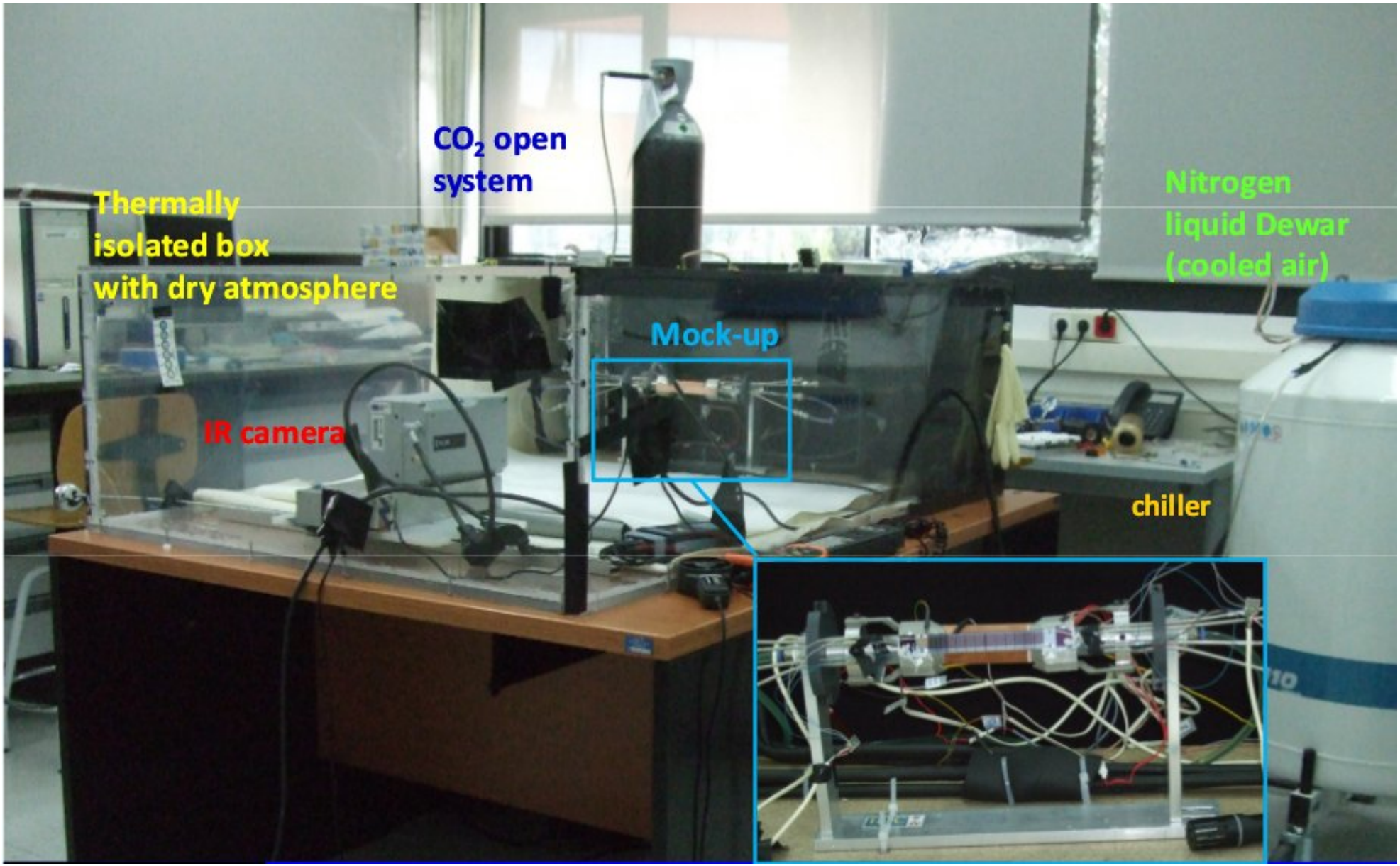
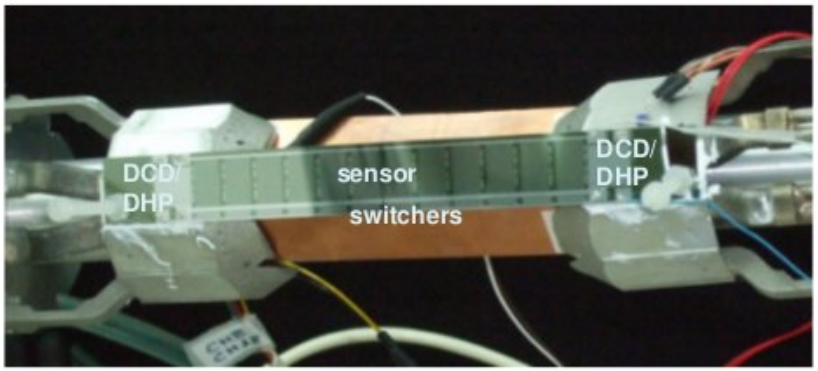
Thermal measurements and mockup At IFIC

