

European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

WGs and MC Meeting at LINKOPING, 3 - 5 June 2015

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Views on Inter-Laboratory Reproducibility of Chemosensing Experiments



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 **cost**
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY





Why this talk? What's in it?

- **Research on chemical sensors and sensing materials is growing**
 - More regulation and laws for the safety of people and workers.
 - Better control of industrial process.
- **There is a strong need for better sensors, better sensing materials**
 - But can we compare sensors and materials in published papers to draw conclusions?



Why this talk? What's in it?

- **Comparing Materials & Sensors**

→ In today's fast-paced research focus is on materials & devices ; the tools used to study them are often left out of reports.

→ But metrics such as the response time of the sensor, its sensitivity and drift strongly depend on the measurement setup.

- **There is a need for better sensors, better sensing materials**

→ Can we compare sensors and materials in published papers to draw conclusions and improve them?



Why this talk? What's in it?

- **Comparison of one sensor on two workbenches exposed to identical atmospheres in France and UK.**
- **Comparison of two different sensors in the same measurement cell.**
- **Close view of a sensor's response and its measurement workbench.**
- **Remarks on sensor experiments described in published papers.**
- **Conclusion.**



Reproducibility of experiments

- Experiment carried out in during a STSM of COST ACTION TD1105 EuNetAir

BETWEEN

EMMD Research Team of ICMUB in Burgundy University (Dijon, France)

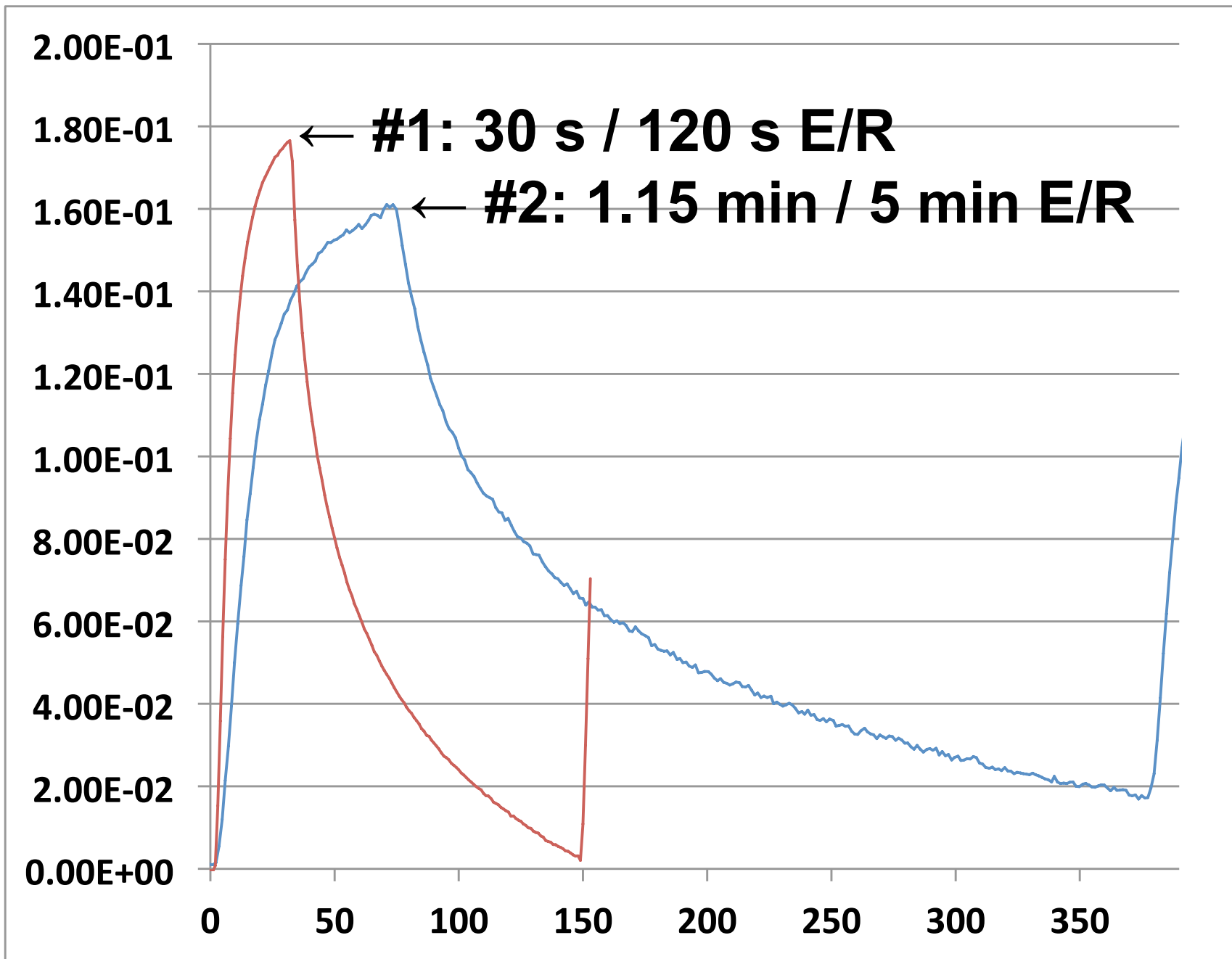
AND

The School of Chemical Engineering and Analytical Science at The University of Manchester, UK.

