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ALBATROS

Sensors & Physical Threats

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Co-funded by the European Union

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Demo 5 : Real time health monitoring of electrical power network to detect arc inception

Objectives

Risk to mitigate: Arc inception on/inside electrical power network

How: Development of a real time health monitoring to detect arc inception before irreversible damages occur on the power network.

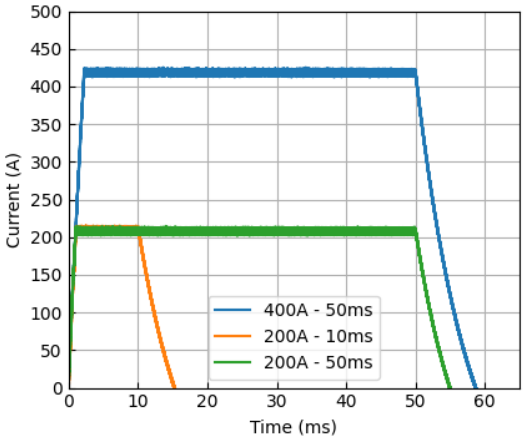
Time response target of the sensor is the µs

Work to do:

- Design of a test set-up for arc initiation
- Design of the detection using Fiber Bragg sensors
- Tests of the detector on academic set-up
- Building of the system
- Tests of the health monitoring

Demonstration: The system capability will be tested on TROPHEA test bench.