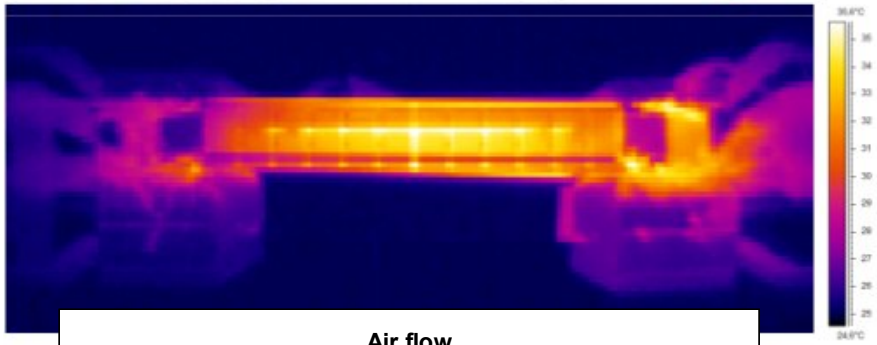
Not too much progress since B2GM in November
Sharing setup with HL-LHC

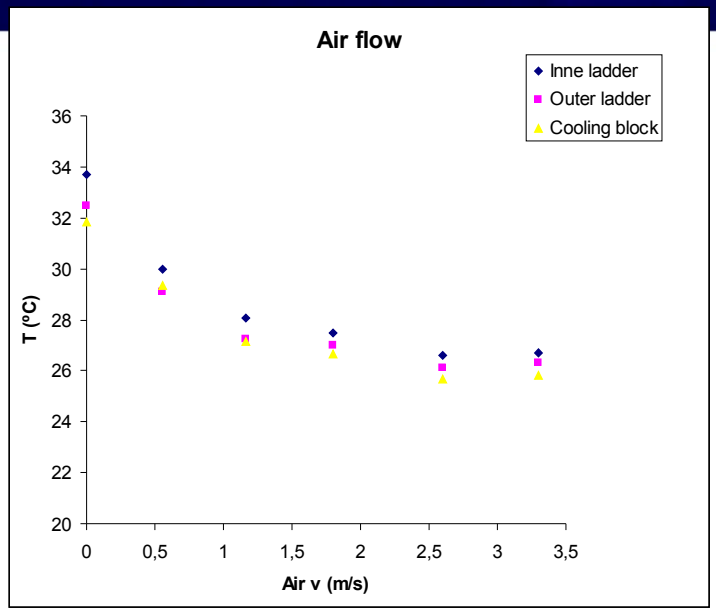
Cooling – the setup (reminder)

