Tests of PCB flex (GPF1, Graphic PCB Flex n°1) equipped with 3 sensors

PLUME Phone meeting

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Introduction

- Last meeting : preliminary results on the calibration showed that the discriminator offset was shifted depending on the sensors activity
- Since last meeting : calibrations were performed on GPF1 sensors
- Calibrations = discriminators scans
- Study focused on the discriminators + pixel behaviours depending on the sensors activity (if one or more sensors is/are ON or OFF)
- A slide on the dropping power supply voltage along the flex

Outline

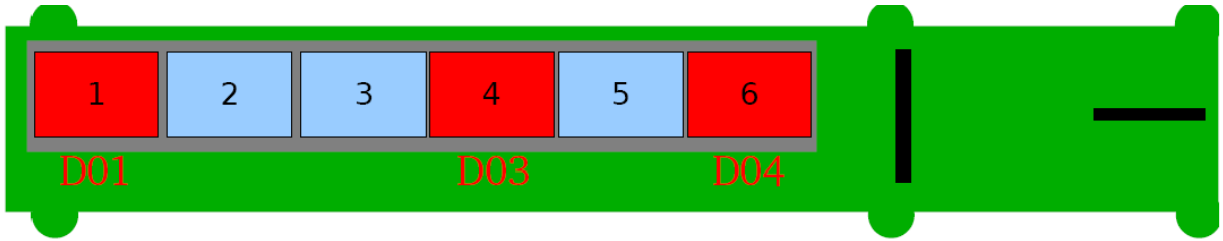
- What is turning ON/OFF a sensor on GPF1 ?
- Dropping voltage on the flex
- The offset parameter shift
- Is the offset parameter shift a problem ?
- Next steps
- Conclusion

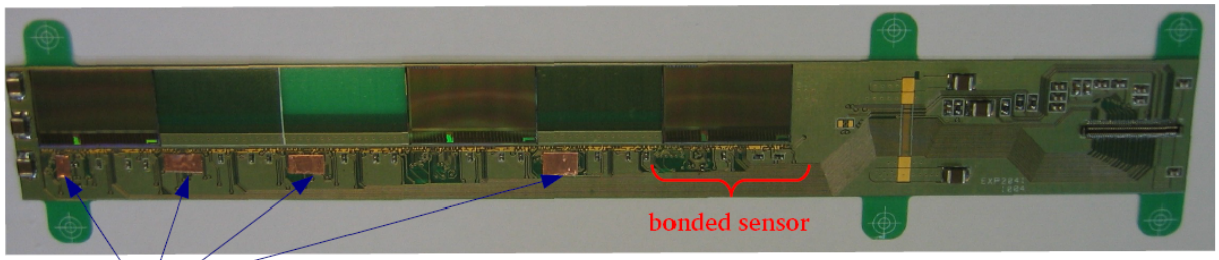
What is turning ON/OFF a sensor on GPF1 ?

- **For sensor 4 and sensor 1**, there are two ways to « turn off » the sensor by JTAG :
  - ILVDS=32 and ILVDSTx=0 :
  sensor is working (internal logic), therefore it is « ON »
  but the LVDS output buffer are disactivated

  - ILVDS=0 and ILVDSTx=0 :
  sensor is not working therefore it is « really OFF »
  and the LVDS output buffer are disactivated

- **For sensor 6**,it's not possible to do the same as it sends back its CLK and SYNC signal to synchronize the data.
  Therefore, when studying sensor 4 or 1, sensor 6 is said to be turned off by setting all the DAC thresholds to their maximum (255 uDAC) so that there are no discriminators activated, but the sensor is working

