Universität Münster

Gas Tightness and Moisture entry Measurements

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Overview

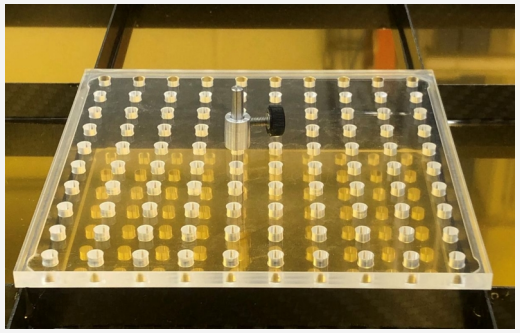
- Gas Tightness
  - **Requirements/Idea**
  - **Setup**
  - **Analysis**
  - **Results**
- Moisture Measurement
  - **Setup**
  - **Measurements**

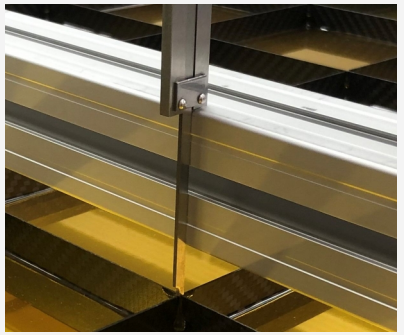
What to measure?

- Gas loss per chamber has to be determined
- Goal: less than 1 ml/h per chamber at operating pressure of +0.7 mbar relative
- Determination of the volume of the detector
  - **Putting the chamber under pressure and monitor the pressure loss**
  - **Connection of pressure loss and volume loss has to be known**

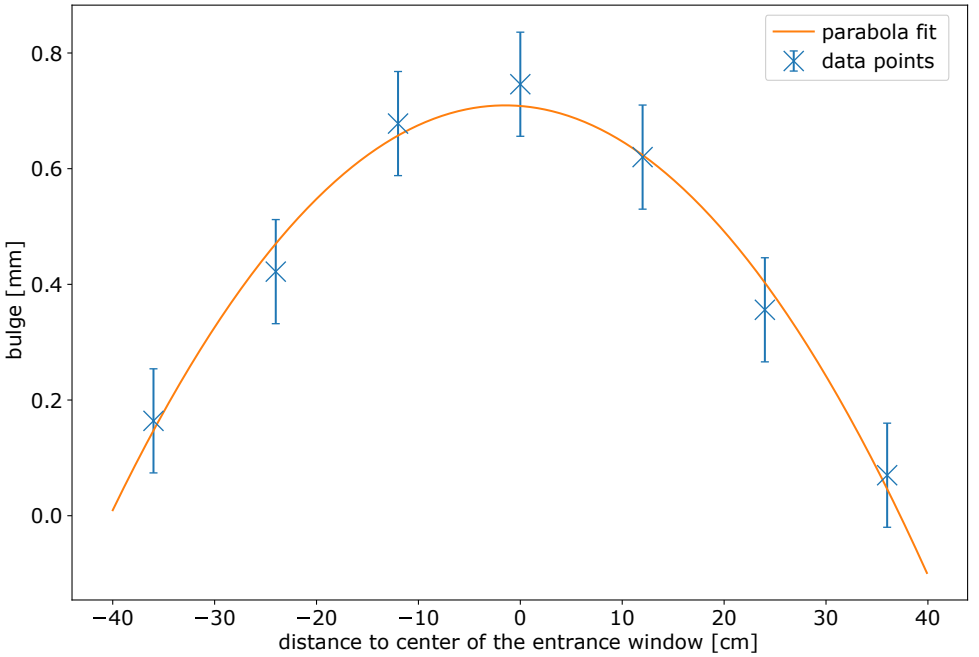
    → Entrance window deforms under pressure

