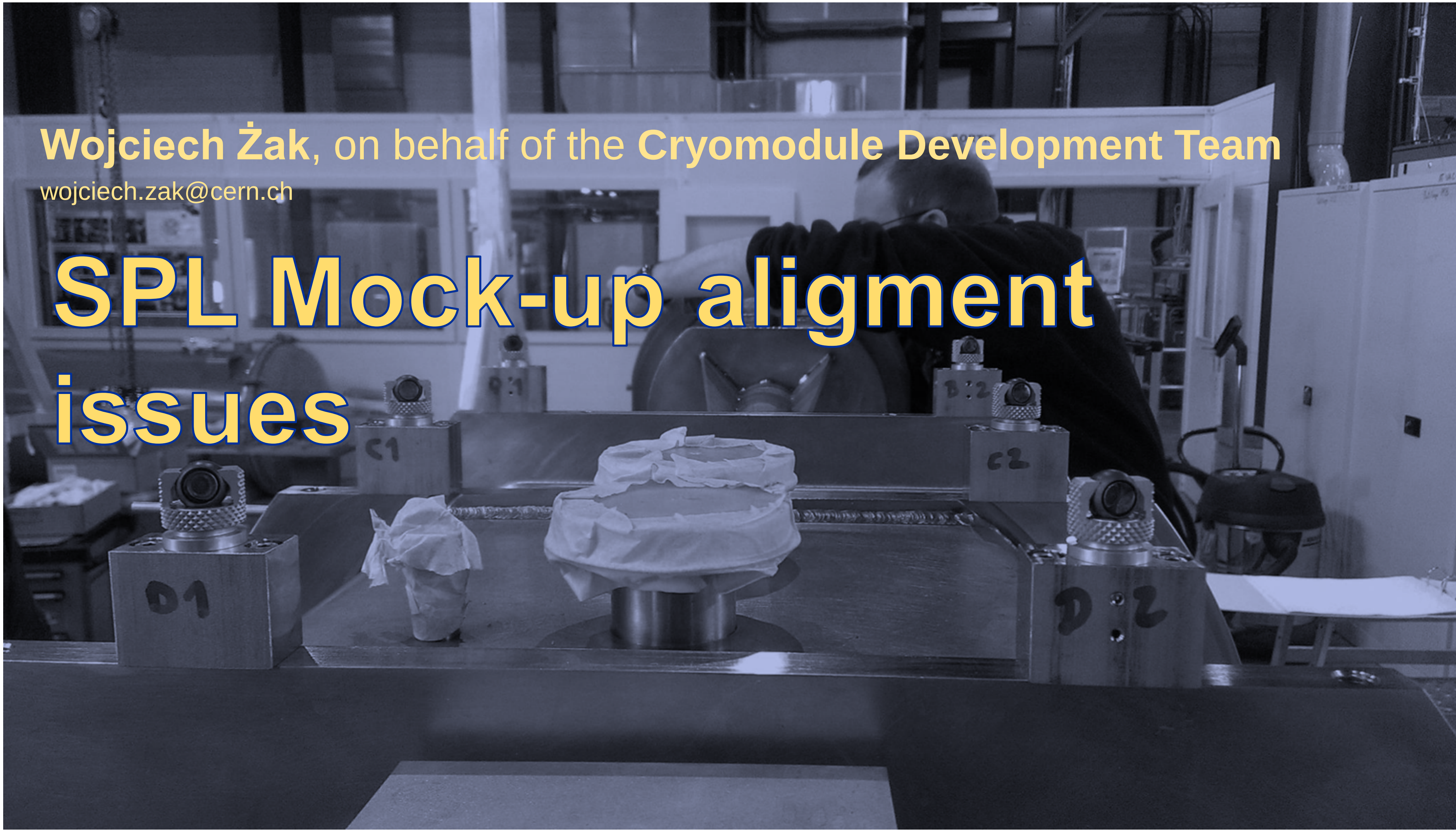


Wojciech Żak, on behalf of the **Cryomodule Development Team**
wojciech.zak@cern.ch

SPL Mock-up aligment issues

Outline

- Introduction of myself
- SPL Mock-up
- Idea of the Optical Wire Position Monitor
- R&D of the OWPM
- Future tasks

Something about me

Name: **Wojciech**
Surname: **Żak**

Date of birth: **01.05.1987**
Place of birth: **Pszczyna**

Higher education:

Masters degree in Power Engineering obtained at Cracow University of Technology (Mechanical Department)

Specialization: **Power engineering systems and facilities**

CERN experience:

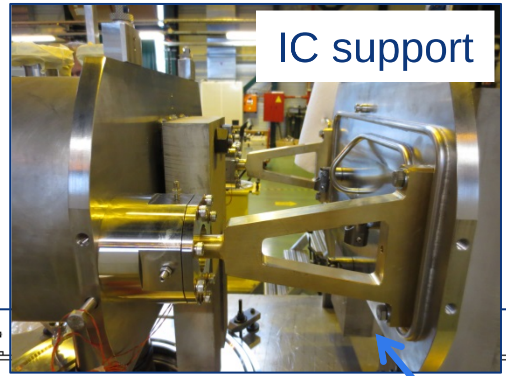
01.06.2011-31.07.2012	**TECHNICAL STUDENT**
01.08.2012-31.01.2013	**UPAS**
01.02.2013-?	**FELLOW CERN/ESS**

Language skills:
Polish, English, French (une peu), **German** (nicht so gut)

