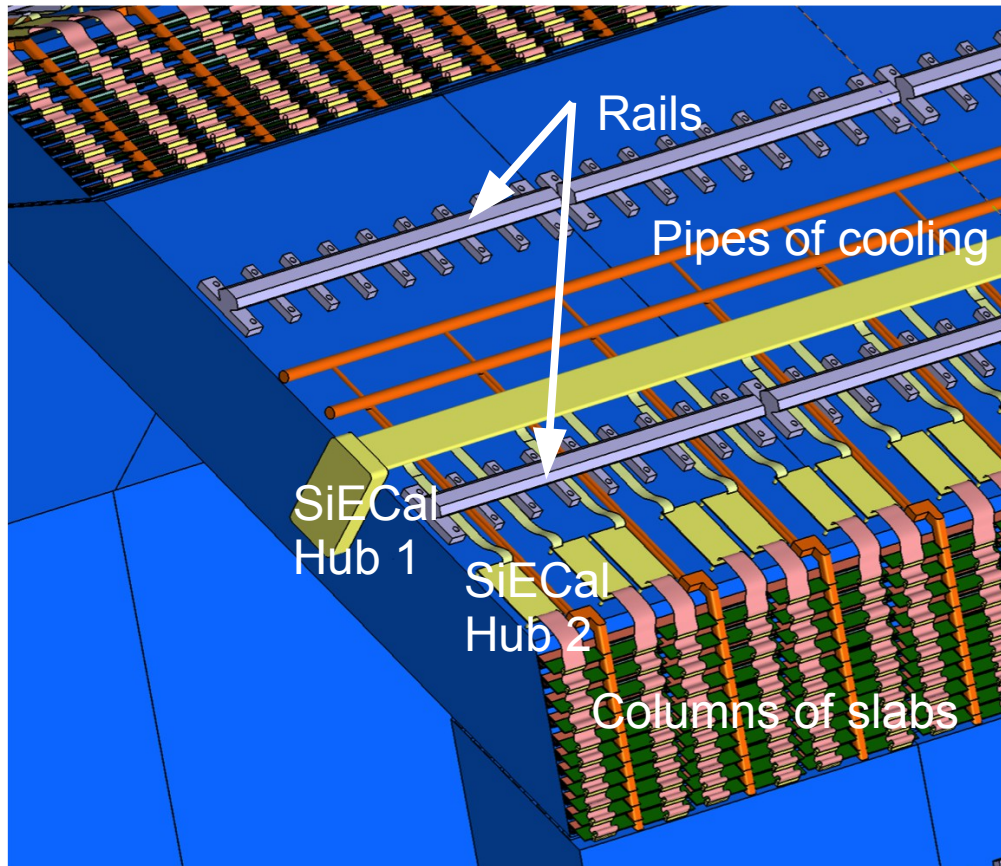
- A first shot -



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Mini-Workshop on ILC Infrastructure and CFS for Physics and Detectors  
KEK/Japan September 2017



## SiECal external components i.e. Relevant for ICD

- SiEcal Hub 1  
(hub to external supplies and DAQ)
- Rails (connection to Hcal)

## SiECal internal components i.e. Relevant for TDD

- Cooling pipes,
- SiEcal Hub2 (internal hub)
- Slab columns

... as long as they don't exceed the space between ECal and HCal or influence detectors in another way (heat, interspersed noise, etc.)

