

# ITk FOS update - Humidity Monitoring

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# MTP-12 connectors

## 2x for Strips Endcaps - **due now**

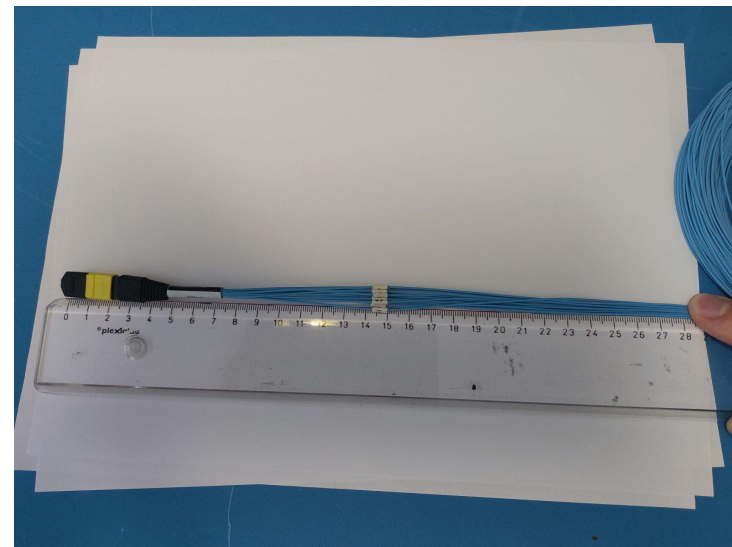
- Spliced, labelled
- QAQC with OTDR
- Ship to Valencia - in progress

10x Pt10k sensors (+6m PEEK twisted pair) to be included with MTP-12s

## 2x for Strips Barrels - **due end July**

Procured new MTP-12s - label moved 10cm from the boot (enables 90° bend for BSM).

- Spliced
- QAQC and labelling still required (~1 afternoon)
- Deliver to Jason Tarrant (can give to George Iakovidis at CERN)



Standard MTP-12 connector  
(label @ boot)

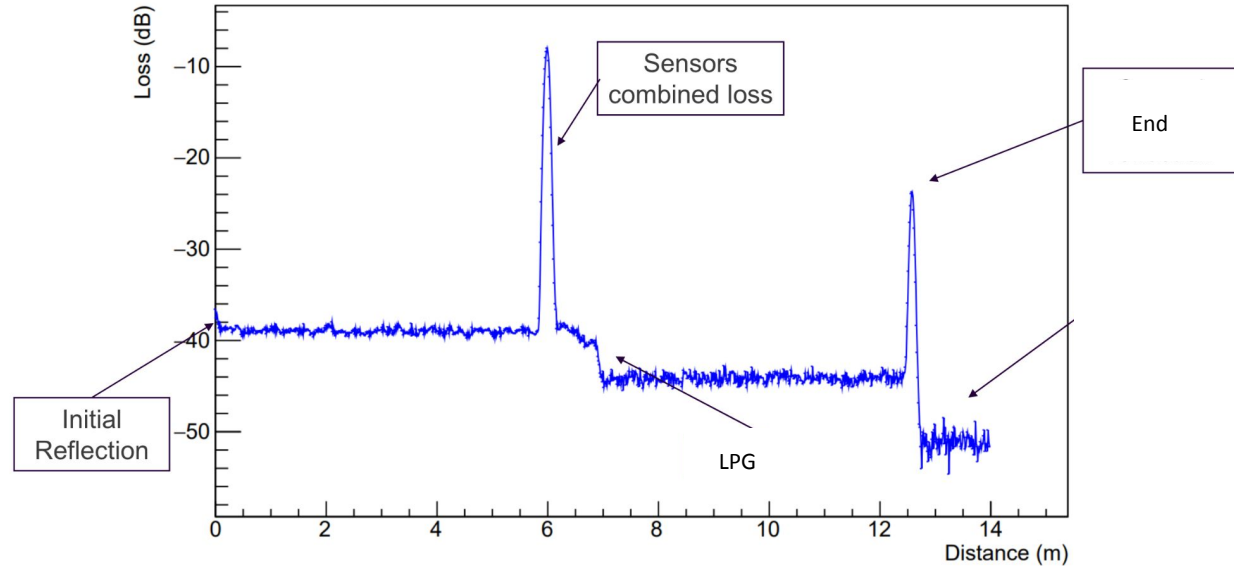
## OTDR Models

- **Current:** [Luciol v-OTDR](#), rented from electronics pool, 10CHF/ day
- **Desired:** [FOTR-201 handheld OTDR](#), €1152

