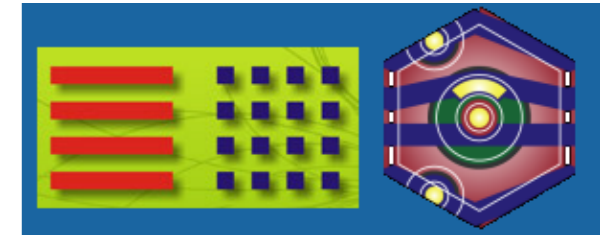




VXD Radiation and Environmental Monitors



- General remarks
- VXD Radiation Monitor and Beam Abort
 - scCVD diamond sensors: characterisation, mechanics, cabling
 - Electronics
- SVD Temperature Monitor
 - NTC thermistors, ELMB
 - FBG/FOS fibers
- VXD Humidity Monitor/Interlock
- Hardwired Interlocks
- Critical issues for discussion in this meeting



General Remarks

- VXD Radiation & Environmental Monitors design

Started relatively late, as an “add-on” feature, in particular for SVD

- R&D, prototypes and final design: mostly completed

- Overall status

Final subsystem validation: to be done

Radiation: BEAST I, early 2016

Environment: DESY thermal mock-up and beam test, early 2016

Some parts are final and ready (NTC readout, for instance)

Diamonds and FBG fibres: orders (before end 2015!) in preparation

Switching to production/installation mode for 2016

- Some fine details to be finalized

Specifically in mechanics, cabling, schedule, assembly procedures



VXD Radiation Monitor & Beam Abort - sensors

- Ongoing activities, 2015

scCVD diamond sensors, 4 prototypes for BEAST I assembled and characterised (I-V, β and α sources)

installed at KEK last week for BEAST I

specs prepared for the tender, purchase of 20 sensors in 2015

position & mechanics agreed, some details to be frozen...

- Plans for 2016

BEAST I at KEK:

Measurement of dose rates, comparisons with PiN diodes

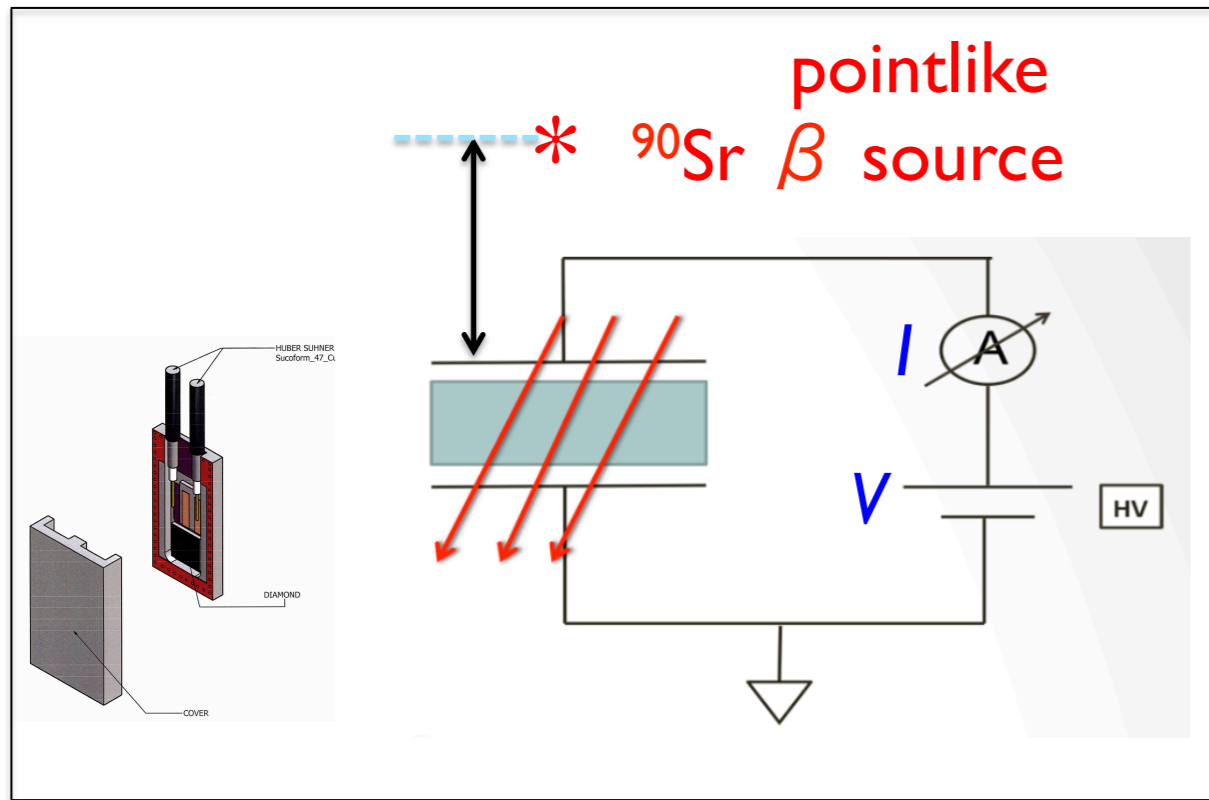
First tests of Beam Abort

Purchase of 4 additional sensors for BEAST 2

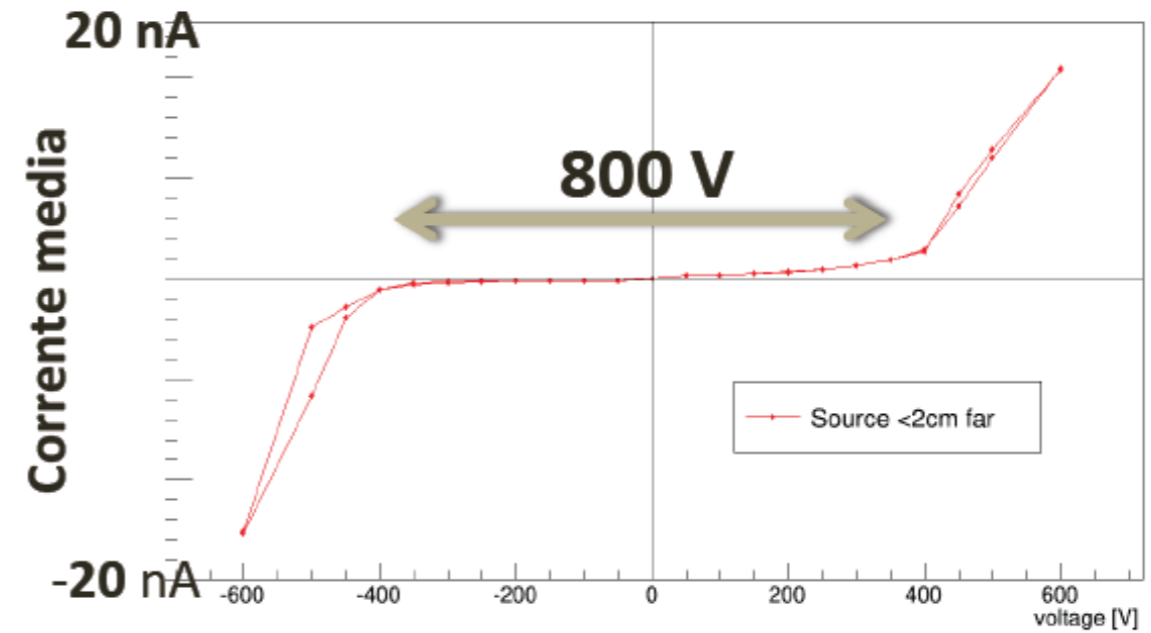
Test and assembly of scCVD sensors

Installations at KEK during SVD (2016) and PXD (2017?) assembly

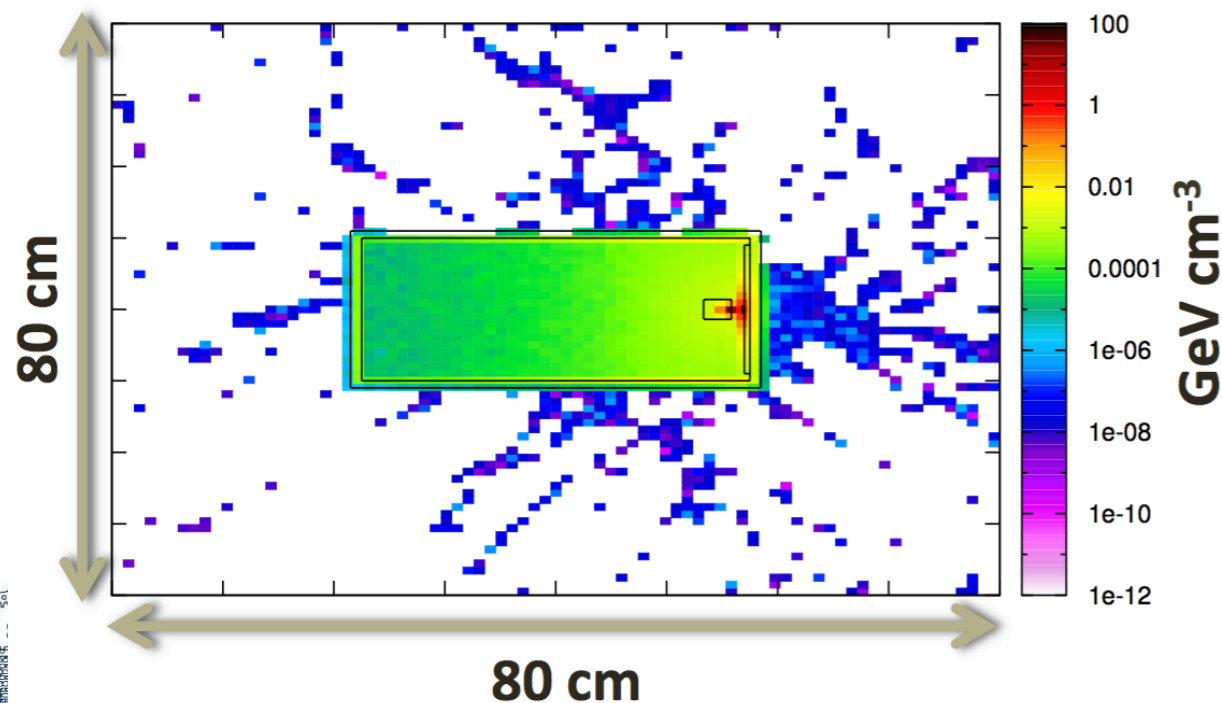
Characterization of scCVD sensors - I



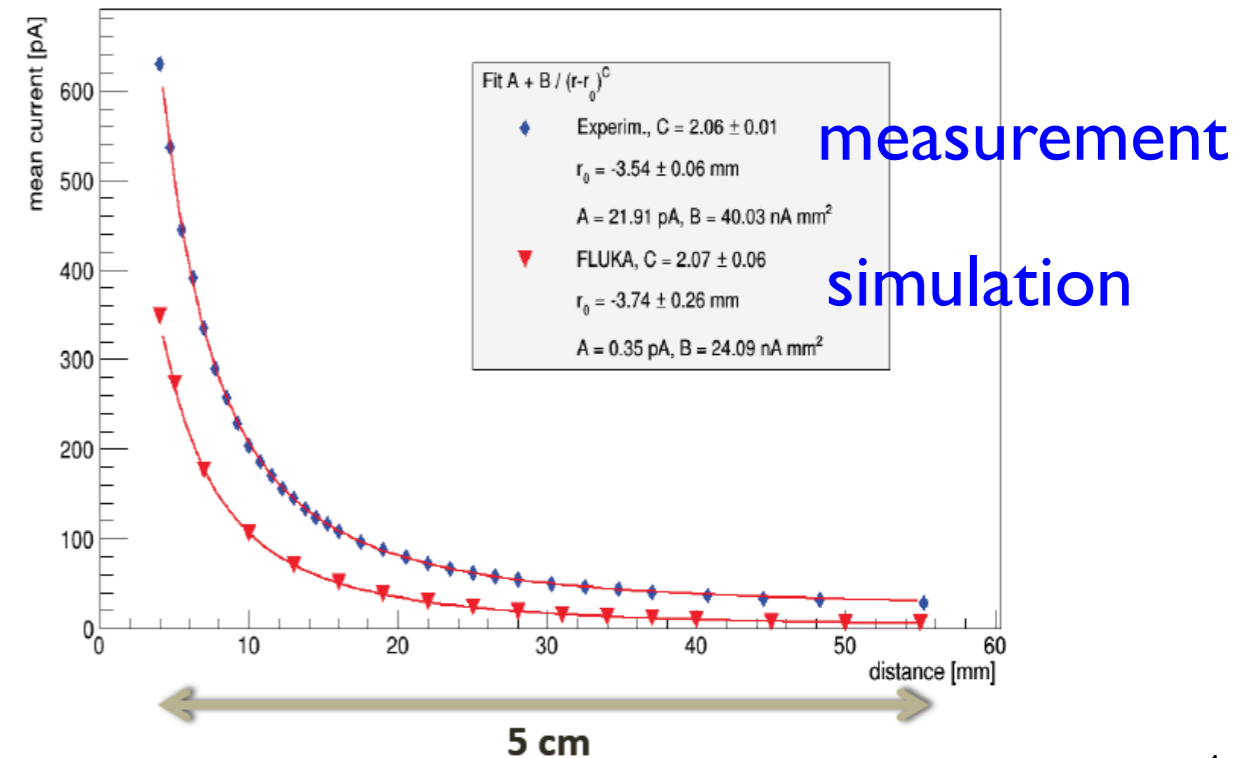
I - V with ^{90}Sr β source at fixed d



FLUKA simulation, ^{90}Sr β source



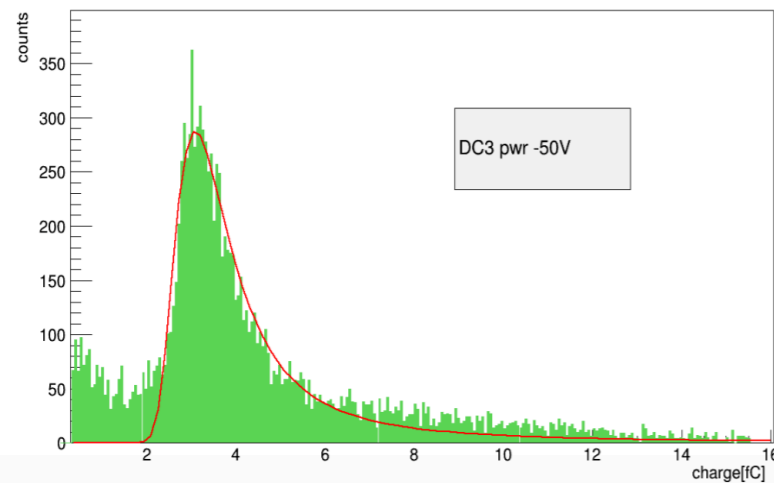
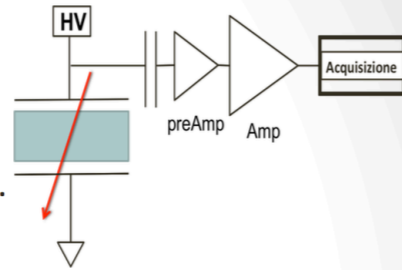
Current I vs distance d of ^{90}Sr β source



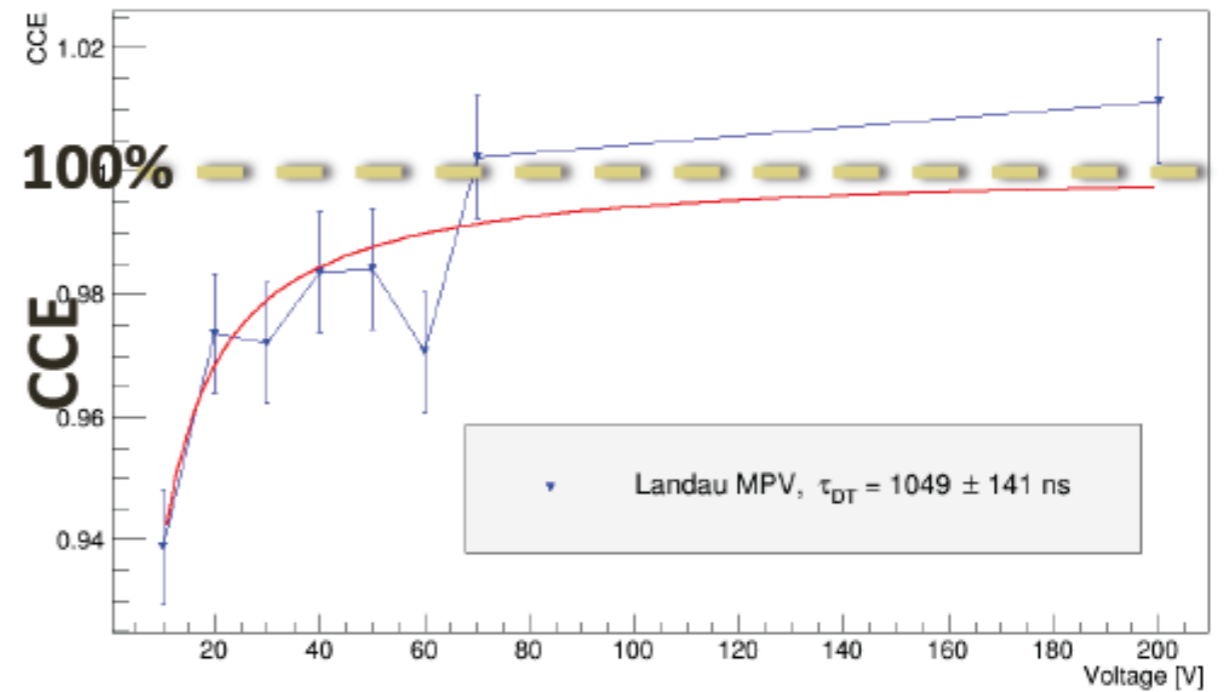
Characterization of scCVD sensors - 2

Particella Singola

- Elettroni β collimati di ≈ 1.5 MeV.
- 1500s di acquisizione, diverse tensioni.
- Fit con distribuzione di Landau.

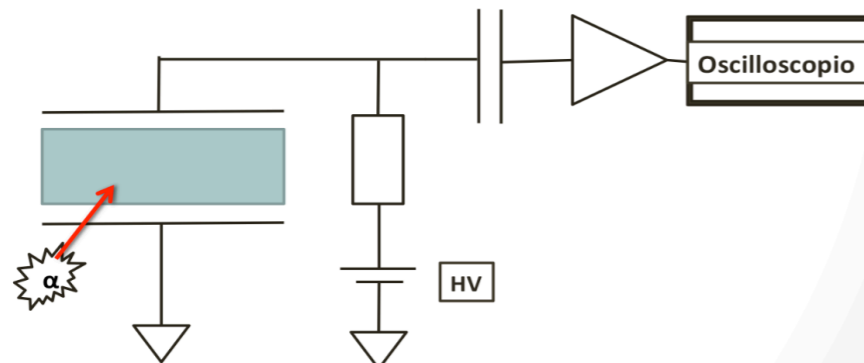
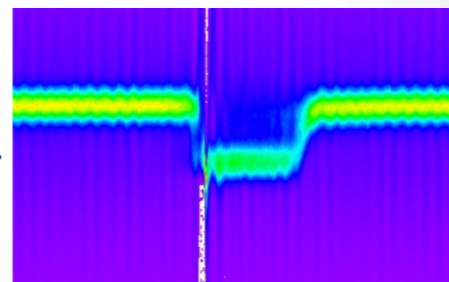


