ECAL Laser Monitoring Upgrade for HL-LHC

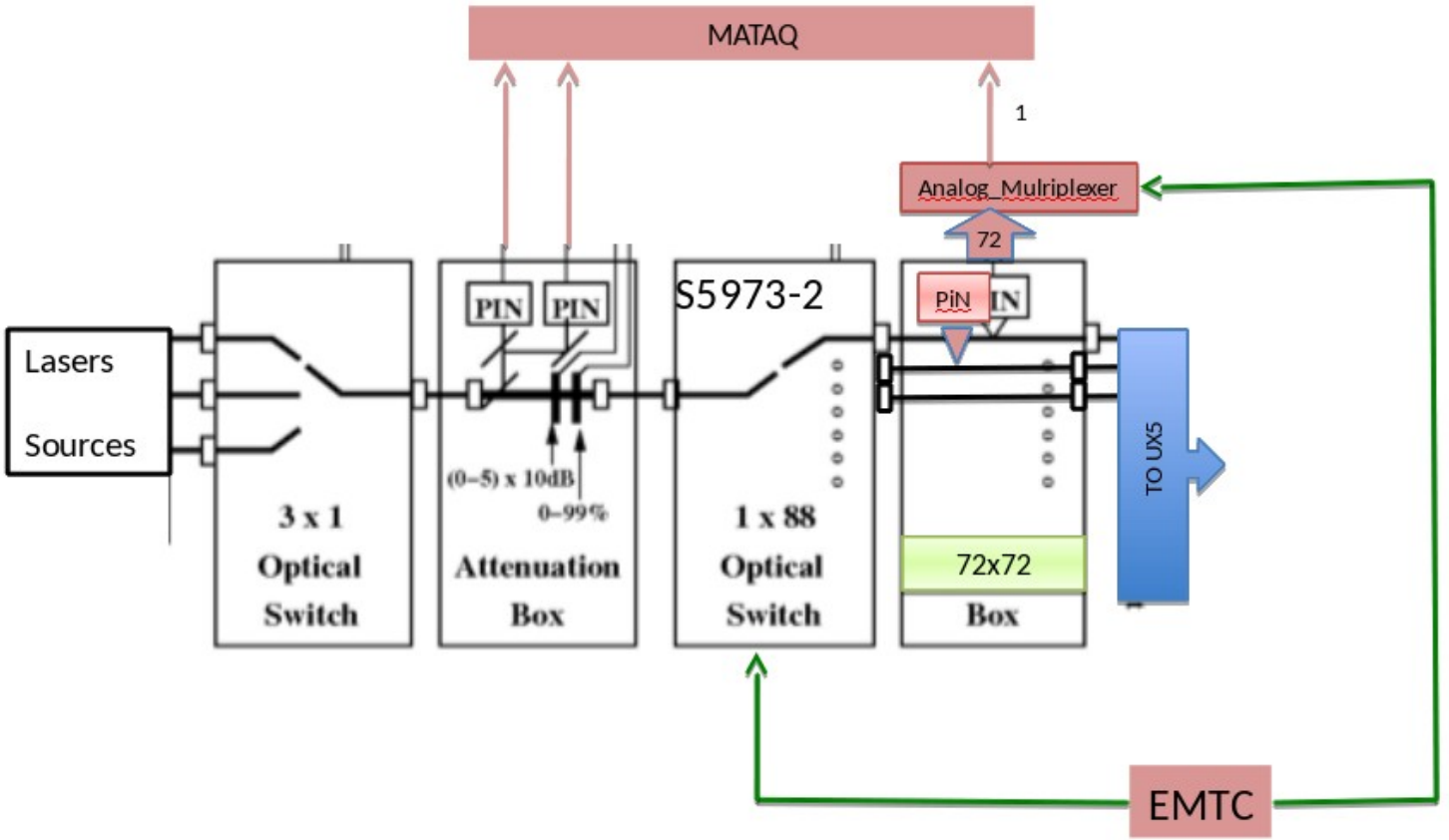
M. Déjardin
Irfu/SPP, CEA-Saclay

Some preliminary tests

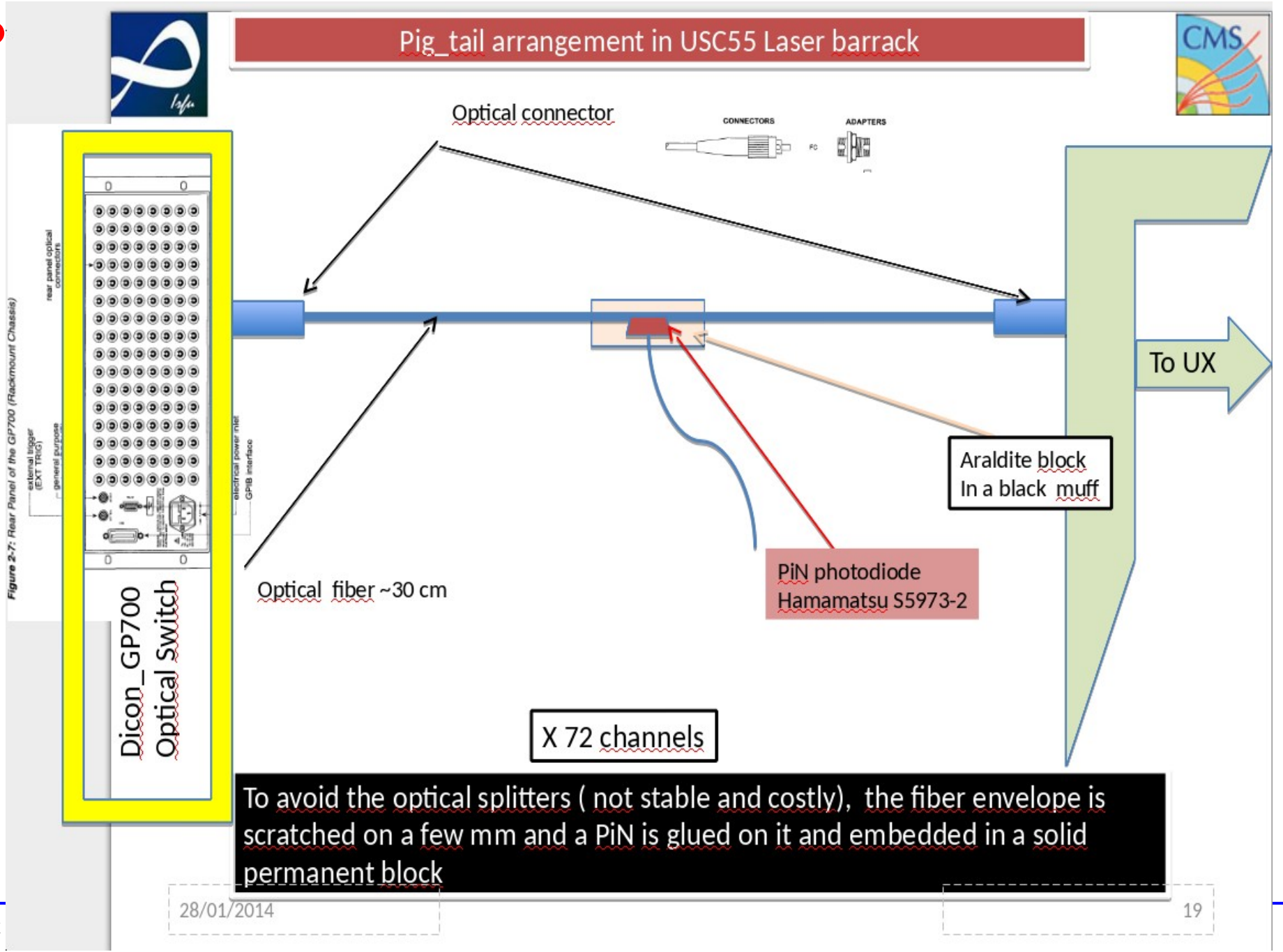
August 28, 2014

Remember JLF presentation

