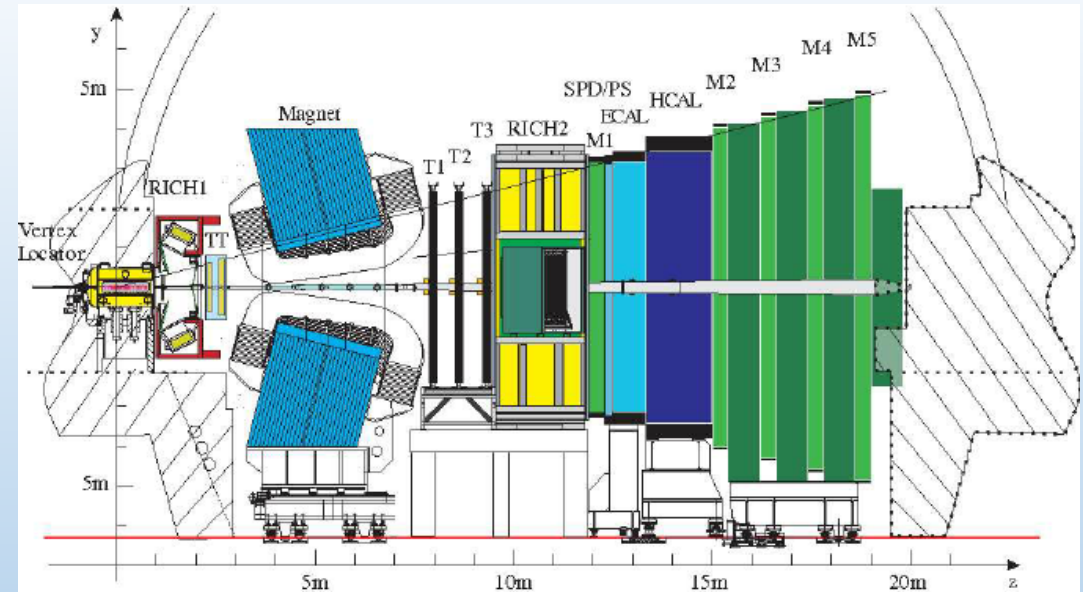


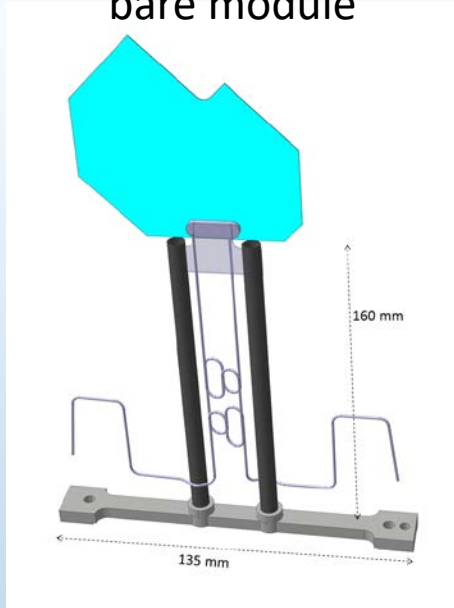
# VELO Upgrade Module Test-setup

- VErtex LOcator of LHCb
  - During LS2 replaced by: 52 double sided modules with 4 pixel sensors each.
  - Nikhef produces 30 modules and takes care of a functionality and readiness test setup (other 30 in Manchester)