Generator GRIFON at ONERA Palaiseau delivering 400 A and in this study 16 kW



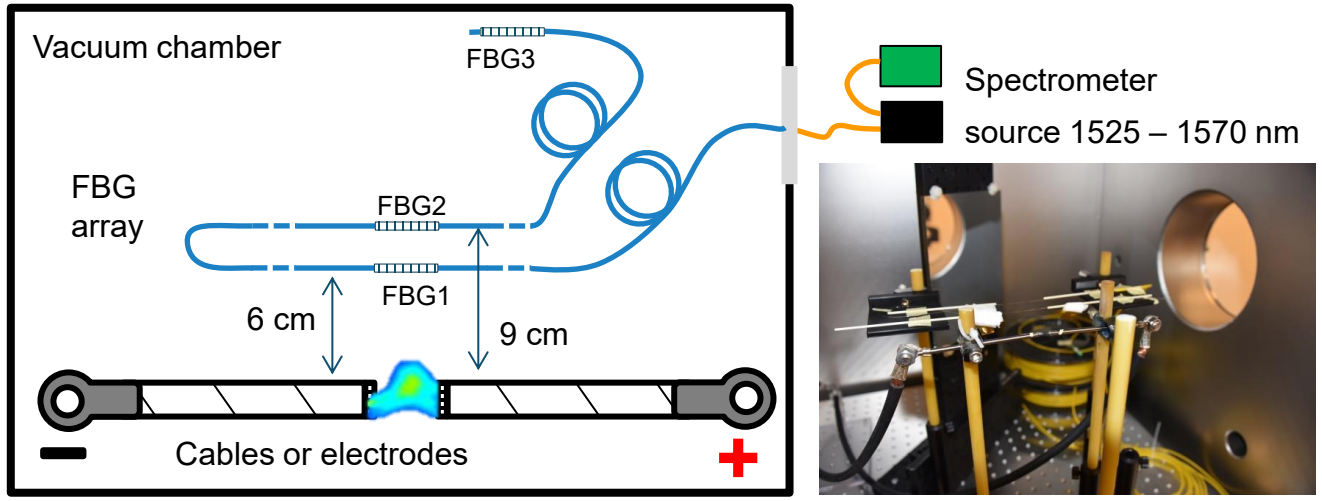
Work performed with FBG

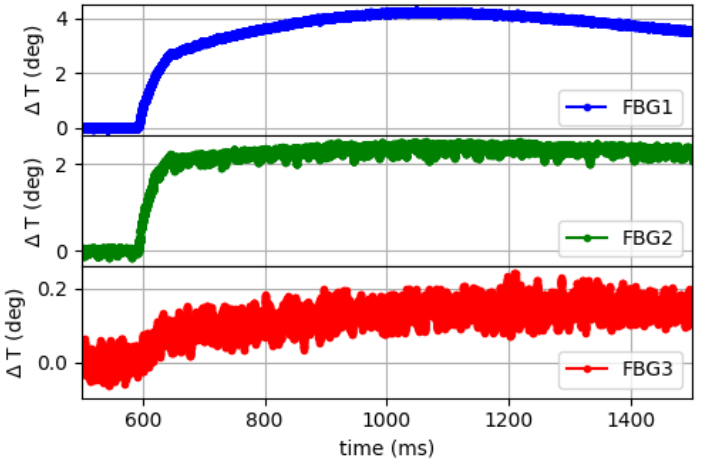
Design With FBG sensors

- ✓ Design of a test set-up for arc initiation
- ✓ Design of the detection
- ✓ Tests of the detector on academic set-up

But FBG sensors ➔ Too slow (~ms)

➔ Replace by a fiber based sensor



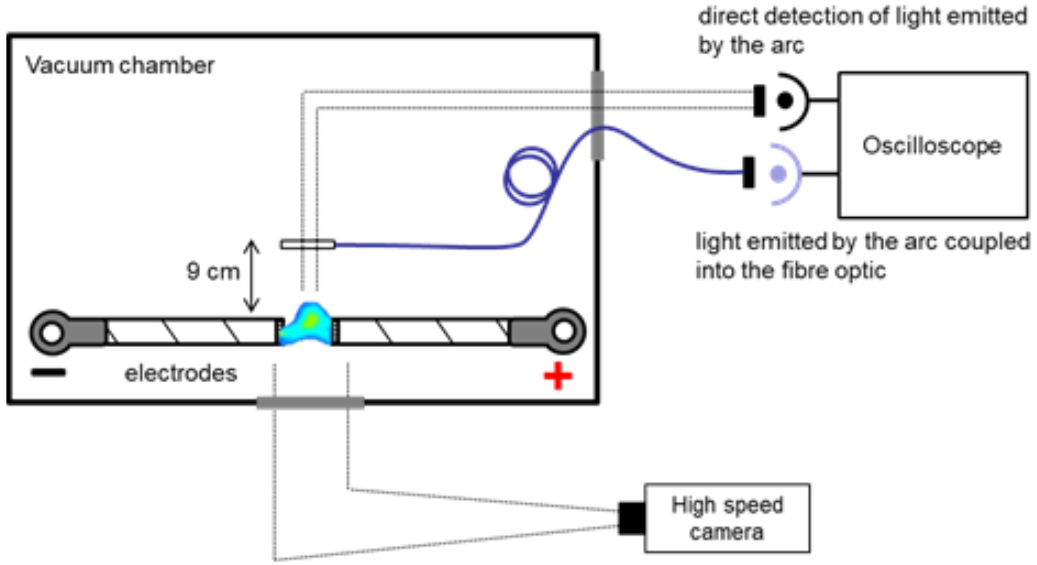


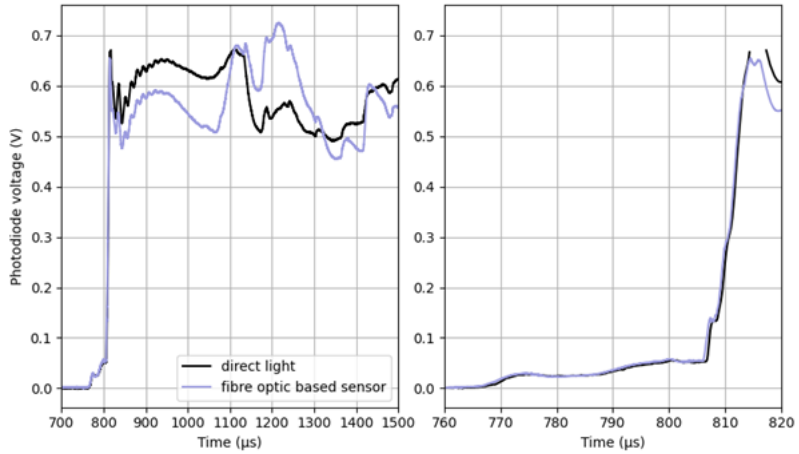
Temperature rise for an arc of 400 A – 50 ms at ambiant pressure measured by the three FBGs