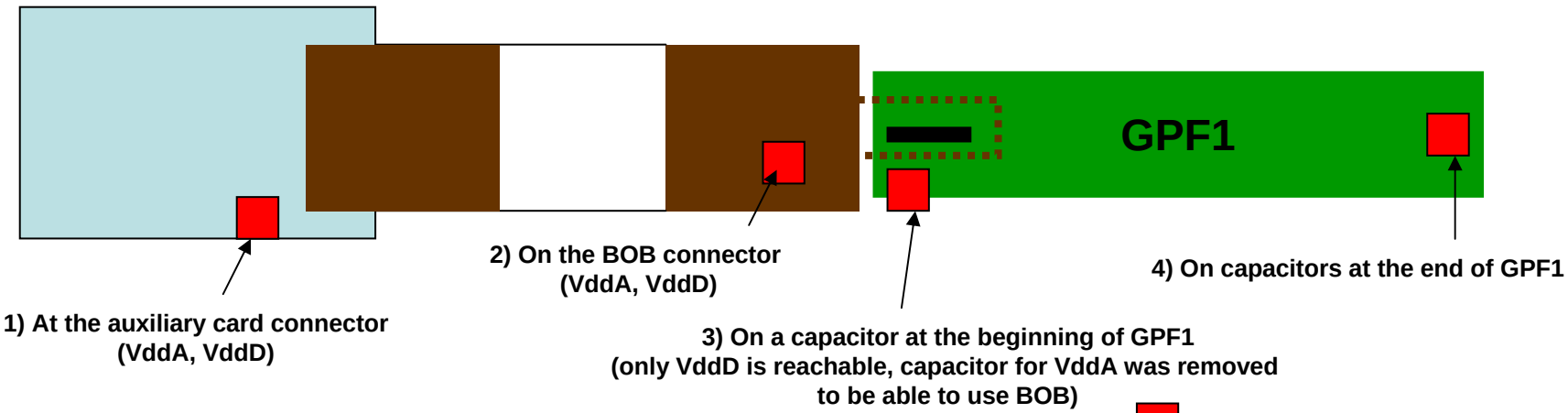




copper scotch to make the bridge between TDO & TDI

Dropping voltage on GPF1

- Different measurements for VddA and VddD according to different conditons :
  - 650M11 means all sensors are set up to 50% discriminator activation and that sensors 4 and 1 are ON as defined previously (ILVDS=32 and ILVDSTx=0), sensor 6 is studied in nominal conditions
  - 650M00 means all sensors are set up to 50% discriminator activation and that sensors 4 and 1 are OFF as defined previously (ILVDS=0 and ILVDSTx=0), sensor 6 is studied in nominal conditions
  - 650M10 means all sensors are set up to 50% discriminator activation and that sensor 4 is ON and sensor 1 is OFF, sensor 6 is studied in nominal conditions
  - 450M11(3V) means all sensors are set up to 50% discriminator activation and that sensor 6 is « OFF » and sensor 1 is ON, sensor 4 is studied when VddD=3V
- ***Rmk 1 :*** there are resistors of 0.1Ω on the power supply to measure the current, therefore the voltages are higher at the power supply
- ***Rmk 2 :*** All values in the table are in Volts
- ***Rmk 3 :*** the 650M11 configuration is used as a « reference », which means that the voltages are set in this configuration and is not adjusted for the other measurements



Dropping voltage on GPF1

Config	1) Aux. Card connector		2) BOB connector		3) On a capacitor (at the beginning of GPF1 = ON the flex)	4) On capacitors at the end of GPF1 (ON the flex)	
	VddA	VddD	VddA	VddD	VddD	VddA	VddD
650M11	3.401	3.405	3.365	3.374	3.325	3.309	3.302
650M00	3.452	3.464	3.420	3.440	3.414	3.351	3.404
650M01	3.405	3.433	3.370	3.400	3.374	3.317	3.360
650M10	3.421	3.433	3.391	3.401	3.376	3.342	3.358
60M11	3.400	3.438	3.371	3.407	3.382	3.317	3.366
60M00	3.443	3.471	3.417	3.455	3.440	3.381	3.432
100M11	3.404	3.412	3.369	3.373	3.342	3.313	3.320
650M00(3V)	3.44	3.170	3.418	3.153	3.136	3.381	3.123
650M11(3V)	3.405	3.127	3.371	3.092	3.064	3.315	3.040
450M00(3V)	3.422	3.148	3.393	3.122	3.099	3.343	3.084
450M11(3V)	3.405	3.130	3.371	3.096	3.069	3.314	3.039
150M00(3V)	3.423	3.153	3.394	3.129	3.107	3.347	3.083
150M11(3V)	3.405	3.129	3.371	3.096	3.069	3.315	3.038