Charge Collection Efficiency from MIPs

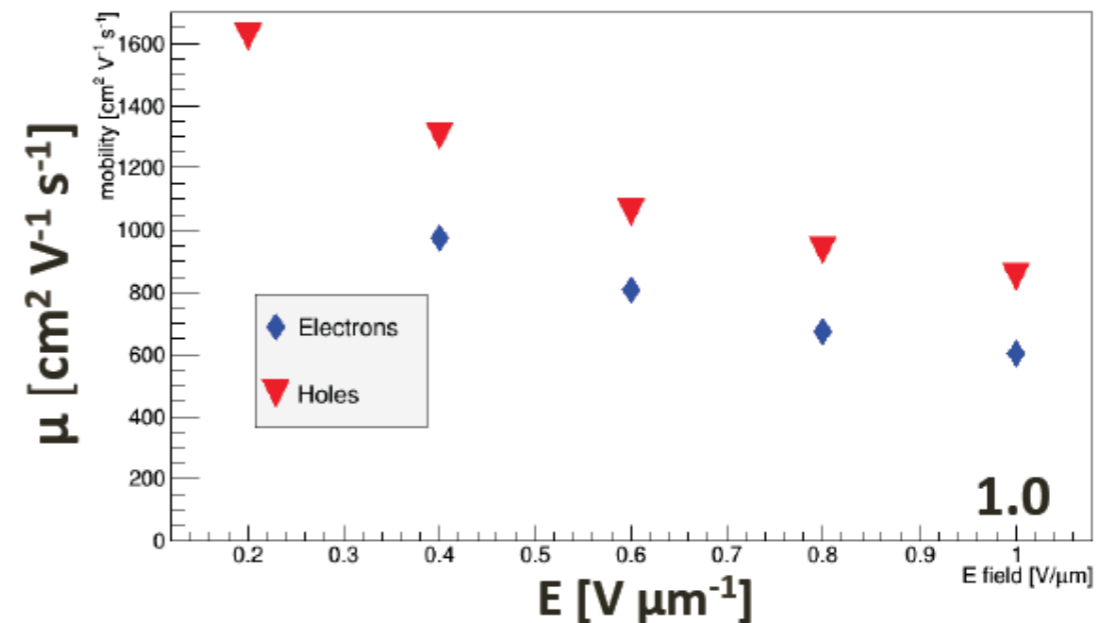


Tecnica di corrente transiente (TCT)

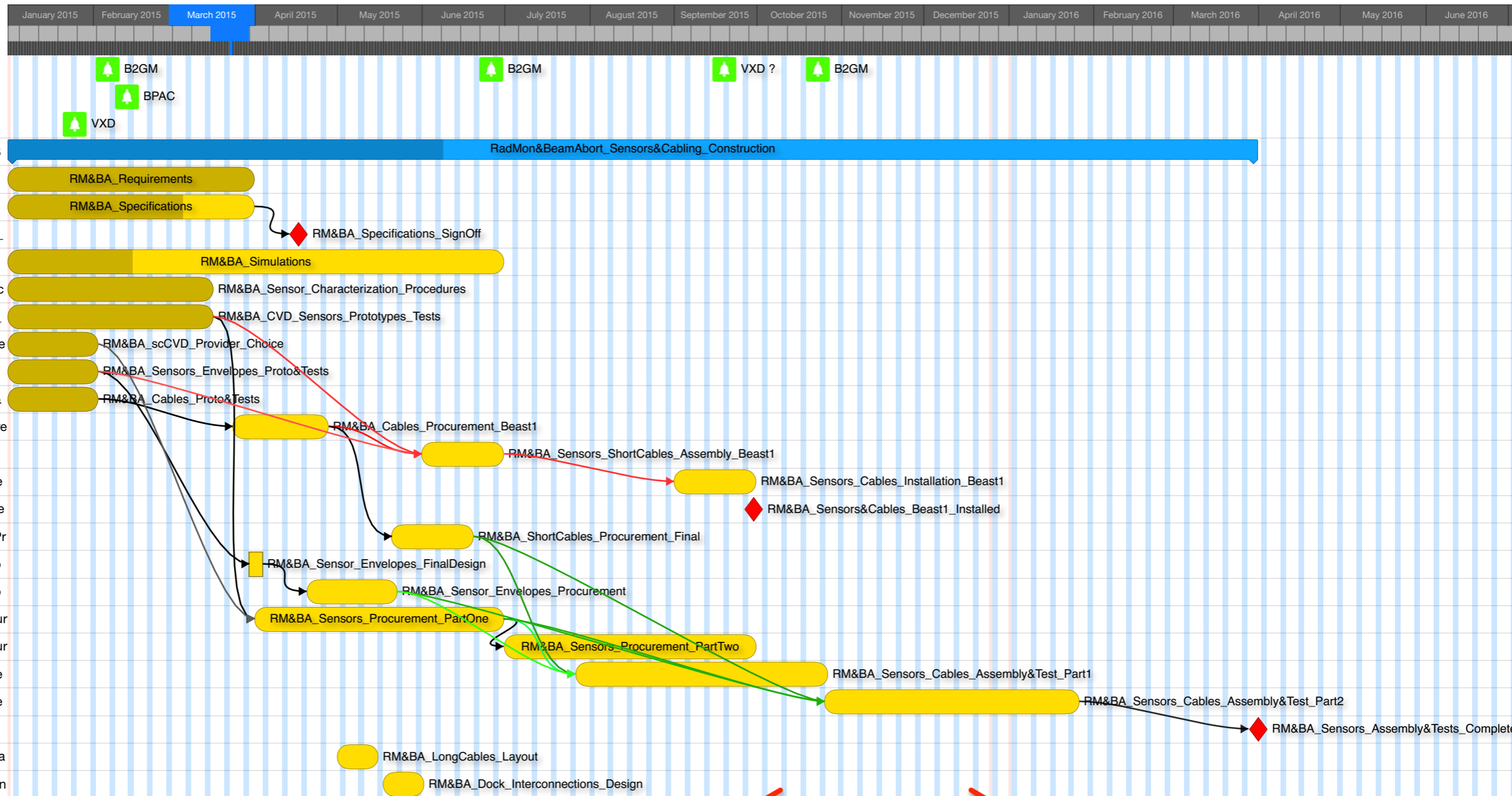
- Sorgente α : 241-Am, 55 kBq
- Segnale letto all'elettrodo opposto.
- Durata \approx tempo di deriva.



Carrier mobility, α source (TCT)



RM & BA sensors: schedule



We are here (VXD Workshop):
On schedule for BEAST I

August/September 2015:
BEAST I

Some delay in diamond procurement (tender)
Sign-off (requested)

Prototypes installed



Radiation Monitor & Beam Abort - electronics

- Ongoing activities, 2015: collaboration with Elettra

Readout and Beam Abort specifications:

Expected dose rates, sensor currents measurements sensitivities

Beam Abort thresholds, signals exchanged with SuperKEKB

First prototype, design and preliminary tests (collab. Elettra)

Module (box) for 4 sensors:

front end, A/D, FPGA, RAM, 2 Ethernet interfaces

Individual HV bias for scCVD sensors

Installation and preliminary tests at KEK (BEAST I preparation)

- Plans for 2016

Prototype validation with 4 scCVD sensors at KEK (BEAST I)

Final design, production of 5 modules (4 ch./mod.) + 1 spare

RadMon & Beam Abort prototype

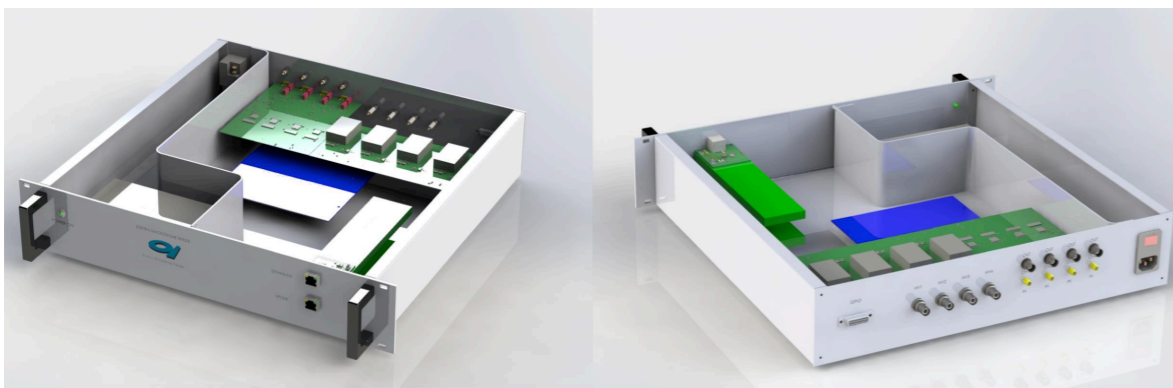
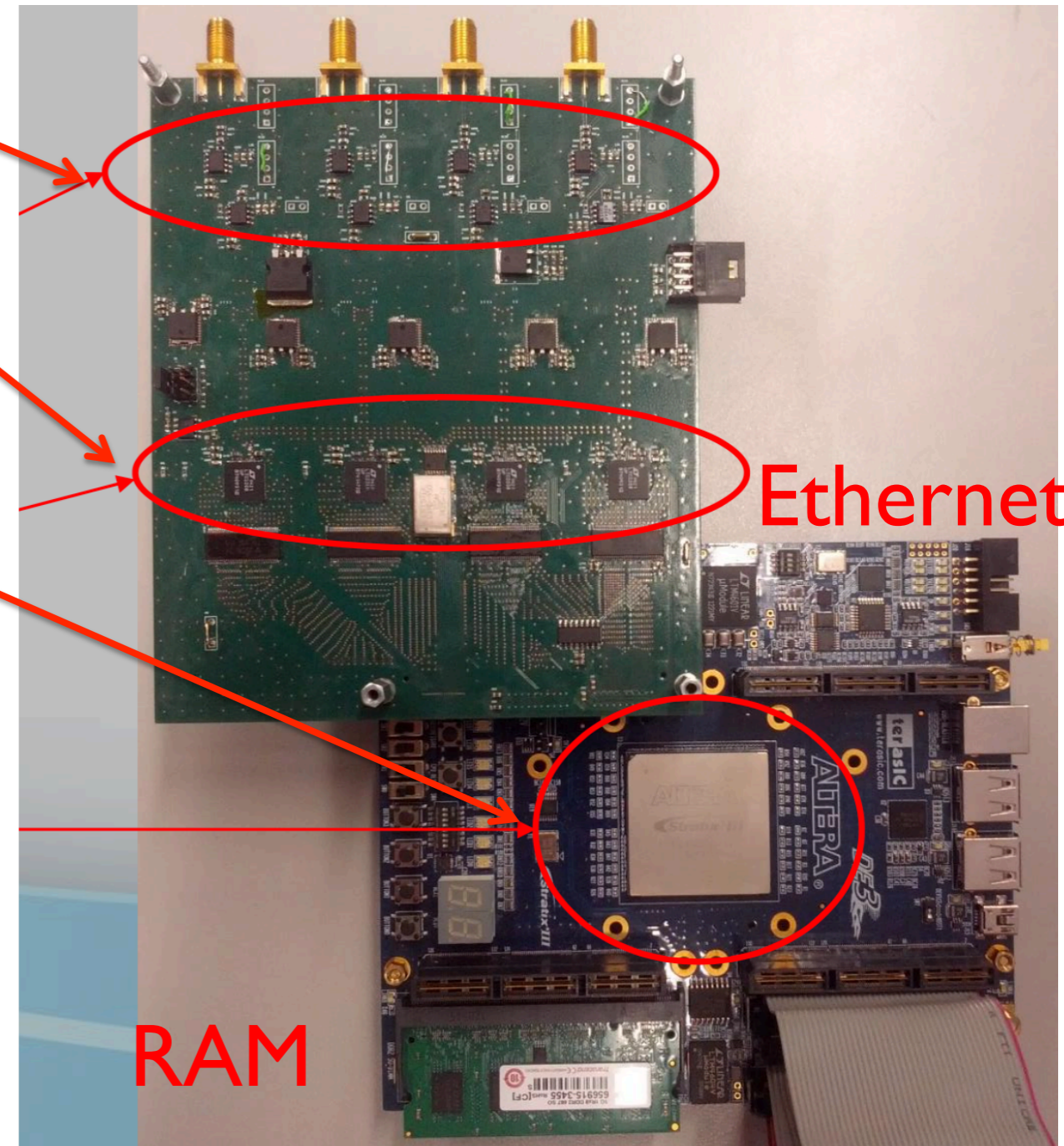
F.Vulpone, thesis with G.Cautero et al. (Elettra)

