RADOPT 2023

TEST BENCH DEVELOPMENT TO MONITOR OPTICAL TRANSCEIVERS AND SUB-MODULES UNDER HEAVY IONS

29/11/2023

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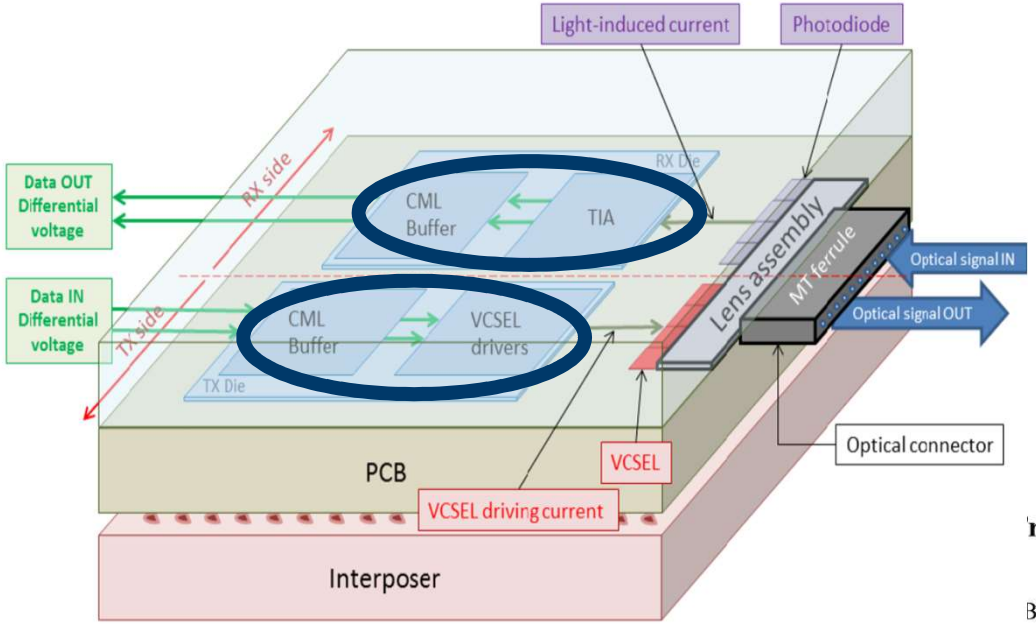
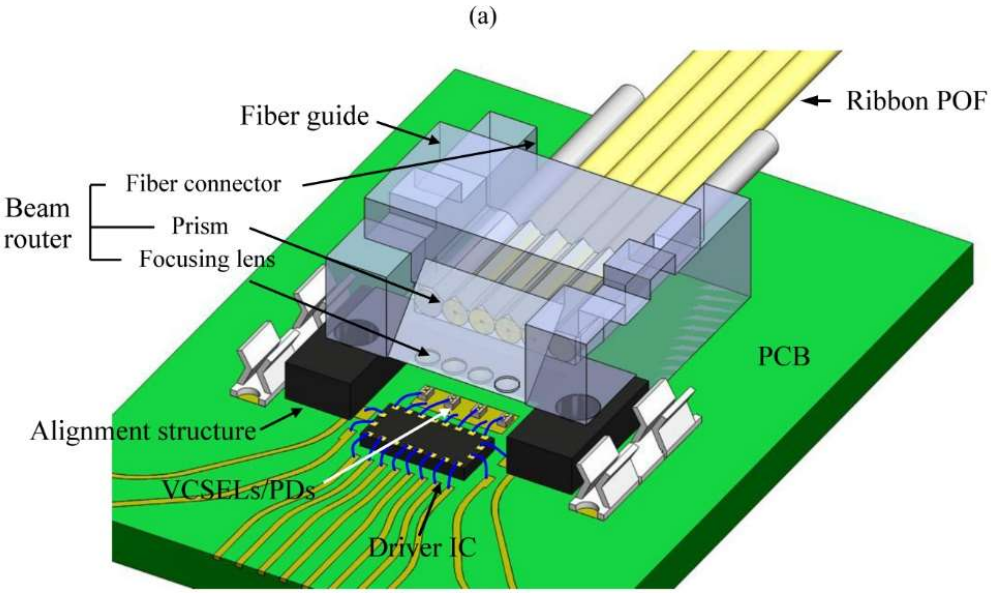
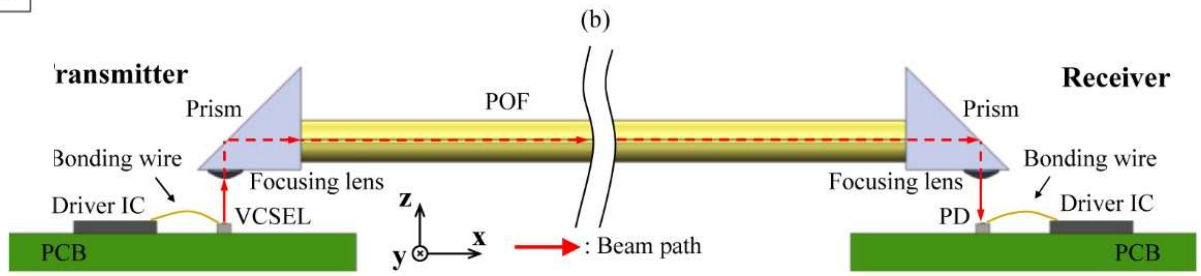
Context