Option 5 (A) ALL parts in USC55 Laser Barrack

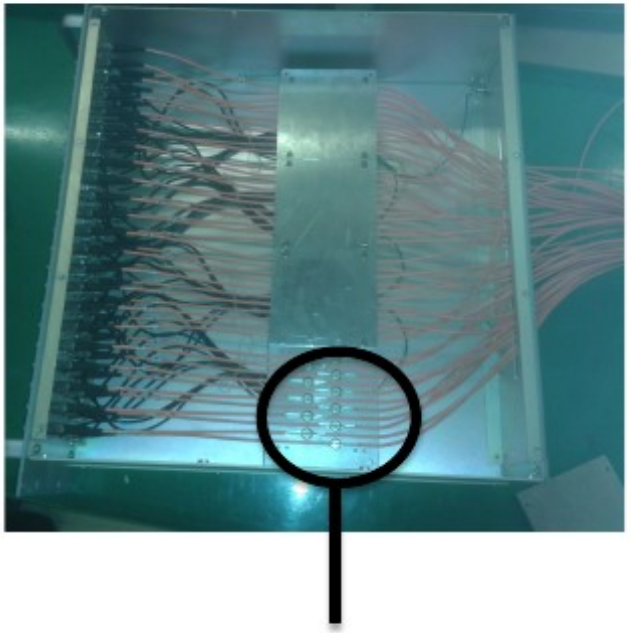


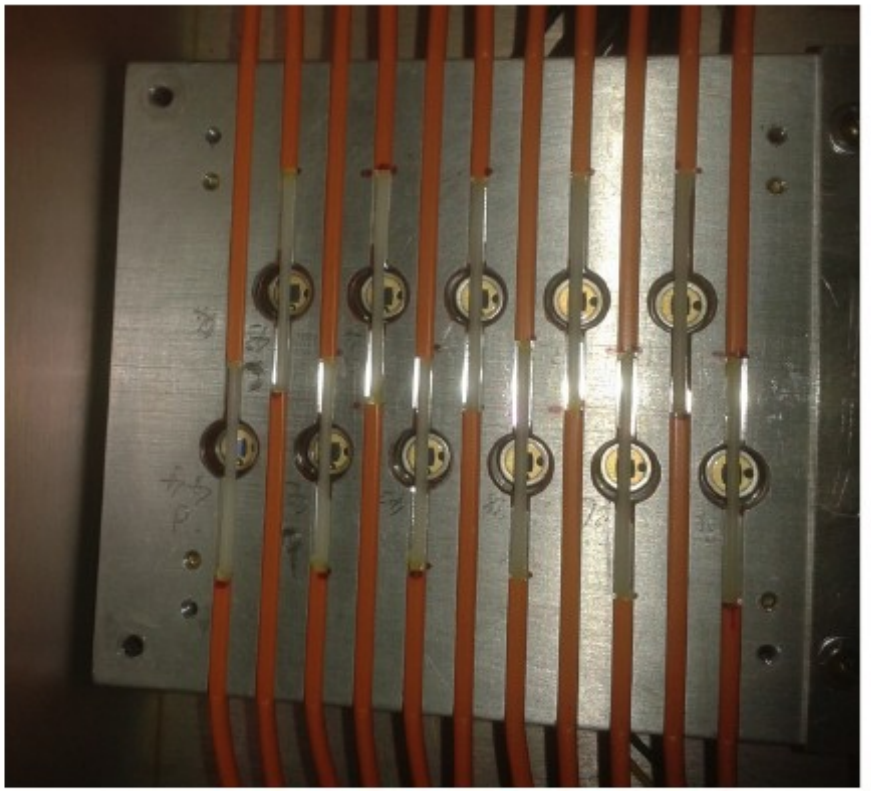
Remember JLF presentation



Remember JLF presentation

Pigtail Boxes found in B.27 basement

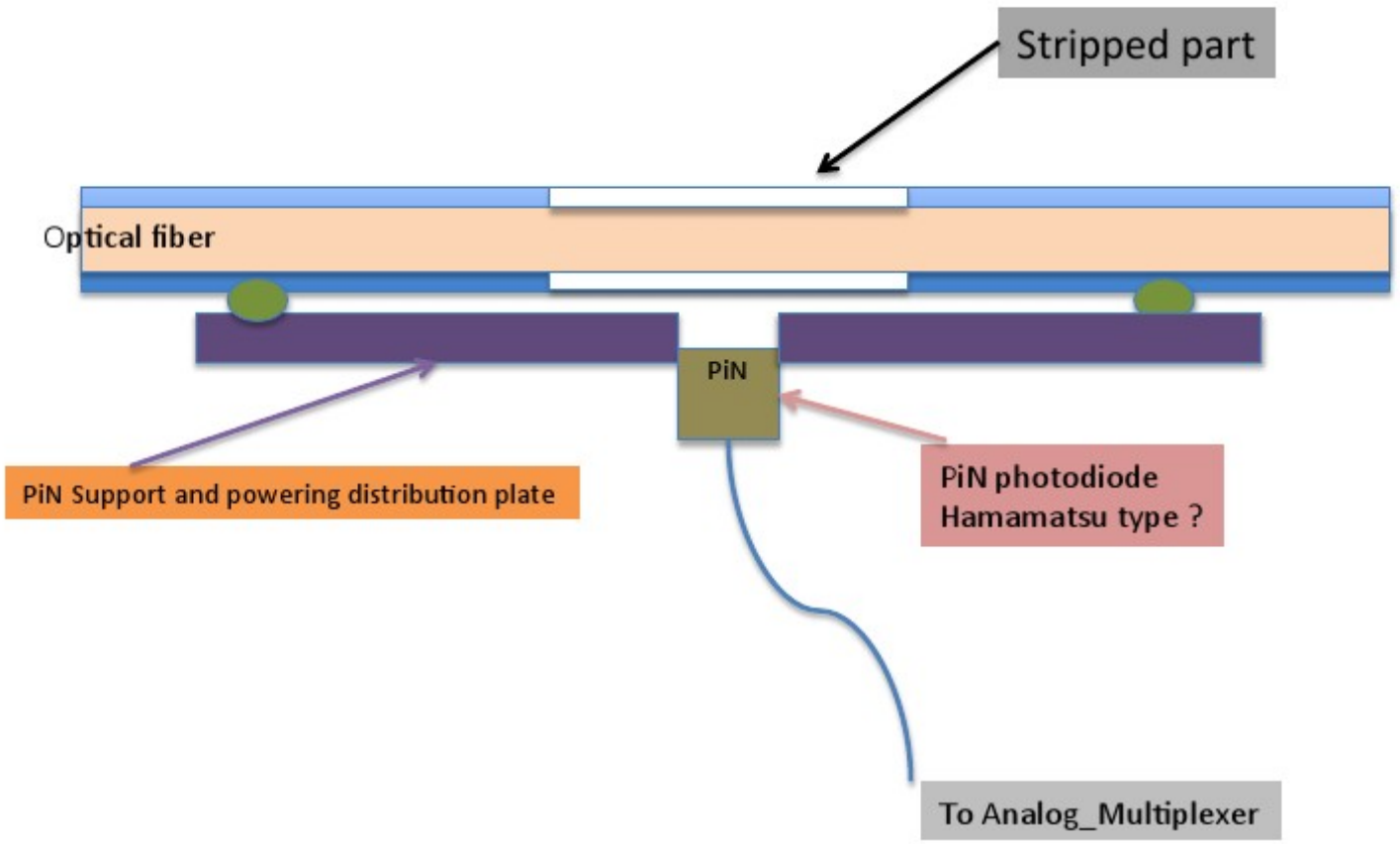