Analog front end: pico-ammeters

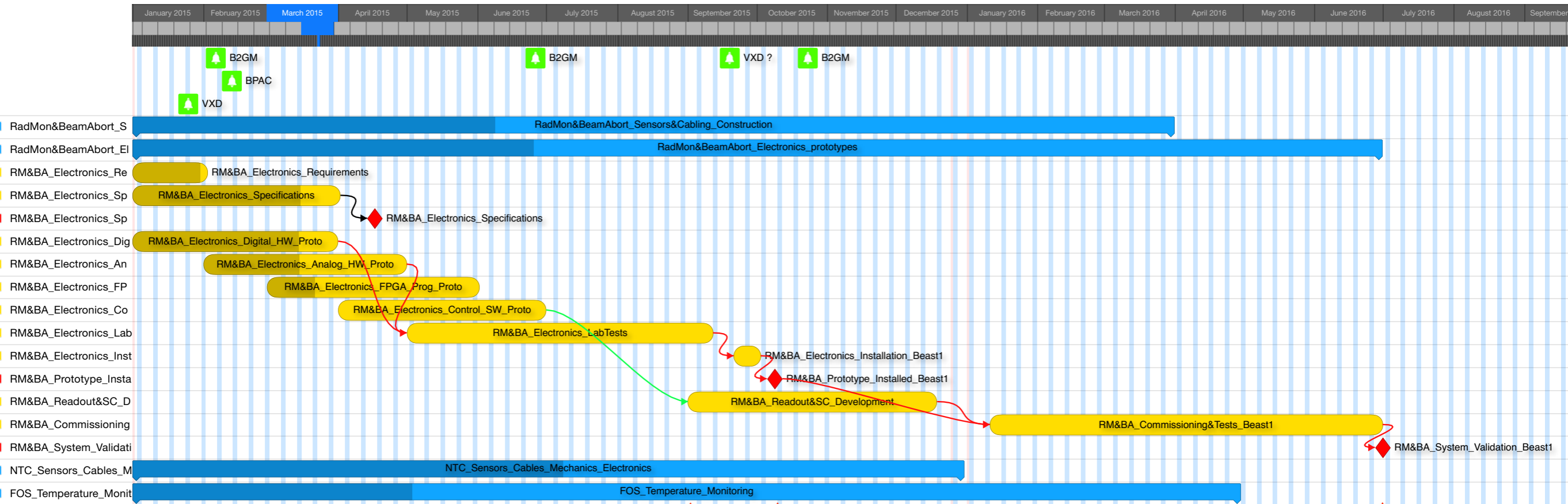
- Transimpedance amplifiers
- ADC LTC2208 16 bits, 130 MHz
- 2 selectable current ranges

Digital section:

- FPGA STRATICS III (running averages, abort thresholds, timing&control)
- External RAM and Ethernet interfaces



RM & BA electronics: schedule



We are here (VXD Workshop):
On schedule, OK
Sign-off requested

October/November 2015:
BEAST I
Prototype installation

June 2016:
End of BEAST I
Prototype validation



SVD Temperature Monitoring – FBG/FOS

- Ongoing activities, 2015

Prototype tests (sensor configurations, providers), *done*

Development of calibration procedures, *done*

Purchase of fibres with final sensors, connectors, couplers: *tbd*

- Plans for 2016

Calibration and preparation of fibres in Trieste

Glueing of holding brackets (Trieste? KEK?)

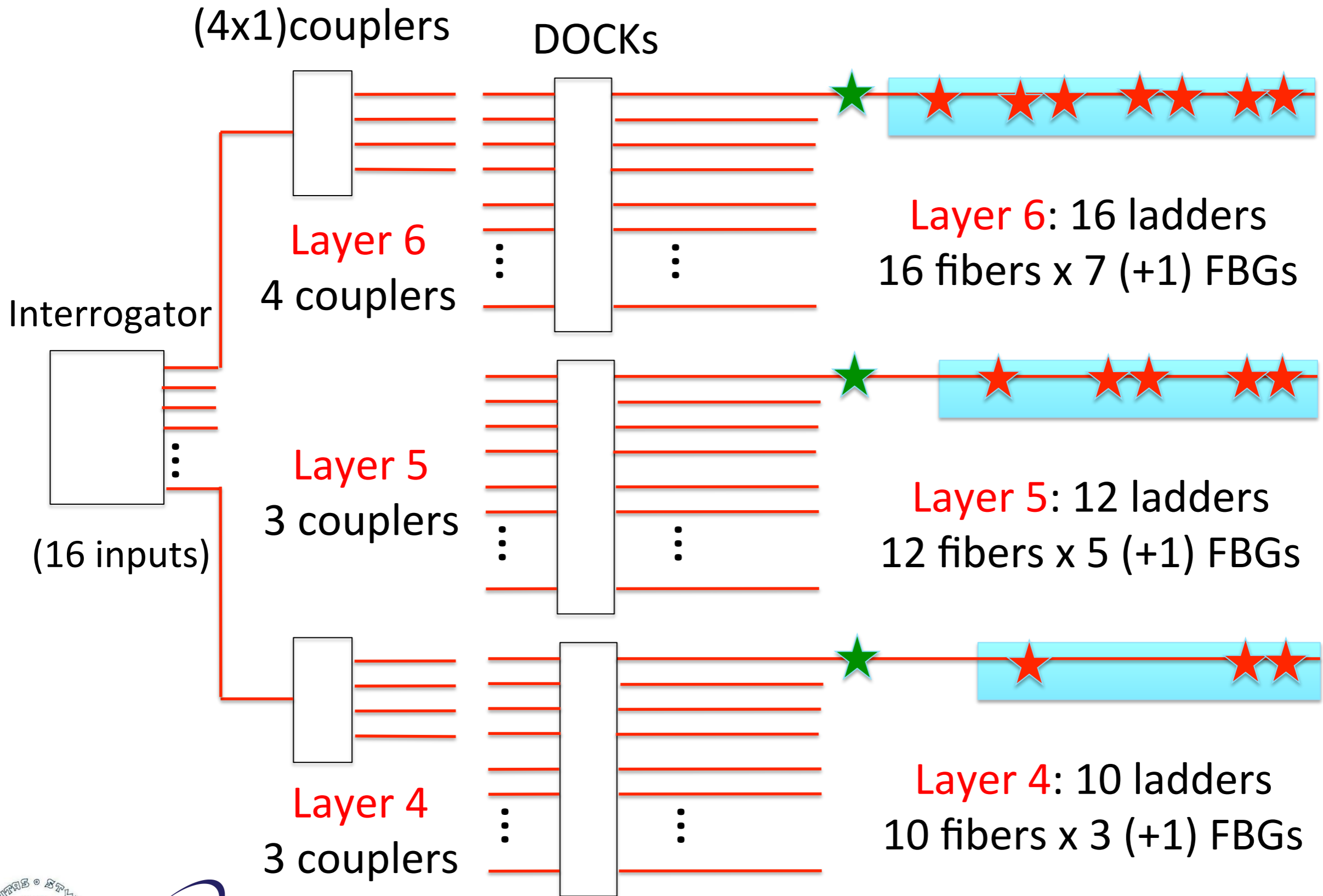
Installation of fibres in SVD ladders at KEK