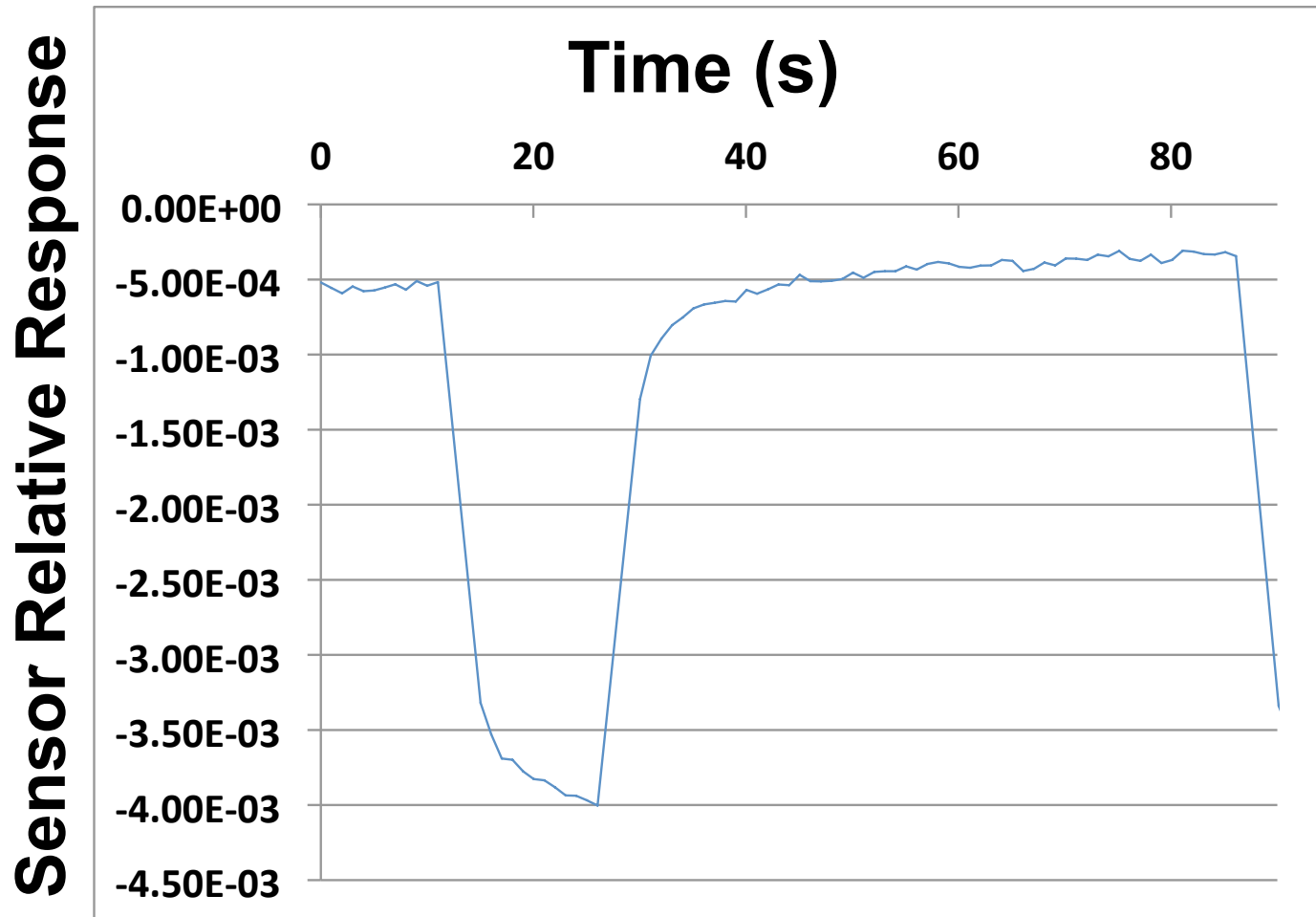
Reproducibility of experiments

- **Same sensor**
 - Fluorinated copper pththalocyanine | Lutetium bisphthalocyanine MSDI heterojunction over comb-shaped ITO electrodes
- **Same conditions**
 - Exposition to ammonia (60 ppm) and humidity (50 % rh) in synthetic air
- **Different setups**
 - #1 : 2.9 mL cell, 100 mccm flow
 - #2 : 13.2 mL cell, 500 mccm flow