- Optical tranceivers main issues
  - Thermal dissipation
  - Reliability (essentially VCSEL)
  - Radiation



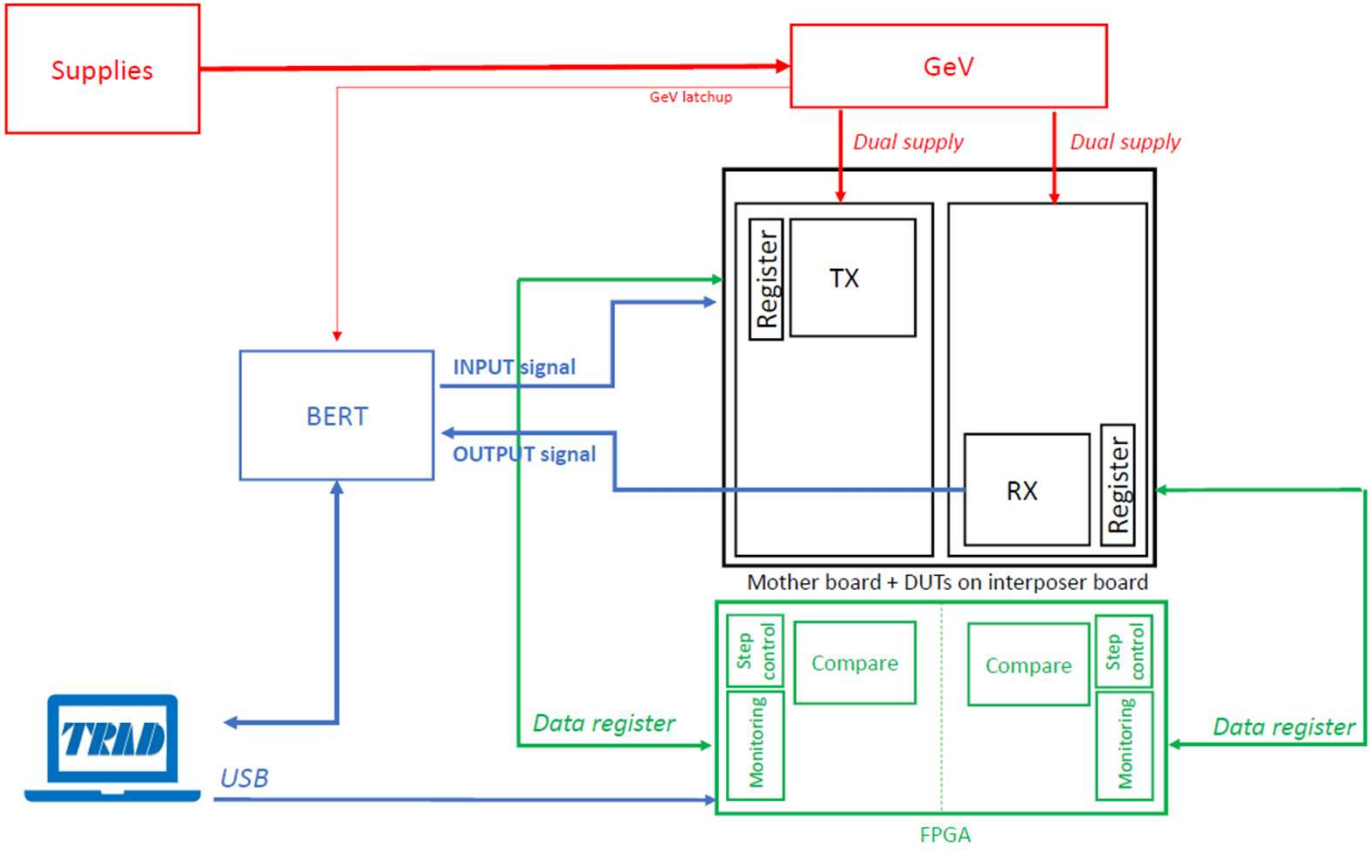
Sensitive to SEE





Optical transceiver test bench development

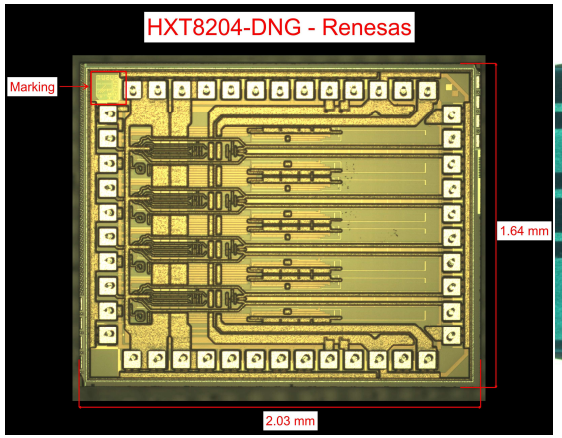
- Project funded by R&T CNES and TRAD
  - This test bench will be able to test both components (VCSEL driver and TIA) and complete modules
  - TRAD will invest on peripheral needed instruments (esssentially BER Testers, GeV adaptation, …)

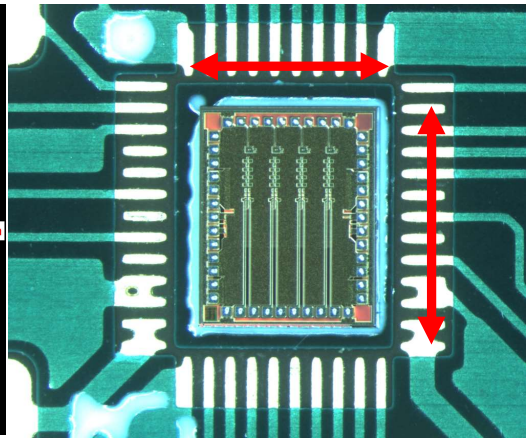


Components tested

- With the help of optical tranceiver manufacturer, we were able to get samples to perform SEE tests

PARTS IDENTIFICATION		
Type:	HXT8204	HXR8204
Manufacturer:	Renesas	Renesas
Function:	VCSEL driver	TIA
PARTS PROCUREMENT INFORMATIONS		
Packaging:	Bare Die	





- Components were delivered without cases, two choices then :
  - Package the DUT, with RF performance, delay and cost contraints
  - Directly assemble the chip on test PCB and wire bonding