Tests at KEK before and after ladder insertion

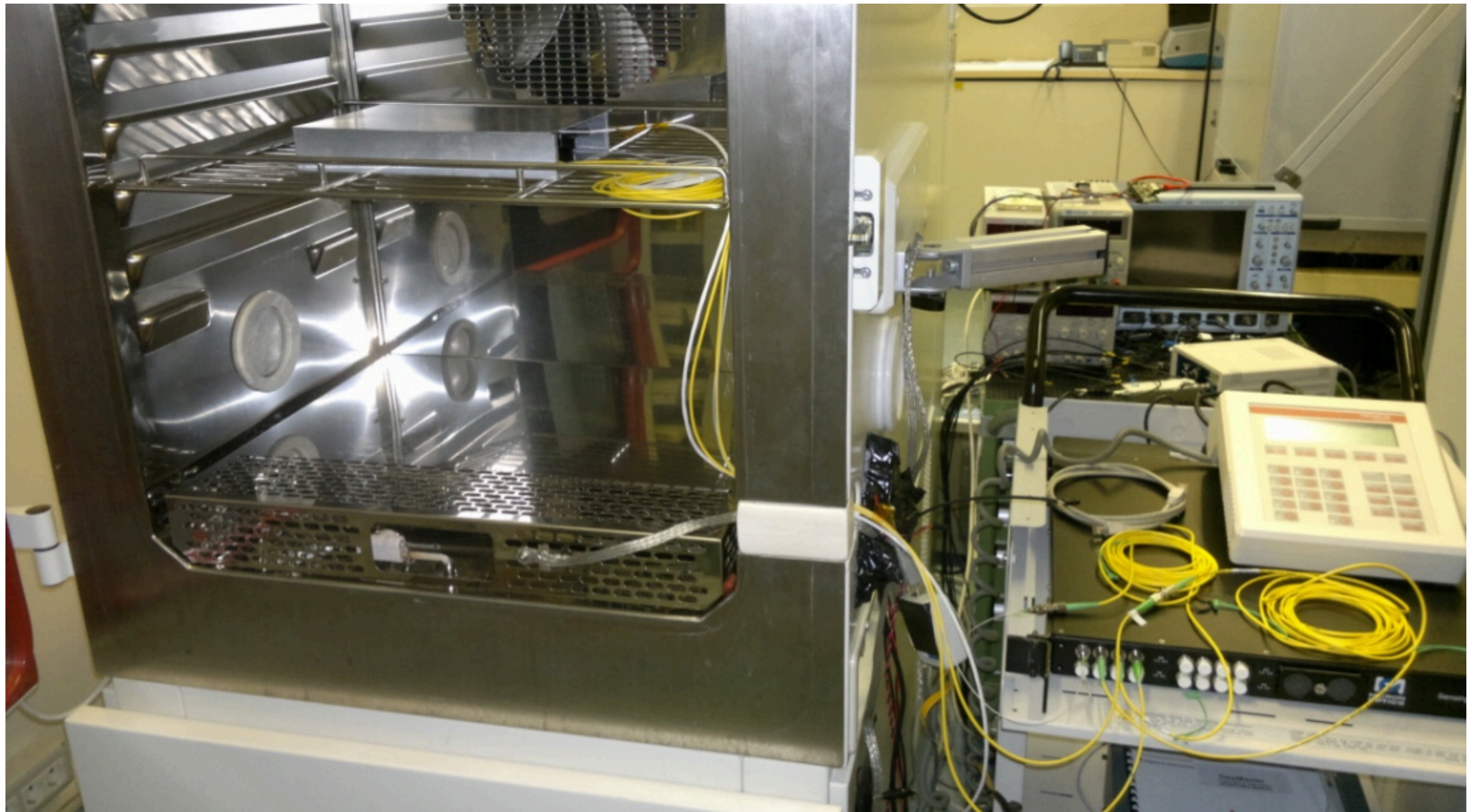
- Open issues

Additional fibres for humidity and temperature of outer cylinder

Temperature: optical Fiber Bragg Grating sensors



FBG/FOS calibrations in thermal chamber



FBG calibrations (-20 to +40°C)

4-parameter polynomial fits: stable and reproducible results, residuals and stability within about $\pm 0.15^\circ\text{C}$ (less than $\pm 0.5^\circ\text{C}$)

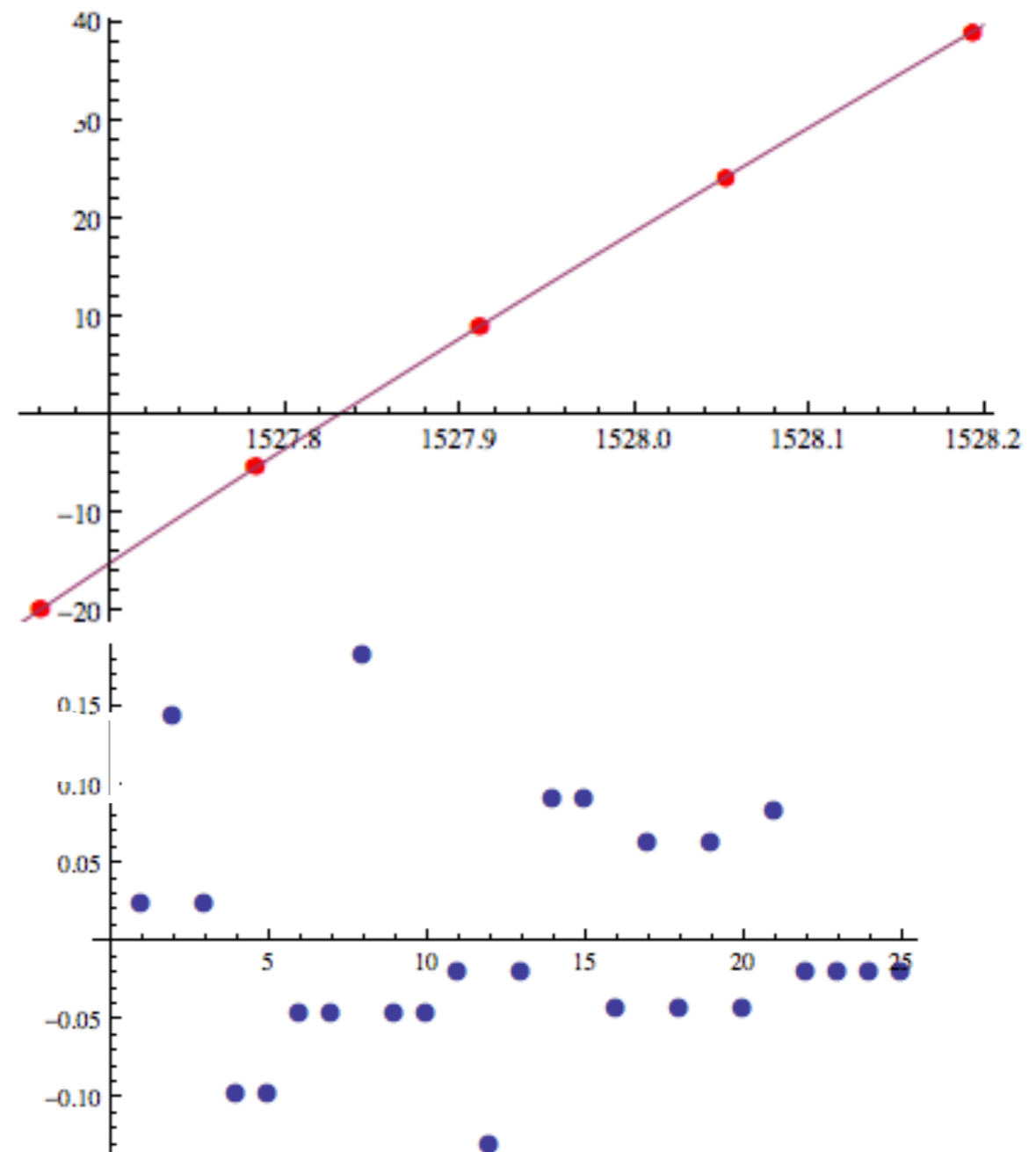
	Estimate	Standard Error	Confidence Interval
d0	40.701	0.0290216	{40.6435, 40.7585}
d1	97.7556	0.451973	{96.8604, 98.6508}
d2	-34.7678	1.95933	{-38.6485, -30.887}
d3	-30.5067	2.28526	{-35.033, -25.9805}

	Estimate	Standard Error	Confidence Interval
d0	45.8861	0.0474087	{45.7922, 45.98}
d1	96.9681	0.591074	{95.7974, 98.1388}
d2	-24.6806	2.06285	{-28.7663, -20.5949}
d3	-10.8643	2.05507	{-14.9346, -6.79396}

	Estimate	Standard Error	Confidence Interval
d0	29.088	0.0160402	{29.0563, 29.1198}
d1	103.943	0.132937	{103.68, 104.207}
d2	-18.4286	1.11424	{-20.6355, -16.2218}
d3	-15.4345	2.12939	{-19.6521, -11.217}

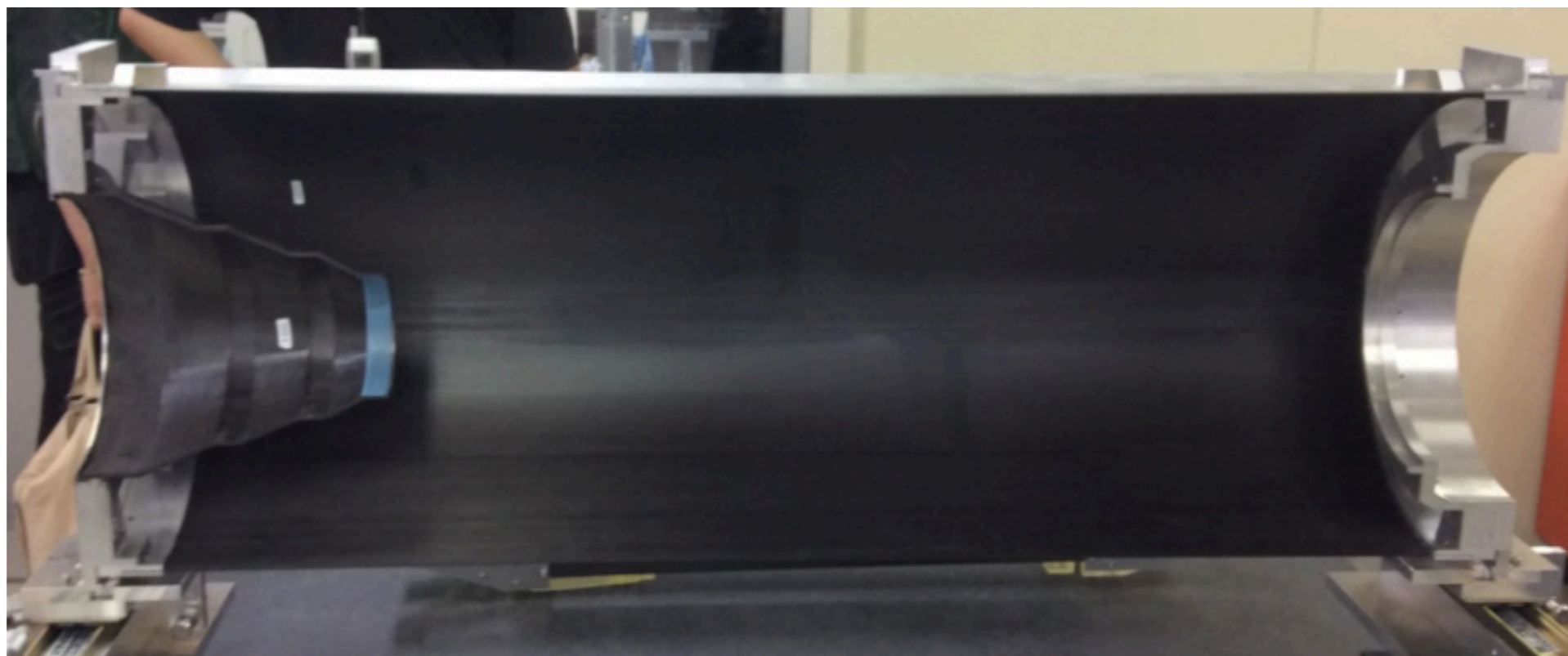
	Estimate	Standard Error	Confidence Interval
d0	36.4001	0.0161585	{36.3681, 36.4321}
d1	100.203	0.25728	{99.6937, 100.713}
d2	-29.0535	1.41678	{-31.8596, -26.2474}
d3	-23.6572	1.9542	{-27.5277, -19.7866}