Sensor Relative Response



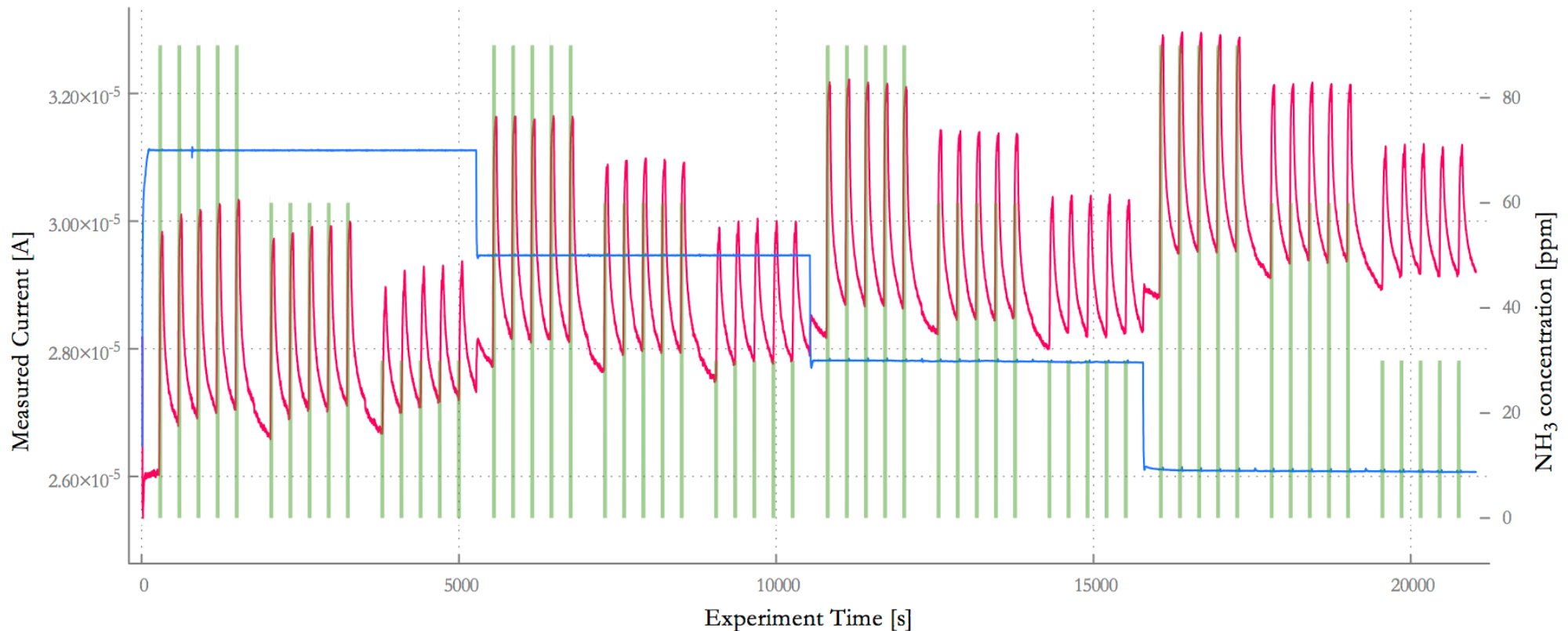
Reproducibility of experiments



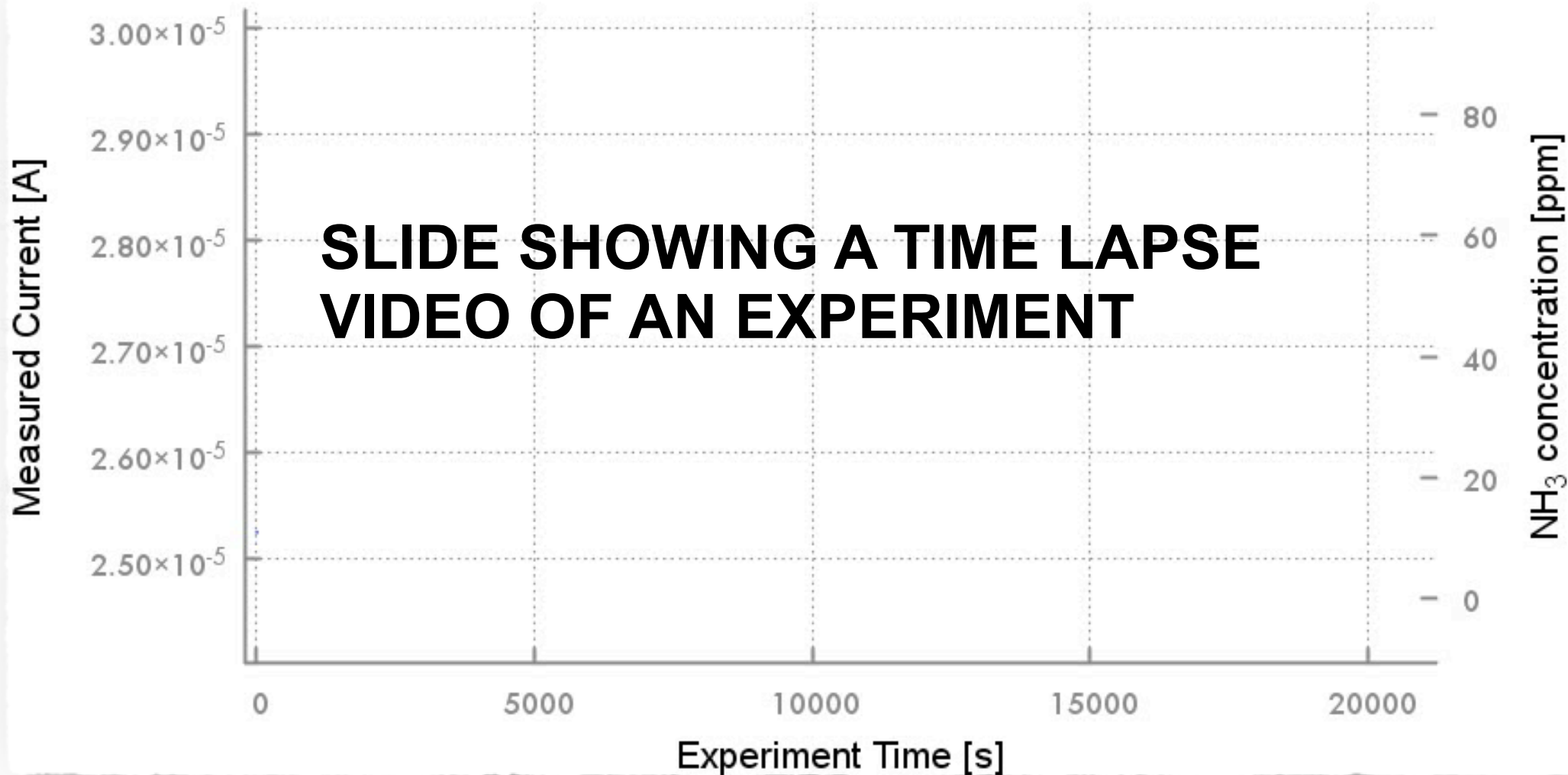
- Different sensor, but same cell, same flow as #2