Work performed with fiber sensors

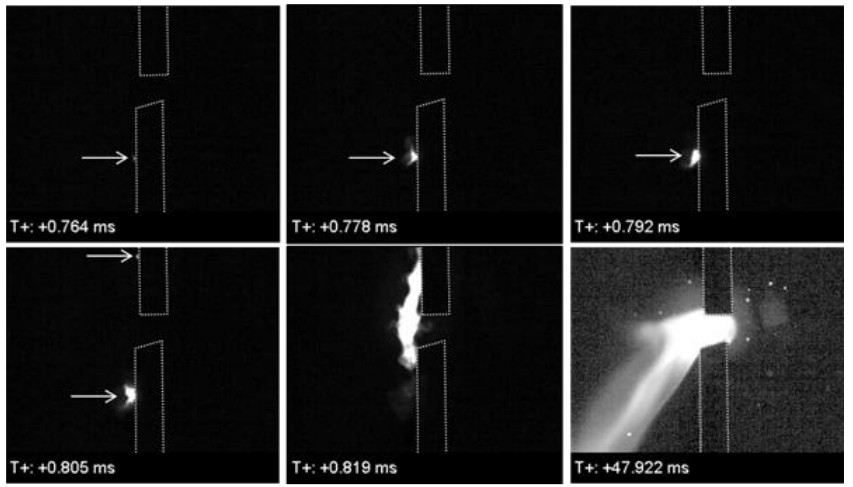
→ Time response of the sensor using fiber to directly collect the light is below 100 ns

→ Sensors can be tested on TROPHEA test stand at ONERA Toulouse



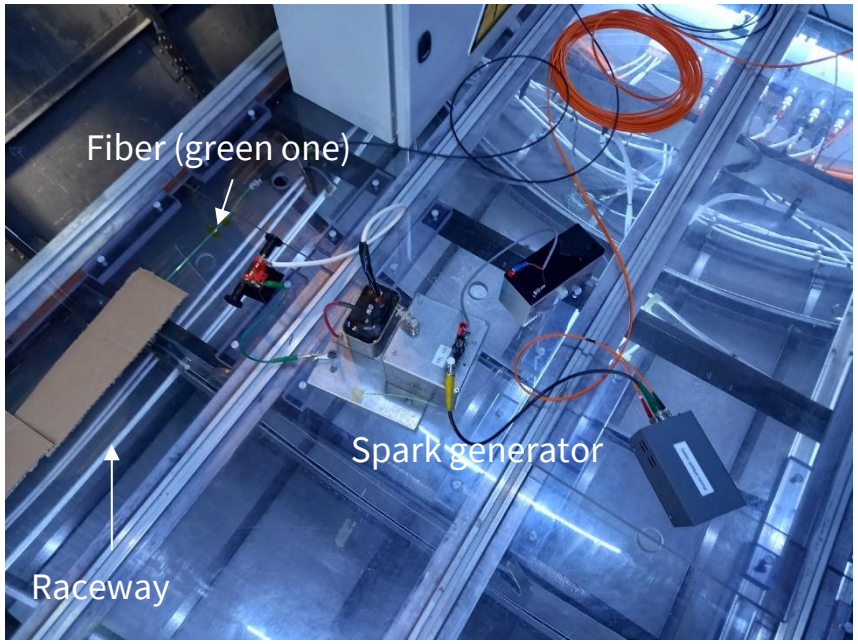


Time response of the sensor (above) and arc imaging (below)