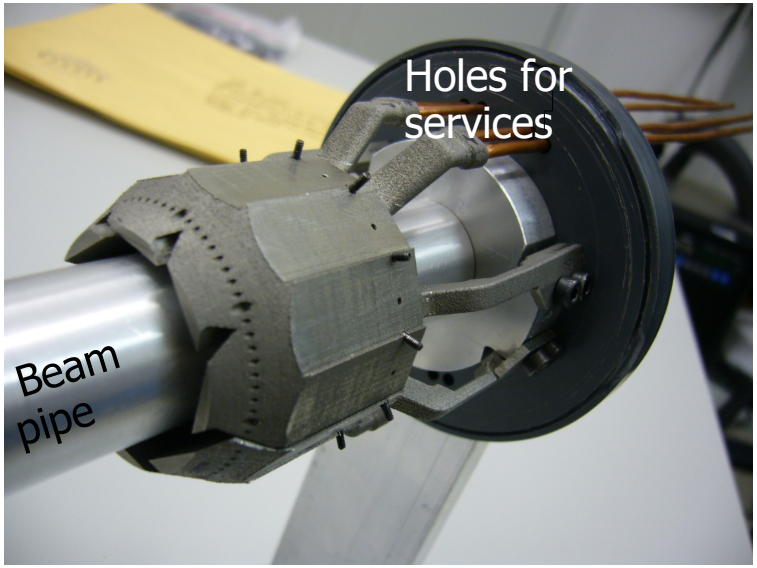


Air cooling





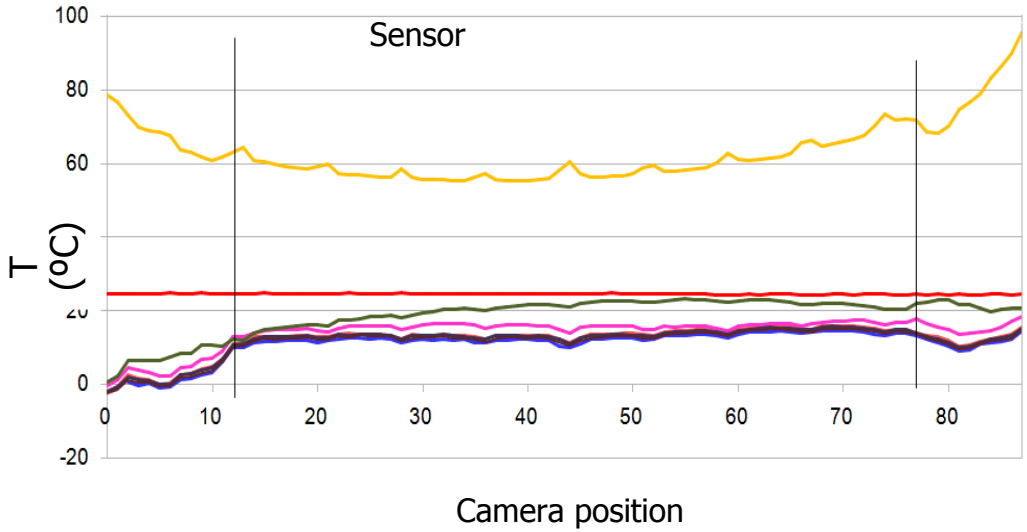




- ✔ Thermal tests made with thin DEPFET modules in PXD mockup
  - ➔ End supports cooled with CO2
  - ➔ Cold air flows through channels in supports
- ✔ Convection needed to control temperature (and temperature gradients) in the center of the ladder
  - ➔ Do not need very high mass flows: just movement
  - ➔ Temperature plateau at environment temperature

Air Cooling

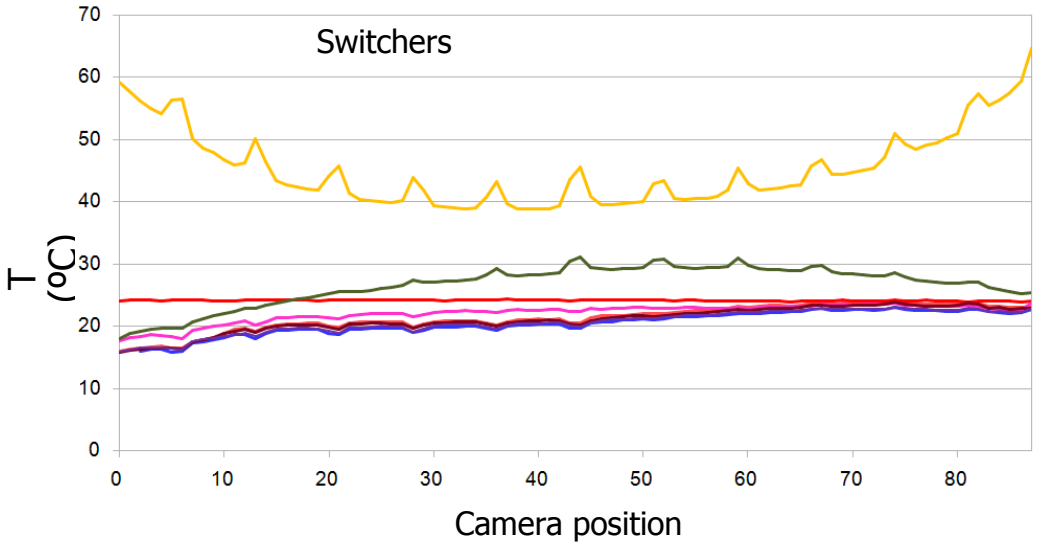
- Sensor region (P~0.5 W x 2): **(corrected emmisivity)**



