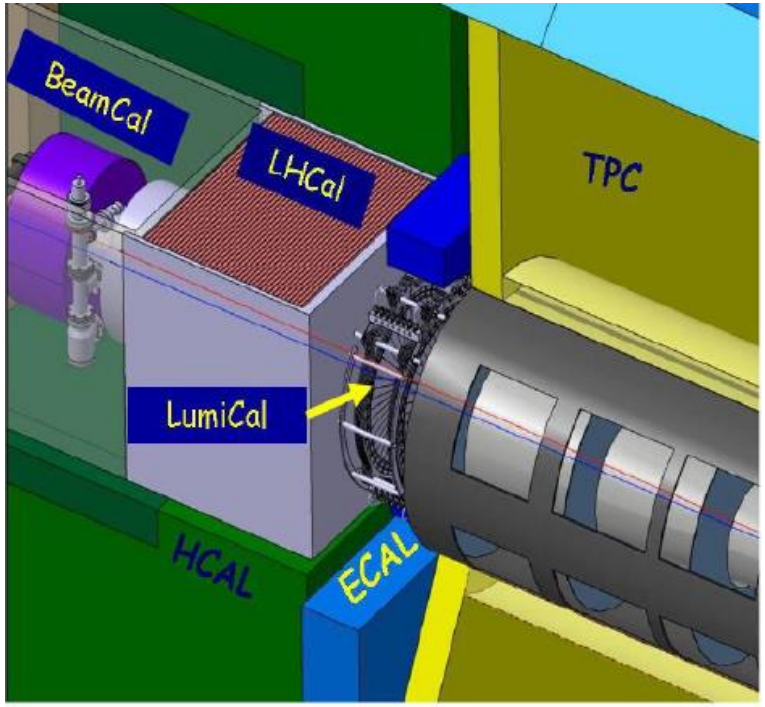
Novel sensors for highly compact electromagnetic calorimeters

The FCAL collaboration and the LUXE ECAL group

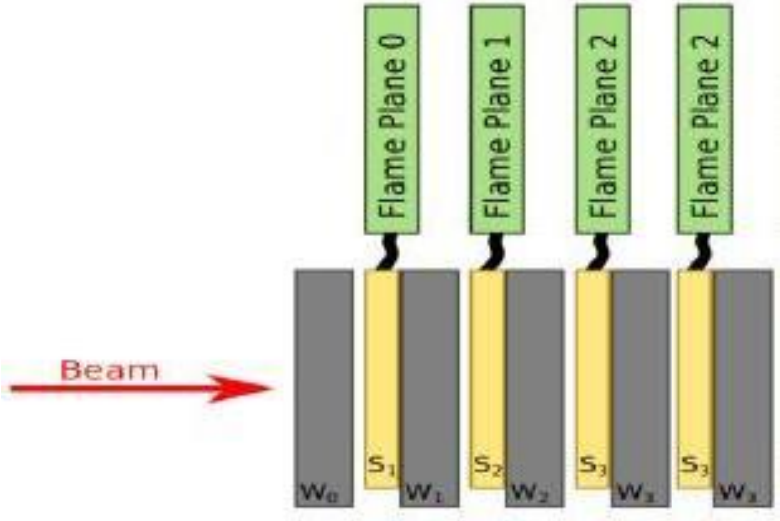
Speaker: Anton Tyazhev,
Tomsk State University, Tomsk, Russia