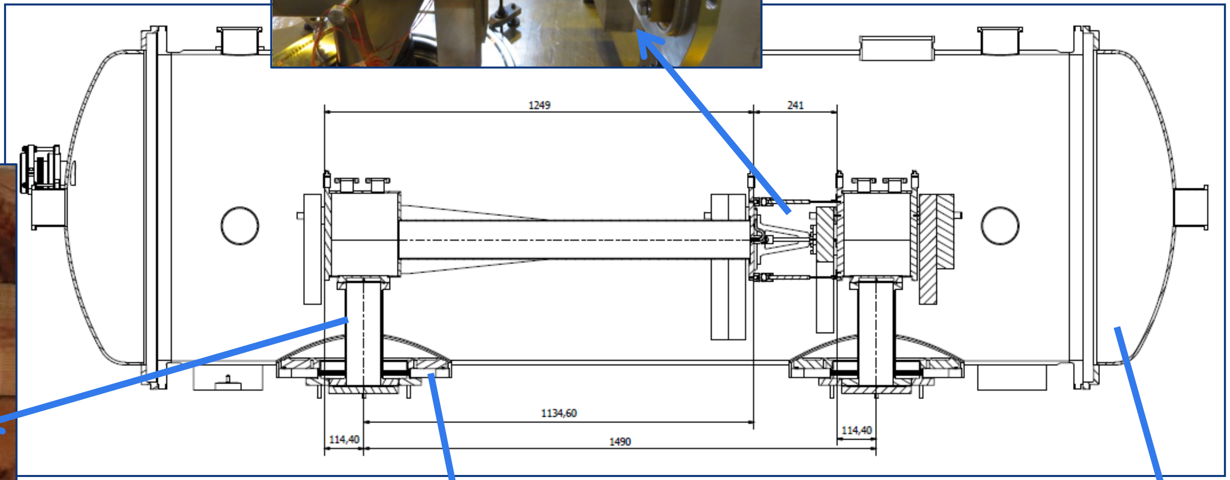
Mock-up

- Mechanically representative of 1 cavity
- Real DWTs and interfaces to VV
- Cooled by liquid-gas N2
- Aimed at validating:
  - Cavity supporting scheme
  - Alignment measuring devices (OWPM)
  - Realignment of cavities via vessel interface
  - Thermo-mechanical behaviour
  - DWTs active cooling

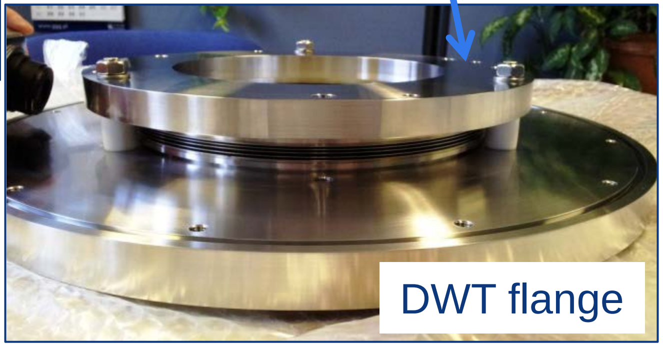
Mock-up


IC support


Laser tracker targets


1249
241
1134,60
114,40
1490
114,40


DWT


DWT flange


Vacuum Vessel

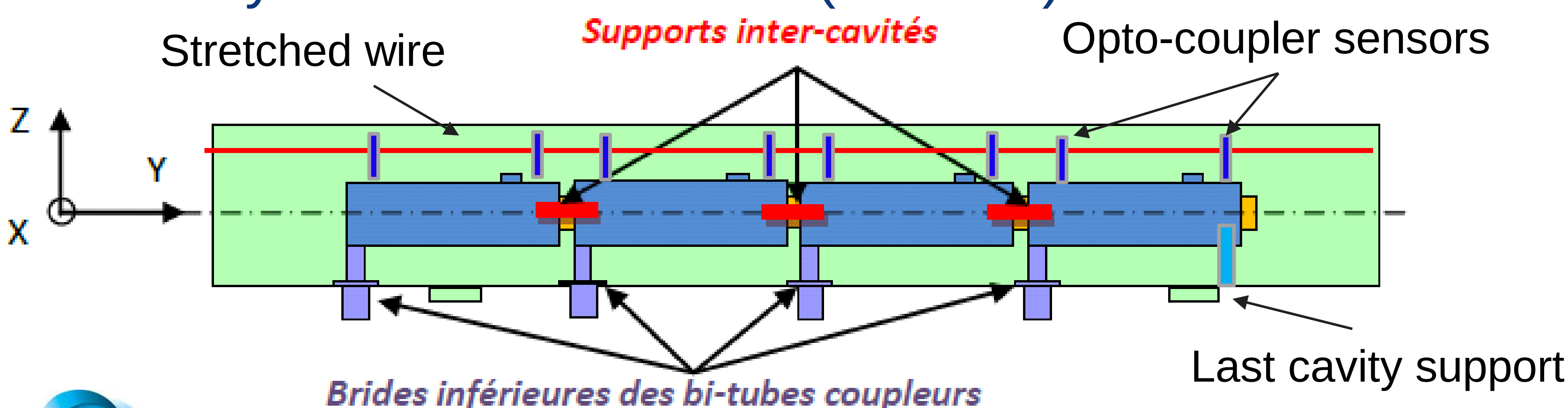
Mock-up – Test program

TEST CONDITION	TEST	COMPONENT / SYSTEM	WHAT	HOW
Room temperature (steady)	Assembly alignment	Assembly not inserted in VV	Obtain assembly alignment at warm (align cavities axes)	Act on DWT lower flange bolts and on ICS bolts to adjust axes of cavities, set zero with laser tracker, then lock
	Alignment sensitivity	Assembly not inserted in VV	Find out sensitivity of alignment system at warm	Act on DWT lower flange bolts and on ICS bolts in a repeatable way, and check the resulting displacements via laser tracker
	Vibration test	Assembly not inserted in VV	Check if vibrations destroy alignment	Vibrations can be generated by a shaker, displacement should be checked via laser tracker
Cold temperature (steady)*	Temperature profile	DWTs	Check accuracy of semi-analytical model / FE simulations of gas-cooled DWTs	Read temp sensors along DWT wall for temperature mapping at cold To have different cooling conditions, change gas N2 mass flow inside the circuit by acting on mass flow controller at gas outlet
	Temperature uniformity	Assembly	Look for temperature differences at cold	Read temp sensors for global temperature mapping at cold
	Liquid N2 quantity / static heat loads	Cavities	Check of liquid nitrogen level inside cavities to get static heat loads	Read level gages inside cavities, act on control valves of N2 dewar to open/close filling circuit
	Mechanical loads	DWTs	Check amount of bending / torsional loads, deformations	Read strain gages on DWT wall to get thermo-mech loads
	Assembly alignment	Assembly	Check assembly alignment at cold	Read OWPM on top of cavity flanges
	Cavities relative position	Cavities	Check displacements btw cavities flanges	Read displacements sensors on flanges btw 2 cavities
Cool down (transient)	Temperature uniformity	Cavities, ICSs	Check temperature uniformity during liquid N2 filling	Continuous read temp sensors on cavities and ICS for dynamic temp mapping
	Temperature uniformity	DWTs	Check temperature uniformity during gas N2 filling	Continuous read temp sensors on DWT wall
	Thermal contractions / stresses	Assembly	Check movements / stresses during cool-down	Continuous check of OWPM, strain gages on DWT wall, ICS and cavity, and displacement sensors btw cavities