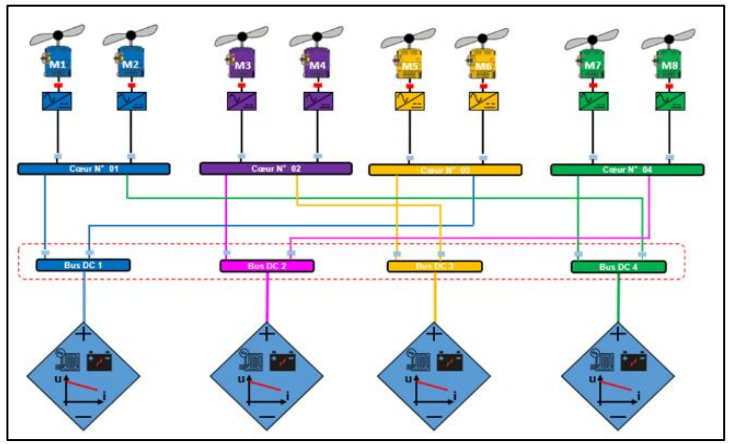
Tests on TROPHEA

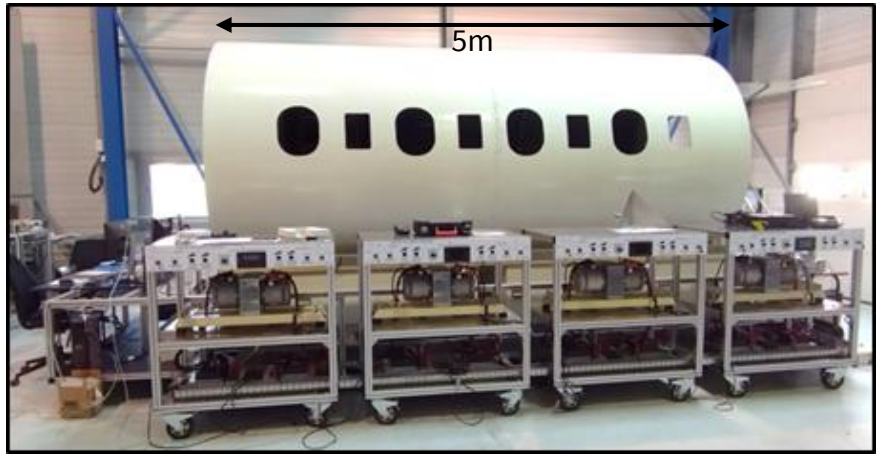
- Tests on TROPHEA (2,3m diameter) were performed in july 2025
- GRIFON 16 kW could not be moved for the campaign
- A 30 mJ discharge replaced the generator to validate the sensor in degraded conditions (less radiative power)



Picture of the spark generator and the fiber sensor

TROPHEA and its equivalent circuit





Tests on TROPHEA

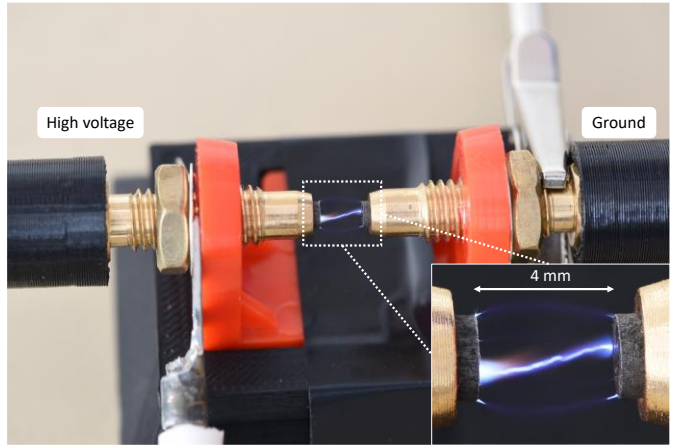
Several configurations tested :

- Sensor (red version) detection successful at 1m of the discharge
- Sensor is sensitive to auto-absorption but 1m of propagation of signal in the fiber is detected and successful
- Sensor is not sensitive to power network electrical noise
- Sensor is sensitive to some extent to ambiant light