Detector on
Background (room T)
End flanges cooled with CO_2
Air flow at room T
Air/N_2 flow cooled [-8,-15]°C *

(* T measured before entering the pipes)

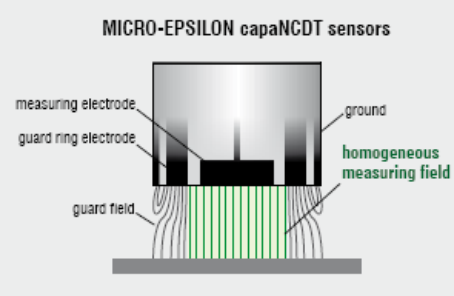
- Switchers region (P~0.5 W): **(corrected emmisivity)**



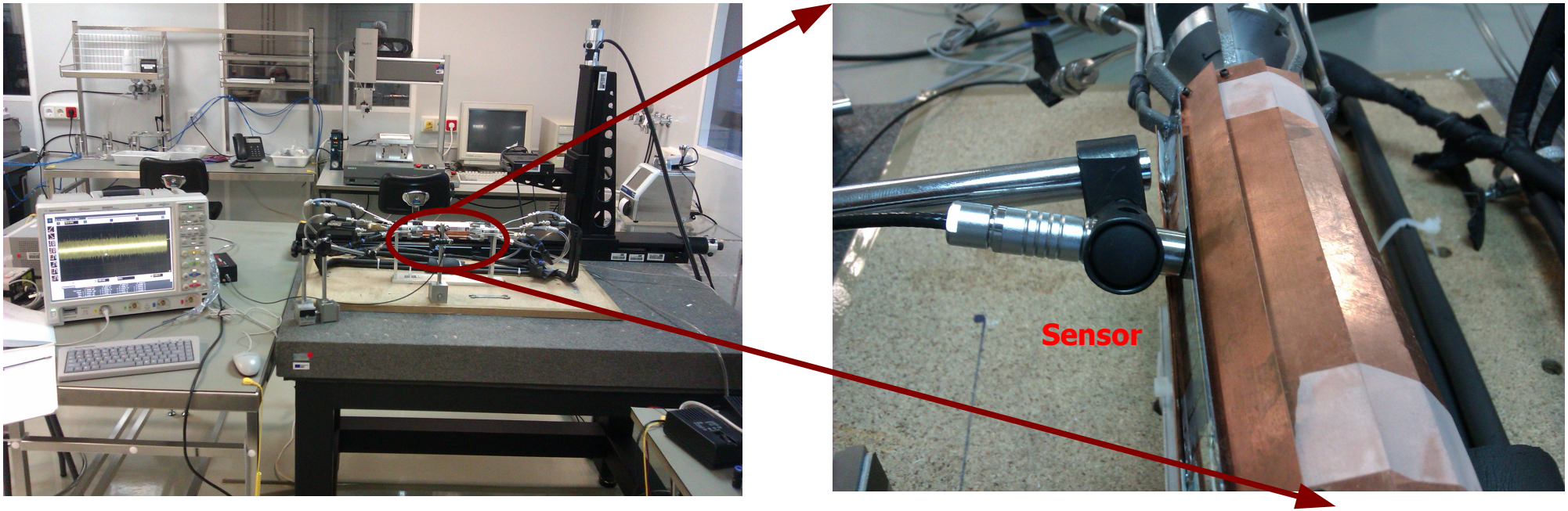
Detector on
Background (room T)
End flanges cooled with CO_2
Air flow at room T
Air/N_2 flow cooled [-8,-15]°C *

(* T measured before entering the pipes)