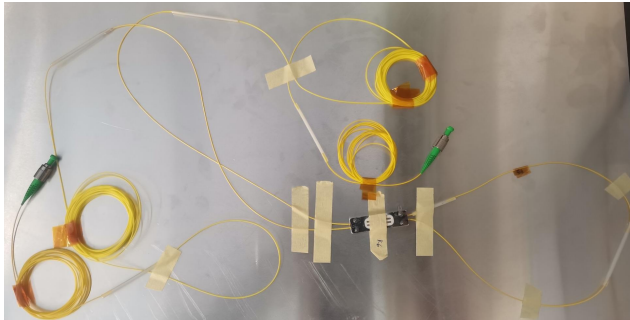
## At installation:

- Health check each fibre
- Compare against spectra recorded in the lab

## OTDR – FOS Packages



Above: Example spectrum from OTDR  
Right: FOS package with full 6m leads



# 2nd Irradiation Campaign



- Required to pass PRR:
  - Demonstrate the FOS can match reference sensors *even after irradiation*.
  - For this we irradiate another 2 packages (previous 2 were broken)
- PRR must be passed before materials can be ordered to 100%.

## IRRAD

- Plan irradiate to 1.5MGy with protons at IRRAD facility, CERN.
- Date not yet set (focusing on immediate production) - potentially August
- Timeline:
  - Irradiation - 1 week
  - 2-3 weeks before irradiated sensors can be returned to lab
  - 1 week humidity and temperature testing
  - Analysis - depends on results

Developed an Auto-Label generator via a [script](#)

Label: n1-n2-n3-n4-n5.

## 1. ITk Volume

- 1 Strips - Barrel, including  $z=0$  ( $L=0,1,2,3$  go out to different ends of the detector)
- 2 Strips - Endcap
- 3 Outer Pixel
- 4 Inner Pixel
- 5 OSV

## 2. Side of detector

- 1 A
- 2 C

## 3. Fixation position

- 1 Mapped point 1 : to a drawing, via a map
- 2 Mapped point 2 : to a drawing, via a map
- 3 Mapped point 3 : to a drawing, via a map
- 4 Mapped point 4 : to a drawing, via a map
- 5 Mapped point 5 : to a drawing, via a map

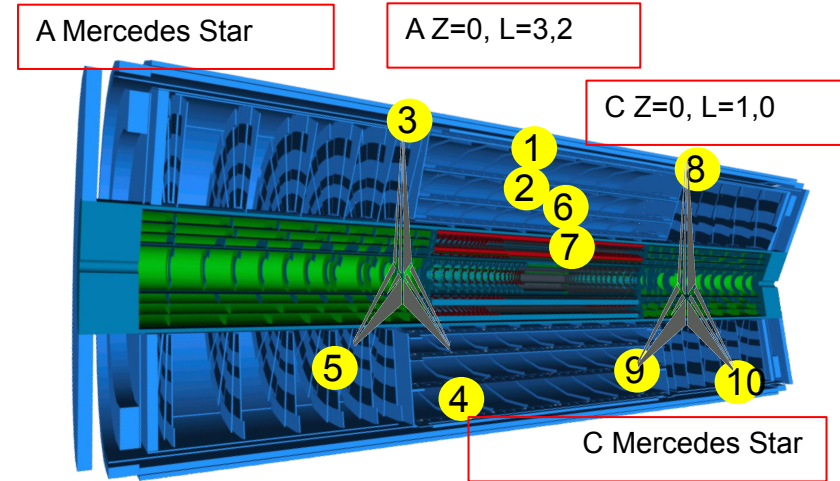
## 4. Pins in MTP or DB25

Pin number  
for FOS, lower pin of pair is the FBG side of the package  
for Conventional