An experiment and its workbench

What's good, what does look good?



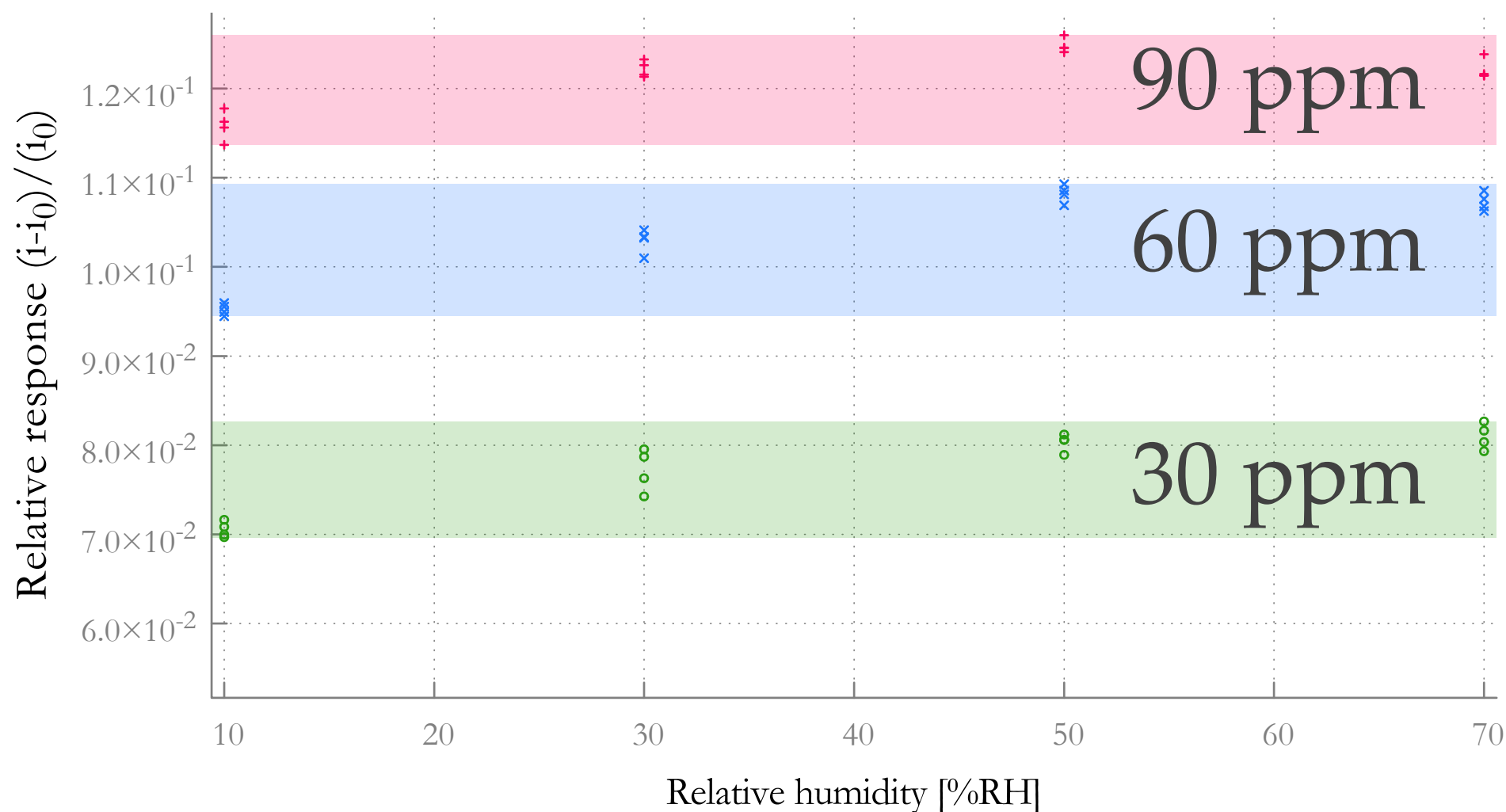
SLIDE SHOWING A TIME LAPSE VIDEO OF AN EXPERIMENT