We have 2 boxes with 44 each

Remember JLF presentation

Pig_tail Detail



30/01/2014

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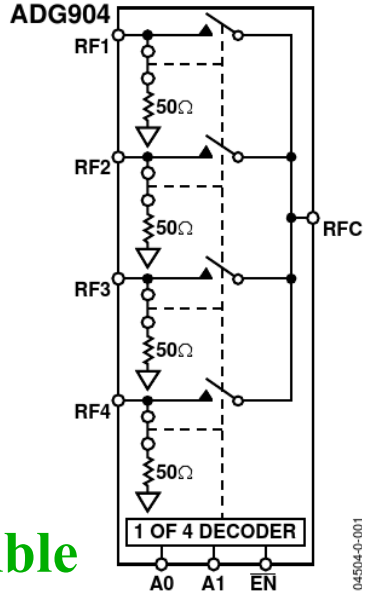
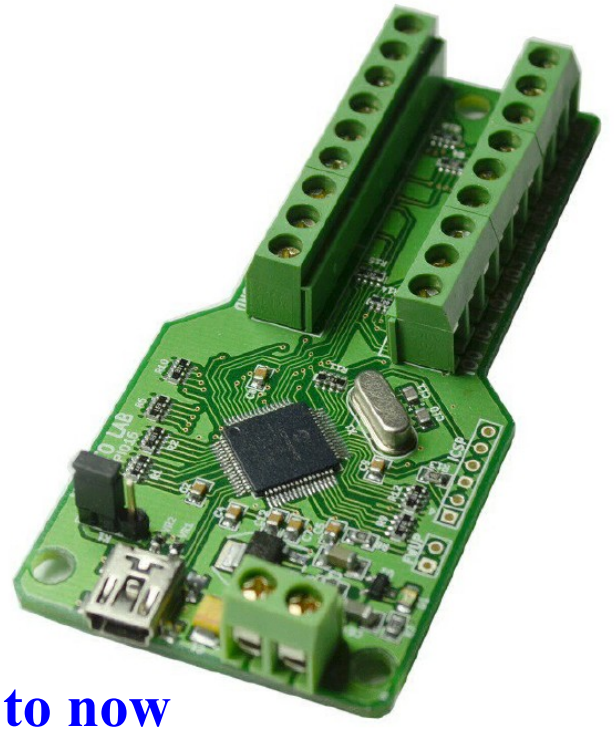
What we have in hands