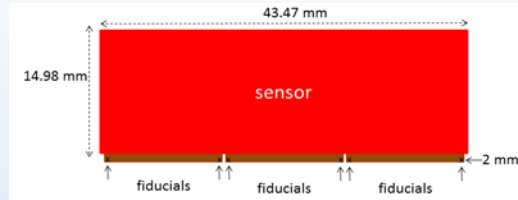


# VeloPix module

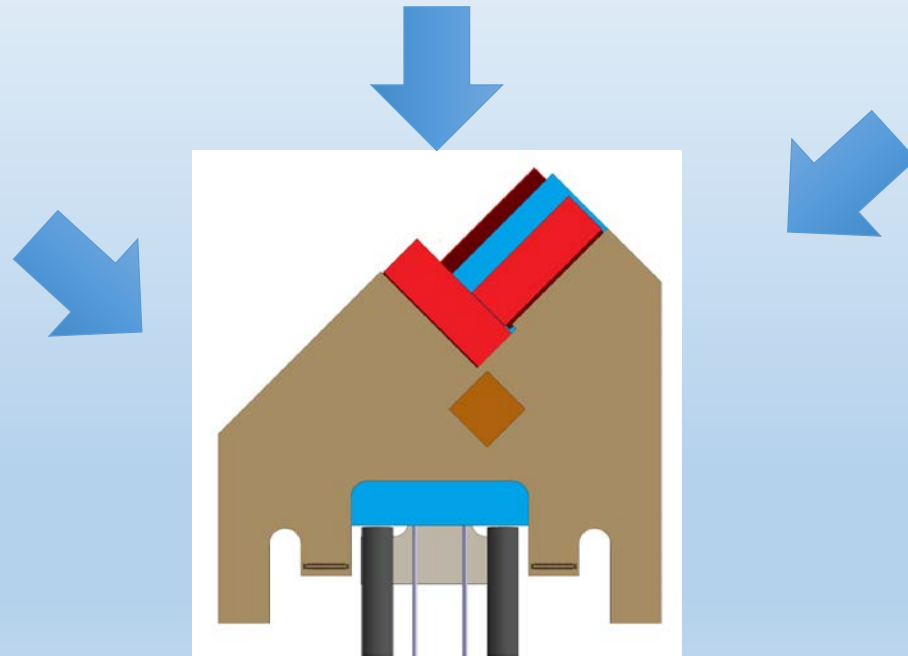
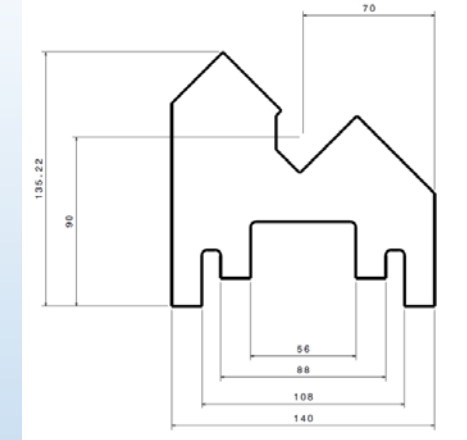
“bare module”