- H₂O → 4 Levels (70, 50, 30, 10 %RH)
- NH₃ → 3 Levels (90, 60, 30 ppm)
- Exposure / Recovery → 5 cycles (60 / 240 seconds)

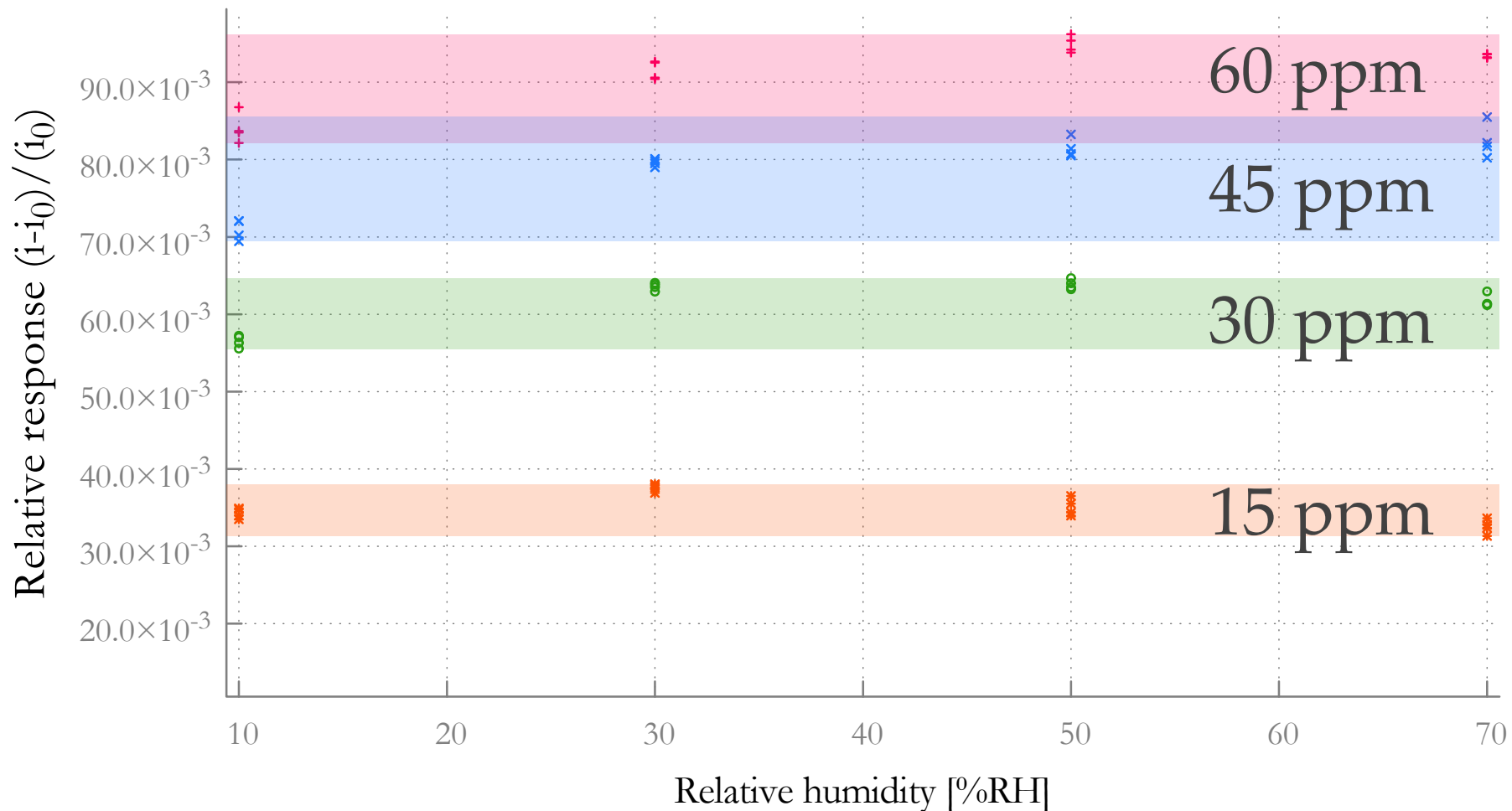
- Ammonia
- Humidity
- Sensor (Current)