Structure of compact EM calorimeter

W absorber plates interspersed with sensor layers



The very forward region of the ILD detector

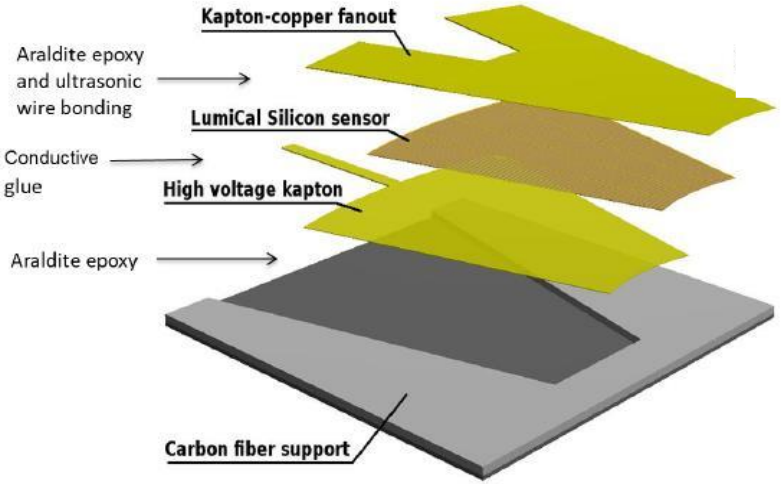


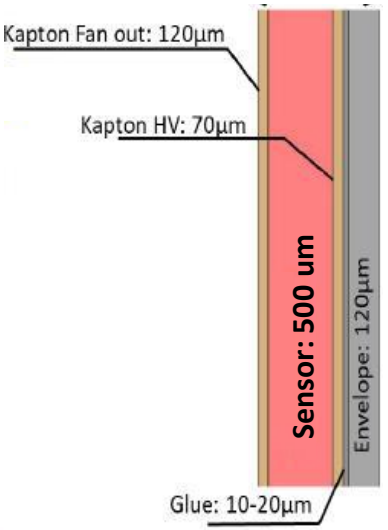
1mm spacing between W plates leads to a Moliere radius equal to the one of W that makes EM compact as the definition