- n+0,1 is for the PT10k, where order does not matter
- n+2,3,4 is for the HiH4000, order is ground, Supply (+ve), Signal

## 5. Overall number

incrementing on the item supplied



Example map ... Barrel

*End*



**BACKUP**

## 2x Packages for Strips Barrels $Z=0$ , $L=2$ and $L=3$

$L=2$  due **July 8th** (next Monday),  $L=3$  due **July 15th**

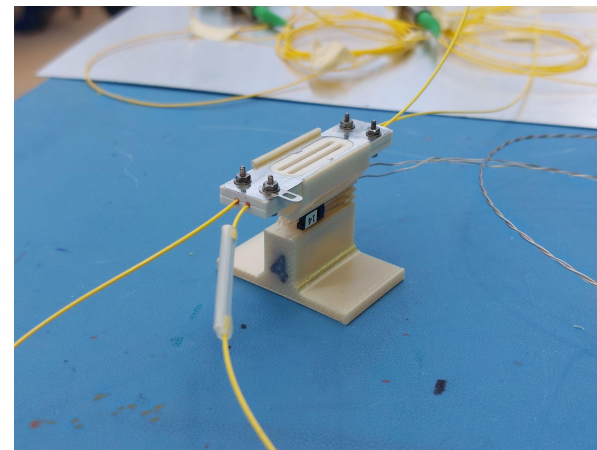
**Status** - under QAQC testing (**had to be lengthened**)

### Schedule

1. Test varying RH at  $-20^{\circ}\text{C}$  -> **finished yesterday, 17:00 CERN time**
2. Flush chamber, run test varying temperature at 35% RH -> **until Wednesday 17:00**
3. Flush chamber, run test varying RH at  $0^{\circ}\text{C}$  -> **until Friday 17:00**
4. Final steps: add last grounding components and check connection, glue reference sensors to bracket, package all -> **until Saturday 17:00**

For  $L=3$ , we await a new bracket (should arrive next week)

Explanation of [grounding](#)



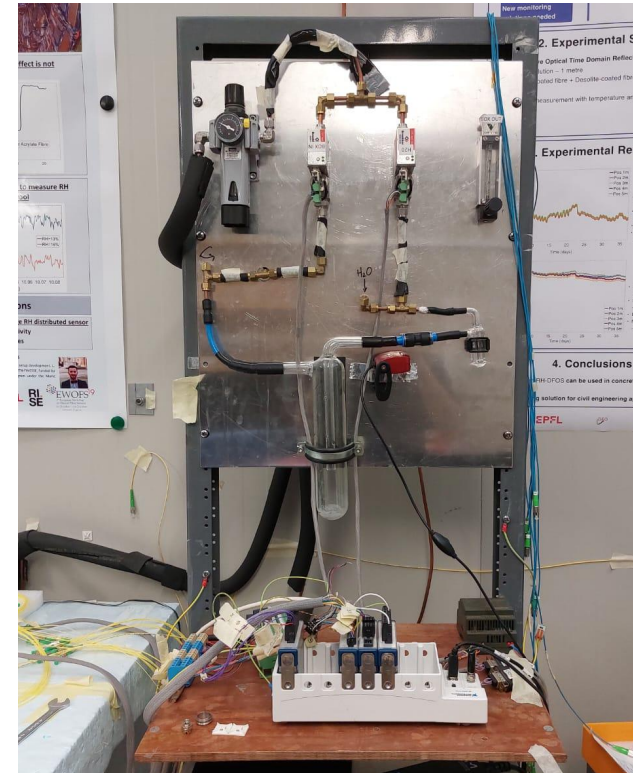
Example FOS package in bracket

### To deliver (2 each):

- Ultem bracket
- HIH sensor + 6m PEEK twisted triplet
- Pt10k sensor + 6m PEEK twisted pair
- Neoceram package, with 2x FBG and 1x LPG sensors