An experiment and its workbench



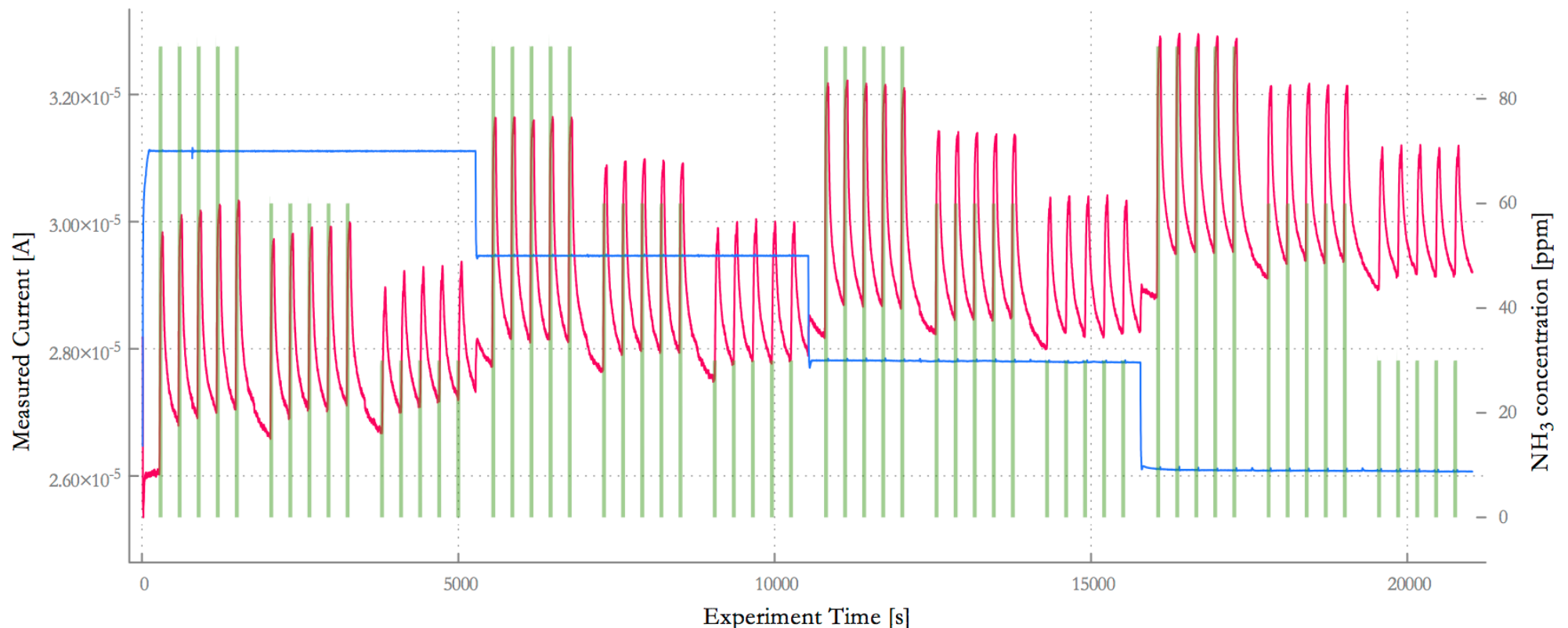
An experiment and its workbench

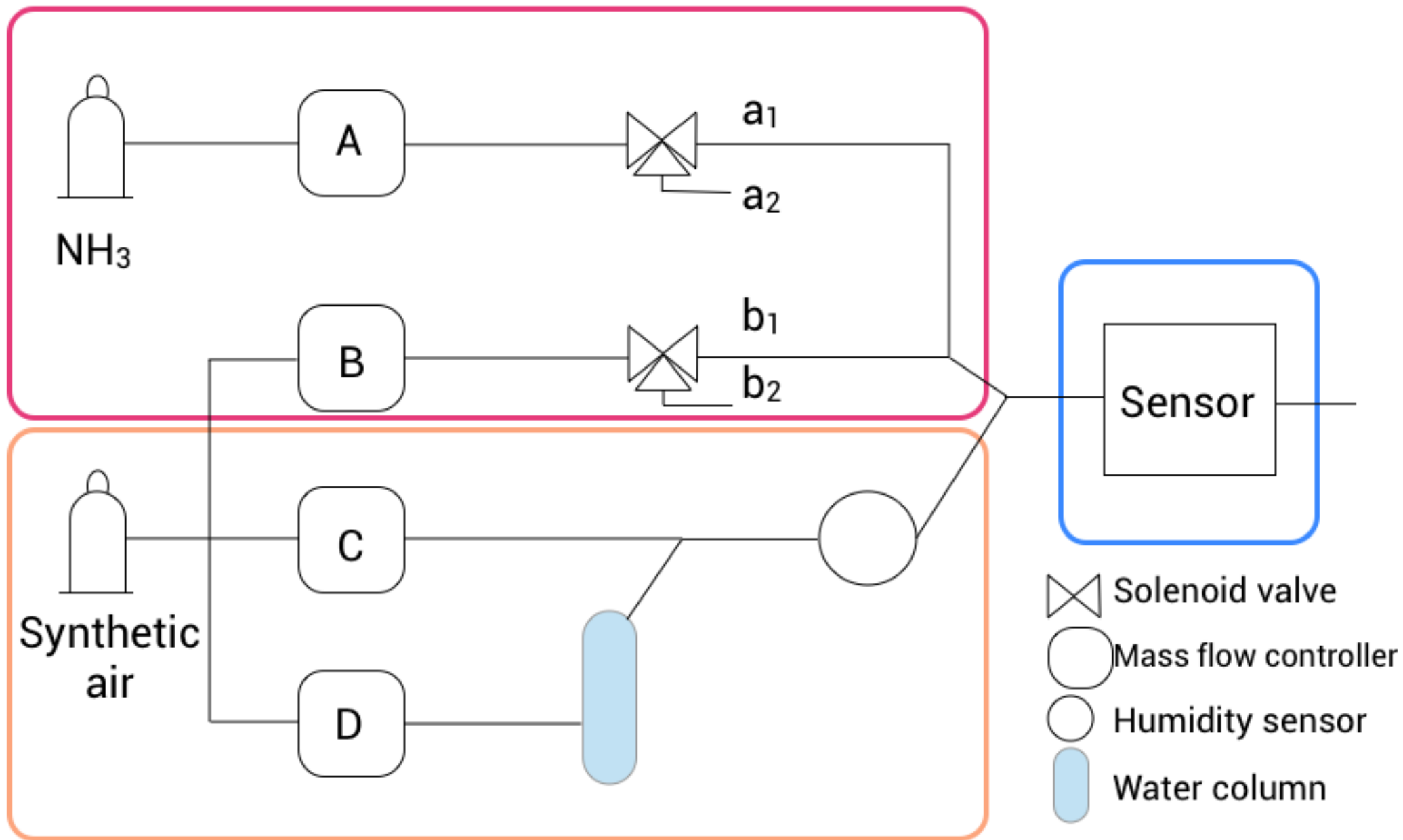
What's good, what does look good?