Conlusion on the dropping voltage on GPF1 in calibration mode conditions

- **Dropping voltage for VddD on the flex : in average ~20 mV**
- We notice that the dropping voltage on the BOB is important in average for VddD ~30 mV, based on the current consumption for a standalone chip on PCB at 50% discriminator activated (170 mA analogue, 120 mA digital), we deduce that the dropping voltage for VddA in the BOB will be ~45 mV (factor ~3/2). Therefore we can deduce the dropping voltage for VddA ON GPF1 (reminder : there is no way to measure it directly at the beginning of the flex)
- **Dropping voltage for VddA on the flex : in average ~10 mV**

static measurements

Voltage sweep results from measurements on one MIMOSA26 on PCB

(results from PHAM Thanh Hung)

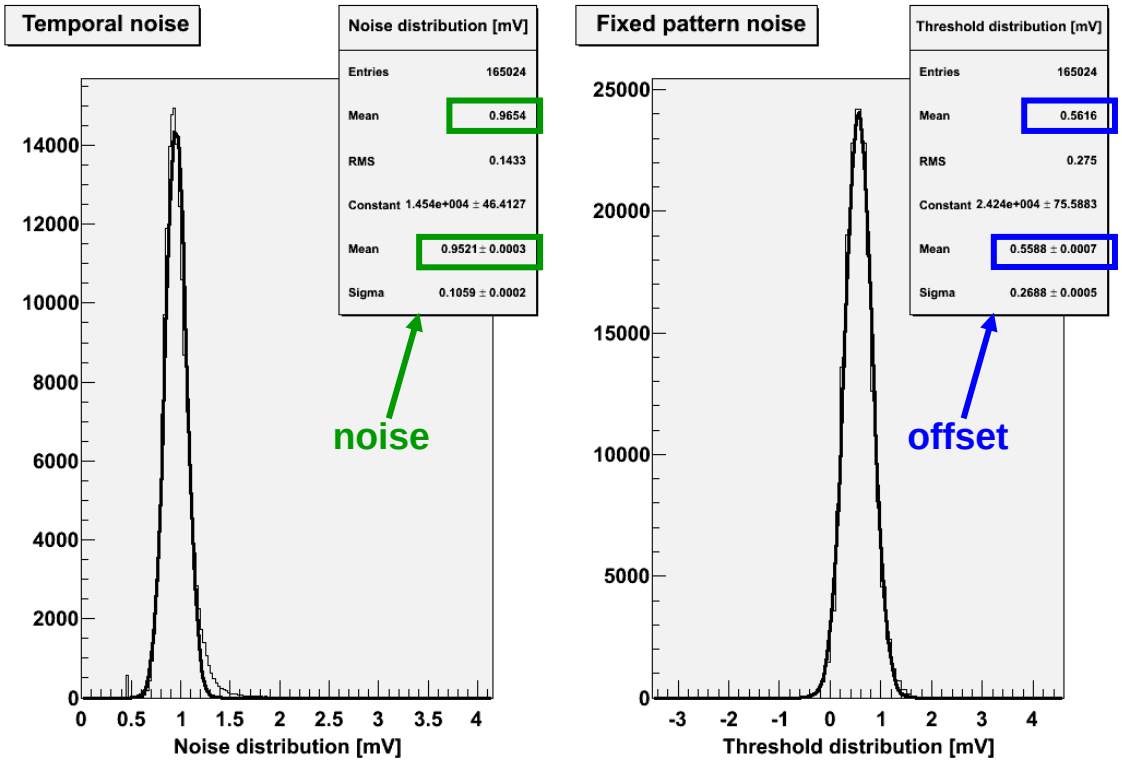
- Influence of the variation of power supply VddA & VddD on MIMOSA26 calibration parameters
- For a variation of **500 mV on VddA** at worst there is a **shift of 4.0 mV** on the offset (FPNμ) parameter (depending on the submatrix)
  Therefore for at most **50 mV** variation on VddA we should have a maximum shift of **~0.4mV**
- For a variation of **500 mV on VddD** at worst there is a **shift of 1.8mV** on the offset (FPNμ) parameter (depending on the submatrix)
  Therefore for at most **50 mV** variation on VddD we should have a maximum shift of **~0.18mV**

Therefore for GPF1 with at most 50 mV dropping voltage it should not be a problem