# QAQC Challenges

- DewMaster (used as high accuracy ref. sensor for RH in lab) is experiencing problems:
  - Requires maintenance (engineer waiting for current test to finish)
  - For now, we use HIH sensors for QAQC
- Complexity of LPG calibration
  - LPG designed to measure humidity
  - However, it is orders of magnitude more sensitive to dose and temperature
  - To compensate, we use:
    - Rad-hard FBG to compensate for temperature
    - Rad-soft FBG to compensate for dose
    - We have found the RH calibration is T dependent
    - Must calibrate in the whole (T, RH) plane
- Humidity control **highly** difficult
  - Industrial sized chambers often see stratification
  - Valves for dry/ humid air input can be unreliable
  - Stable humidity for given valve combination can be different each time



Humidity control setup, 168/R- G14



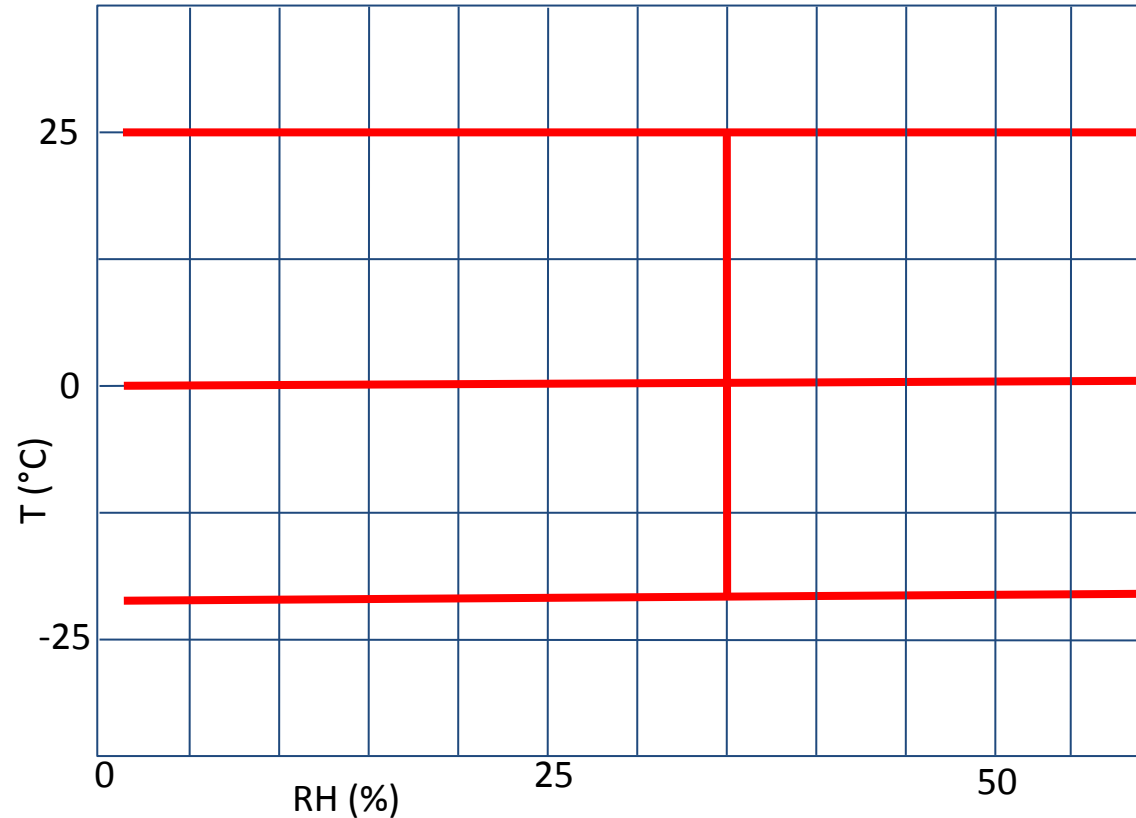
QAQC procedure expanded to reflect complexity of calibration.