Side effects - Vibrations

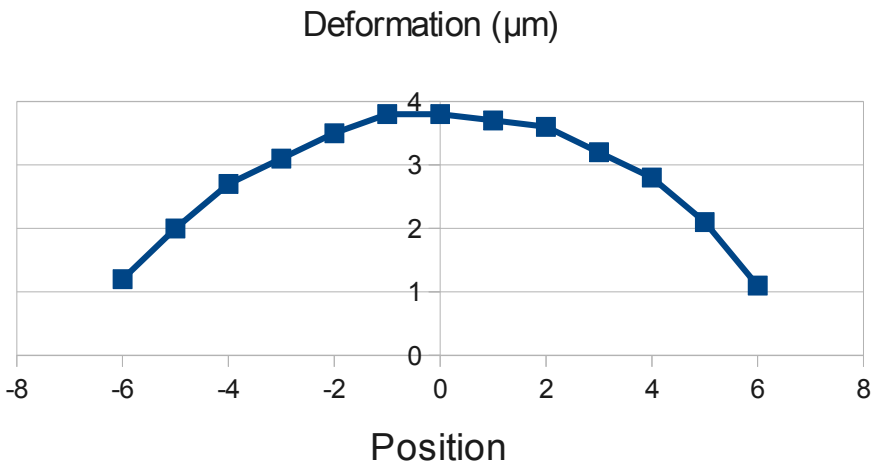


- ✔ The air flow may induce vibrations of the module (50 μm in the mockup)
- ✔ We use capacitive non-contact displacement sensors
  - ➔ RMS ~0.2 μm
- ✔ 1 mechanical dummy.
- ✔ Close the 2 layers with copper ladders to force "real" air circulation
- ✔ Blow air at a speed of ~2 m/s (nominal 1 m/s)
- ✔ Measurements done at room temperature