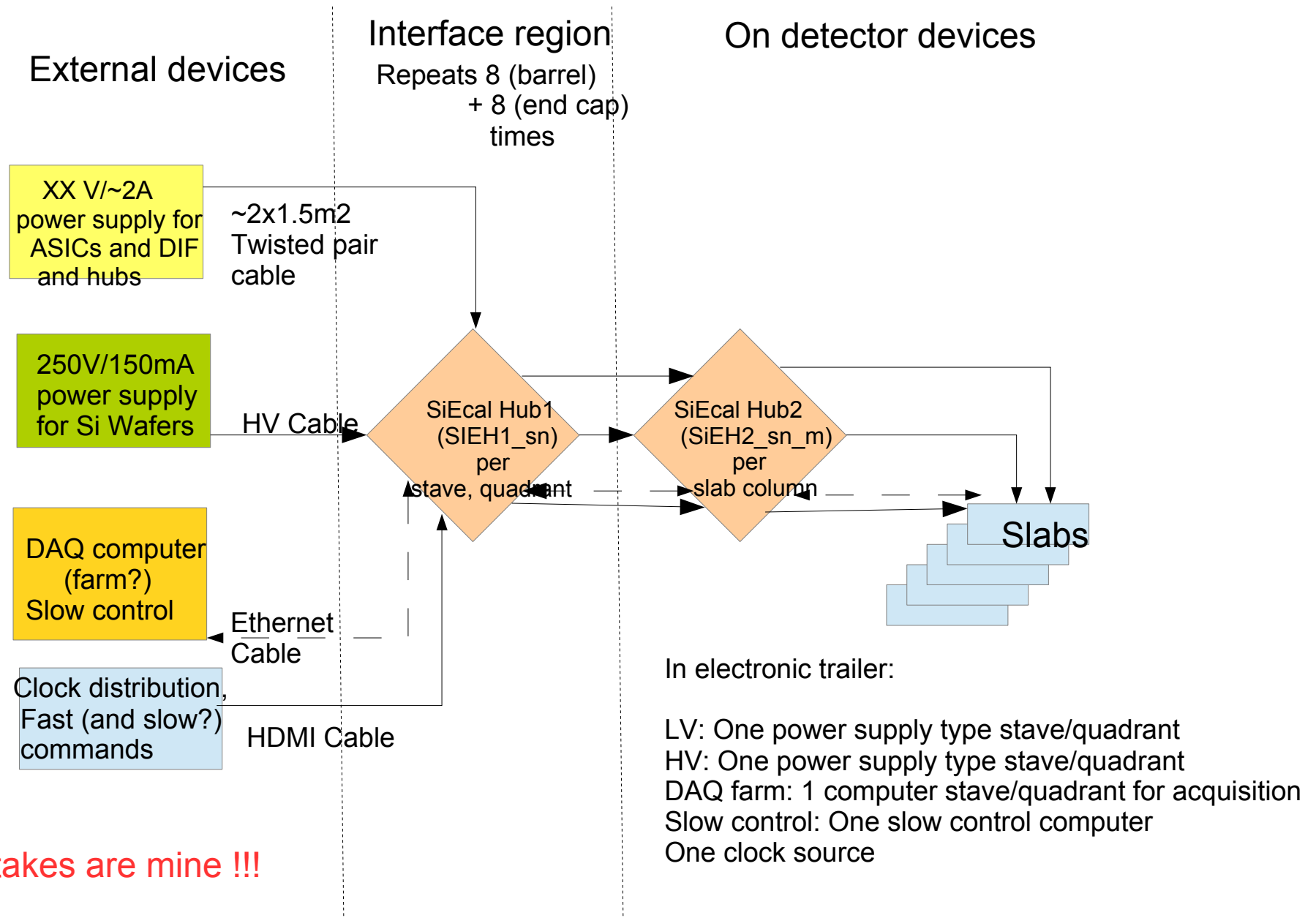
Disclaimer: Design subject to change

Disclaimer for Ecal:

Numbers have been compiled by R.P. based on experience  
In beam test and on testbenches assuming material that is at least  
Similar to what has been used or what has been discussed

Expect serious revision in coming months!!!

N.B.: The comparison to the better founded values of AHCAL tell me  
however that I am not utterly wrong



All mistakes are mine !!!