HXT8204 Test board

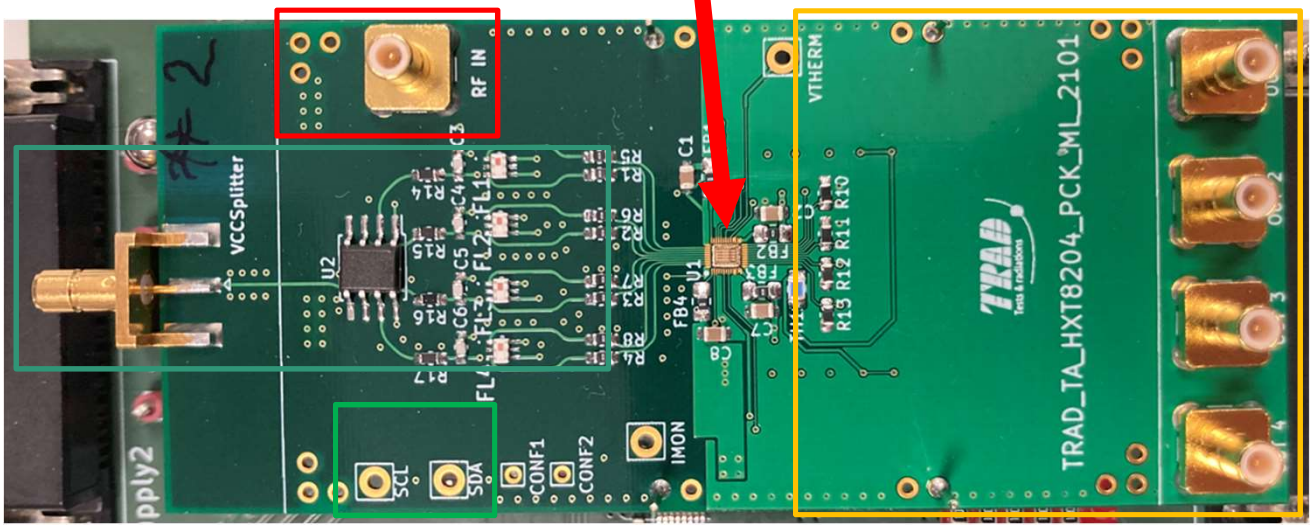
- Test board for the HXT8204 device

Input HF
HF signal up to 28 Gbps

DUT

Output adaptation
To visualize the outputs

Splitter distribution
Allows to distribute the Signal on the 4 inputs.
And to interrupt the signal if a SEL occurs



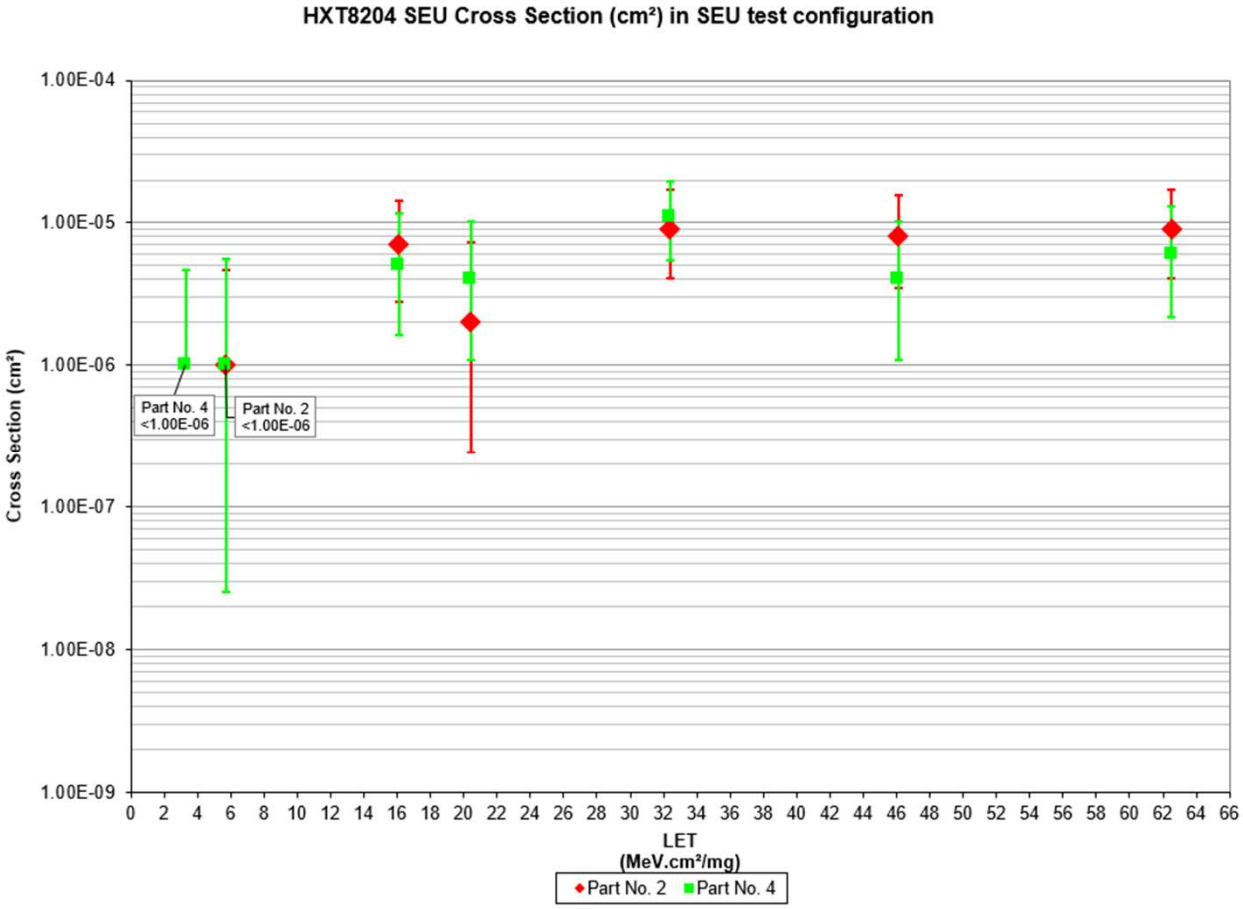
I²C tests point for programmation debugging