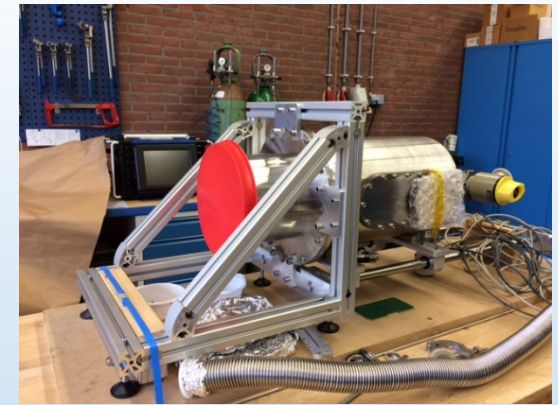
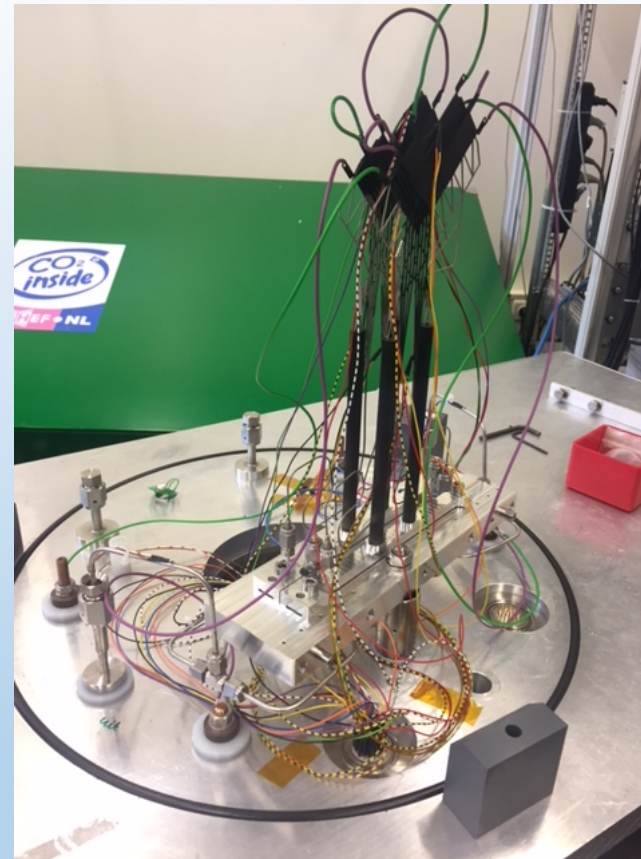
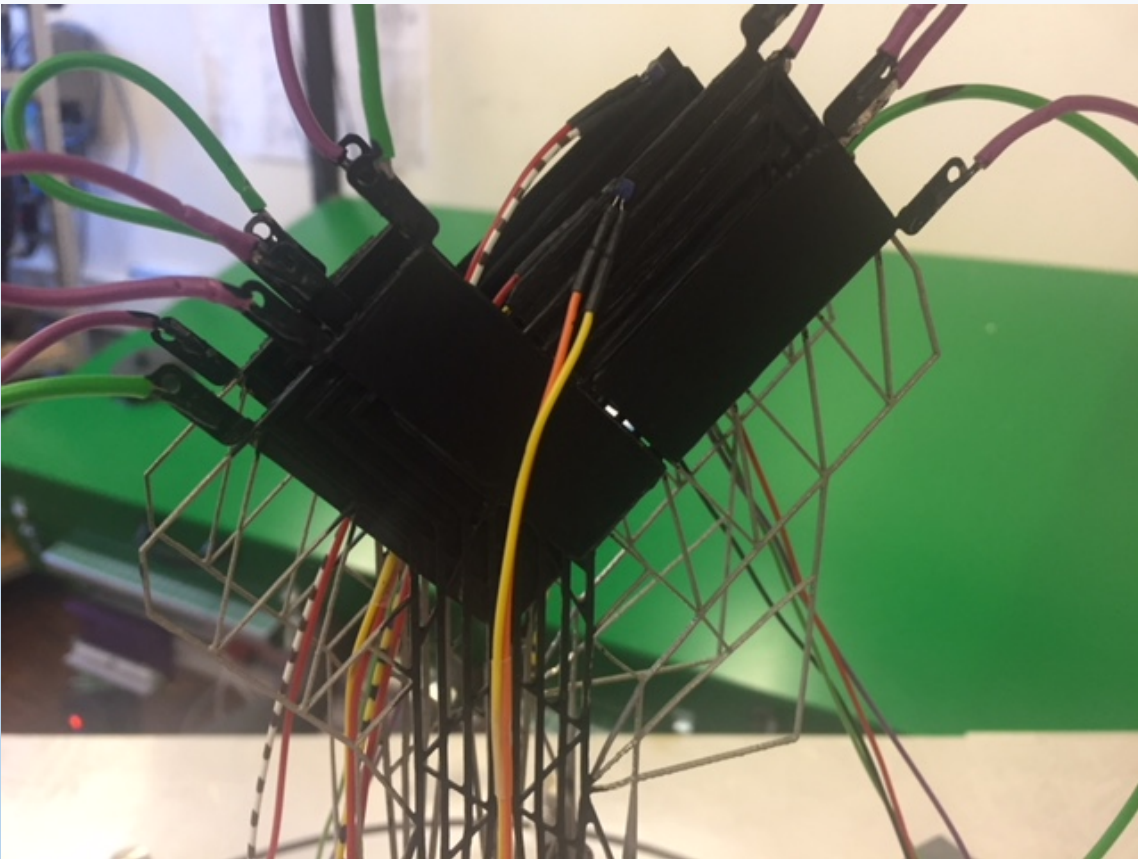
“tile= sensor + 3 ASICs”



“hybrid (Cu-capton PCB)”