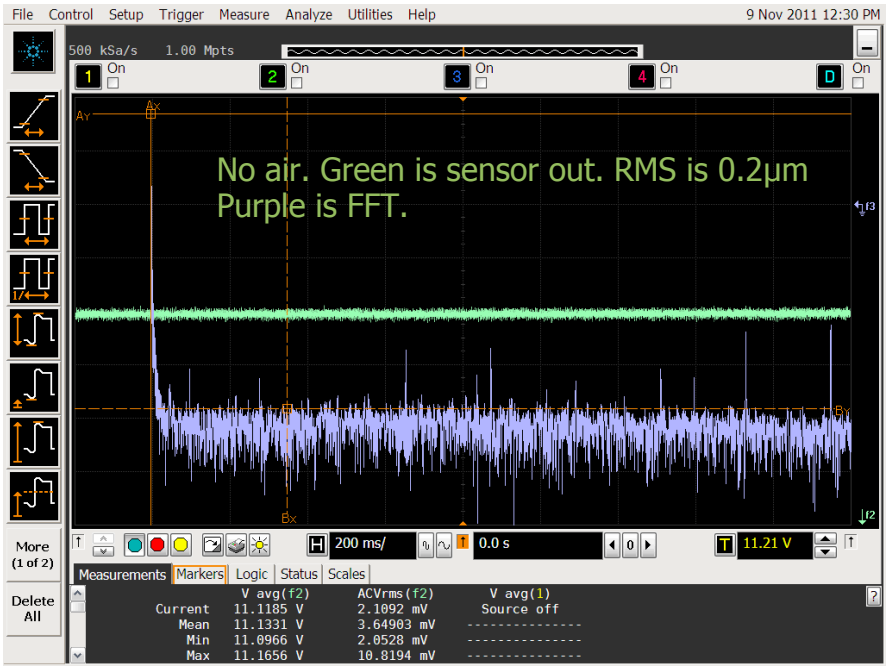
Vibrations

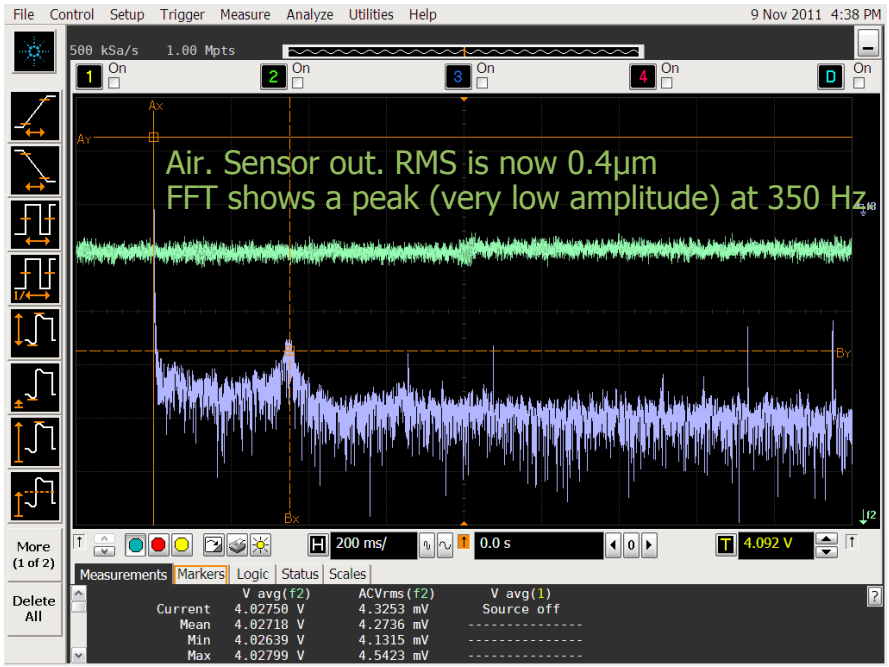
- Measure vibrations at several points along red line (close to edge where we expect greater amplitude).



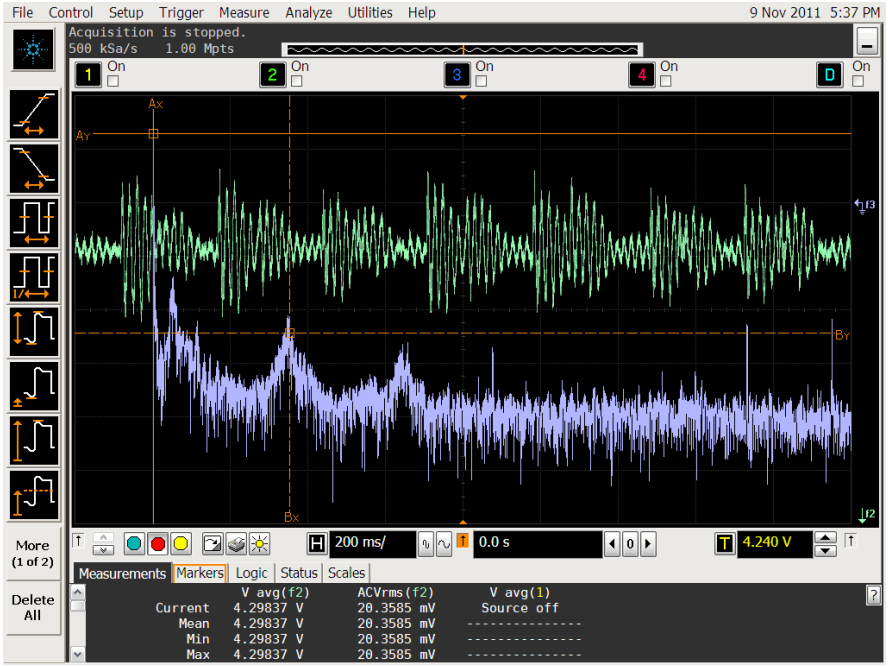
- Need to study stability of deformation.
- ... However, very low amplitude (below 0.4 um RMS) frequency peaks found

Vibration frequencies





- ✔ Right is center of ladder movement when tapping the granite table.
- ✔ Our system has 3 freq.
  - ➔ 50 Hz, 350 Hz and 640 Hz
- ✔ Only 350 Hz appears when blowing air
- ✔ Not clear who produces that:
  - ➔ Ladder itself ?
  - ➔ Loose SS pipes on the sides ?
  - ➔ Our particular system... ?
- ✔ Needs further studies....



Summary

- ✔ Work done
  - ➔ First thermal mockup where the DEPFET cooling "concept" has been proved
    - ↘ CO2 at supports together with Karlsruhe
    - ↘ Air cooling on sensors
- ✔ Work to be done
  - ➔ Repeat vibration analysis with CO2 and air flowing
  - ➔ Document results
  - ➔ Be available during DESY ramp up