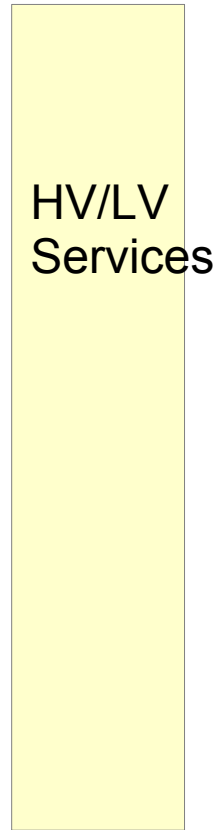


- **LV**
  - Need to power Chip AVDD, DVDD, DIF and hubs
  - Peak currents for AVDD, DVDD will be fabricated by on-detector capacitances
  - **Power**
    - “On PCB”: 4.6 kW total Ecal
    - DIF: ~7kW (1 W if in continuous mode, negligible if in pp)
    - Hubs: ~300 Hubs a 50 W -> 15 kW (big source of uncertainty!!!)
    - => **Total: 27 kW, add factor 2 safety margin**
  - Power supply will be of type Lambda TDK Genesis 1U, need 16 supplies (x2 for redundancy)
  - => 2 racks, more to reduce power density
- **HV**
  - 300 V / 200 mA per stave/end cap quadrant
  - => **Total Power consumption ~1kW**
  - Assume 1 power supply per stave/end cap quadrant (may be too much)
  - => 16 power supplies (x2 for redundancy), e.g. iSeg supplies => should fit into 1-2 racks
- **Computing and slow control**
  - 1 server type Dell r730 Poweredge per stave/end cap quadrant, typical consumption 1kW
  - => 16 server (x2 for redundancy)
  - Add a few servers for SC and online monitoring
  - **Total consumption 40 kW**
  - 3 racks

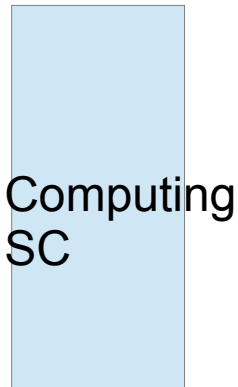
Grand total:

Power: 95 kW including safety margin

Space: 7 -10 racks



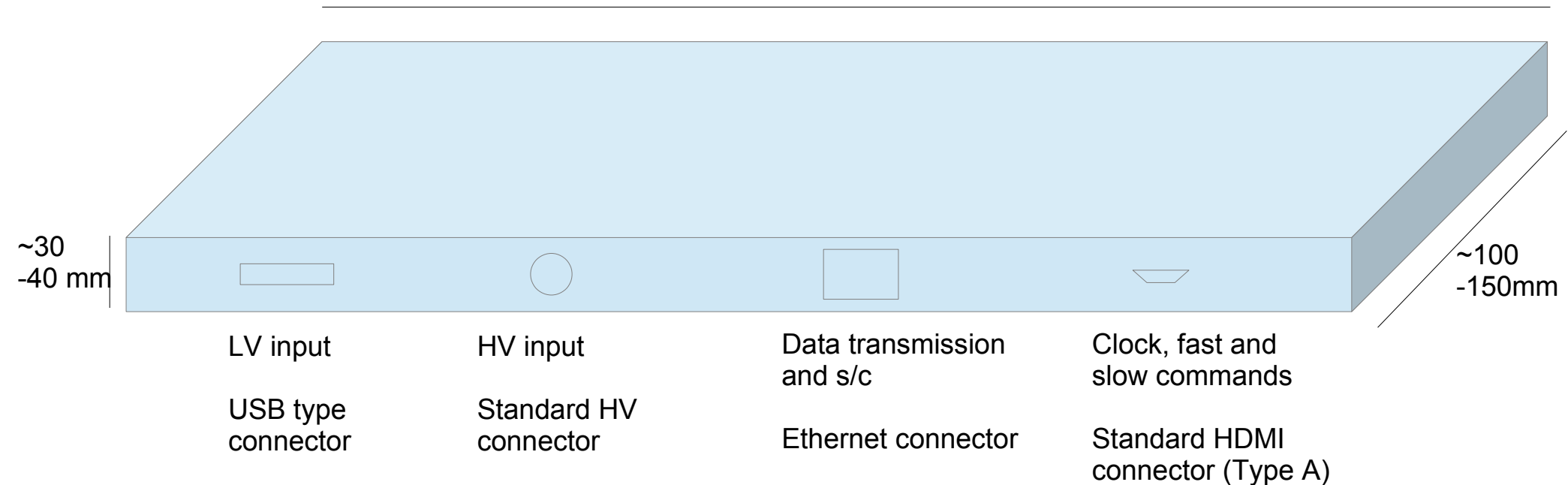
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One aisle should be enough  
Add a second as safety margin