Optical Wire Position Monitor (OWPM)

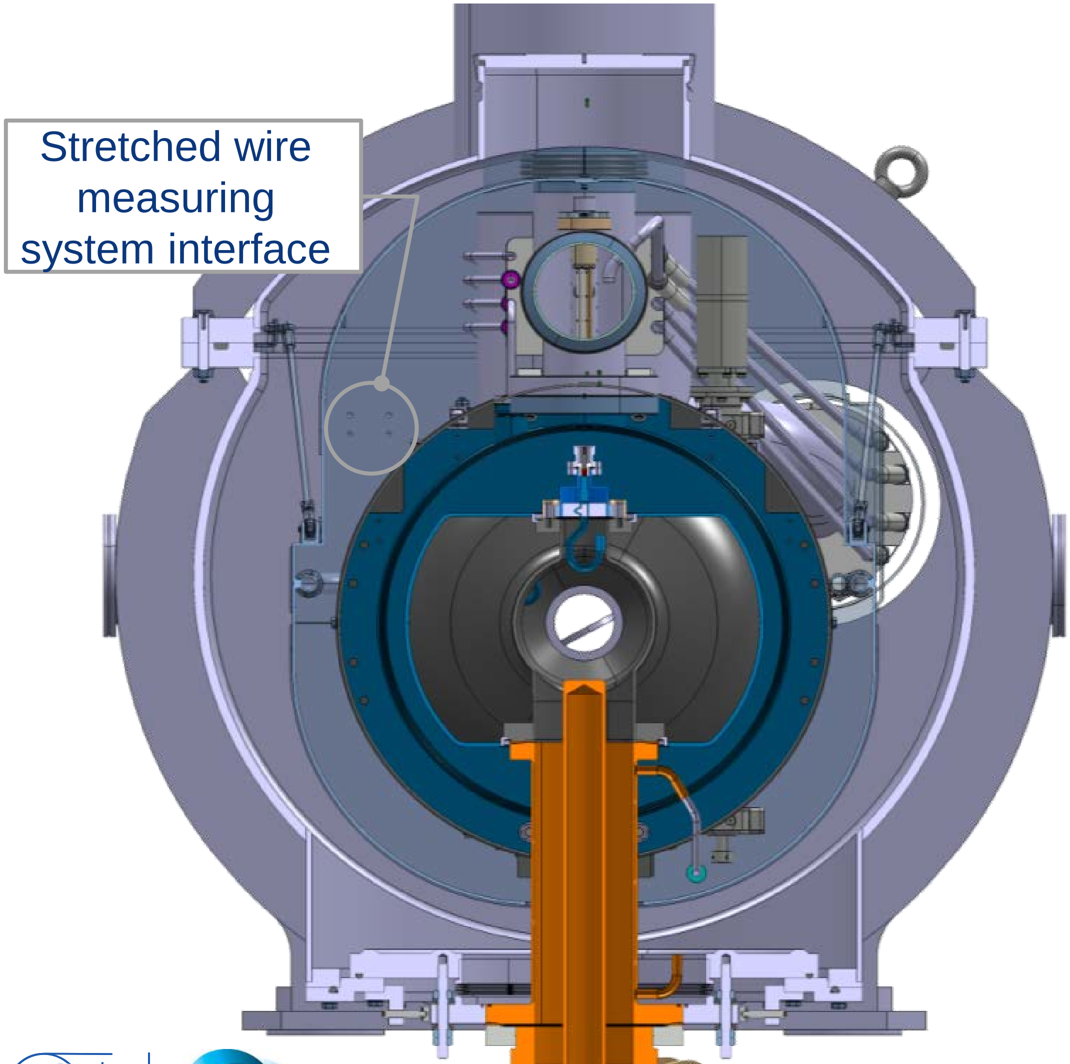
SPL SCM Cavity position monitoring specs:

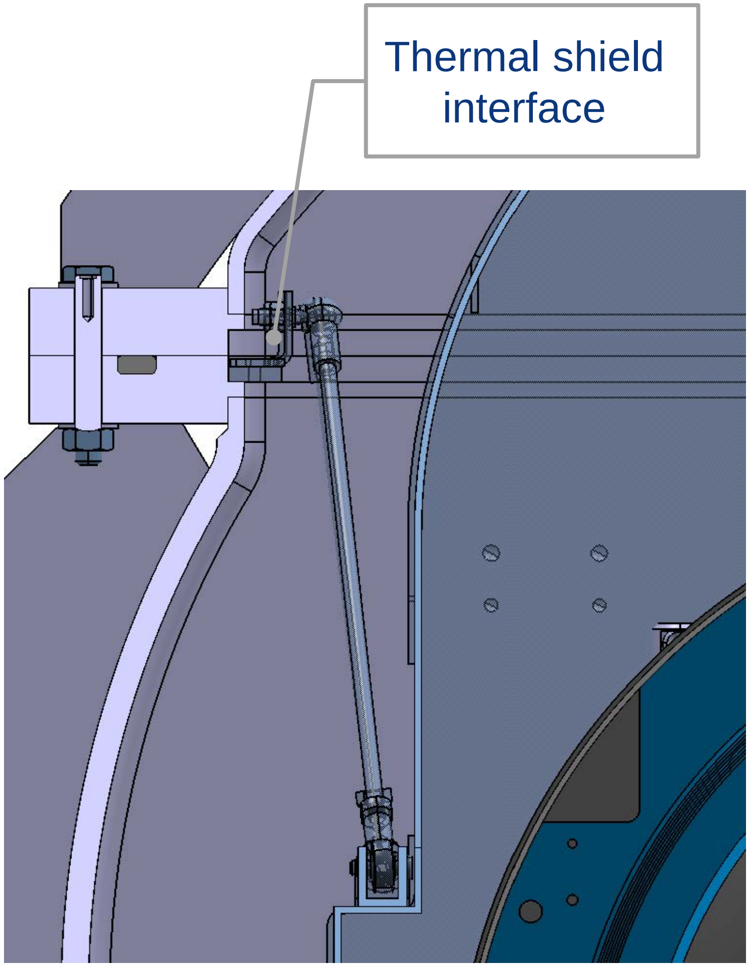
- Static position or slow movements: absolute movements (x,y,z) of each of 4 cavities during steady state operation and cool-down/warm-ups (300-2 K)
- Vertical range 0-2 mm
- Precision < 0.05 mm
- Resolution < 0.01 mm
- Possibly vibration measures (0-1 kHz)