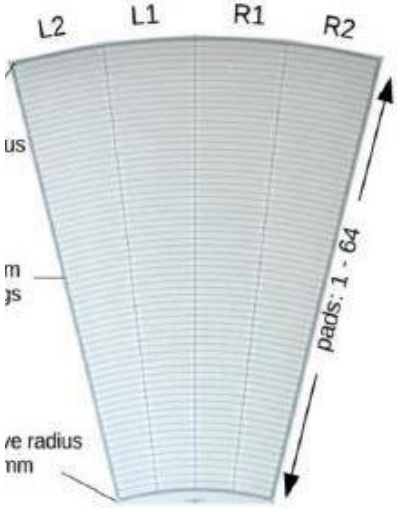
Current sensor design

Radiation hard 500 um thick GaAs sensor

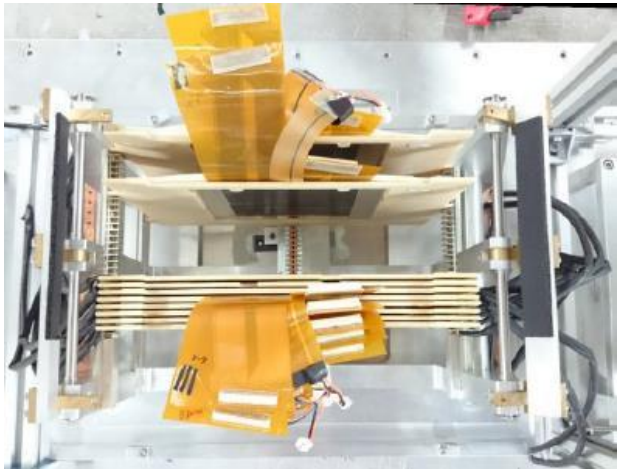
Sensor assembly
830 um thick







320 um thick Si sensor

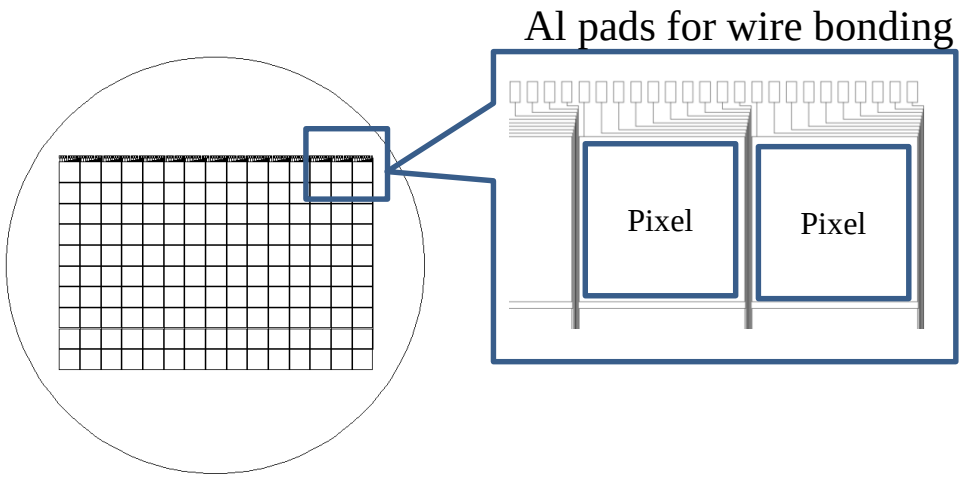


EM calorimeter prototype 2020

Novel concept: GaAs sensor with tracings

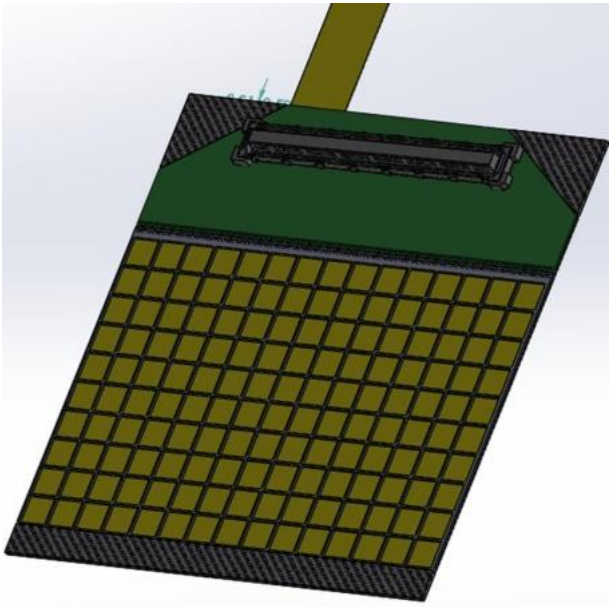
Thin sensor assembly 700 um !

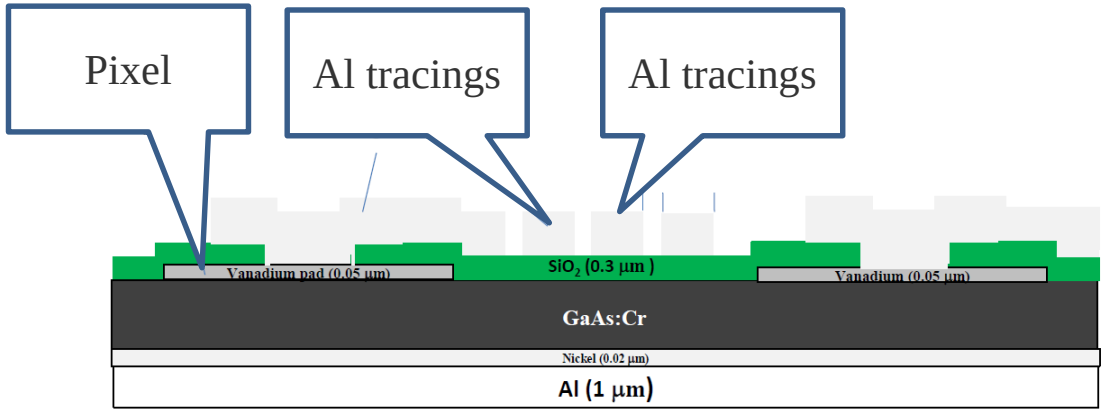
15x10 pixel array



Sensor :	**500 um**
Conductive glue (sensor - RO kapton):	**100 um**
RO kapton :	**100 um**

Compact sensor module





Cross section of the sensor with tracing (not in scale)

Conclusion

- Sensor with tracings allows to make the sensor planes
  extremely thin that is the key point for compact electromagnetic calorimeters

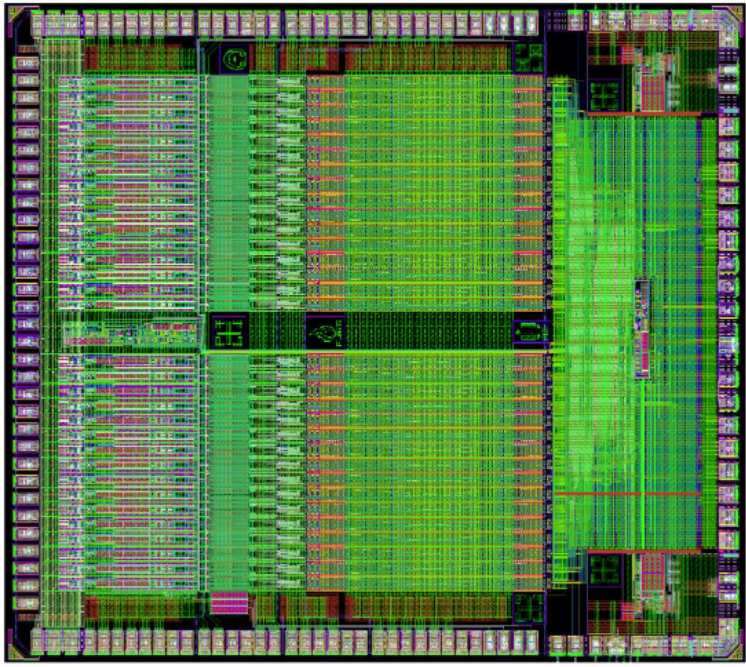
- The sensor prototypes will be produced and tested up to the end of 2021