## Hub1 front side

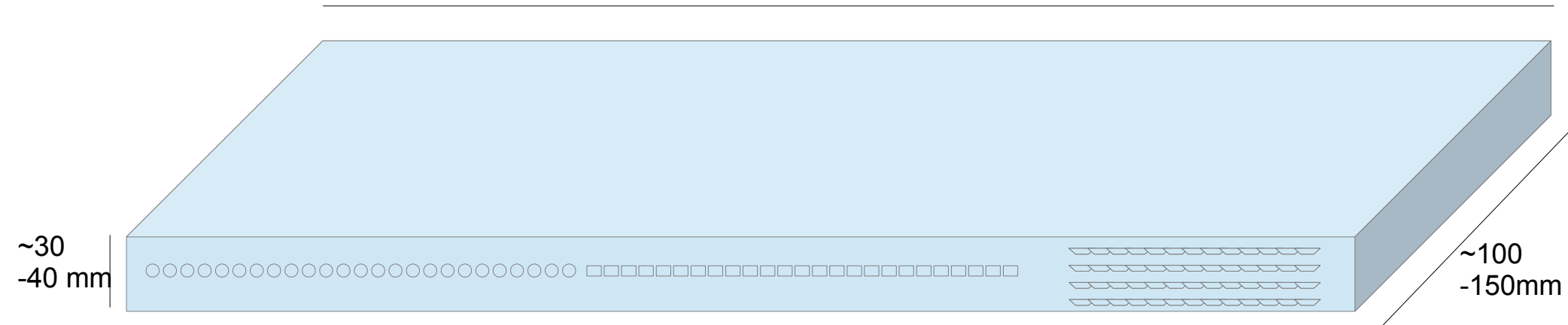
~1000 mm



- Looks a bit like your Livebox at home
- Sizes are subject to change as discussion continues
- Will be connected to long cables, several 10 meters!!!
- Has to fit into overlap region (and to allow for space for cables from other detectors)
- Hub will be passive material in delicate region

## Hub1 back side

~1000 mm



HV out

Ethernet

Upper two rows:  
 LV, micro USB  
 Lower two rows:  
 Clock etc,  
 micro HDMI (Type C)