- To heat the DUT an internal heating system is integrated to the board
- The PCB is built to allow to work at 28 Gbps

HXT8204 results

- Tests performed at UCL in November 2022
- SEL tests and SEU on registers, following ESCC 25100 recommandations

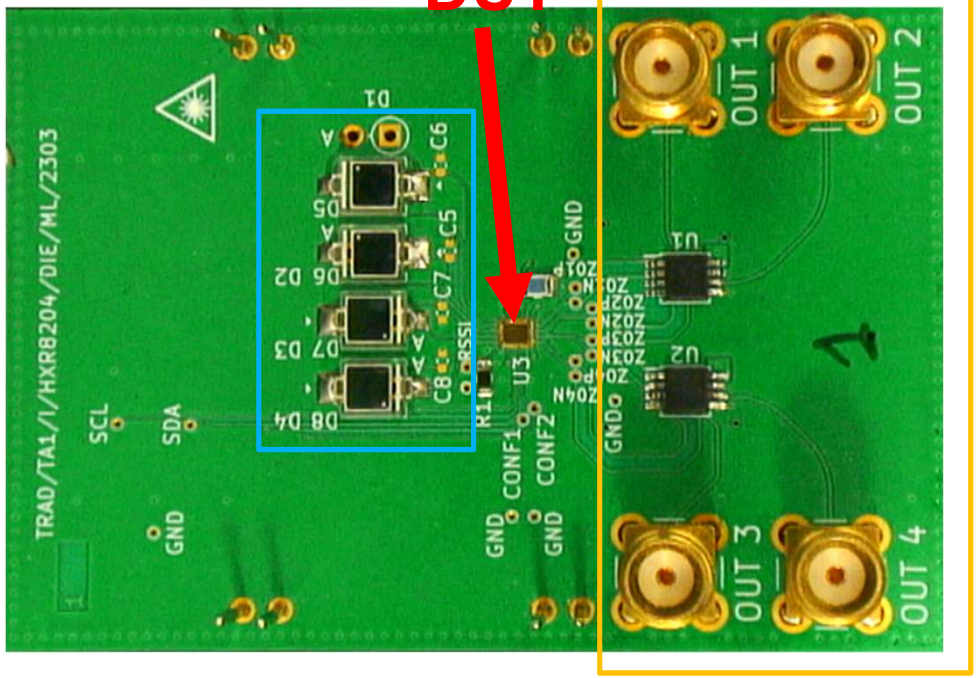
- No SEL were observed with a LET of 62.5 MeV.cm²/mg, Xenon ion.
- SEU were observed with a minimum LET of 5.7 MeV.cm²/mg, Aluminium ion



HXR8204 Test board

Photodiodes
Allows to distribute the Signal on the 4 inputs.

The photodiodes are stimulated with laser diode to allow the dut to work during the irradiation test



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HXR8204 results

- Tests performed at UCL in September 2023
- SEL tests and SEU on registers, following ESCC 25100 recommandations

- No SEL, SEFI were observed with a LET of 62.5 MeV.cm²/mg, Xenon ion.
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- SEU were observed with a minimum LET of 5.7 MeV.cm²/mg, Aluminium ion
- MBU were observed with a minimum LET of 46.1 MeV.cm²/mg, Rhodium ion