Bulging



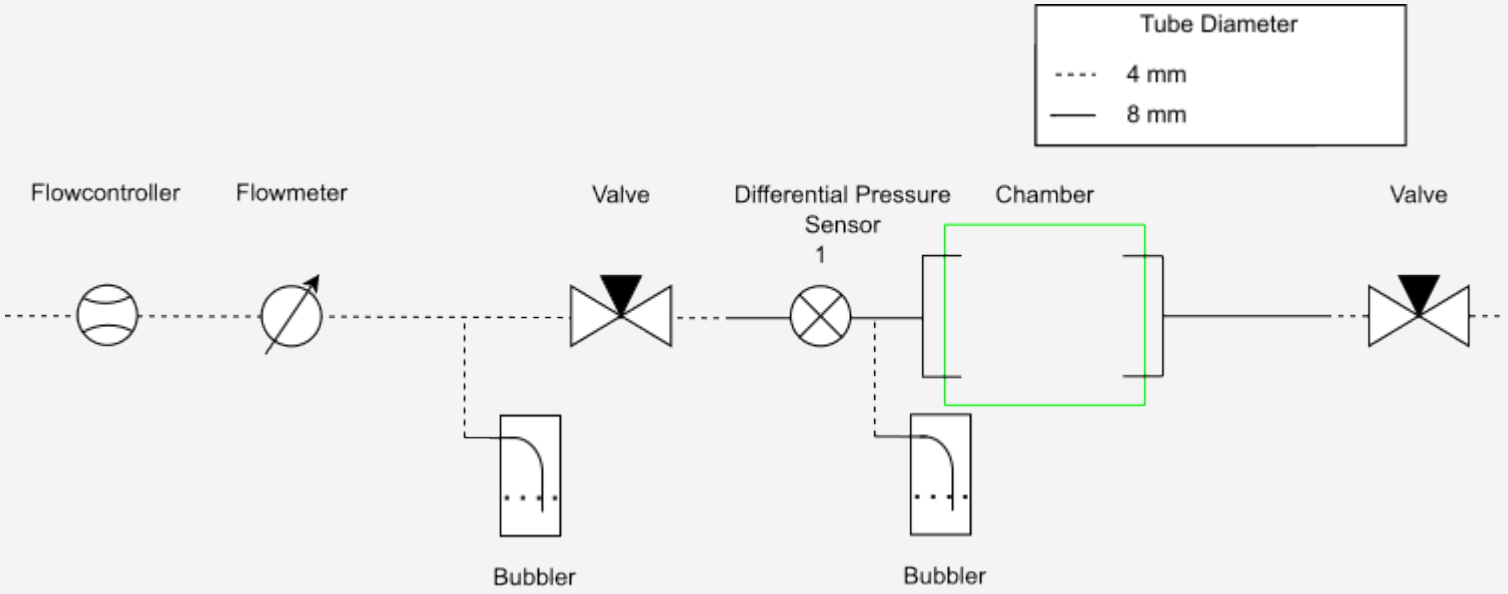


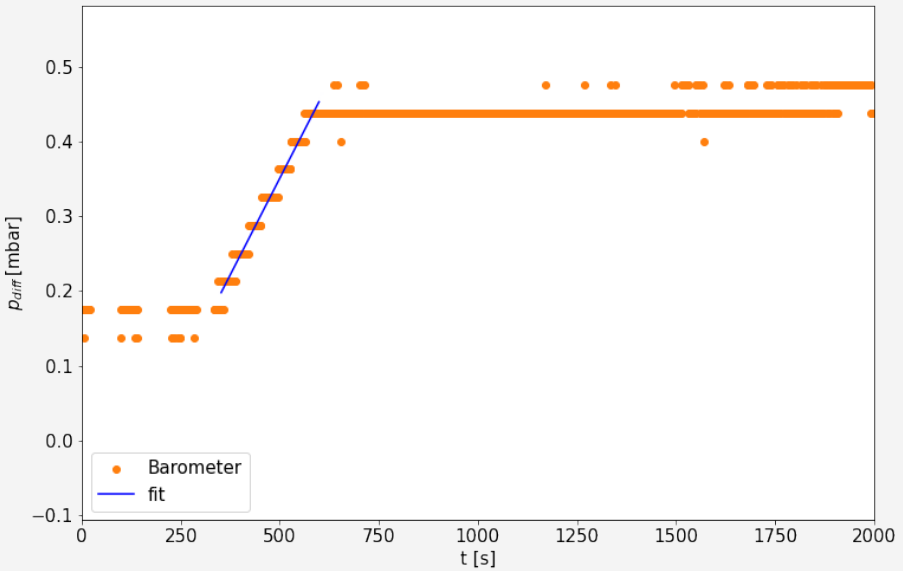
- Bulging compensates variations in the environment pressure
- Threshold of bulging for 1mm is reached at an over pressure of ≈ 0.7 mbar
- Bulging makes it difficult to estimate the volume analytically