	Estimate	Standard Error	Confidence Interval
d0	28.3552	0.0376438	{28.2807, 28.4298}
d1	103.718	0.294058	{103.135, 104.3}
d2	-14.8572	2.50602	{-19.8207, -9.89374}
d3	-7.00192	4.92861	{-16.7636, 2.75981}

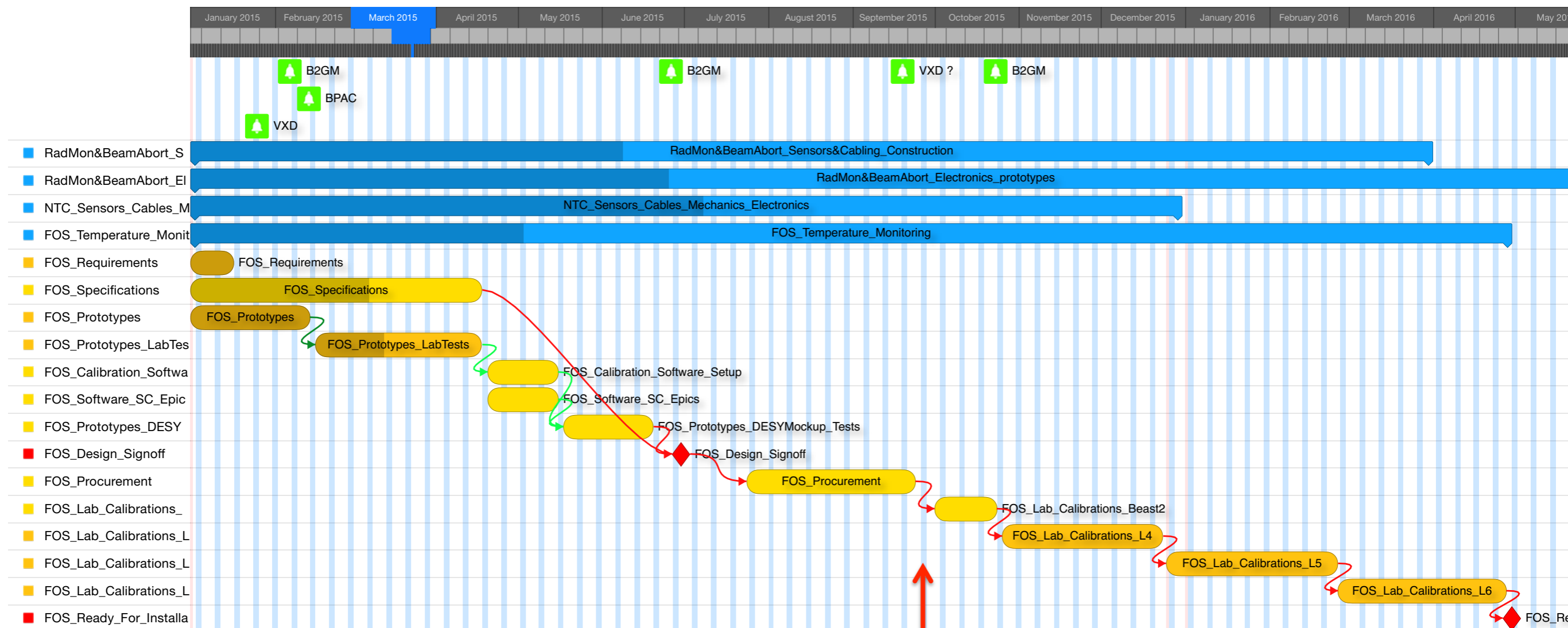


Temperature close to CDC?

Initial discussion in the June B2GM, not finalised yet: proposal of 2 fibres with several sensors to monitor temperature close to CDC (detailed output path, glueing method: to be clarified).



FBG/FOS - schedule



We are here (VXD Workshop):
 General tests ok, but: delays on procurement
 Specifications sign-off requested

Goal: April 2016
 ready for installations



Temperature Monitoring, NTC thermistors

- Ongoing activities, 2015

New 10k NTC thermistors, optimized for -30°C (*purchased*)

Mechanical fixtures (*designed*)

ELMB-based readout and interlocks, LabView prog. (*completed*)

Interconnection boards for docks (*done*)

Tests at the DESY thermal mock-up (*to be done*)

- Plans for 2016

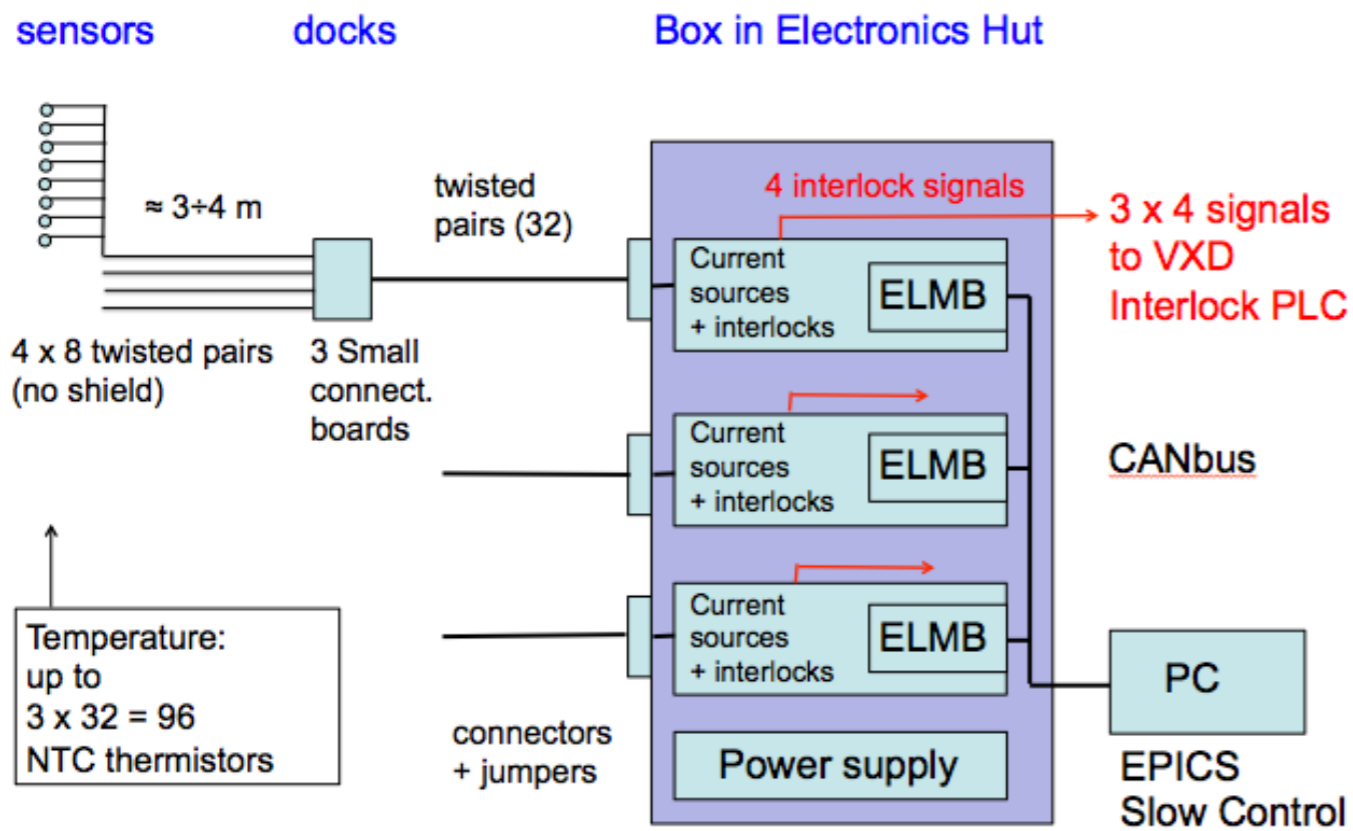
EPICS programming (*started*)

Mechanics, cabling

Installation and tests during SVD assembly at KEK (Apr. – Dic.)

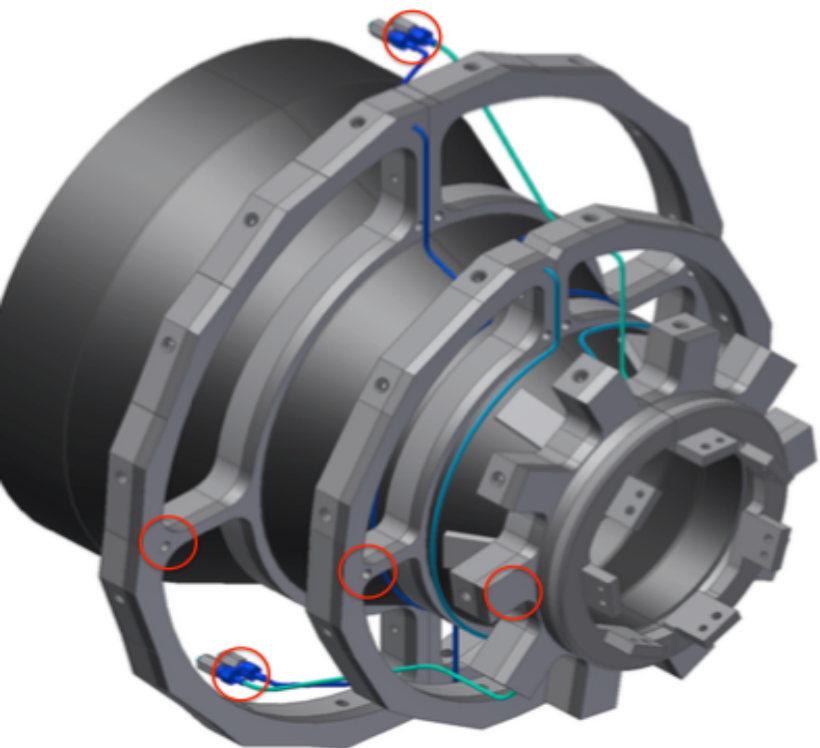
Temperature Monitoring & Interlock - NTC

NTCs – ELMB-based electronics ready!