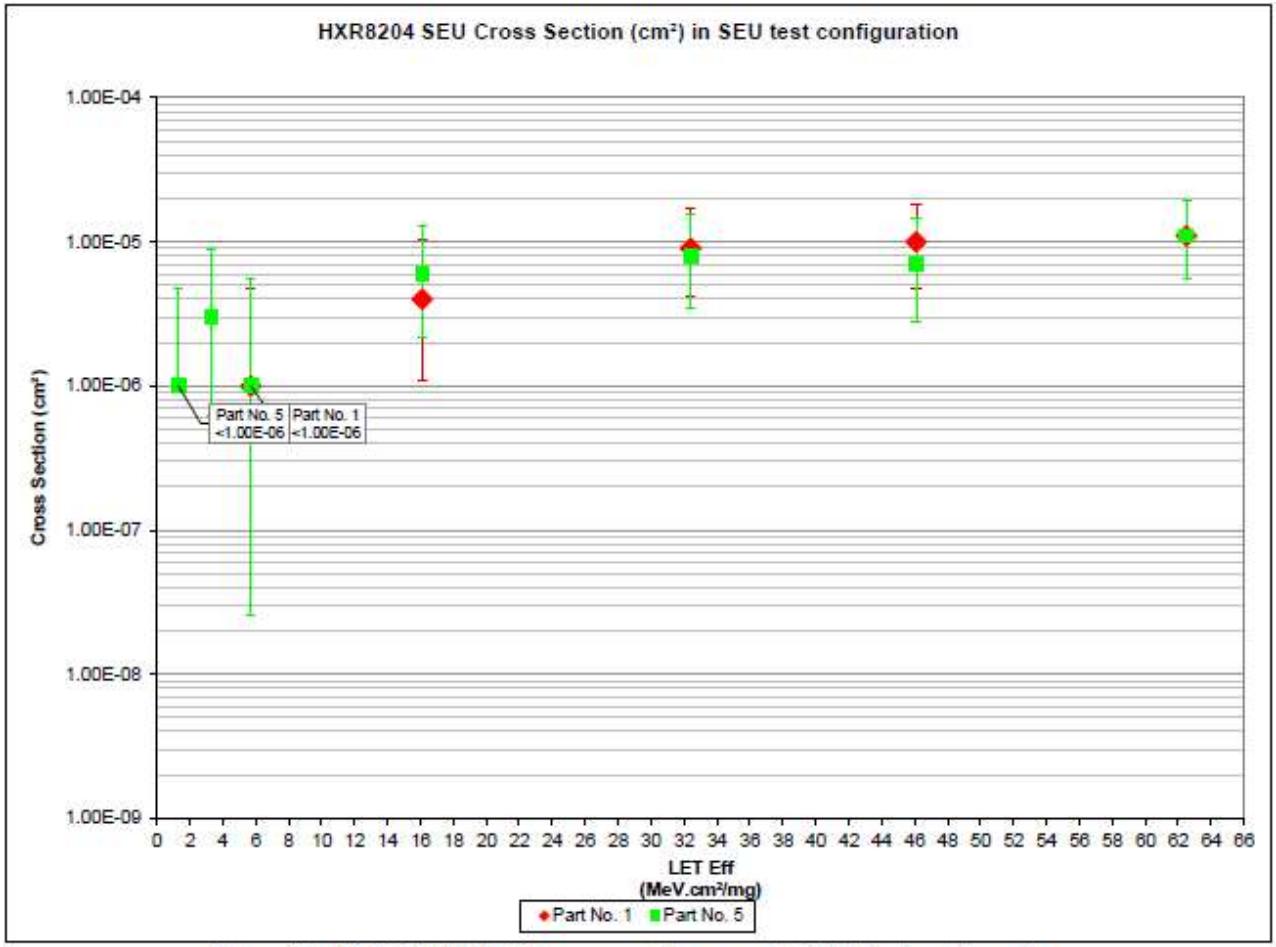


Figure 11: HXR8204-DNG SEU cross section curve in SEU test configuration

Forthcoming tests

- CNES is highly motivated for finding a optical transceivers products with an european manufacturer
  - DLR is currently evaluating optical transceivers from Amphenol in 28Gbps on multiple aspect
  - CNES (with TRAD) has proposed its help to perform SEE test on such devices