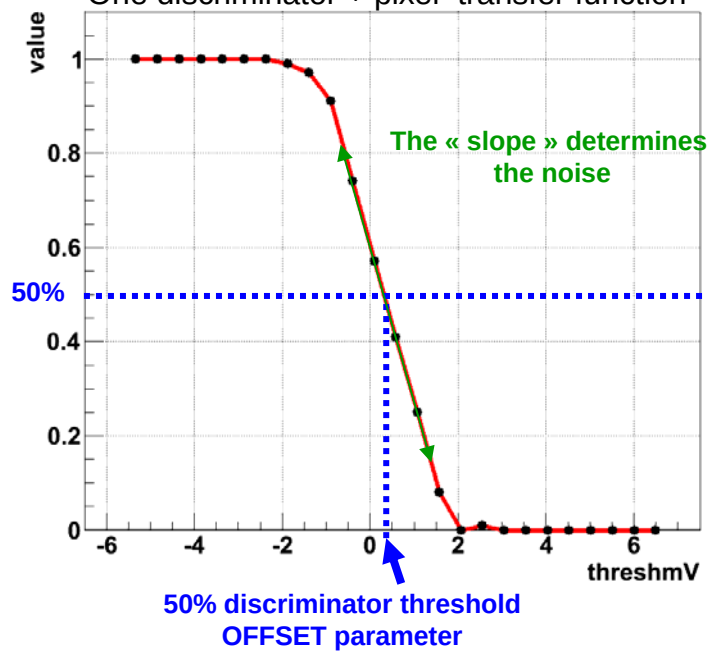
What is the offset parameter ?

- Important to determine the discriminator threshold S
- Approcimation : only mean values are taken into account
- **S = offset + n × noise**

Parameters histograms for all pixels



One discriminator + pixel transfer function



Sensor 6 offset param. shift ~ +1.7mV in average

1 NOMINAL, M11, chip6

2 VddD=3V, M11, chip6

3 VddD=3V, M00, chip6

4 Vclp=2.4V, M11, chip6

5 Vclp=2.4V, M00, chip6

6 NOMINAL NO SUZE, M11, chip6

7 NOMINAL NO SUZE, M00, chip6

8 NOMINAL Discri only, M11, chip6

9 NOMINAL Discri only, M00, chip6

10 NOMINAL Vclp bout flex, M11, chip6

11 NOMINAL Vclp bout flex, M00, chip6

12 Vclp=2.4V, au bout flex, M11, chip6

13 Vclp=2.4V, au bout flex, M00, chip6

14 NOMINAL Vclp GND au bout flex, M11, chip6

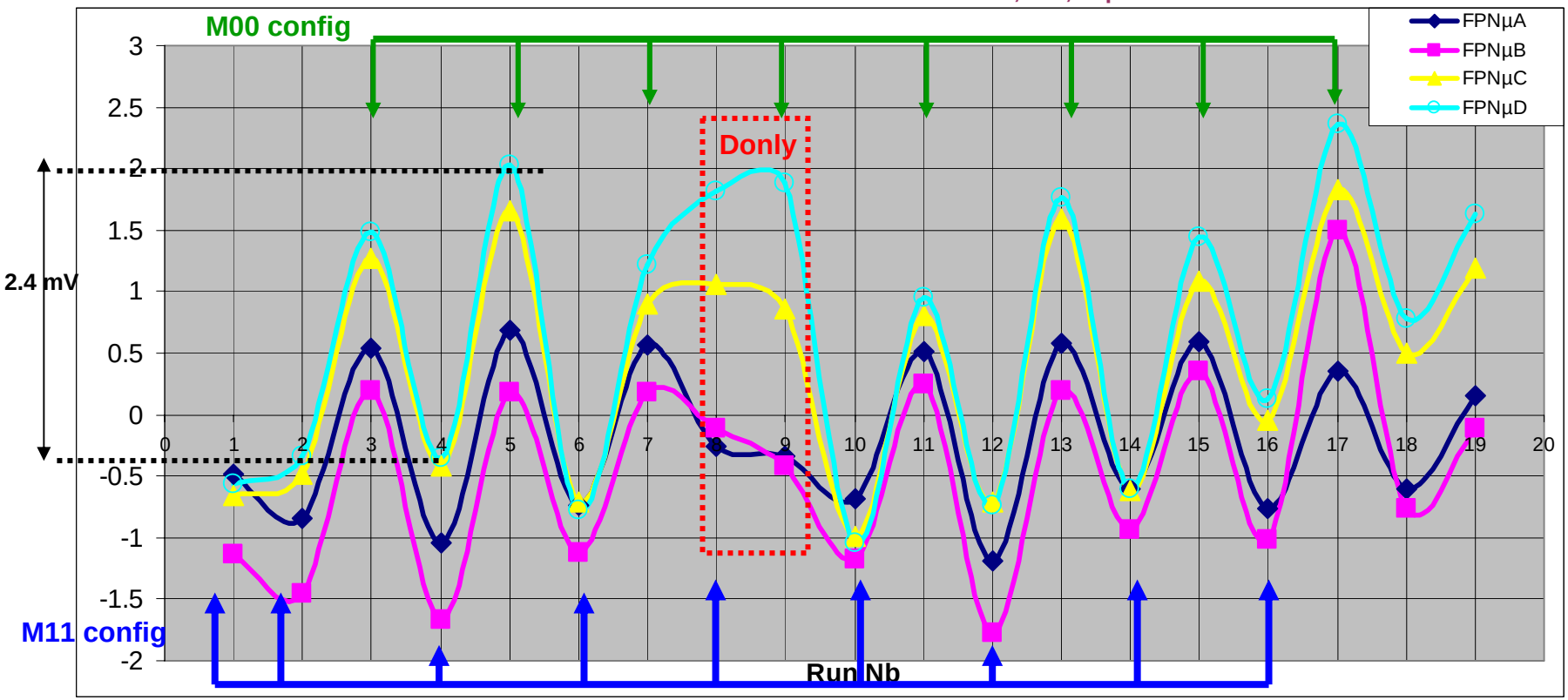
15 NOMINAL Vclp GND au bout flex, M00, chip6