Courtesy of V. Parma

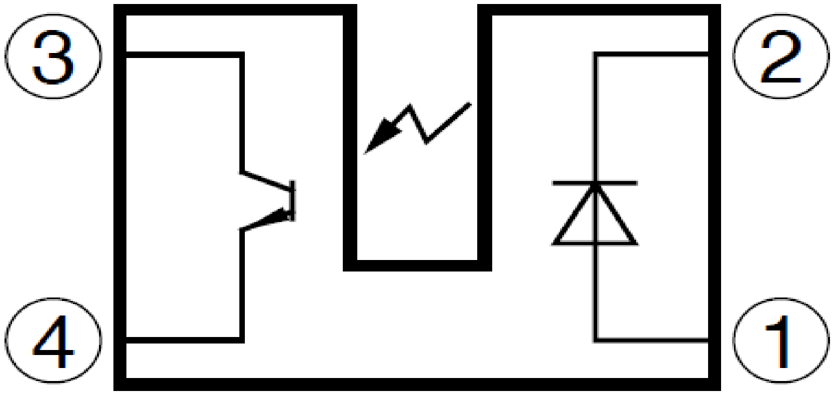
OWPM position on the SPL SCM





Courtesy of CNRS

SHARP GP1S56TJ000F



1 Anode
2 Cathode
3 Collector
4 Emitter

GP1S56TJ000F is a standard, phototransistor output, transmissive photointerrupter with opposing emitter and detector in a case, providing non-contact sensing. For this family of devices, the emitter and detector are inserted
in a case, resulting in a through-hole design.
This device is unique because it uses position pins
to insure accurate placement on the PCB, and has the short profile.