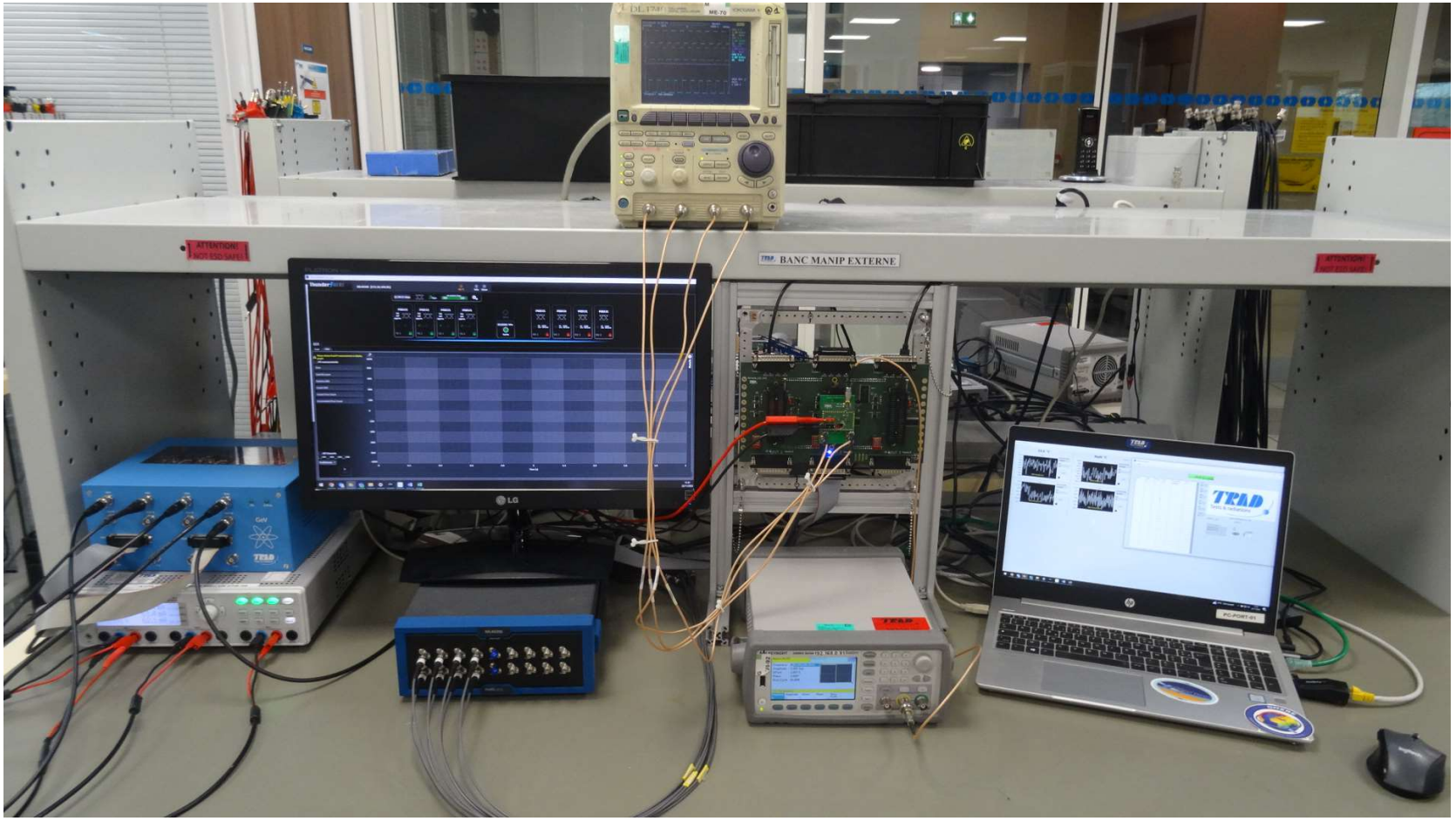
  - Then, in 2024, SEE test will be performed on a 28Gbps optical tranceiver from Amphenol.
    - Strong cooperation with the manufacturer is mandatory as it is a complex devices, with lots of assemblies process.

  - Tests on optical transceivers @56Gbps will be also scheduled

Perspective: Bit Error Rate Test in full test bench

This is the future test bench allowing to test full module

We will plan to test the module through the BERT witch applying a pattern to check if an error occurs.
The optical part will be looped on the device.



THANK YOU FOR YOUR ATTENTION