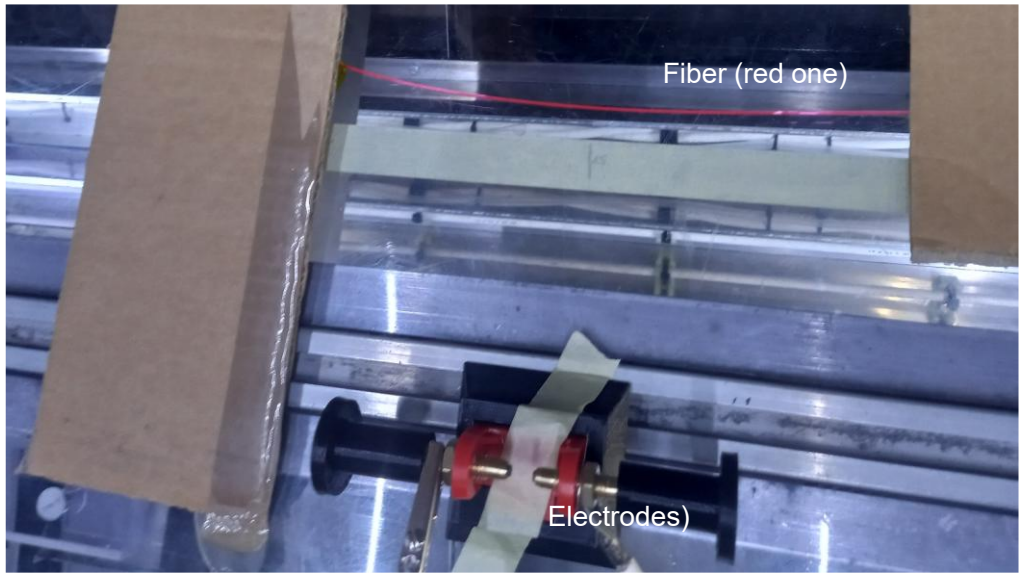
Overall the campain is succesful and the red sensor detected succesfuly the discharge in all case

Main conclusion :

- **Fiber sensor is a promising solution to complement existing solution based only on electrical measurements (redundancy)**
- **A single fiber line is sufficient to detect a few meters of cables**
- **In the case of small energy discharge, ambiant light affect the detection statistics.**



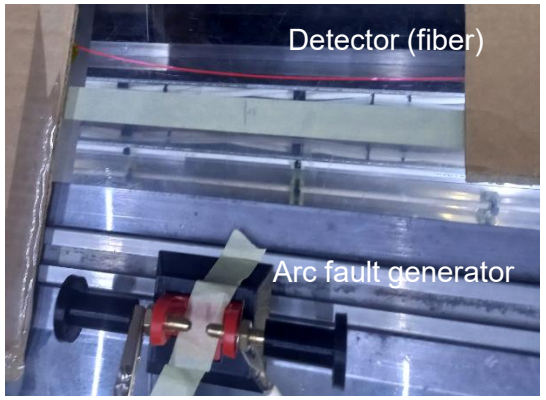
Spark discharge used for the validation, E~30mJ



Outlook and next steps

Current status:

The system successfully detects electrical arc faults along the optical fiber in a simulated power train environment (TROPHEA test stand)



Next steps – System development

- Ruggedize the complete system for industrial applications, including protective sleeves for the optical fiber and industrial-grade connections
- Optimize data acquisition by integrating an FPGA for real-time signal processing and communication
- Validate a complete safety chain on a real powertrain, including the feedback loop to the onboard systems

Applicability & IP

- Investigate potential applications of the technology in other fields
- Monitor competing solutions and assess the patent landscape, as a competitor appears to be developing a similar approach

- More info :

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Demo 9 : Prevent fire events on hydrogen aircraft

GH_2 detection for safe use of H_2 in aviation

	Optical	Electric*
Fast GH_2 detection	Few seconds ☑	Tens of seconds
Low concentrations	5% LFL ☑	10% LFL
Explosion safe	Intrinsic ☑	possible
Lightweight	40g ☑	800g
Wide pressure & temperature range	☑	☑