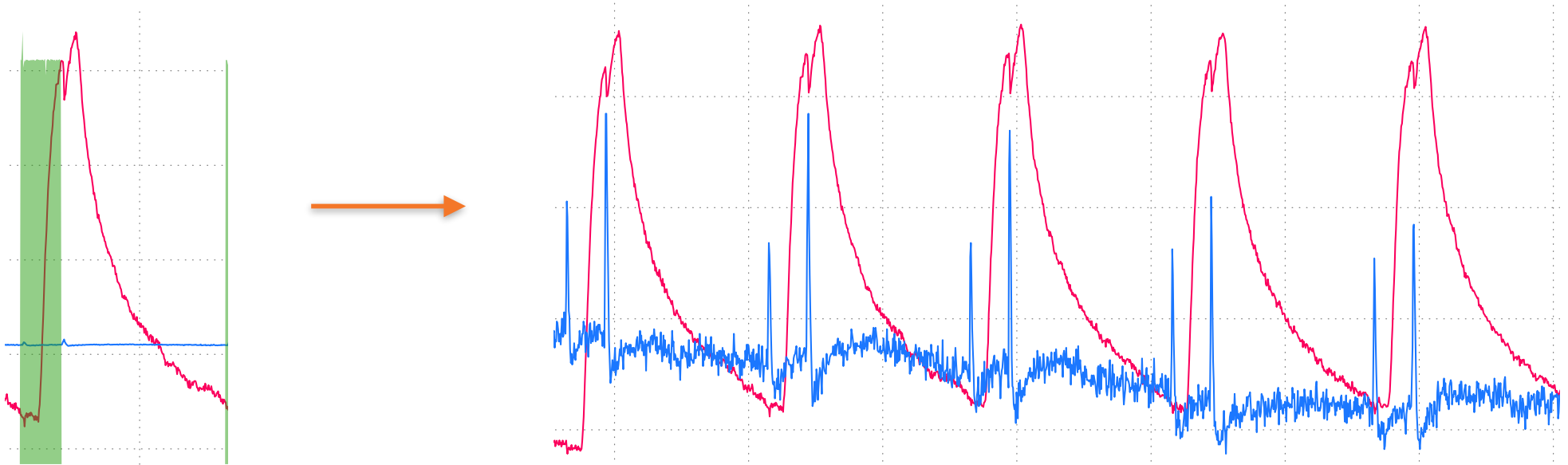
An experiment and its workbench

What's good, what does look good?