- **Monitoring box from Caltech**
  - **Designed for laser and switch tests**
  - **2x44 stripped fibers**
  - **Equipped with PIN diodes**
    - ► **Hammamatsu S1223**
      - **2.4x2.8 = 6.6 mm² effective photosensitive area**
      - **30 MHz Cutoff frequency**
      - **10 pF @ 20V**
      - **0.2 A/W photosensitivity @ 447 nm**
      - **Negative signal output**

What we need

- Fast PIN diodes
  - Target diodes
    - ► Hammamatsu S5973 (BW~1GHz)
- Fast multiplexers
  - 44->1
  - Target chip
    - ► ADG904
      - 4->1 mux
      - 2.5GHz BW
      - CMOS compatible

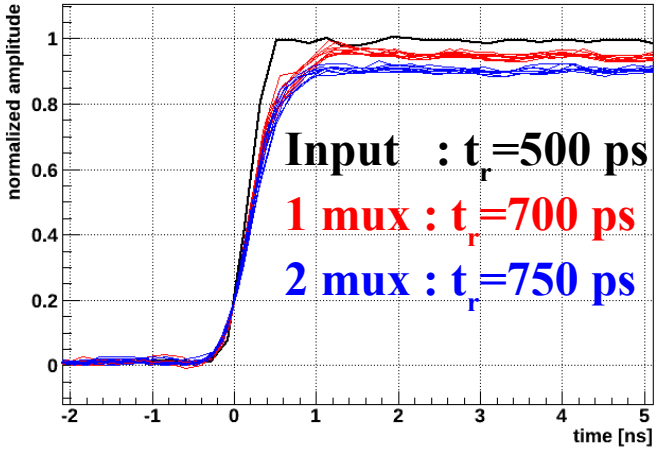




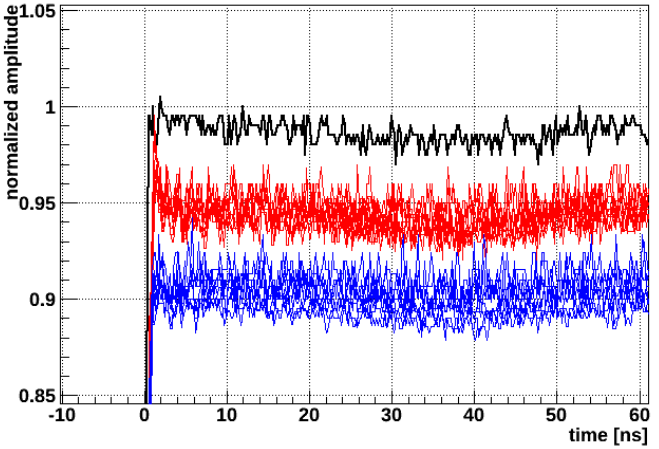
- Connection with CMS
  - Use laser supervisor
  - USB-GPIO module
- Light measurement
  - Matacq channels 3 and 4 not used up to now

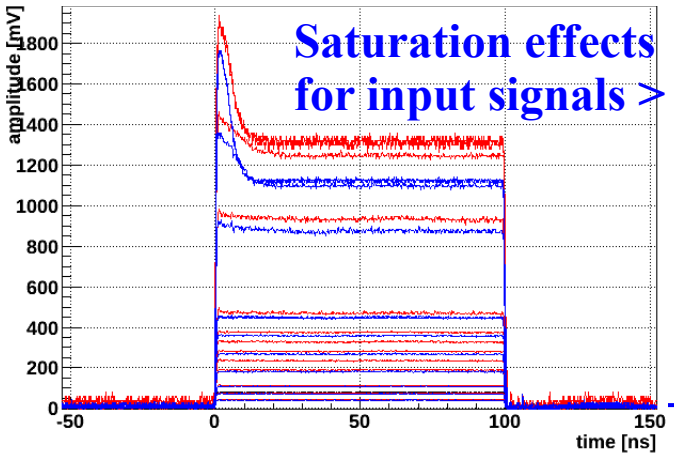
Tests done so far

- **Multiplexer**
  - **Test mux performances and cascade possibility**
    - ► Send square signal (Tr=500 ps)
    - ► Look at output after 1 or 2 mux stages
    - ► Look at timing performances, attenuation, linearity and crosstalk