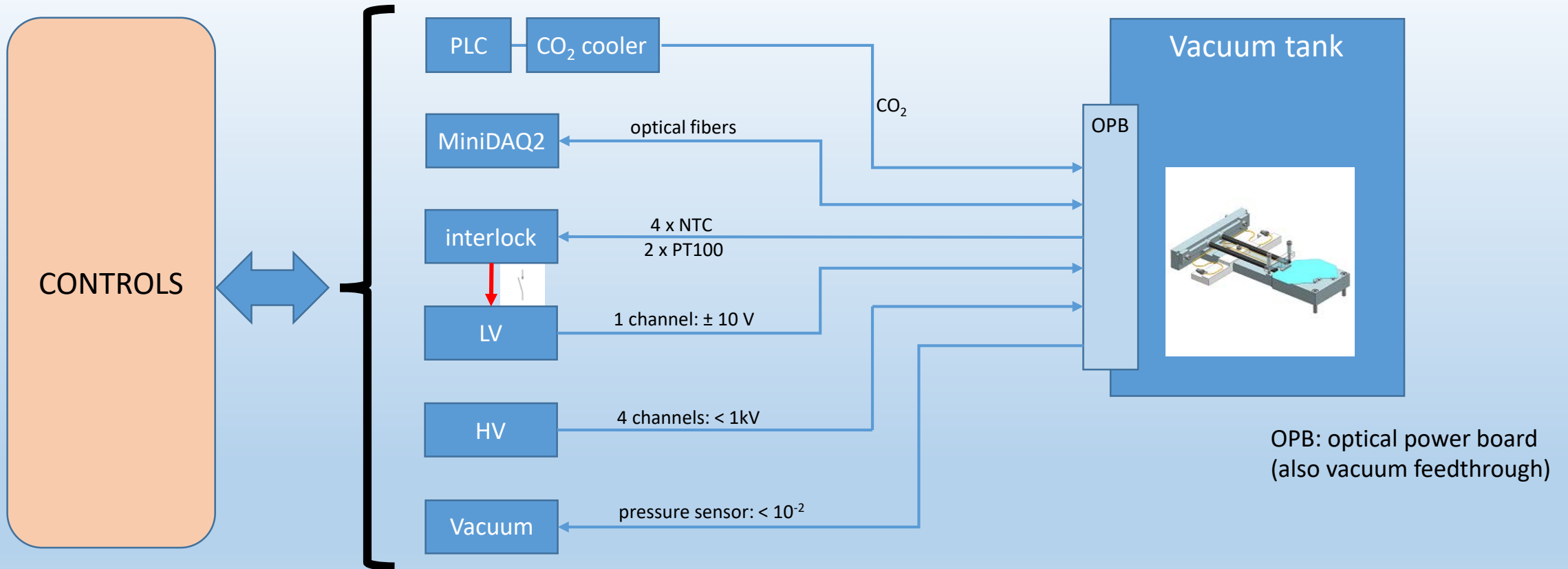
# VeloPix Module (2)