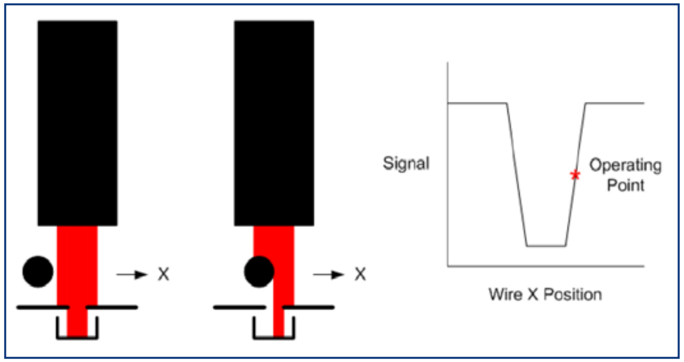
SHARP

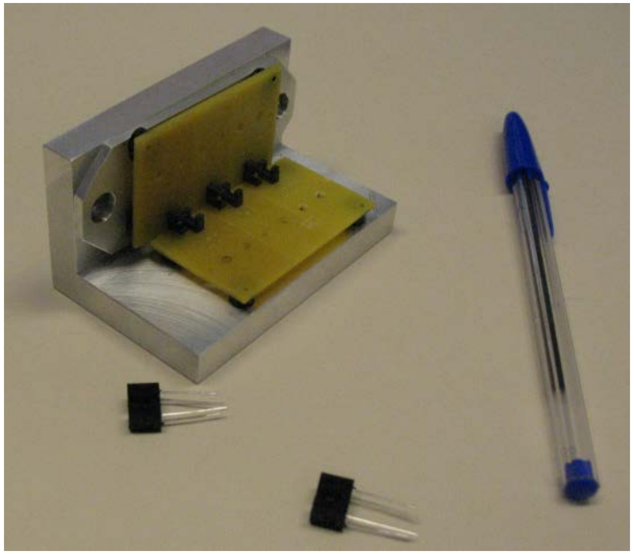
GP1S56TJ000F

Courtesy of M. Guinchard

Photo-interrupter as displacement measurement devices: R&D in progress

Basic principle

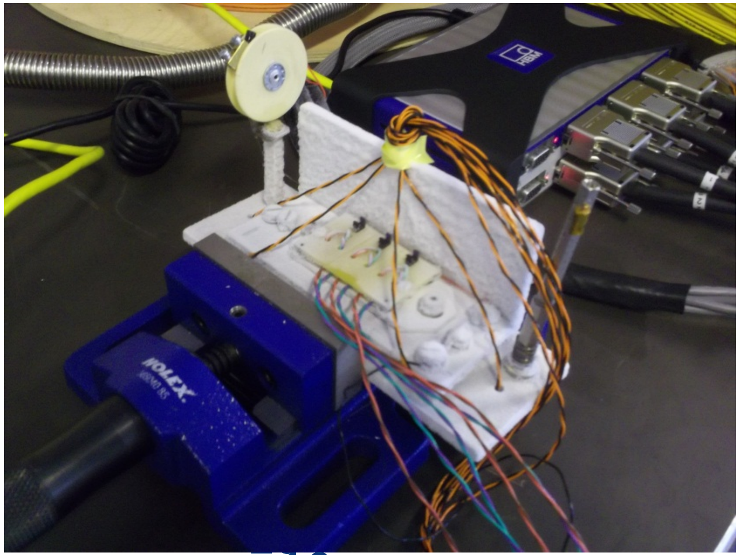




Multiple interrupters examples

Operating tests in LN2

Courtesy of J. Perez

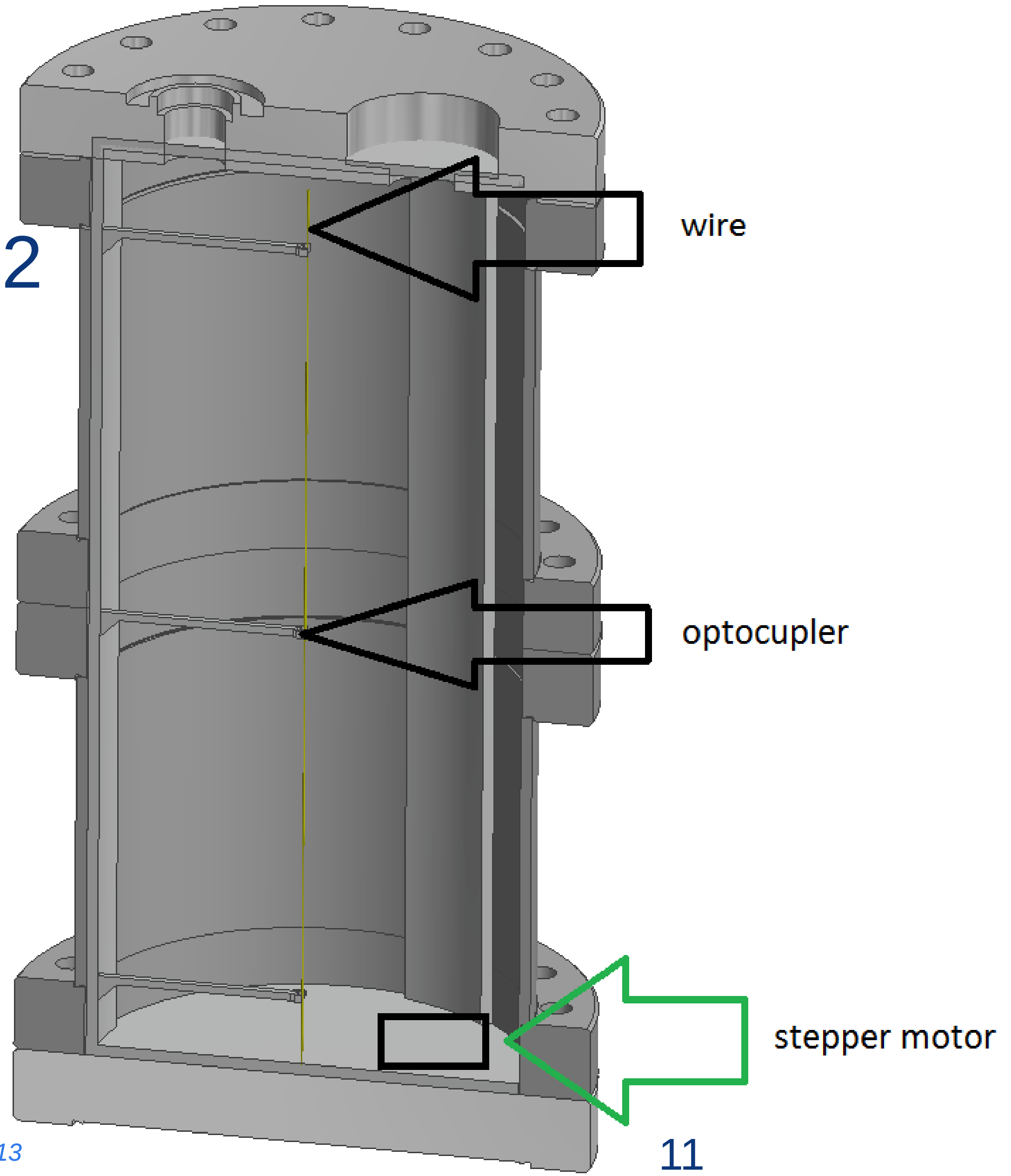


New test concept

- Small cryostat merged in liquid N2
- Under vacuum
- “Movable” wire

The Aim of the test:

Find out if we can obtain uninterrupted signals from the optocouplers



Future tasks

- Everything depends on the results obtained from our new test mock-up
- In case we obtain satisfying result we will proceed with mounting the system on the SPL mock-up
- If this solution fails we will have to look for something different (for example WPM for XFL)

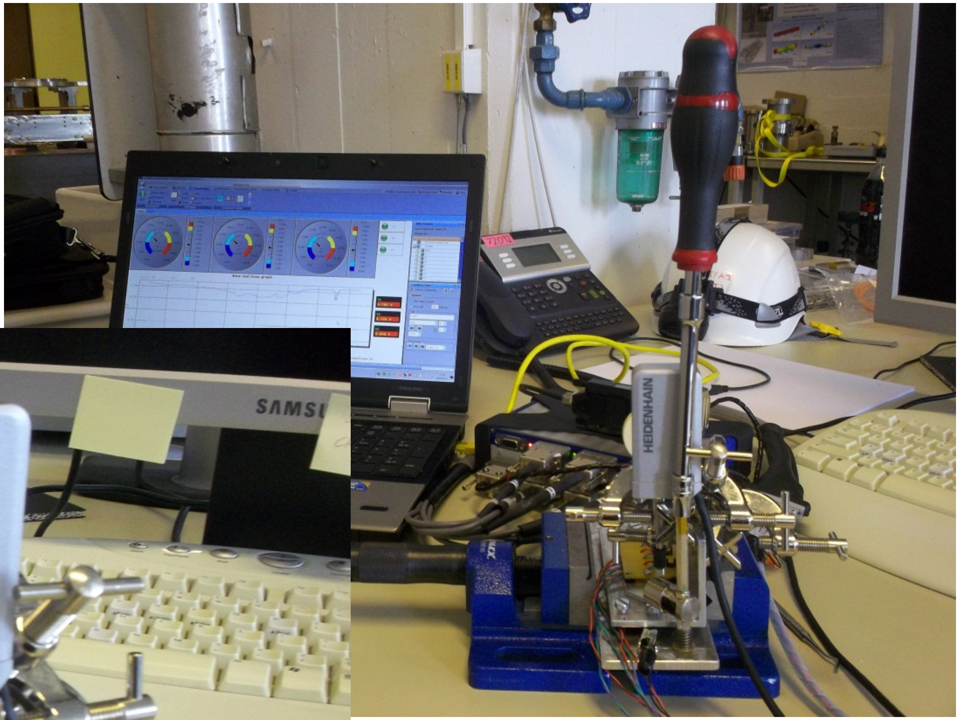
Thank you for your attention!