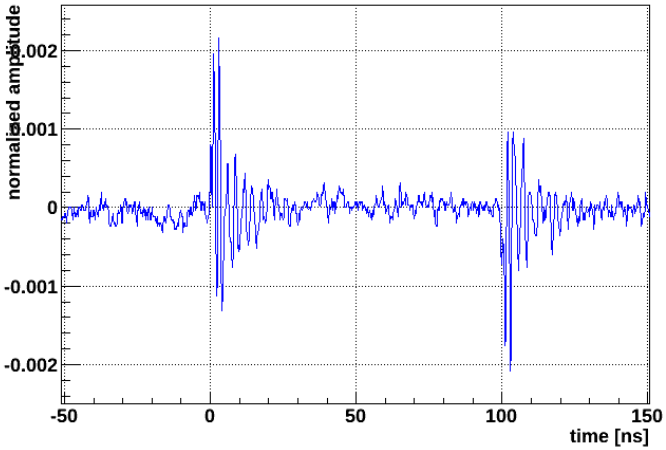


Input : 0.99
1 mux : 0.95
2 mux : 0.91
Attenuation = 5%/stage



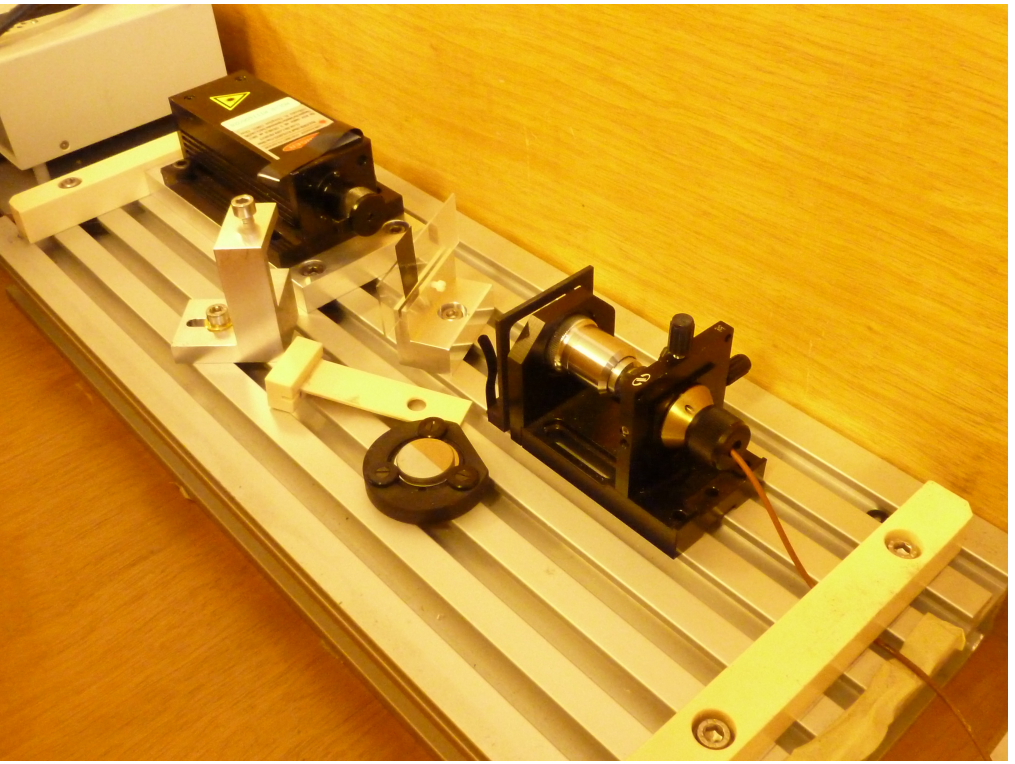


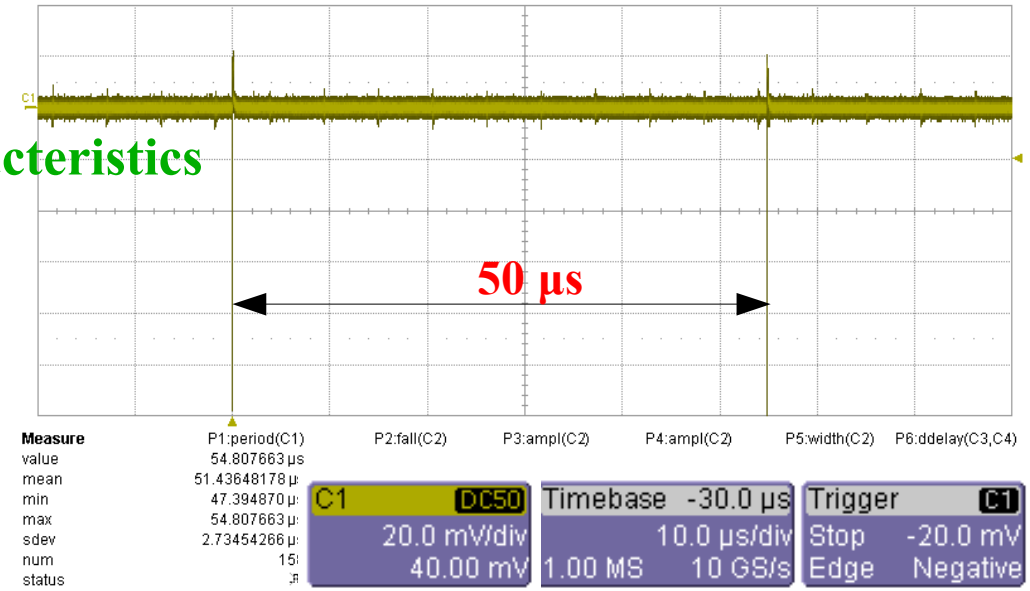
Selected channel : 2
1V on channel 1
Parasitic signal seen: 2 mV
(decrease with rising time)
-> OK for laser pulses

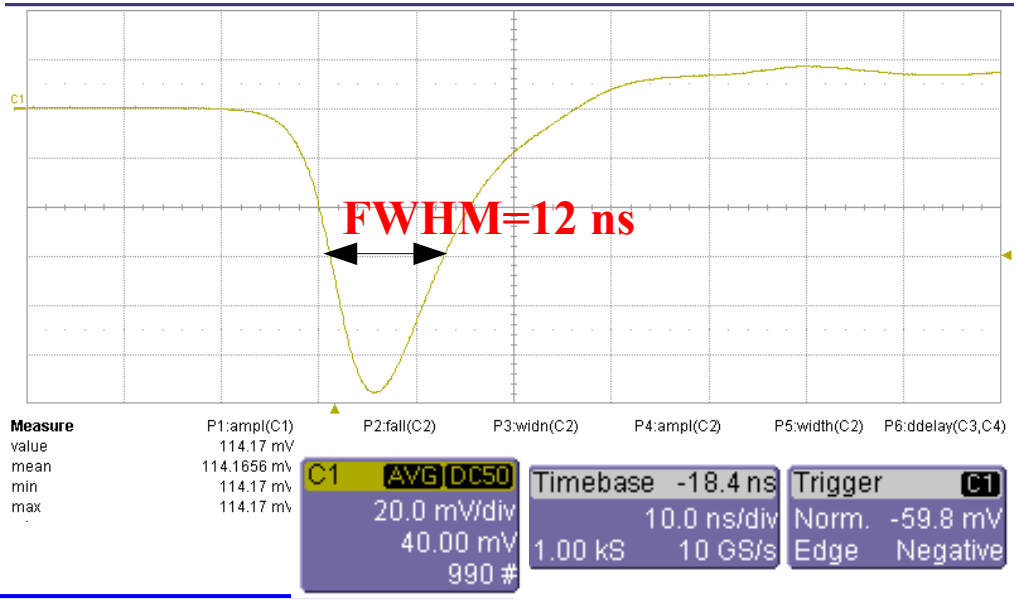


Look at light

- **Use DPSS laser 532 nm 50 mW 20 kHz**
  - **Not yet calibrated**
    - ► **2.5 uJ/pulse from known characteristics**