*Reference: NEO983HT

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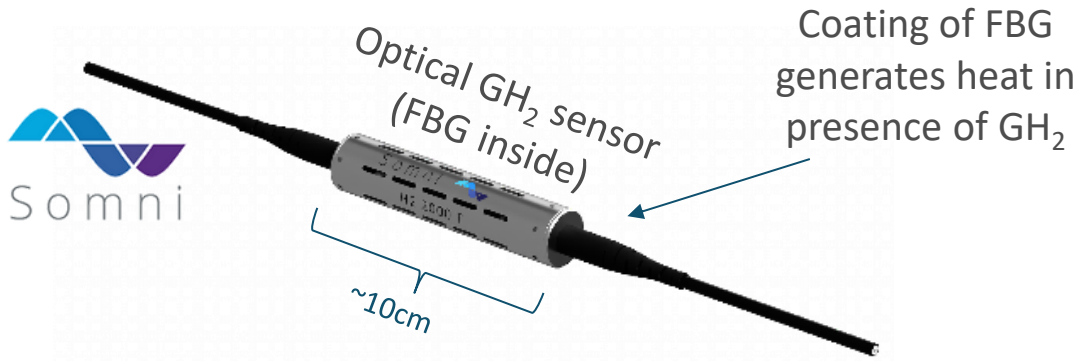
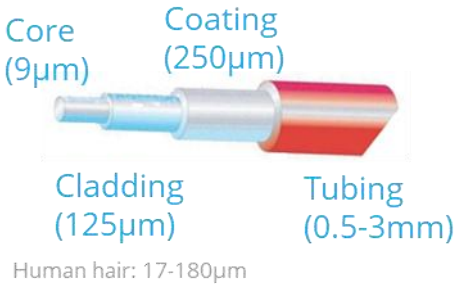
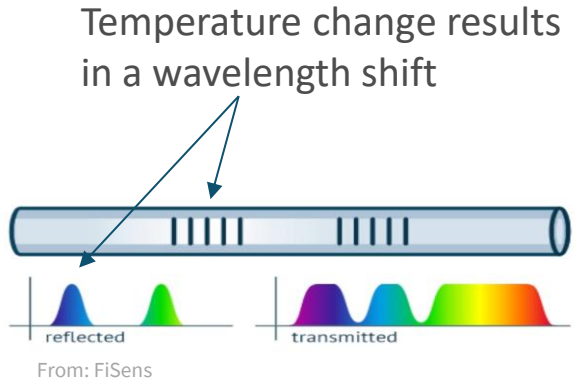
AIRBUS

Somni

Working principle fiber optic GH_2 sensor







- Highly sensitive to GH_2
- Light weight
- Multiple sensors per fibre (Daisy chain)
- Completely passive, no EMI / electricity (No ignition source)

- Operates over relevant pressure range (0.25 to 1.5atm)
- Wide temperature range (-30 °C ... +80°C)
- Long term stability and durable
- Operate over long distances (>km)

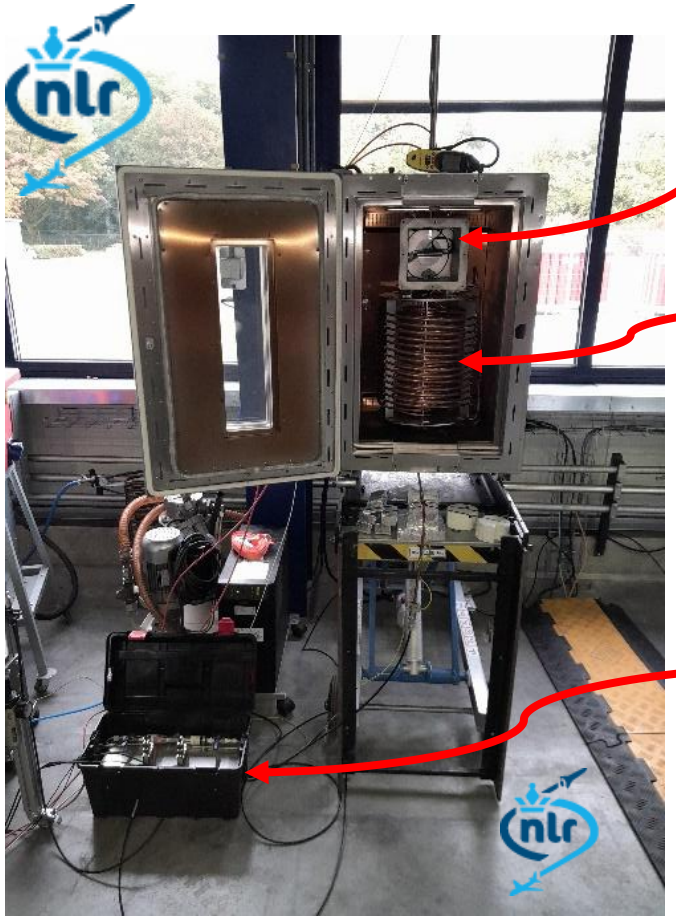
(Luna)