NTC mechanics

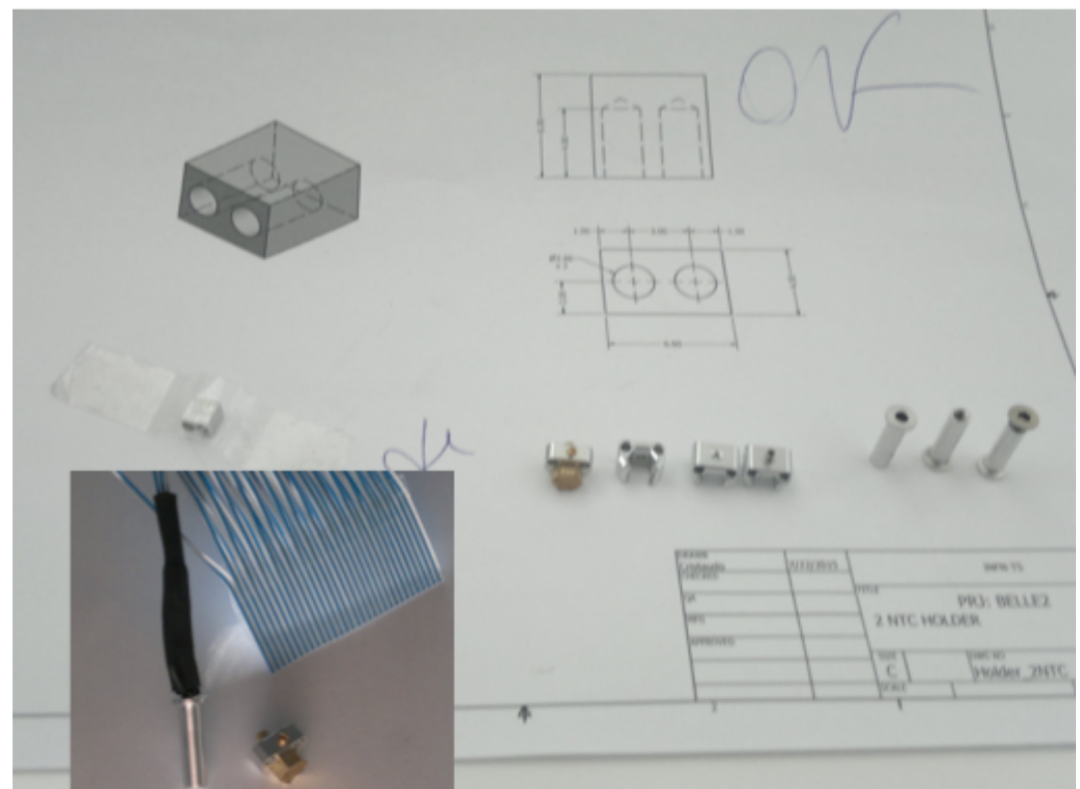
NTC final locations and fixing



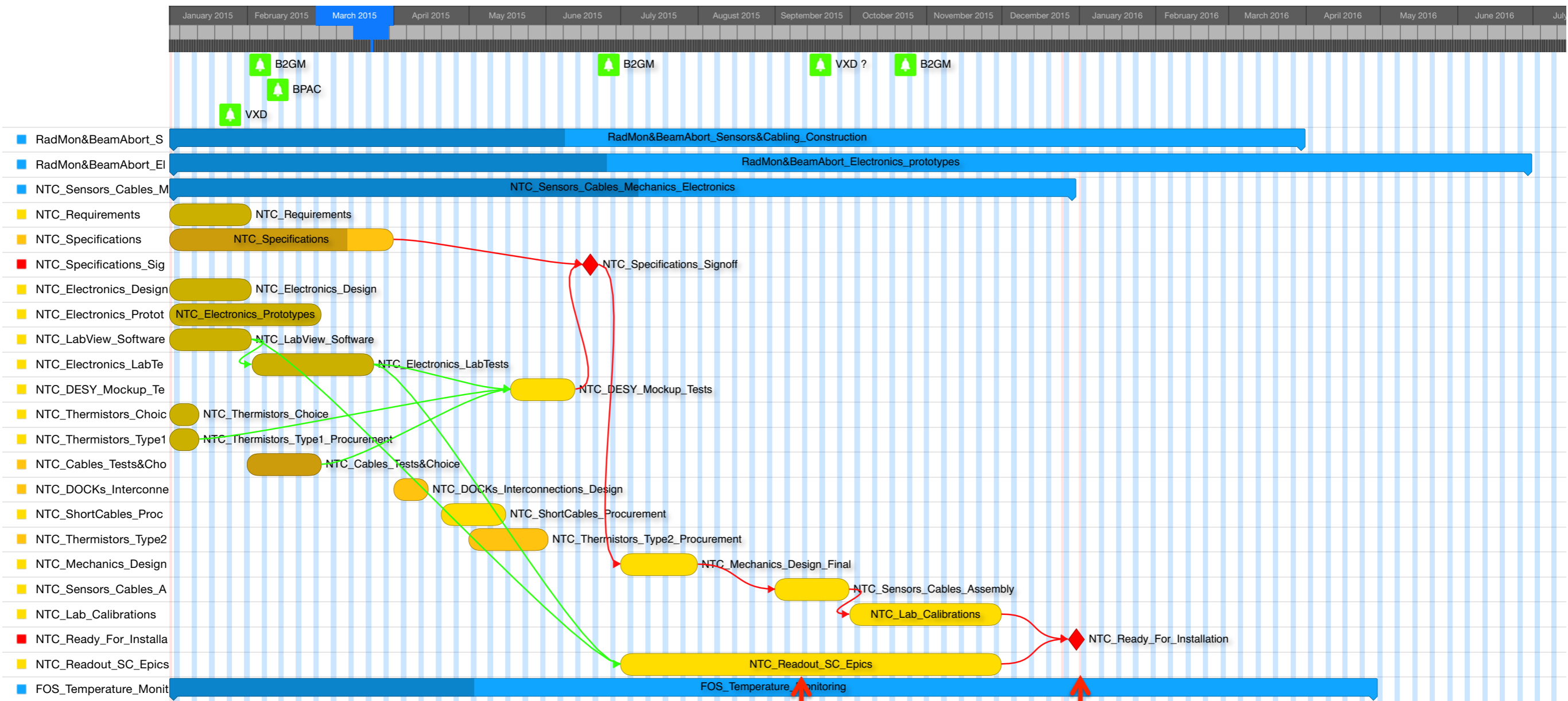
12 sensor pairs attached to the 12 half-rings supporting the SVD ladders:
4mm alignment holes in half rings L5 and L6, glued L3-4

16 sensor pairs on the inlets and outlets of the CO₂ cooling pipes:
on the “streuli connectors” of CO₂ inlets-outlets

A few (~8) positioned near fibers for cross-calibration



NTCs - schedule



We are here (VXD Workshop): essentially on track
non-critical delay on cables and sensors;

Goal: December 2015
ready for installations

DESY validation tests delayed; sign-off requested



3. Humidity Monitoring with sniffing pipes

- Agreed specifications (DESY + B2GM gemba)

4 sniffing/sucking pipes (2 inner, 2 outer dry volume)

Total output flow: about 50 litres/minute

CO₂ cooling fluid at -30°C; dew point < - 40°C

pipes diameter, layout outside the detector: to be decided

- Ongoing activities, 2015

Prototype sniffer with one Vaisala Dew Point Transmitter (*ready*)

Chilled Mirror Hygrometer for calibrations (*available*)

Calibrations and alarm signals/interlocks (*to be done*)

Test on DESY thermal mock-up (*delayed to beginning 2016*)

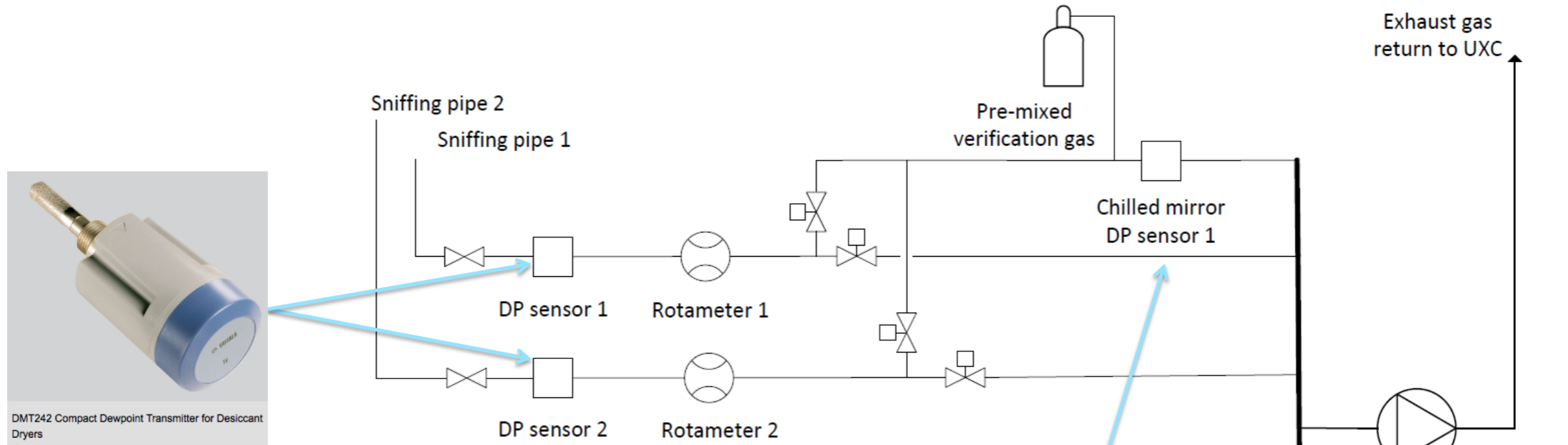
- Plans for 2016

Completion of equipment for 4 sniffing pipes (3 additional Vaisala)