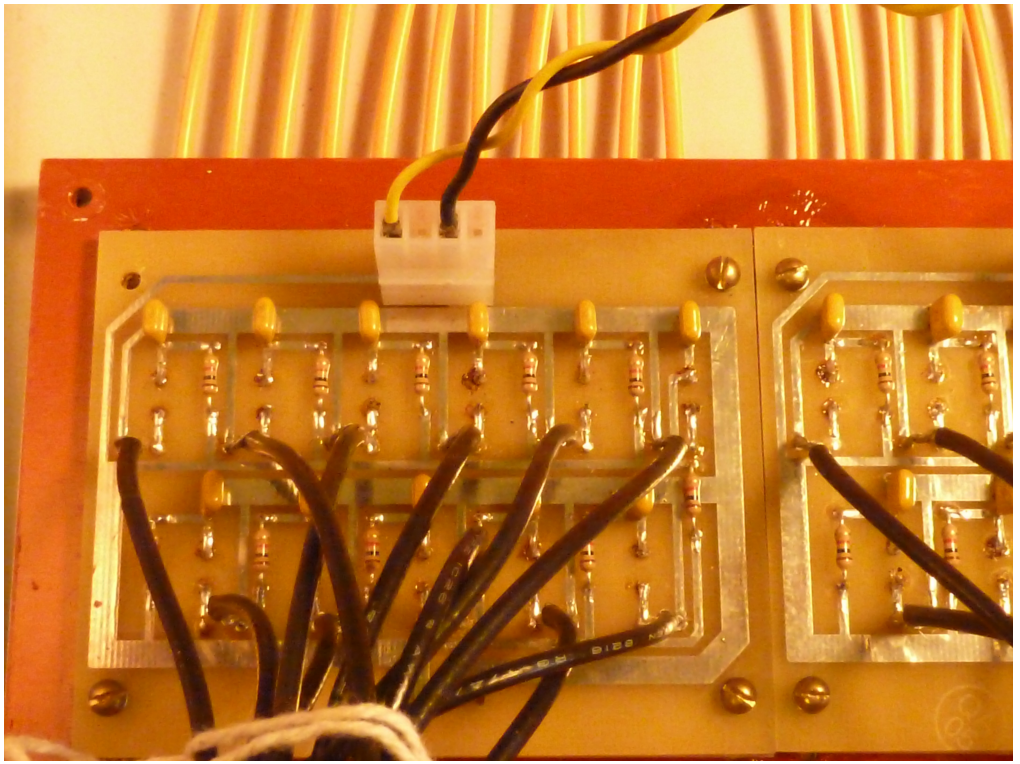


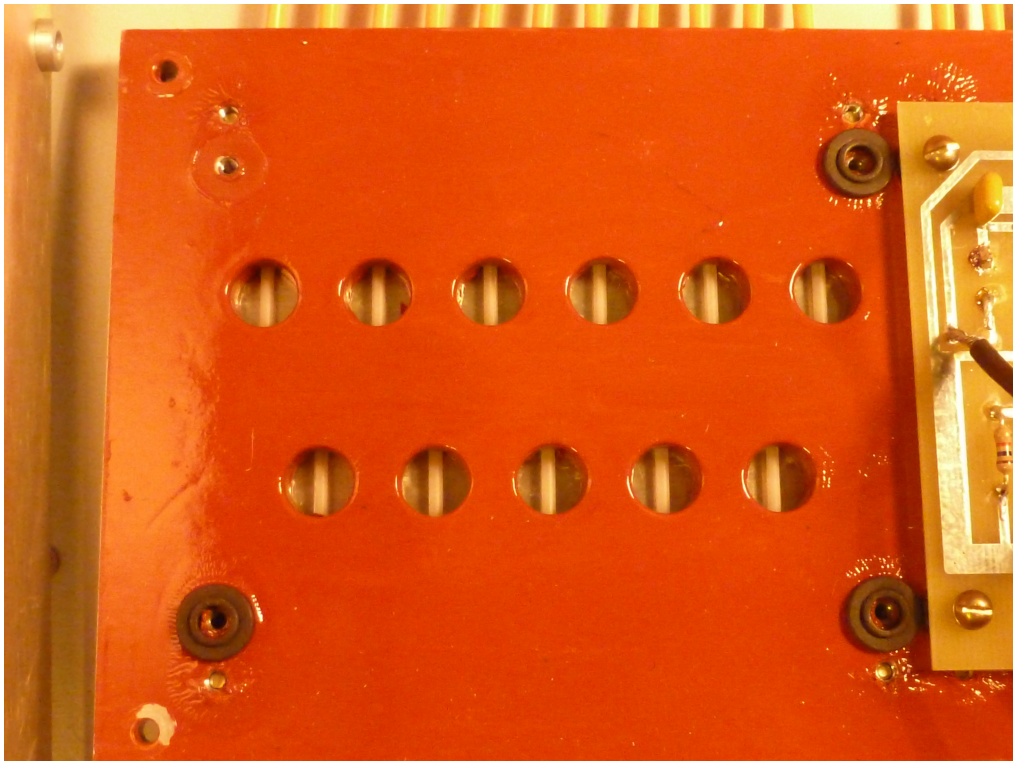


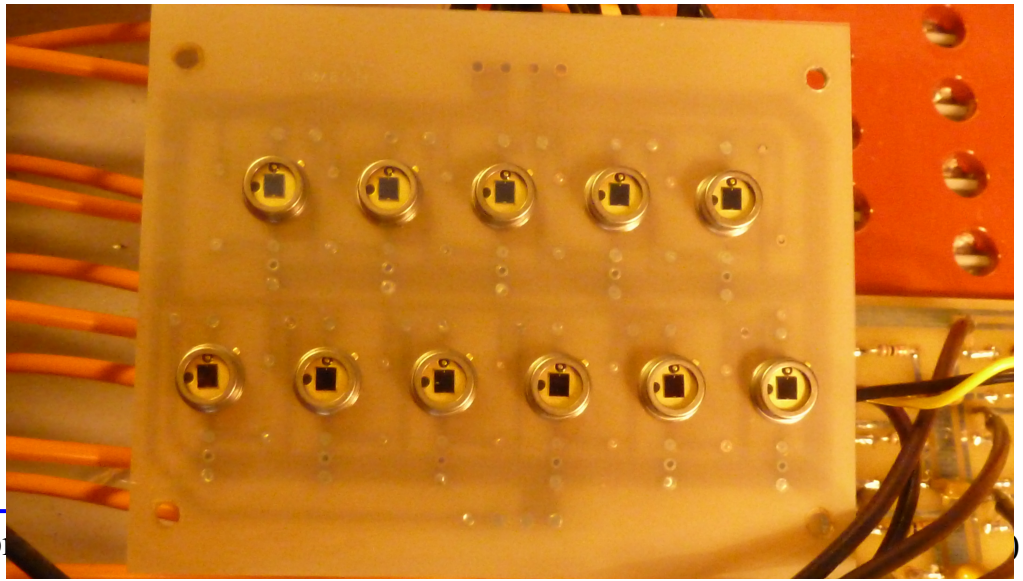


Pigtail box test

- Setup
  - 44 stripped fibers
    - ► 4 boards with 11 fibers

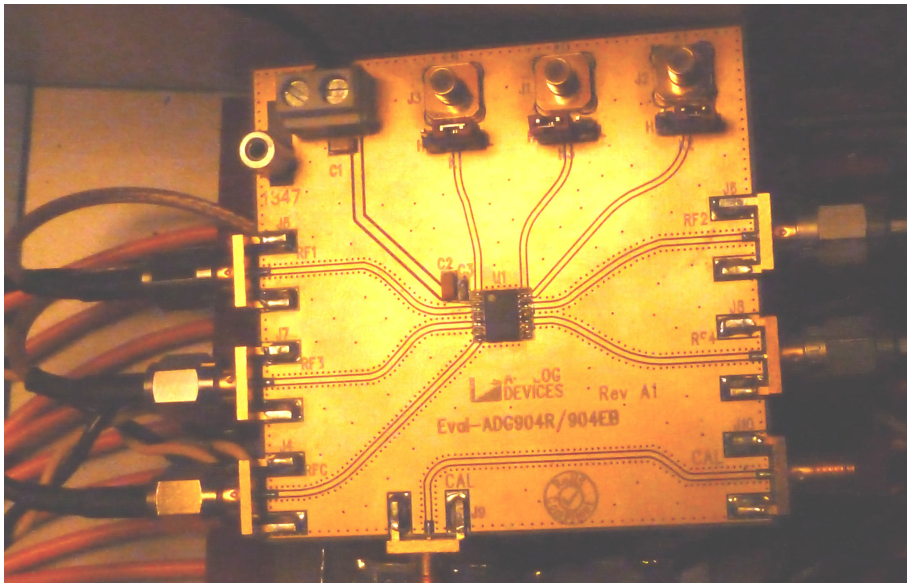


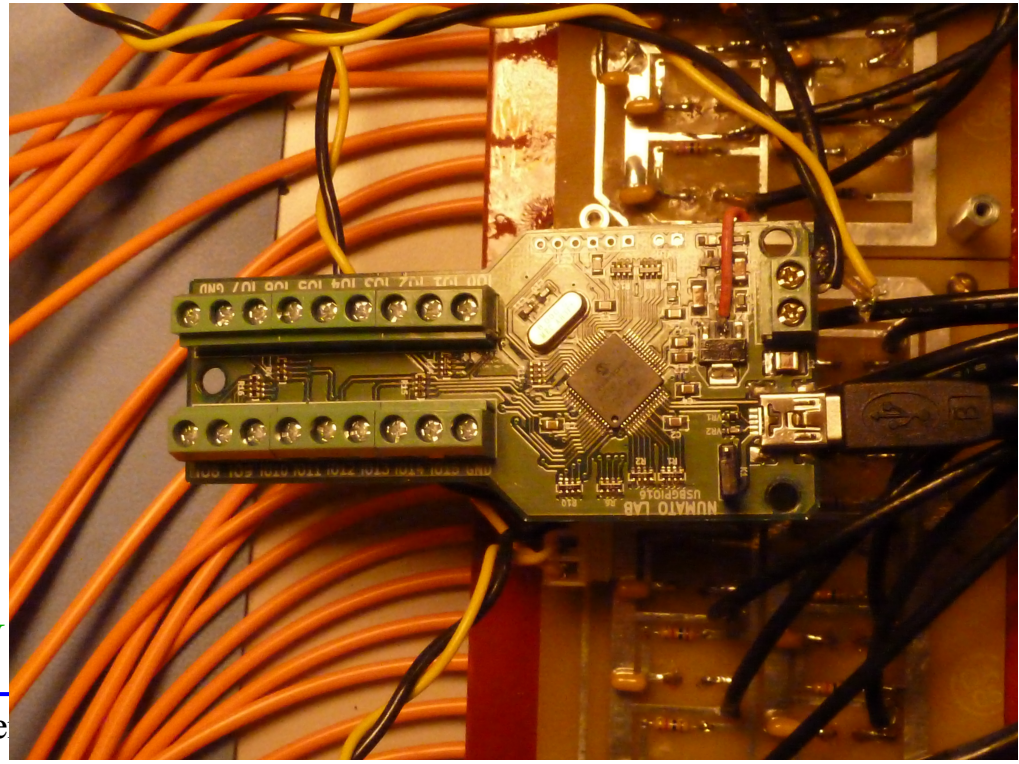




Pigtail box test

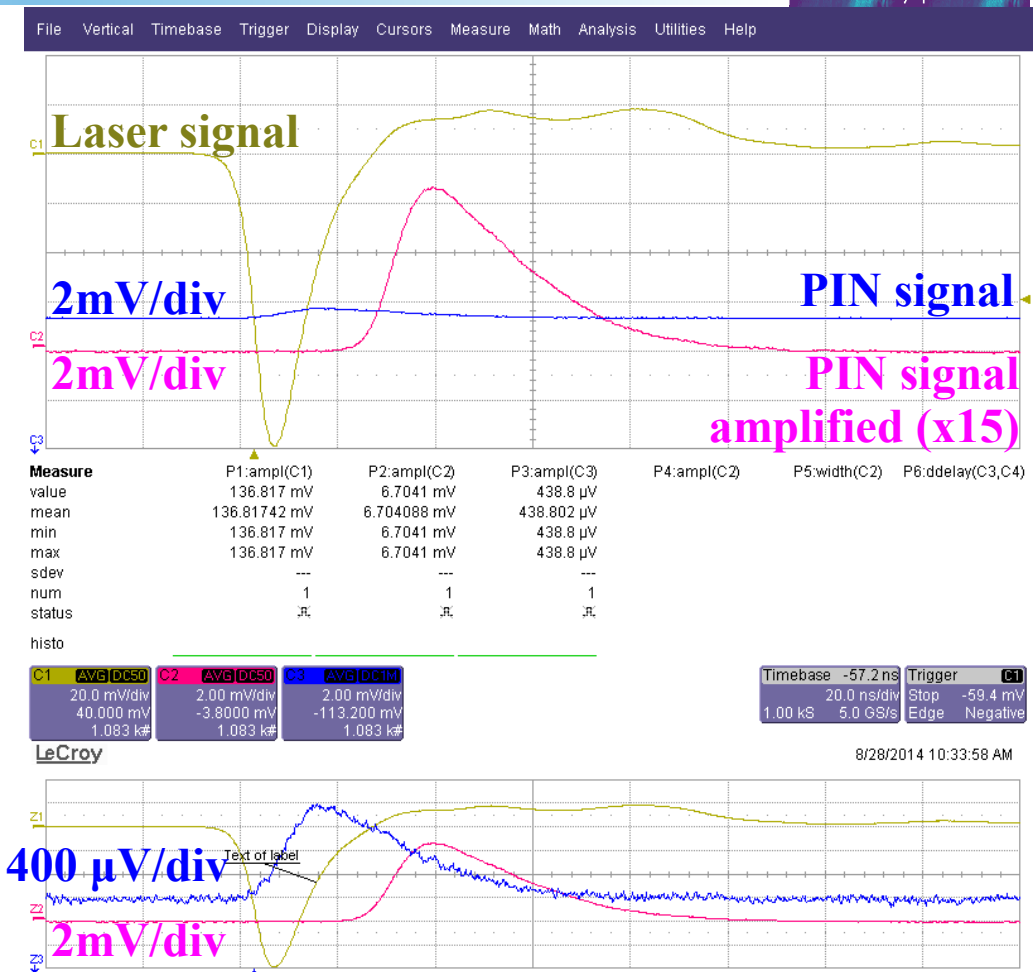
- Setup
  - PIN diodes
    - ▶ S1223
    - ▶ S5973
  - Analog multiplexer
    - ▶ Development board from AD
    - ▶ 4->1 mux
  - Connection to PC