## Previous QAQC (pre-2024)

1. Constant RH 35%, vary temp. -20->25C
2. Constant temp. 25C, vary RH 1->60%

## Current QAQC

3. Constant RH 35%, vary temp. -20->25C (same as before)
4. Constant temp. -20C, vary RH 1->60%
5. Constant temp. 0C, vary RH 1->60%



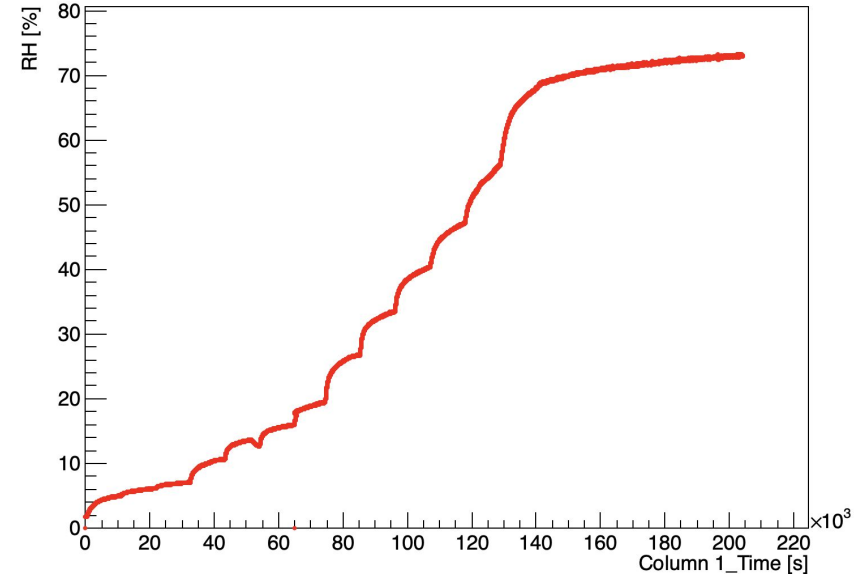
## PID control - in progress

- Currently humidity control is done in 2 ways:
  - Manually adjust valve opening %, check humidity by eye - **slow, noisy data**
  - Script to adjust valve opening % - **inconsistent RH values**
- Goal: develop a system to automatically adjust humidity

## Optical switch

- Previously only 2 packages could connect to Hyperion interrogator at once (only 4 channels)
- Optical switch allows up to 12
- Greatly speeds up QAQC

HIH 4 vs. Column 1(Time)



Example reference sensor output for QAQC, showing humidity steps

# Questions from FOS for Strips

FOS need by dates [doc](#)

- MTP-12s for Strips Barrels
  - Due when? By end July (can be done after Strips packages)
  - Need more HIH and Pt10k??
  - Do we supply the F-F MTP-12 coupler?
- Further packages
  - Strips Endcaps - 6 due during 2024? Need to wait for PRR
  - Strips Barrels - due March 2025? Yes this date should be fine
- OTDR
  - How will it be shared - just for a day? Can only be at CERN - Should be fine
- Brackets for packages
  - We only have 4 brackets for Strips Barrels
  - New design? Already made, can be sent by Jason Tarrant (waiting on finalizing labelling)
- Labelling
  - Question about the ATLAS Accredited label
    - Is there a specification ? - G. laokvidis: change 'Fixation position' numbers to match e.g. Barrel level 0, 1, 2, 3
    - Must it be Rad Hard ?
  - Apparently the TC Co-ordination also maintain a DB., in addition to the Production DB (called ACES).

# Inventory



1. MTP-12 Connectors
  - a. **9** regular
  - b. **2** MTP couplers - 16 ordered
2. Pt10k: **61**
3. HIH: **10**
4. Ceramic packages: **74**
5. PEEK wire: **6.5km** twisted double, **1km** twisted triple
6. **300e** Titanium Screws (order 200 more each)
7. Grounding
  - a. Goodfellows Aluminized Kapton **300mm x 300mm**
  - b. Araldite – **2x 15ml** tubes
  - c. Non-woven mesh – **0.14m<sup>2</sup>**
  - d. **100** Solder tags
  - e. **70e** PEEK nuts and washers
8. Fibre connectors
  - a. LC/APC - ?
  - b. FC/APC - 50 ordered
9. Labelling machine - need to place order
10. FBGs:
  - a. **11** Radsoft
  - b. **11** Radhard
11. LPGs: **11**

## Produced

1. MTP-12 Connectors
  - a. **2** spliced for Strips Endcaps
  - b. **2** spliced for Strips Barrels
2. **8** Packages
- 3.

Items in bold are in the lab (168-R-G14)

Not procured

25% procured

100% procured