PLC interlock interconnections and programming



Humidity interlock: prototype under test



Vaisala DMT242B
Dew Point Transmitters
[-60, +60]°C dew point range

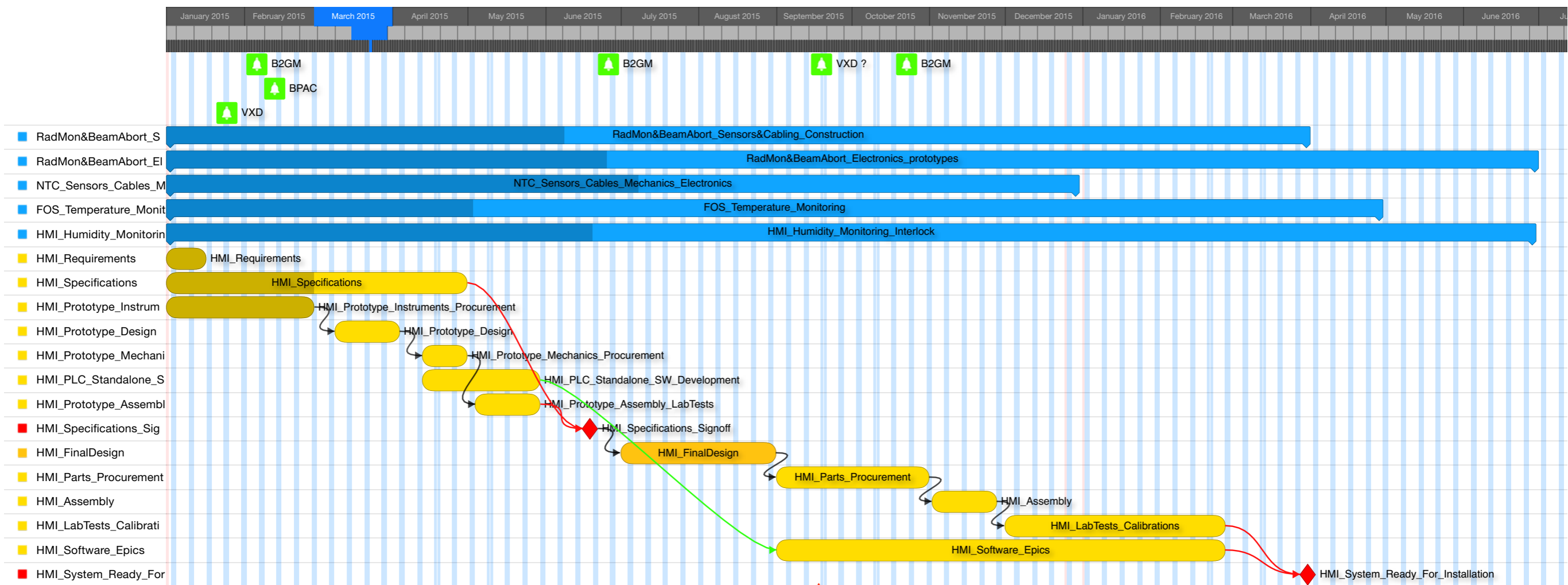
Rotameter
flux meters



Edgetech Dewmaster
Chilled Mirror Hygrometer
(for calibrations)

Pump

Dew point interlock: schedule



We are here (VXD Workshop):
 Prototype assembly completed,
 large contingency available.
 Specifications sign-off requested

Goal: April 2016
 ready for installations



Hardwired Interlocks

- **VXD (PXD and SVD) hardwired interlocks**
from several conditions, to VXD power supplies
from VXD, to Injection Control (see Nakayama-san) ?
- **VXD power supplies interlock: Schneider PLC**
initial exercise planned for tests at the DESY mock-up:
Inputs: from NTCs and DewPoint sensors
Outputs: to CAEN SVD power supplies

complete specifications? Google spreadsheet

<https://docs.google.com/spreadsheets/d/1phObzUJqPZeJmHaMWo6xS9jYZysFMDsT5ReaLIFli4c/edit?usp=sharing>

- **Injection Control**

See Nakayama-san's slide, shown at the B2GM interlock meeting

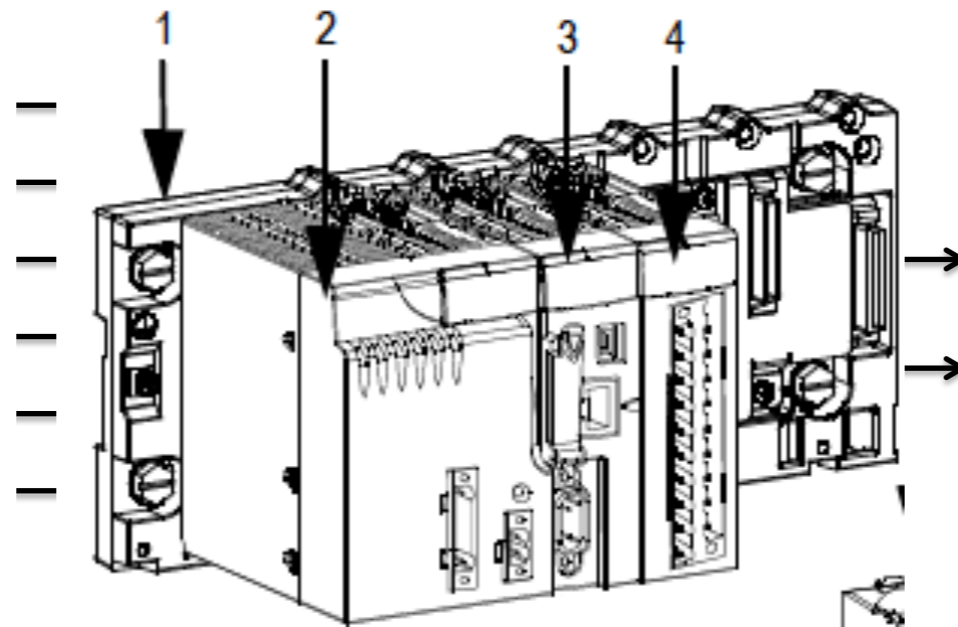


SVD + PXD Interlocks

INPUTS

Temperature (NTCs)
Dew point (Vaisala)
Sniffer Pump(s)
Cooling plant failure
Beam Abort
Fire alarm?
...etc

INTERLOCK LOGICS



OUTPUTS

PXD power supplies
VXD power supplies
(not segmented)
...etc

Programmable Logic Controller (PLC)

Schneider M340 – cpu BMX P34 2030

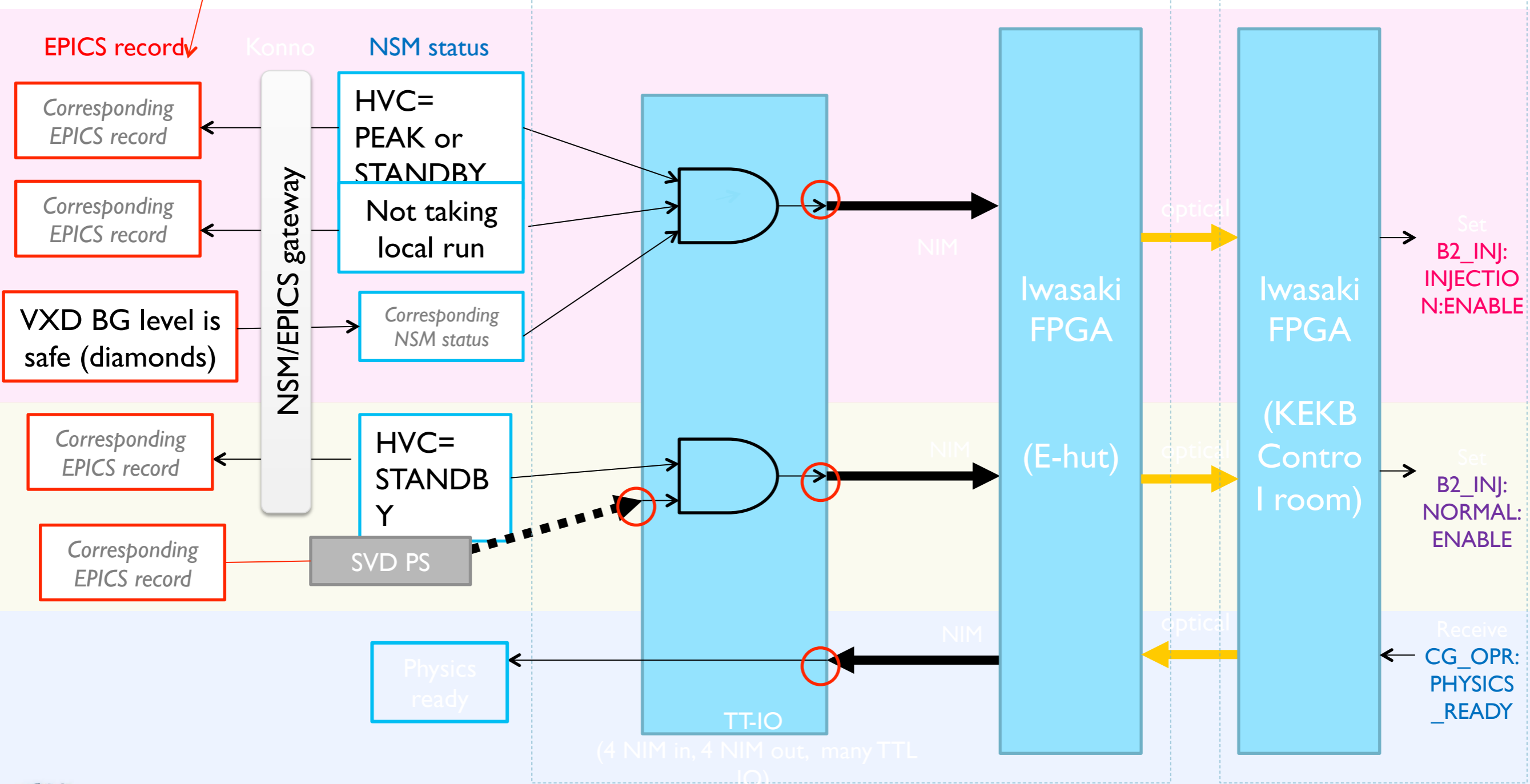
Modbus/EPICS drivers exist! expandable

kit (p.s. + cpu + I/O + software) now functional

Local expertise

Injection control diagram

These EPICS records should be readable from KEKB EPICS via CA gateway



Summary of issues for discussion

- Radiation & Beam Abort

Cable grooves (PXD); cables path; Docks patch panel

- Temperature: FBG fibres

Glueing on clamps; outer cylinder details; additional humidity

- Temperature: NTC

Layer 3-4 support cones glueing; cable path, docks space

- Humidity (sniffers)

Pipes path outside the detector (length not a problem)

- Hardwired interlocks

Progress towards an initial definition of conditions

Tests of PLC interface with interlock sources and power supplies