    - ▶ Numato 16 channels GPIO USB board ($20)
    - ▶ Power from PC
    - ▶ Genuine LV=3.3V
      - Work also at 2.5V
      - Provide LV to mux and PIN





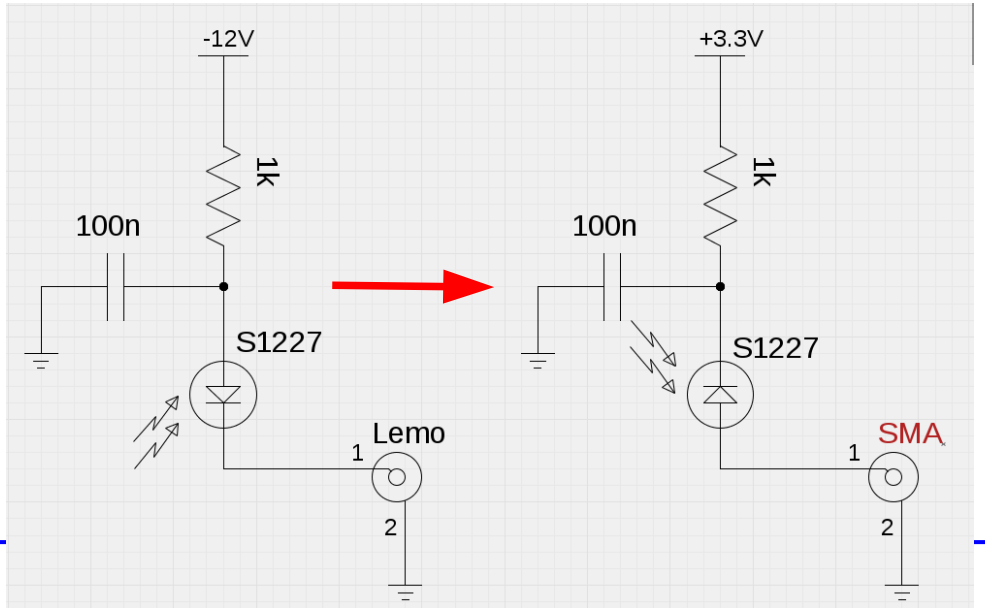
Pigtail box test

- Measurements
  - With S1223 PIN diode
    - ► Small signal seen
    - ► ~400 µV
  - Expected signal @ P5
    - ► 40 mV
    - ► Can be limit for analysis
    - ► Should be measured in situ
  - With S5973 PIN diode
    - ► No signal seen
    - ► 0.4x0.12 = 0.048 mm²
    - ► Expect 1/140of S1227 signal



Conclusions

- First test are encouraging
  - Multiplexing should be OK
- Signal amplitude could be the limiting factor
  - Calibrate laser to have better estimate of P5 signal
  - Measure signal in-situ with second pigtail box
  - Possible actions in case of :
    - ► Amplify signal at source
- Need to re-cable PIN diodes to get positive signal



Possible layout

- 17 multiplexers/box
  - 17 Enable lines
  - 2 address lines
    - ► 19 command bits/box
    - ► Need GPIO 32 bits module