Wireless readout

Yan Benhammou

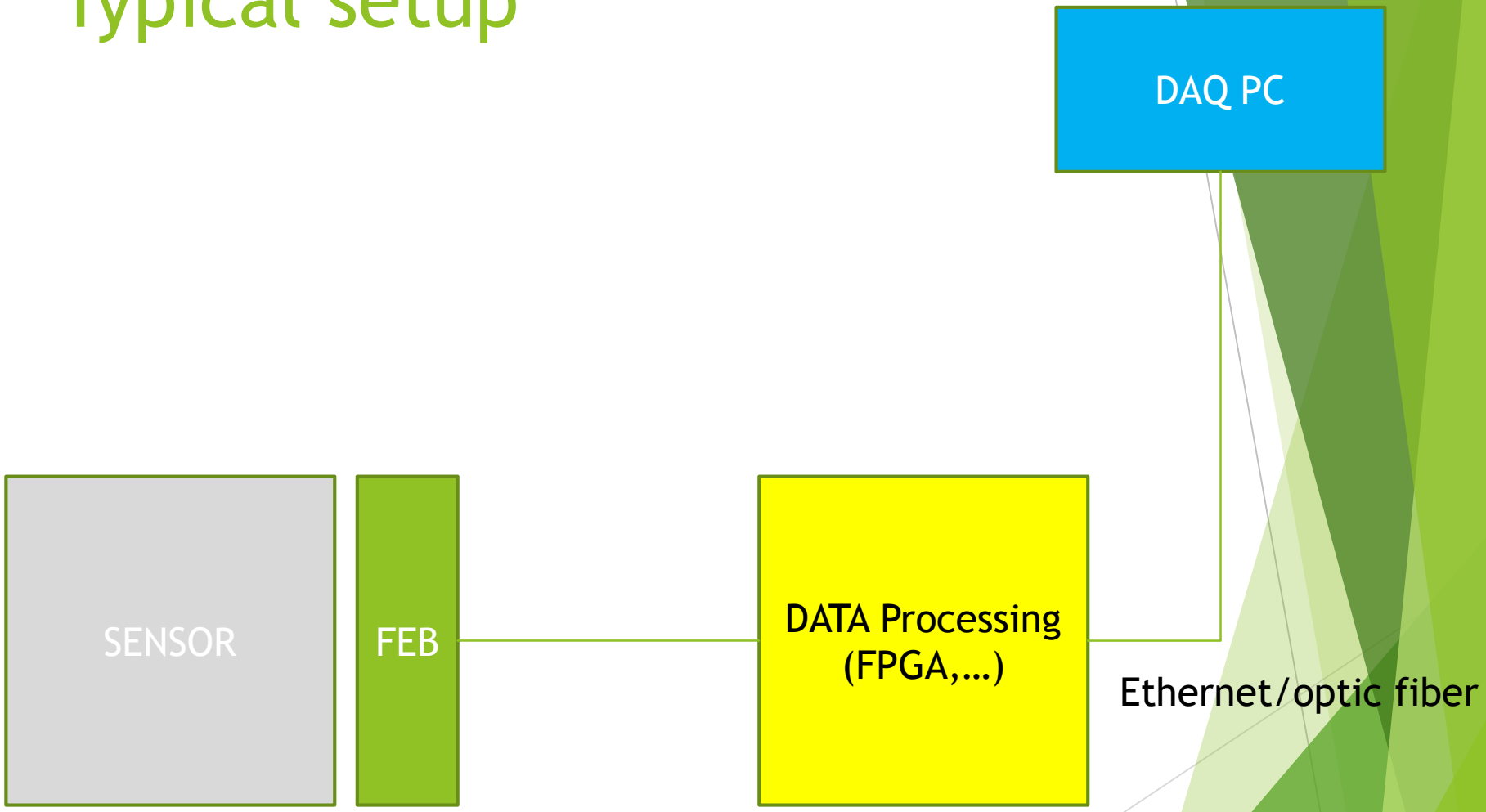
Tel Aviv University

READOUT



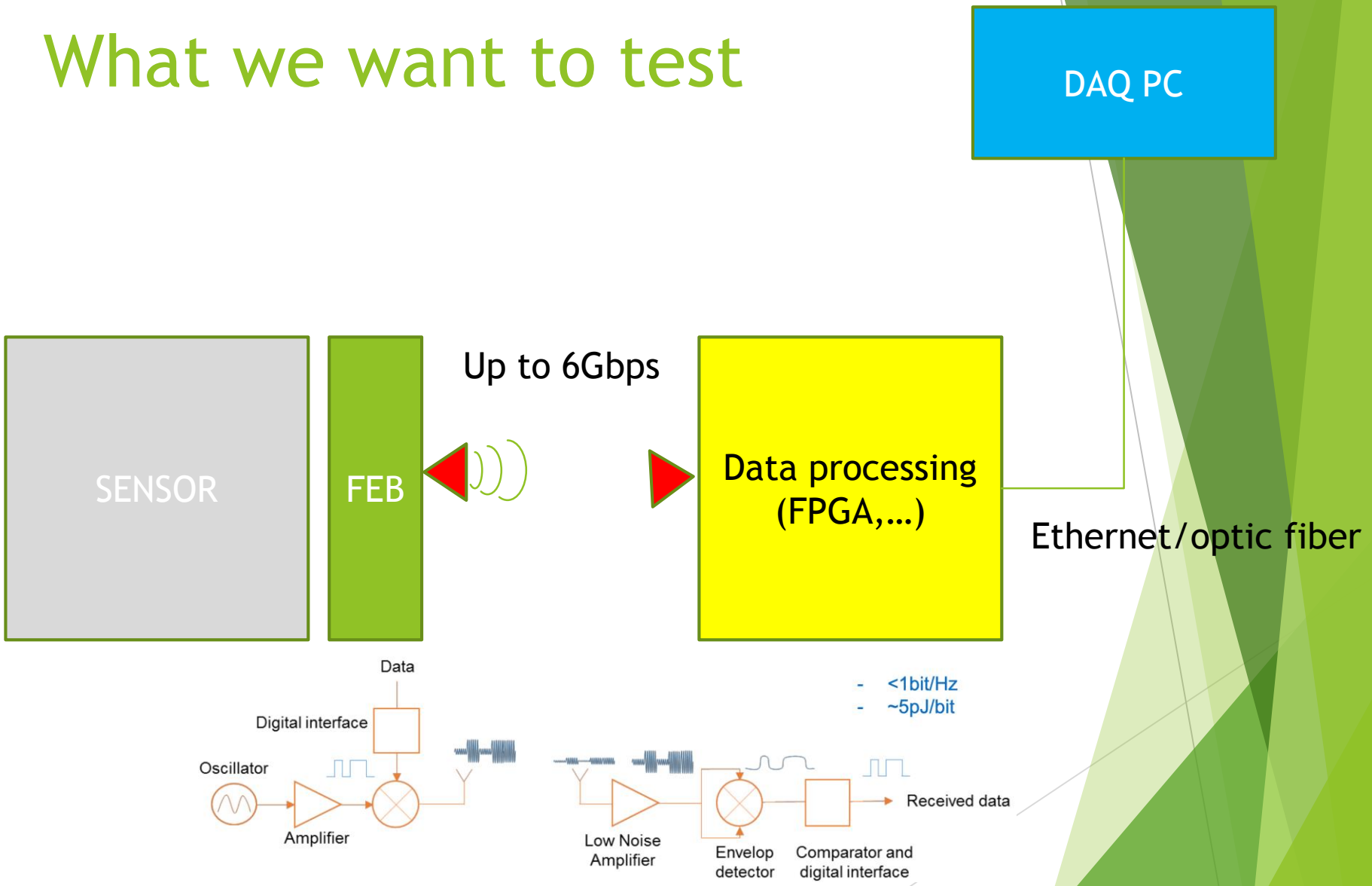
- Sensor signal is send to a dedicated ASIC : FLAME
- 32 mix mode channel comprising:
  - Variable gain front end
  - 10 bit SAR ADC with sampling rate up to 50MSps
  - Ultra low power consumption
- Mutli-phase PLL based fast serializer
- Fast SST driver
- Two 5.2 Gbps links to the FPGA (we need ~5 FLAME per sensor)
- From FPGA to DAQ : zero suppressed and trigger so rate depends on the occupancy and event rate

Typical setup



Could be a problem of space in the very forward region : cables,…

What we want to test



Thanks to the WADAPT CERN group