16 VddD=3V,M11,chip6

17 VddD=3V,M00,chip6

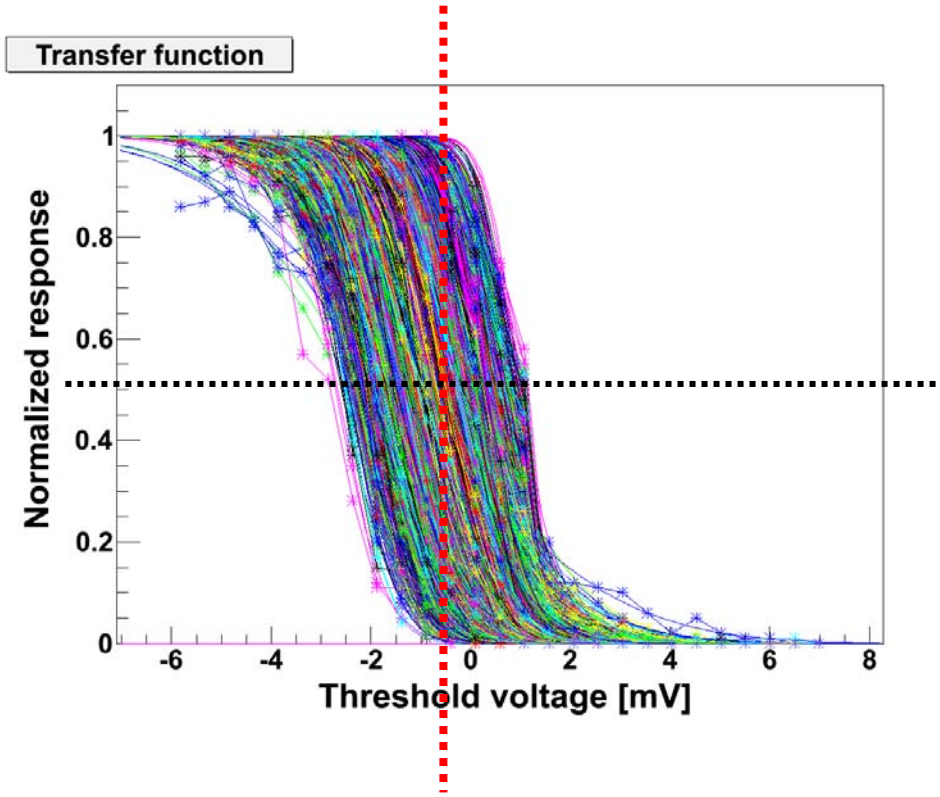
18 VddD=3V,M01,chip6

19 VddD=3V,M10,chip6



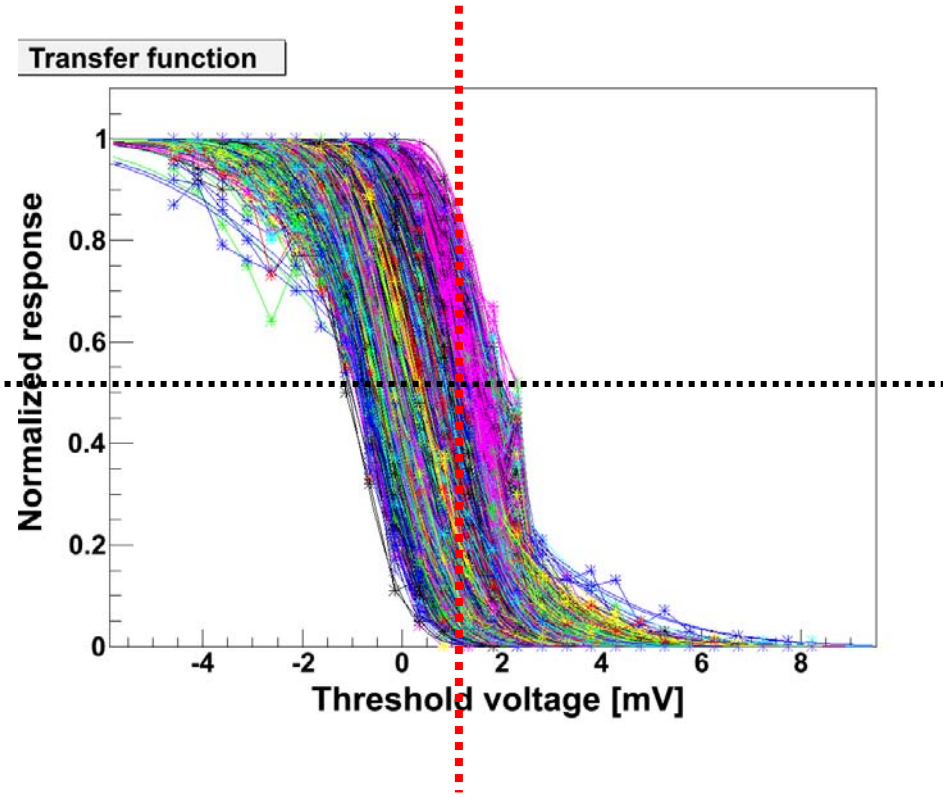
Sensor 6 transfer functions examples

Run n°[13/2], **M11**



-0.838 mV

Run n°[16/3], **M00**



0.995 mV

~ 1.8 mV shift for matrix A

Sensor 4 offset param. shift ~ -1.5mV in average

1 NOMINAL, M11, chip4

2 NOMINAL, M00, chip4

3 VddD=3V, M11, chip4

4 VddD=3V, M00, chip4

5 Vclp=2.4V, M11, chip4

6 Vclp=2.4V, M00, chip4

7 NOMINAL NO SUZE, M11, chip4

8 NOMINAL NO SUZE, M00, chip4

9 NOMINAL Discri only, M11, chip4

10 NOMINAL Discri only, M00, chip4

11 NOMINAL Vclp bout flex, M11, chip4

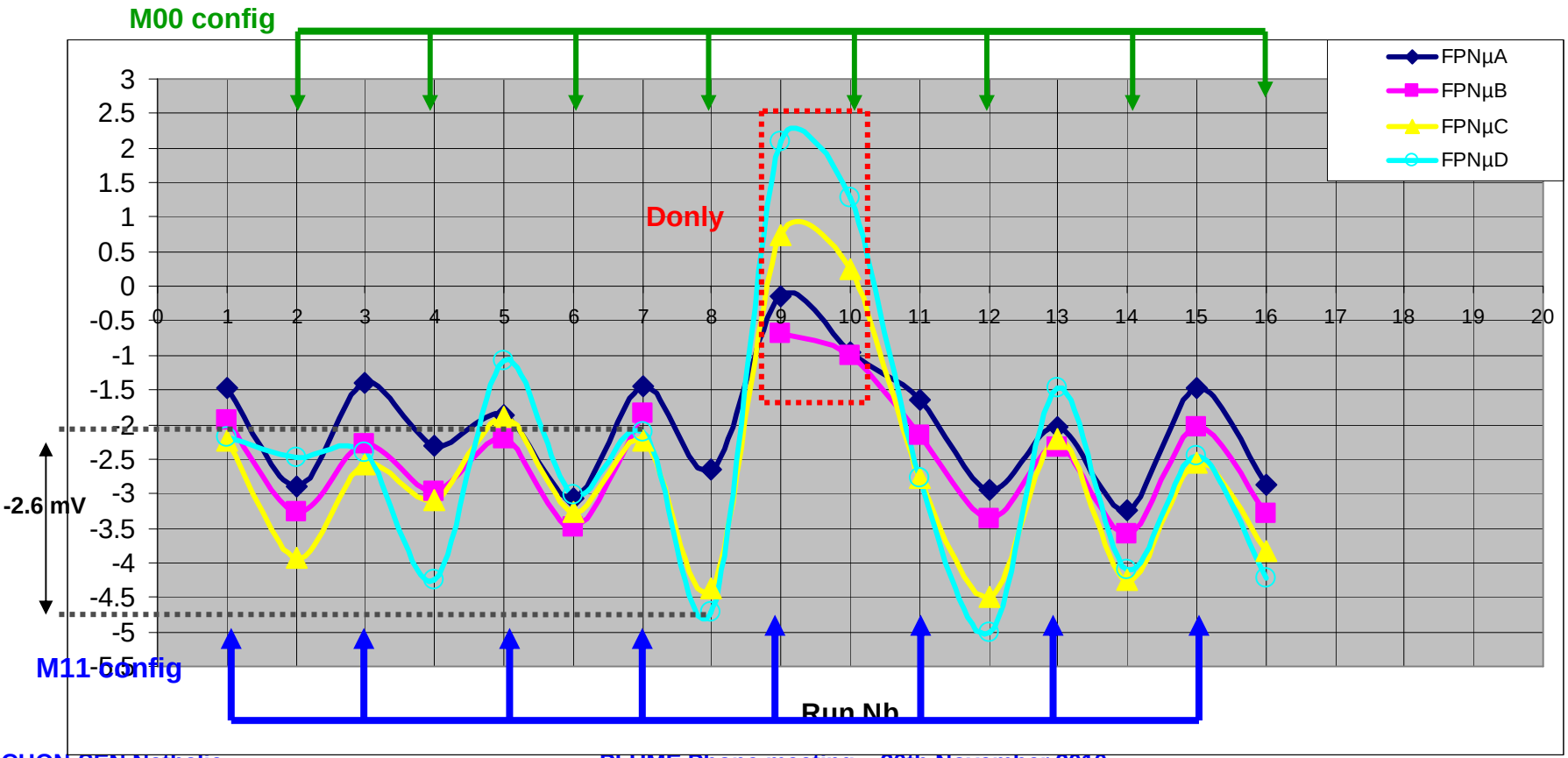
12 NOMINAL Vclp bout flex, M00, chip4

13 Vclp=2.4V, au bout flex, M11, chip4

14 Vclp=2.4V, au bout flex, M00, chip4

15 NOMINAL Vclp GND au bout flex, M11, chip4