Issues not visible on the full experiment



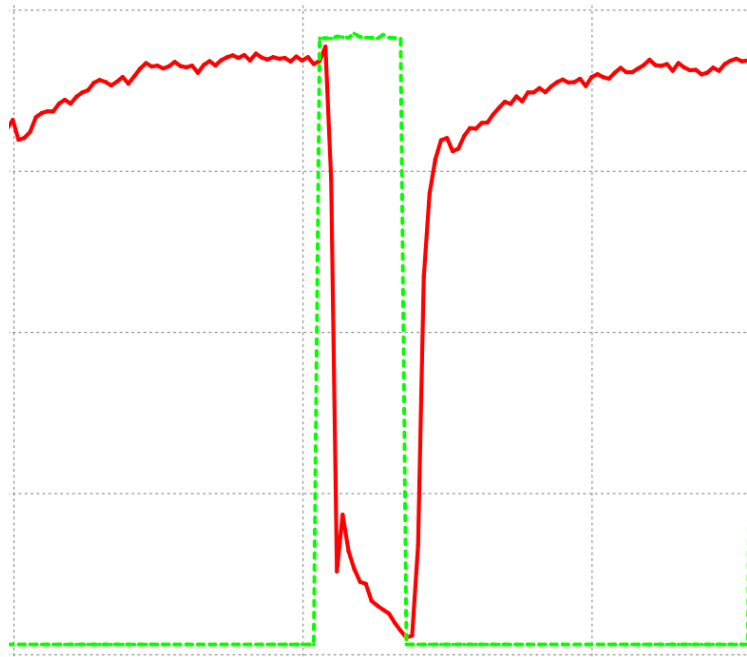
- **Is this sensor really fast?**

→ Disappears when replacing 3-ways EV by two 2-ways EV and switching them separately a few ms apart.

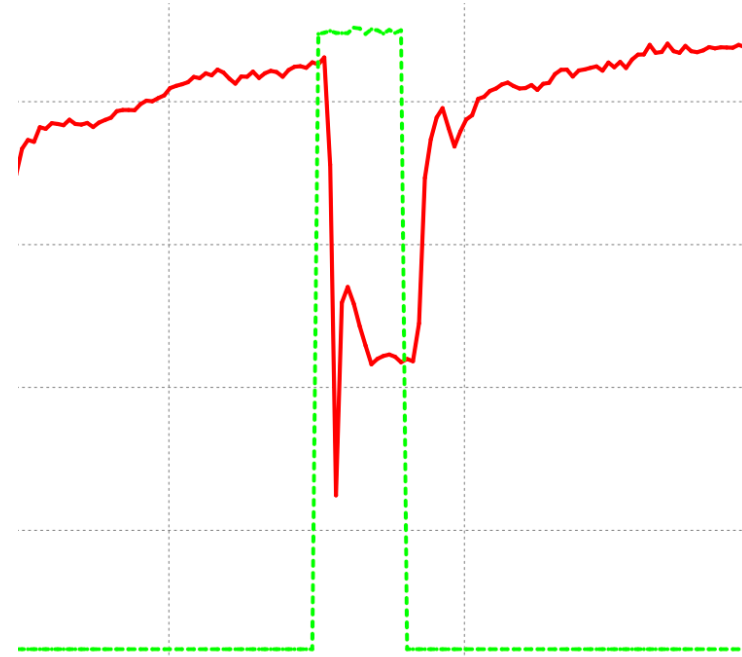
→ Flow effect. Can affect the relative response.

Exposition: 15 s; Recovery: 60 s

Higher concentration in headspace



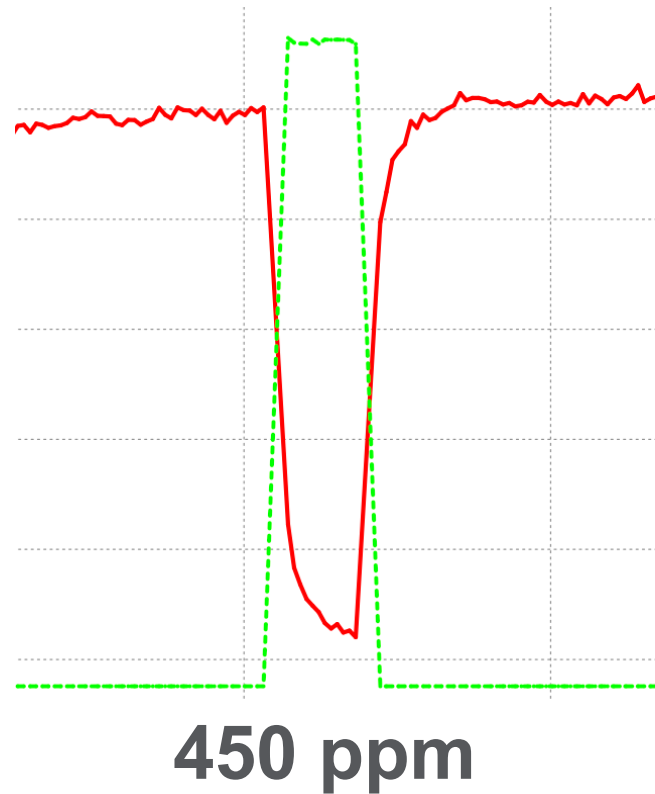
900 ppm



400 ppm

Exposition: 15 s; Recovery: 60 s

After fixing the issue





Examples from published papers

- **Fast response in huge measurement cell with fan & injection**
→ The setup strongly affects the response time.
- **No drift sensor**
→ But the study was performed over a short period of time and gas concentrations kept changing quickly.



Conclusion

- **Response time, drift, sensitivity**
 - Can vary with the workbench.
- **Experiments such as the one conducted in Aveiro are of crucial importance**
 - Starting point to get a picture of the issues
- **Evaluating sensors & materials from other research teams is important**
 - But can only be done with an accurate and comprehensive description of the measurement setup

Acknowledgements

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