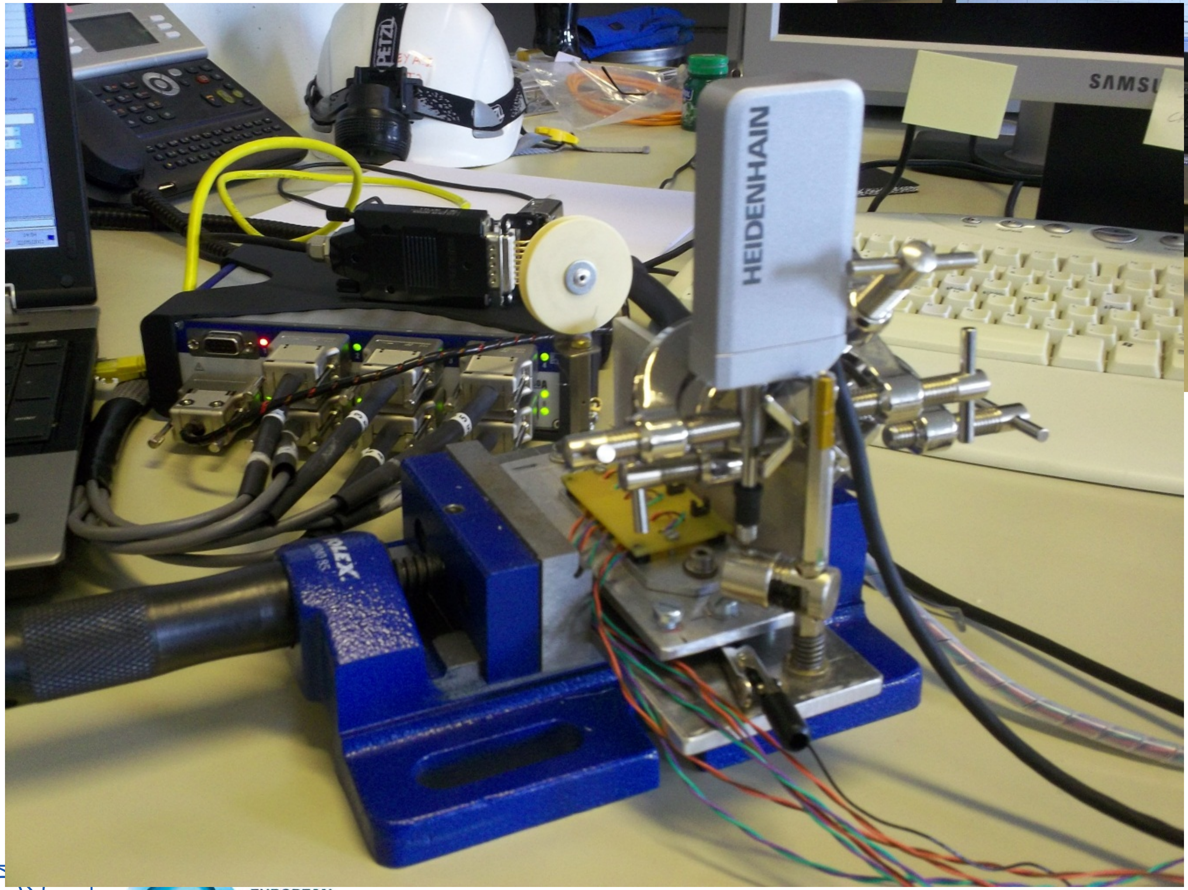
• Spare slides

Calibration with a reference sensor

HEIDENHAIN-METRO

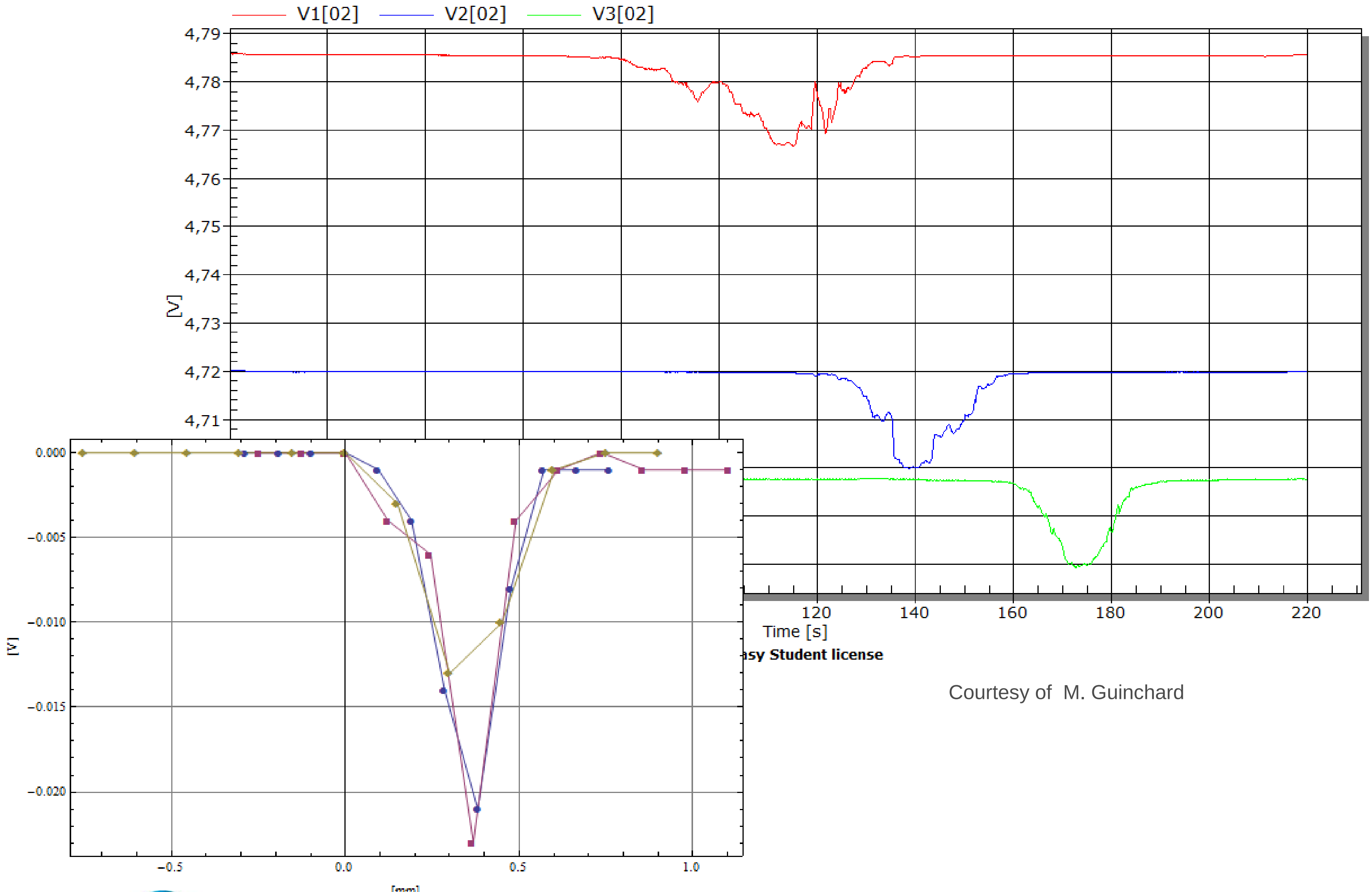
Length Gauges with ± 0.2 µm Accuracy





Courtesy of M. Guinchard

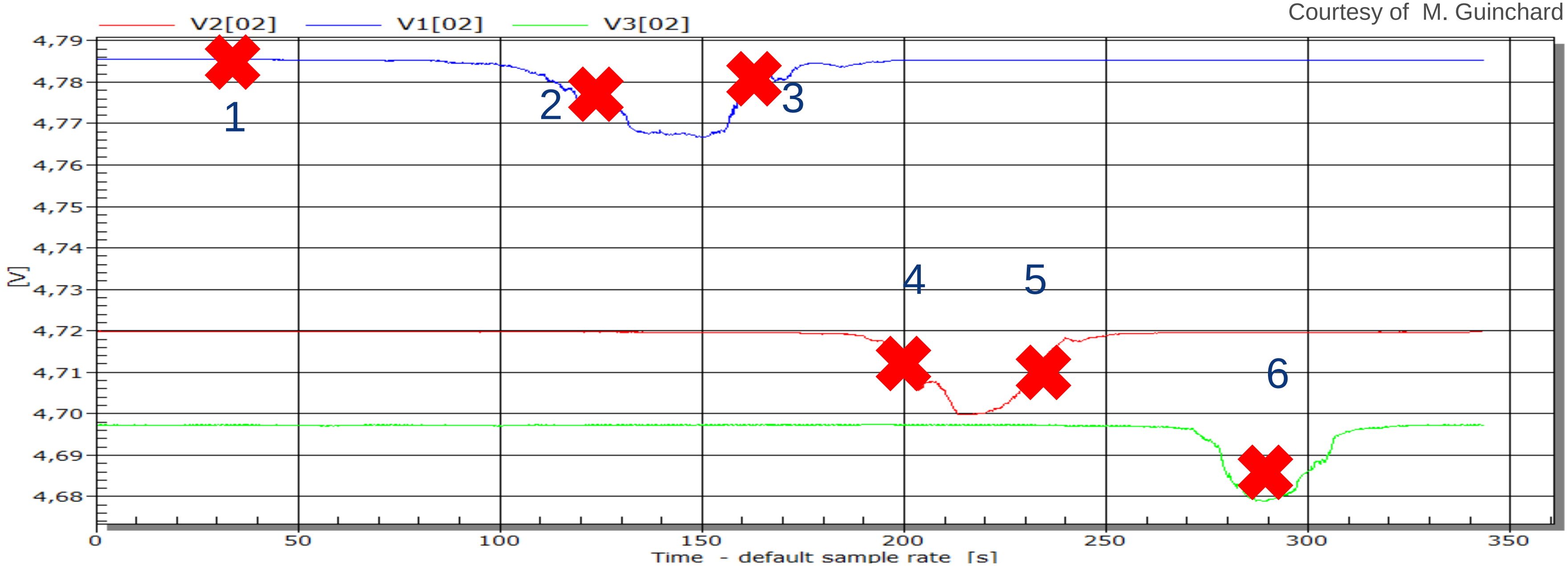
Functional tests

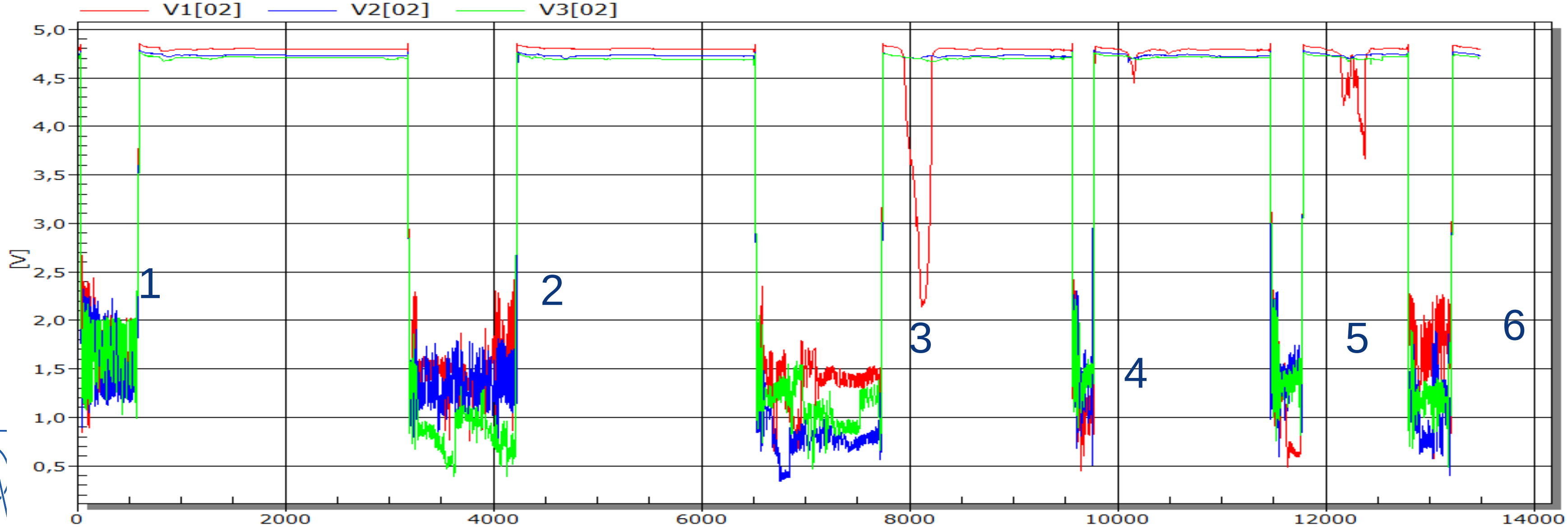