16 NOMINAL Vclp GND au bout flex, M00, chip4



Conclusion

- Dropping voltage seems not to be a problem on GPF1

- There is a shift on the offset parameter depending on the activity on GPF1 in calibration discrimator scan mode.
  This shift is ~+1.7mV for sensor 6 and ~-1.5mV for sensor 4
  Sensor 1 offset parameter shift could'nt be estimated as its dispersion was too important in nominal conditions to take the numbers into account

- There are several other tests that could be done on GPF1 in order to search for the origin of the offset parameter shift
  - activity of the sensor (decrease the number of active pixels, redo the measurement with the non studied sensors at a higher threshold)
  - VddA better control (I mainly monitored VddD)
  - check if the problem really don't come from the power supply of sensors (turn off sensors but emulate them by a resistor with the same current consumption) and not from the sensor activity itself
  - to precise at the sensor architecture level what does turning off a sensor means (Vclp power supply line by line even for non used sensors)
  - …

But we have to move on to the next steps (radioactive source, thermal test bench etc) so additional electronic tests would not be done on this purpose.

Next steps

Not a priority list

- Tests with radioactive source, cluster multiplicity, fake hits rate
- Calibration of OKF3
- Thermal test bench to set up (mechanical pieces to be designed for air flow cooling and devices to be bought (?))
- We have decided not to reproduce the jumper cables for the moment
  => tests with the jumper cable (data of sensor 6 and sensor 1 unused, crosstalk with CLK, CLKD)
- New soles to be made for the new OPTIPRINT flexes