H026

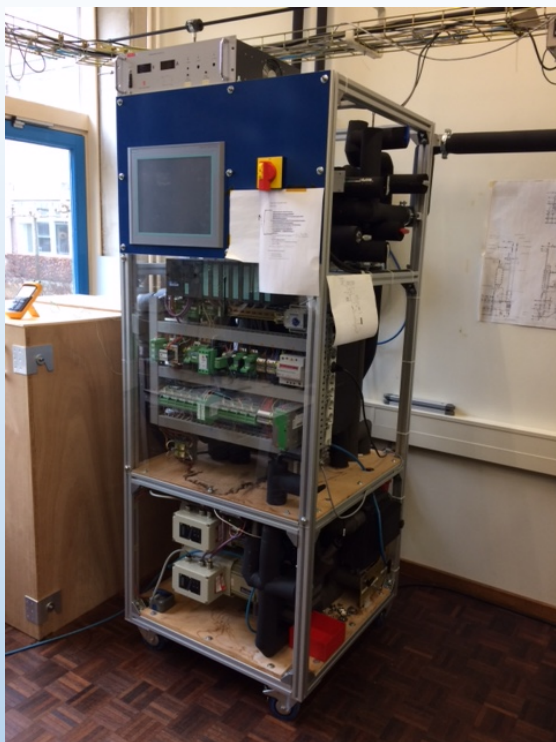
# Upgrade test setup

*What's needed*

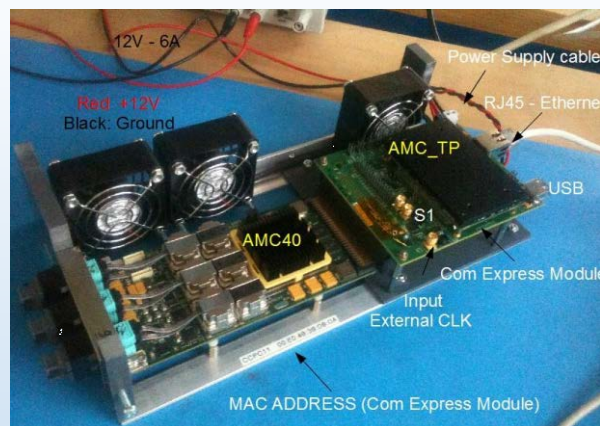




# Test setup hardware



CO2 cooler (@nikhef)



MiniDAQ2



HV: CAEN DT1471

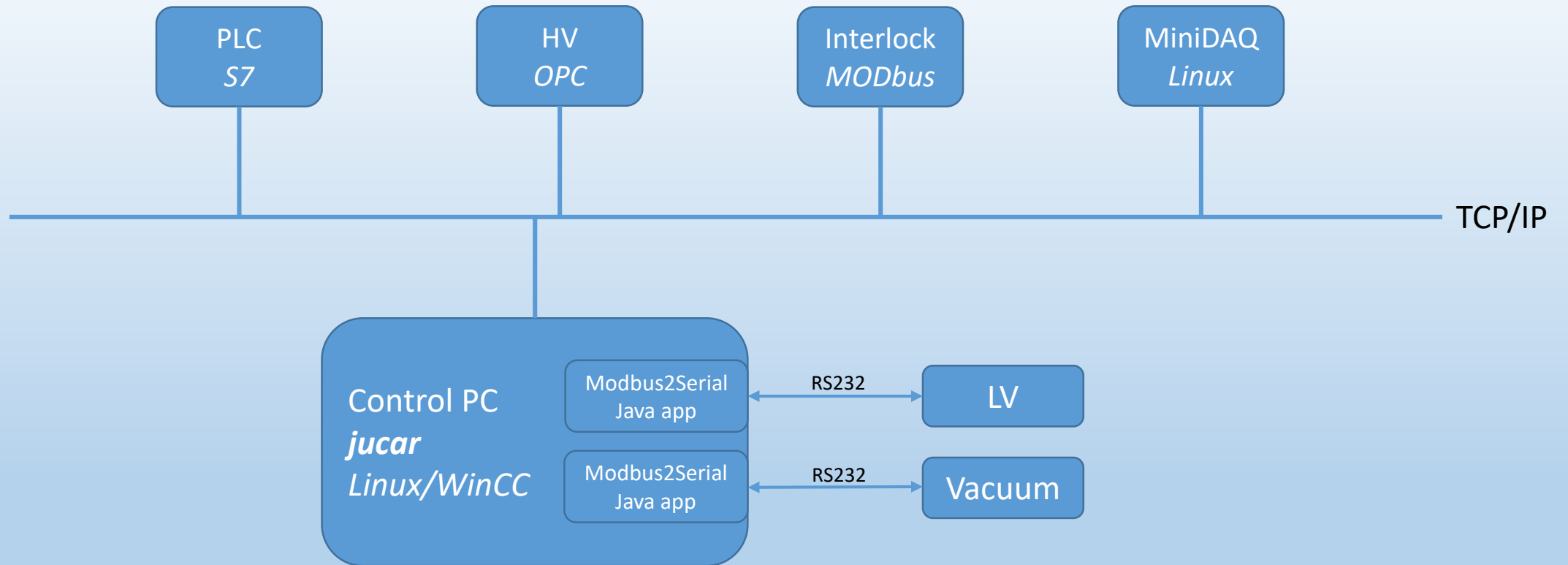


LV: Agilent E3633A



Interlock: NI CompactRIO

# Network connection layout



# Controls

What do we need to control this heterogeneous system?