Sensor characterization for use in aviation

ISO 26142:2010(E) - Hydrogen detection apparatus — Stationary applications

Sensor Criteria for:

- Accuracy
- Repeatability
- Long term stability
- Response time
- Temperature
- Pressure
- Humidity
- Selectivity
- Poisoning
- Operation above the measuring range



Gas mixture is cooled or heated in climate chamber (-30°C – +80°C)

Air and Hydrogen gas flows mixed by flow control (0.0-4.0 vol%H2)

AIRBUS

Requirements tuned for aviation together with airbus

Test campaigns show fast and repeatable sensor response

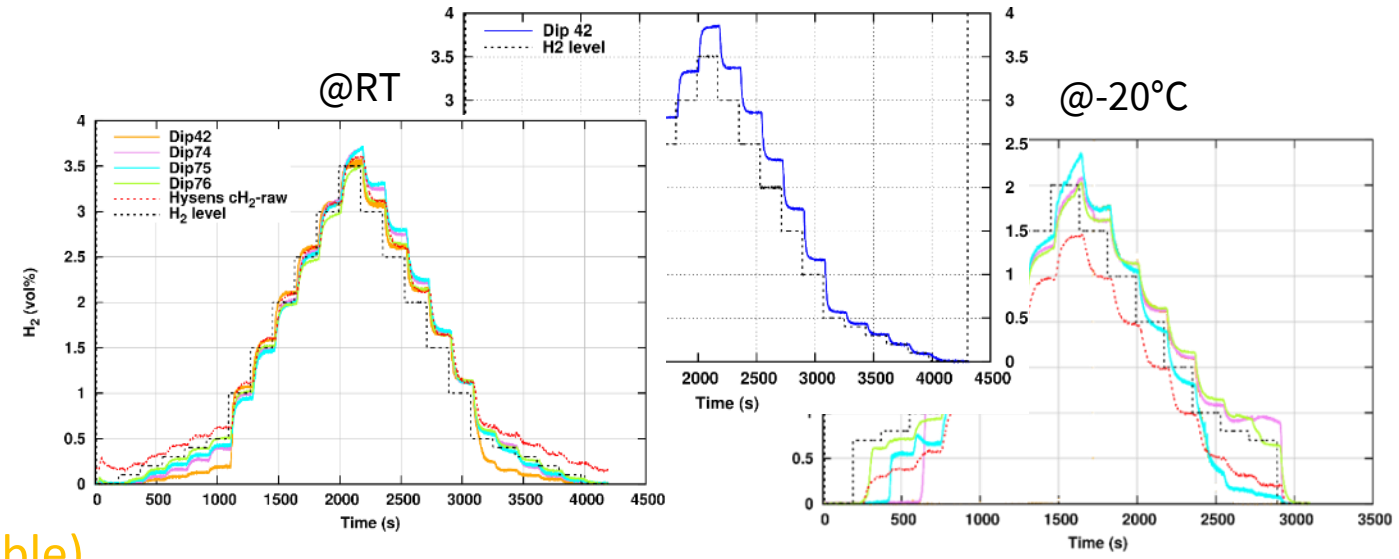
Sensor performance

- Sensitivity (good)
- Repeatability (good)
- Accuracy (good)
- Response time (very fast)
- High temperatures up to +80°C (good)
- Low temperatures down to -30°C (reasonable)
- Moisture sensitivity (to be improved)
- Robustness (good)
- Pressure dependency (good)
- Sensor Poisoning / Selectivity (no / to be tested)
  - Tested: Methane, 95%RH air, low Oxygen concentration
- Vibration (to be tested)