Courtesy of M. Guinchard

Functional tests at 77 K

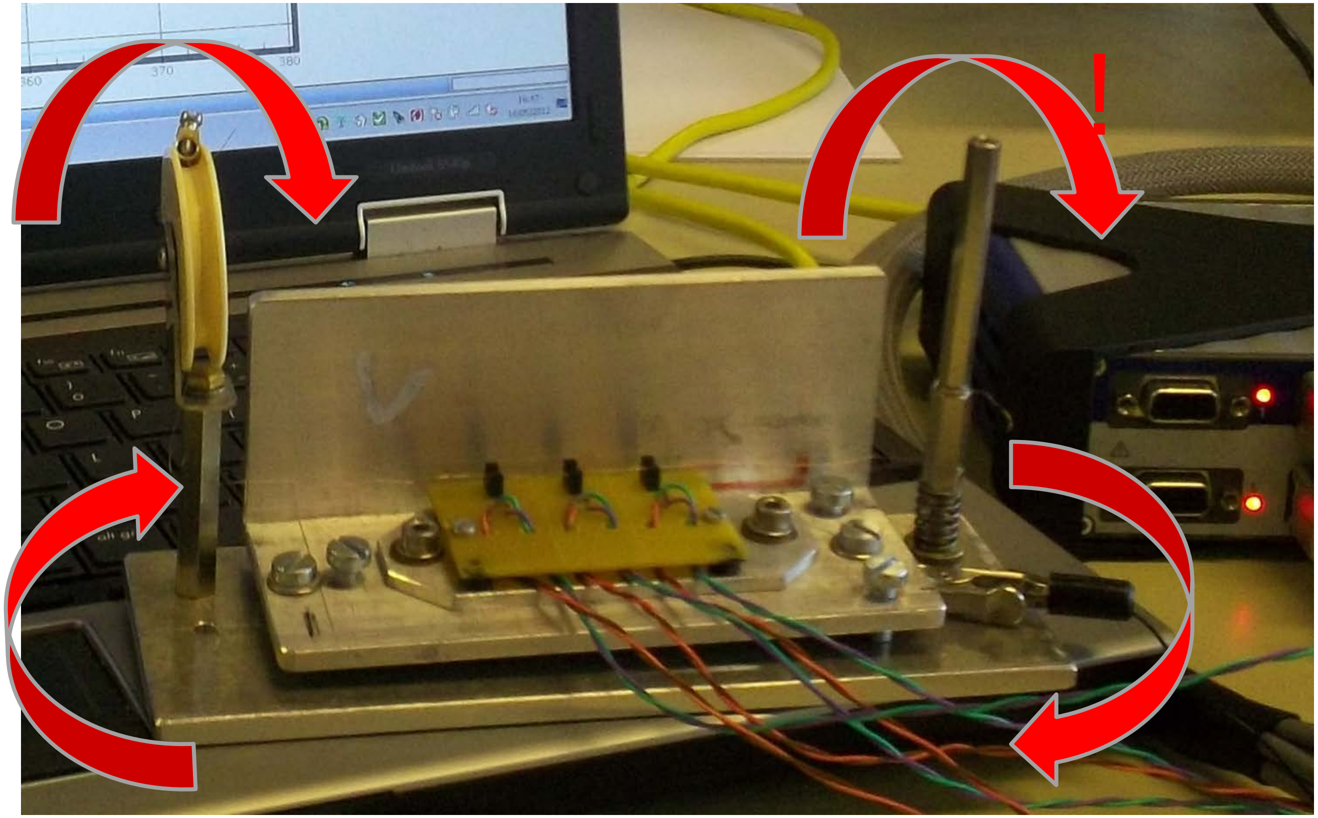
Courtesy of M. Guinchard





Functional tests at 77K

Courtesy of M. Guinchard



Deformations which can not be compensated for are:
support,
mounting system,
mounting bracket
cable,
support of the thermal compensation circuit wire.
The last two elements are fundamentally changing the geometry of the system, making it impossible to make the validation of measurements

Thermal deformation measurement system are so large that finding the correctness or incorrectness of its operation is impossible.