- Coherent and common Supervisory Control and Data Acquisition System (SCADA) which supports S7, OPC and MODbus

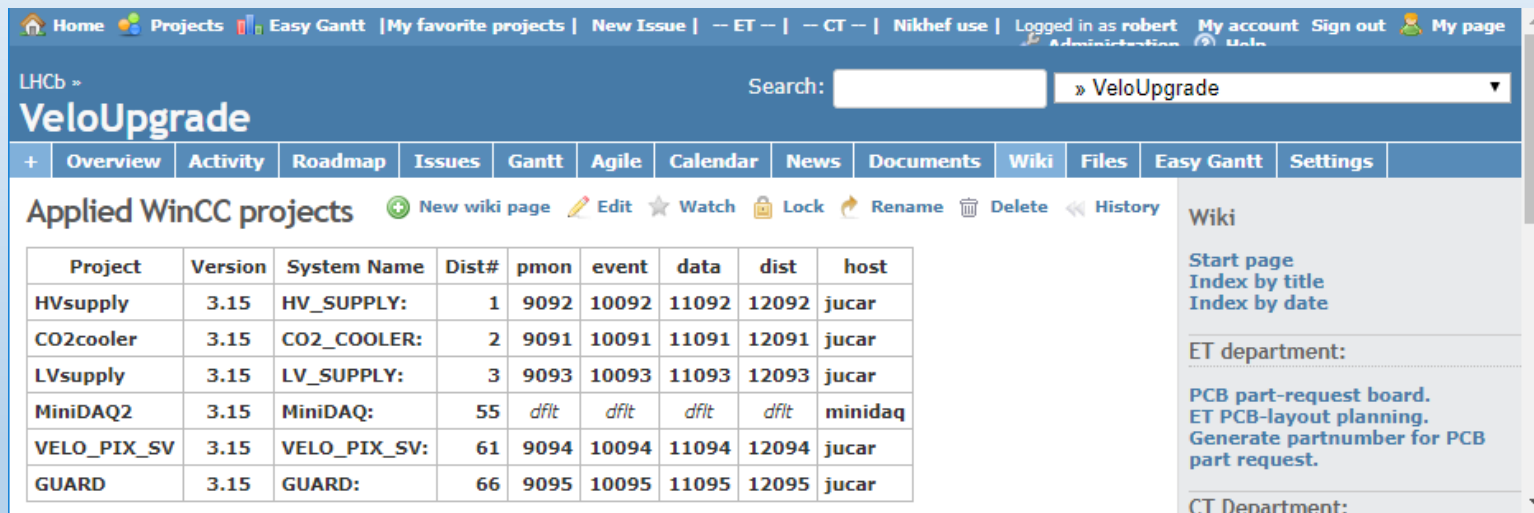
- Solution: **WinCC**



- Founded by ETM as PVSS, taken over by Siemens (2007) and now called WinCC
- Available on Linux and Windows
- Provides all SCADA functionality: archiving, alarm handling, MMI, control scripts, ..
- *Datapoint*: the basic data-container of a variable, being a simple type (*int*, *float*) or complex type (*array*, *struct* or *reference* to another datapoint). It may have *configs* like *address*, *function*, *archive* or *alert*
- Selected by CERN (2000) for all LHC experiments
- Available for collaborating institutes participating in a LHC experiment
- JCOP framework: built on top of WinCC, providing common utilities and hardware support

# Controls (2)

- For each sub-system (*LV, HV, Cooling, Interlock, MiniDAQ*) a WinCC Project exists, providing the basic functionality
- For a global overview, monitoring and watchdog a super-visor WinCC projects is running
- *Redmine*, a web-based project management and issue tracking tool, is applied
- All projects run on *jucar*, except the *MiniDAQ* which runs on its own machine



The screenshot displays the 'VeloUpgrade' web application interface. At the top, there is a navigation bar with links for Home, Projects, Easy Gantt, My favorite projects, New Issue, and user information (Logged in as robert). Below this is a search bar and a dropdown menu set to 'VeloUpgrade'. A secondary navigation bar contains tabs for Overview, Activity, Roadmap, Issues, Gantt, Agile, Calendar, News, Documents, Wiki, Files, Easy Gantt, and Settings. The main content area is titled 'Applied WinCC projects' and features a table with project details. To the right of the table is a sidebar with a 'Wiki' section containing links like 'Start page', 'Index by title', and 'Index by date', as well as a section for 'ET department' with a link to 'PCB part-request board'.