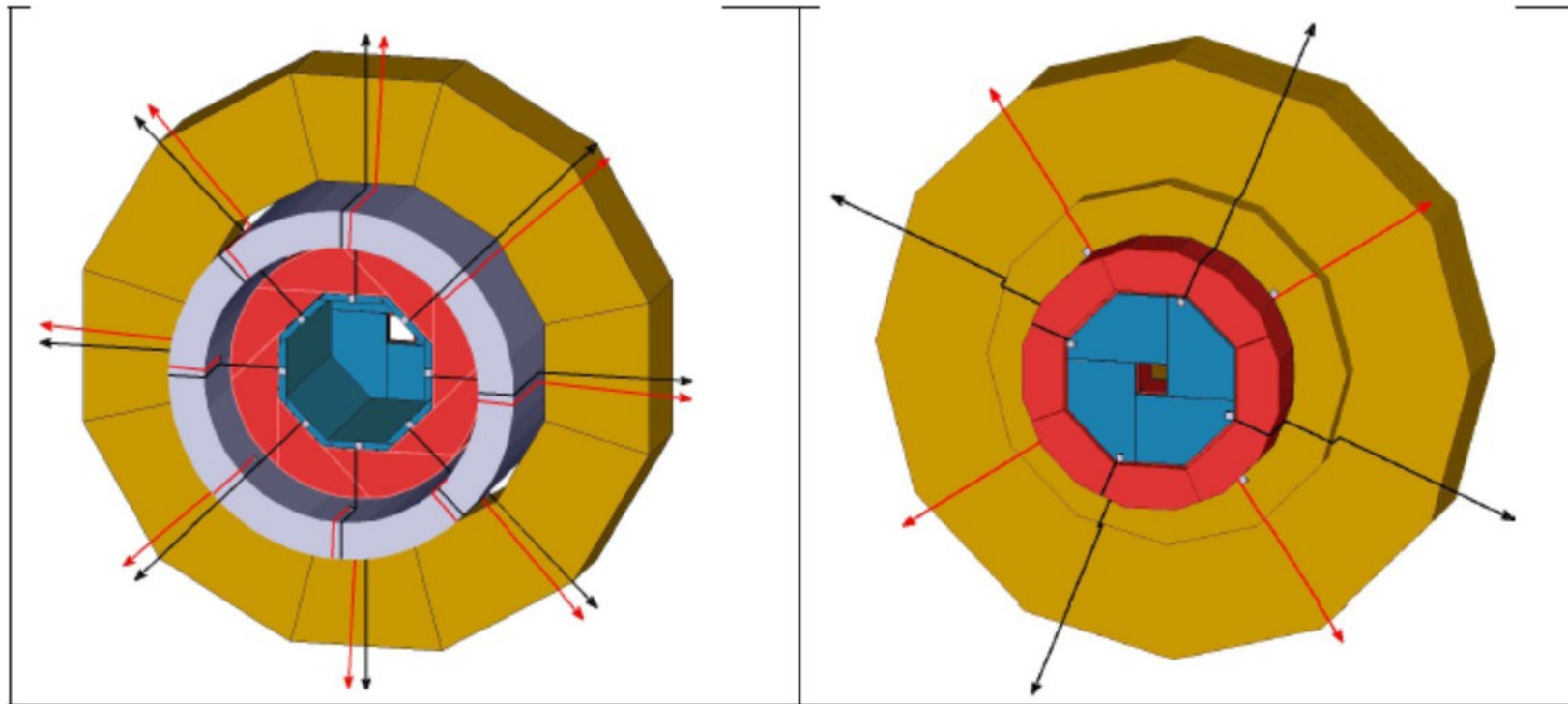
### Inside Hub1:

- HV/LV distribution (1-to-many)
- Ethernet hub
- Clock fan out, fast signal distribution

### What kind of cables can we use?

- e.g. Small HV connectors, apparently Japanese law allow for small HV connectors (dixit Didier Jehanno)
- Optical fibre instead of ethernet cables (Fibre may be better since less space consuming)
- Alternatives to micro USB and micro HDMI





- Service lines leaving from barrel

- Service lines leaving from endcap

## AHCAL Cooling

- Cooling of on-detector electronics:
  - see separate talk
- Cooling of off-detector electronics:
  - here

- In the active layers, 8M channels
  - ASICs: 200 W (25  $\mu$ W/ch) ←
  - SiPMs: 120 W (15  $\mu$ W/ch)
  - goals according to TDR, currently 5x more) ←
- On-detector electronics
  - per layer: DIF 5W, CALIB 2W, Power 2W
  - 48 layers x 60 sectors: total 26 kW
    - current values, DIF can be optimised, 3-5x lower ←
  - data concentrator: 60x 20 +/-10 W = 1.2 kW
- Total 20-30 kW

May become issue in part. for Ecal -> to be monitored  
However, zero suppression in ILD

R.P. thinks that 5 W DIF is too much  
would be serious issue for Ecal!!!!