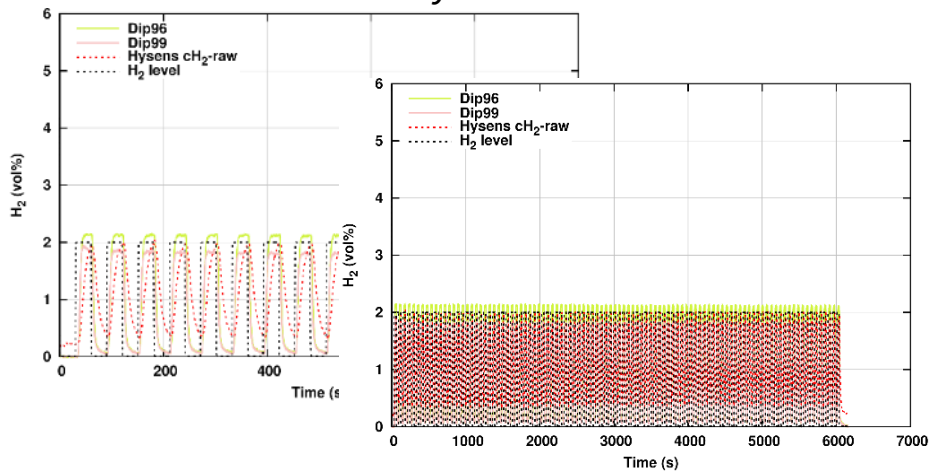
@80°C

@RT

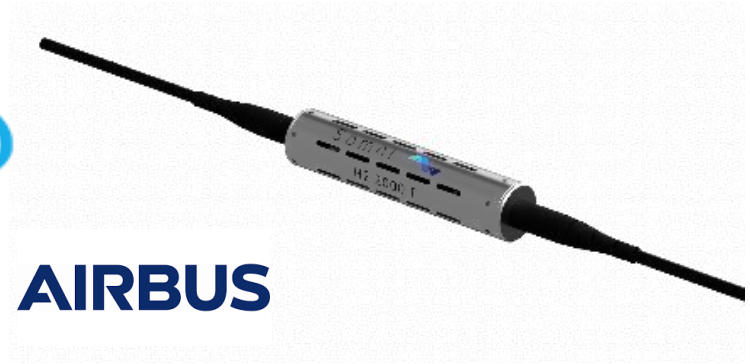
@-20°C



180 cycles of 2 vol%

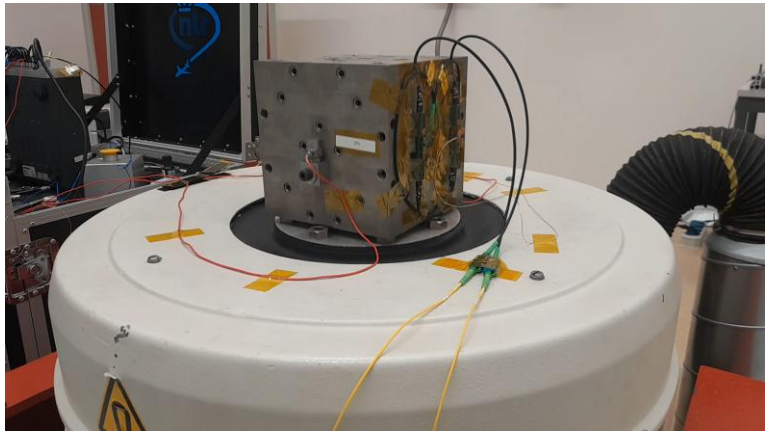


GH_2-sensor summary



A robust, lightweight and highly sensitive optical GH_2-sensing solution as safety measure for H2-fueled aviation. Operating at high and low pressures and temperatures.

Assessments follow on vibrations, poisoning and humidity.



Target: sensor demonstration in Airbus ZeroE A380 (beyond ALBATROS timeline

More info

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Consortium

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DEUTSCHES ZENTRUM FUR LUFT - UND RAUMFAHRT EV (DLR)
OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES (ONERA)
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