Project	Version	System Name	Dist#	pmon	event	data	dist	host
HVsupply	3.15	HV_SUPPLY:	1	9092	10092	11092	12092	jucar
CO2cooler	3.15	CO2_COOLER:	2	9091	10091	11091	12091	jucar
LVsupply	3.15	LV_SUPPLY:	3	9093	10093	11093	12093	jucar
MiniDAQ2	3.15	MiniDAQ:	55	<i>dfit</i>	<i>dfit</i>	<i>dfit</i>	<i>dfit</i>	minidaq
VELO_PIX_SV	3.15	VELO_PIX_SV:	61	9094	10094	11094	12094	jucar
GUARD	3.15	GUARD:	66	9095	10095	11095	12095	jucar



# Expert Control panels

Vision\_1: cooling\_procedures.pnl

### CO2 COOLER PROCEDURE

START

STOP

Status

ALARMS

PRIMARY

MASS FLOW

ACCU

Primary

Accumulator

Warm

Cold

-5 °C

-50 °C

15 °C

-30 °C

Warm/Cold cycling

Counter

Duration

Time left

0

30 Min

00:00

START

Event messages

29/05/18 10:56:34: Primary off  
29/05/18 10:56:34: Control script started  
29/05/18 10:56:34: State reset  
29/05/18 10:56:34: Primary off  
29/05/18 10:56:34: Heater is off  
29/05/18 10:56:34: PLC connection is ok  
29/05/18 10:56:34: Primary off

Vision\_1: Interlock.pnl

### 4 channel Interlock Setup & Control

Sensors

PT100	Temp.	Threshold
1	22.7 °C	40.0 °C SET
2	2.3 °C	40.0 °C SET
NTC		
1	42.3 °C	40.0 °C SET
2	25.0 °C	40.0 °C SET
3	25.0 °C	40.0 °C SET
4	25.1 °C	40.0 °C SET
5	25.0 °C	40.0 °C SET
6	25.0 °C	40.0 °C SET

Relay state

Relay	State	Action
1	ON	TOGGLE
2	OFF	TOGGLE
3	OFF	TOGGLE
4	OFF	TOGGLE

Relay dependency

Relay1	Relay2	Relay3	Relay4
<input checked="" type="checkbox"/> ptc1	<input checked="" type="checkbox"/> ptc1	<input checked="" type="checkbox"/> ptc1	<input checked="" type="checkbox"/> ptc1
<input checked="" type="checkbox"/> ptc2	<input checked="" type="checkbox"/> ptc2	<input checked="" type="checkbox"/> ptc2	<input checked="" type="checkbox"/> ptc2
<input type="checkbox"/> ntc1	<input type="checkbox"/> ntc1	<input type="checkbox"/> ntc1	<input type="checkbox"/> ntc1
<input checked="" type="checkbox"/> ntc2	<input checked="" type="checkbox"/> ntc2	<input checked="" type="checkbox"/> ntc2	<input checked="" type="checkbox"/> ntc2
<input checked="" type="checkbox"/> ntc3	<input checked="" type="checkbox"/> ntc3	<input checked="" type="checkbox"/> ntc3	<input checked="" type="checkbox"/> ntc3
<input checked="" type="checkbox"/> ntc4	<input checked="" type="checkbox"/> ntc4	<input checked="" type="checkbox"/> ntc4	<input checked="" type="checkbox"/> ntc4
<input checked="" type="checkbox"/> ntc5	<input checked="" type="checkbox"/> ntc5	<input checked="" type="checkbox"/> ntc5	<input checked="" type="checkbox"/> ntc5
<input checked="" type="checkbox"/> ntc6	<input checked="" type="checkbox"/> ntc6	<input checked="" type="checkbox"/> ntc6	<input checked="" type="checkbox"/> ntc6