R.P.: Note difference to Ecal:

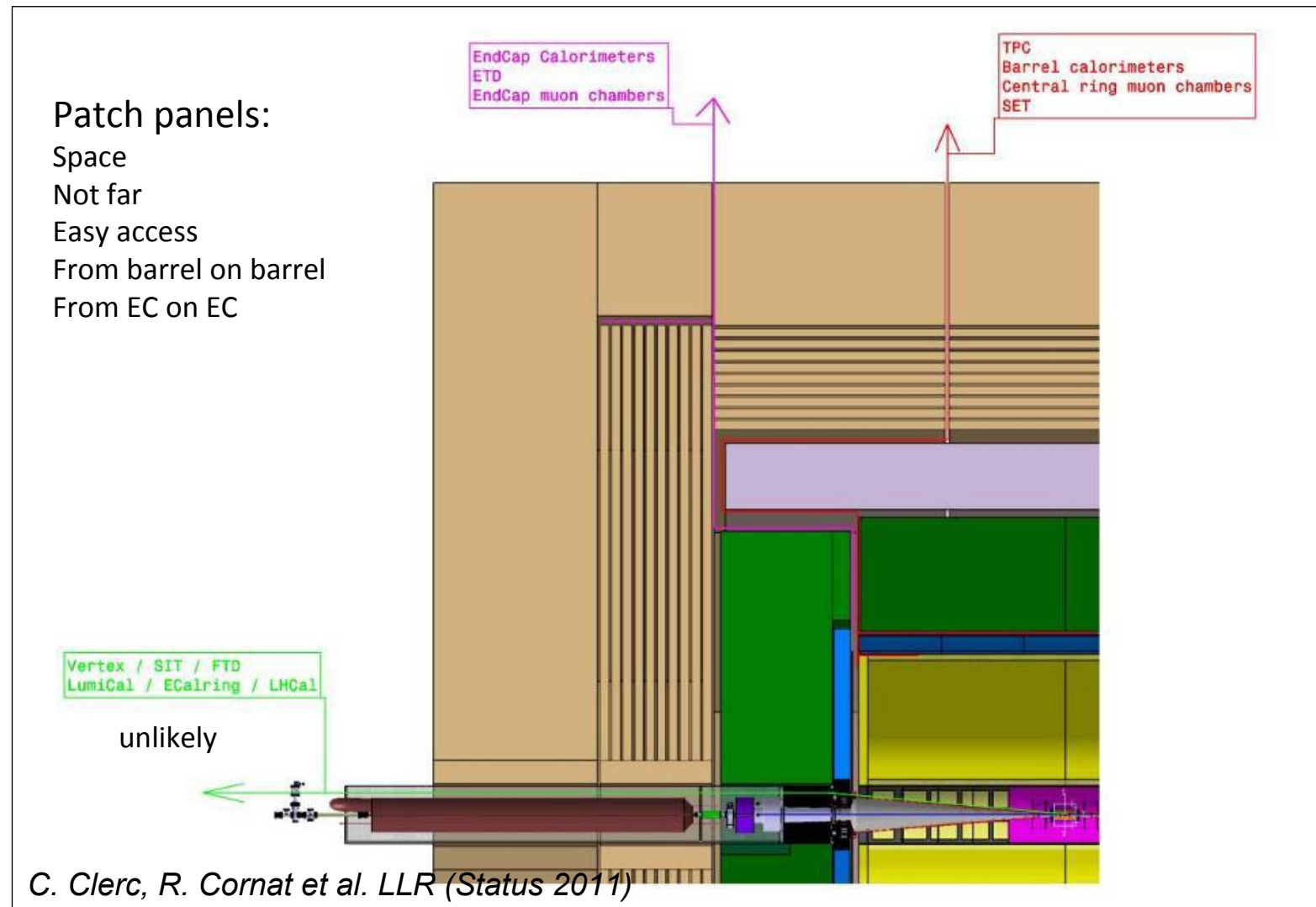
- Ecal has much more cells (~10 times) but less consumers
- DIF consumption has to be controlled to 1W or even less in case of Ecal

- Power supplies: 75% efficient
- 40 kW off-detector power
  - 10 kW additional off-detector cooling
- In principle less than 1 rack, but then power density too high
- Expect 12 racks
  - current commercial system would need ~2x more
  - custom development started

- one or two network switches, 100W
- event building: one or few  $\mu$ TCA modules, 100-200 W

**Backup ....**

## A reminder



Study for DBD needs regular update!!!!  
 Use ICD