Connected: No

Vision\_1: CaenDT14xx.pnl

### CAEN DT14xx High Voltage Control panel

Info

Model: DT1470ET  
Channels: 4  
SerialNr: 79  
Firmware: 01.04

Status

Over Power: No  
Internal Power: Ok  
Local Bus Termination: Off  
HV Clock Status: Ok

Interlock

Active when:  
☒ Open  
☐ Closed  
State: No

Channel 1

Channel 2

Channel 3

Channel 4

Readings

Polarity: +  
Vmon: 0.0 V  
Imon: 0.00 uA  
Status: Off

Settings

Power: Off Toggle  
Vset: 130.0 V Set  
Iset: 302.20 uA Set  
MaxV: 8000 V Set  
Ramp up: 10 V/s Set  
Ramp Down: 20 V/s Set  
Trip: 10.0 s Set  
Power Down: Kill Toggle  
Imon Range: High Toggle

# Super-Visor

1. Provide a coherent overview of all sub-systems  
ATLAS style applied (state, status)
2. Prevent dangerous actions  
switching on LV or HV depends on other sub-systems
3. Provide a *soft* interlock  
HV and LV are switched off in case other sub-systems transit to a status other than OKAY or WARNING

The screenshot displays the 'Velopix Module test-setup' interface. At the top, it shows the LHCb logo and the title 'Velopix Module test-setup'. The date and time are 'Tue May 29 2018 11:32'. A 'Close' button is in the top right.

**General**

Module	State	Status
vpm-#001	UNKNOWN	UNKNOWN
MiniDAQ	UNKNOWN	UNKNOWN
Guard	UNKNOWN	FATAL
Cooling	OFF	OK
LV	ON	FATAL
HV	UNKNOWN	FATAL

Buttons: More, Config, Sim

**Guard**

ptc0: 22.7 °C	ptc1: 2.3 °C
ntc0: 42.3 °C	ntc1: 25.0 °C
ntc2: 25.0 °C	ntc3: 25.1 °C
ntc4: 25.0 °C	ntc5: 25.0 °C

press: 347.1 mBar

Interlock: Resume

**LV**

Setpoint: 0.00 V  
Readback: 10.01 V  
Current: 0.051 A

Switch: noop

**MiniDAQ2**

DAQ: Noop

**Cooling**

Setpoint: 15.00 °C  
Readback: 19.27 °C  
FT201: 0.00 g/s

Cycle: Warm (selected), Cold

**HV**

	Chan 0	Chan 1	Chan 2	Chan 3	
Vmon:	0.0	0.0	0.0	0.0	V
Vset:	130.0	0.0	0.0	0.0	V
Imon:	0.00	0.00	0.00	0.00	uA
State:	FATAL	FATAL	FATAL	FATAL	
Switch:	ON	ON	ON	ON	

Buttons: More, More, More, More

**Log**

```

2018-05-29 11:31:25 HV DPE's missing
2018-05-29 11:31:30 HV DPE's missing
2018-05-29 11:31:35 HV DPE's missing
2018-05-29 11:31:40 HV DPE's missing
2018-05-29 11:31:45 HV DPE's missing
2018-05-29 11:31:50 HV DPE's missing
2018-05-29 11:31:55 HV DPE's missing
2018-05-29 11:32:00 HV DPE's missing
2018-05-29 11:32:04 INFO: project [ 1, HV_SUPPLY:, Hvsupply ] resumed connection
2018-05-29 11:32:05 INFO: [HV: UNKNOWN->FATAL]
    
```

# Summary

- A typical Nikhef project
  - Lack of requirements (on demand)
  - Weekly meetings with little commitment
  - Small system with lot of different protocols (Ton solved them all!)
  - PLC programming is still dependent on a retired Nikhef employee
- *Redmine*: convince others to use it
- PRR: July 2018 (postponed several times)
- Controls are ready?! Demo has been shown. Real work comes when first module will be tested.
- Usage *MiniDAQ*: uncertain, implementation by LHCb physicist
- No contact with Manchester. Are they waiting for us?