Setup

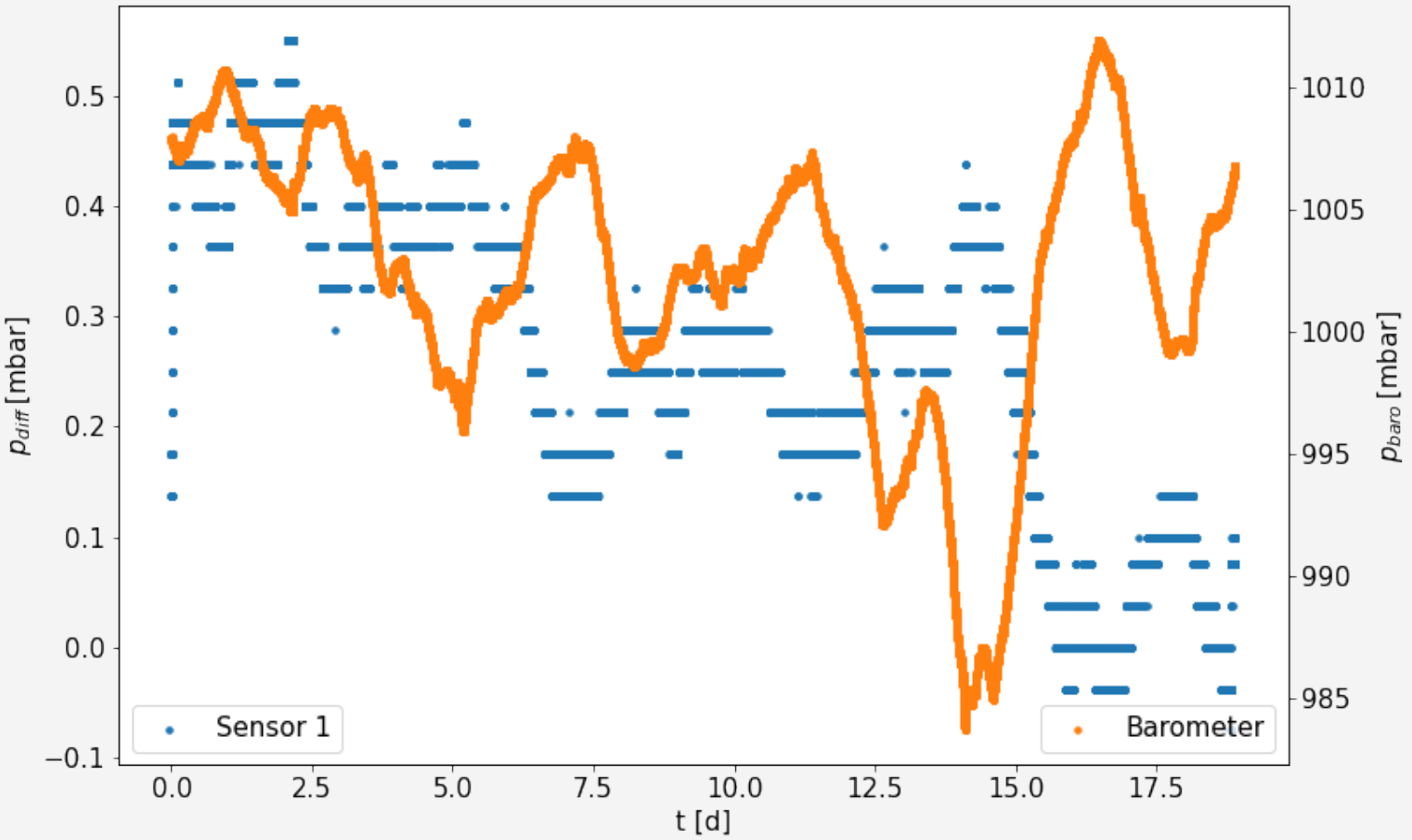
- Gas floating through the system
  - **Stable conditions → Close outlet valve**
  - **Pressure increases → Given pressure value reached → Inlet valve closed**
- Pressure and flow measurement gives the possibility to calculate the volume





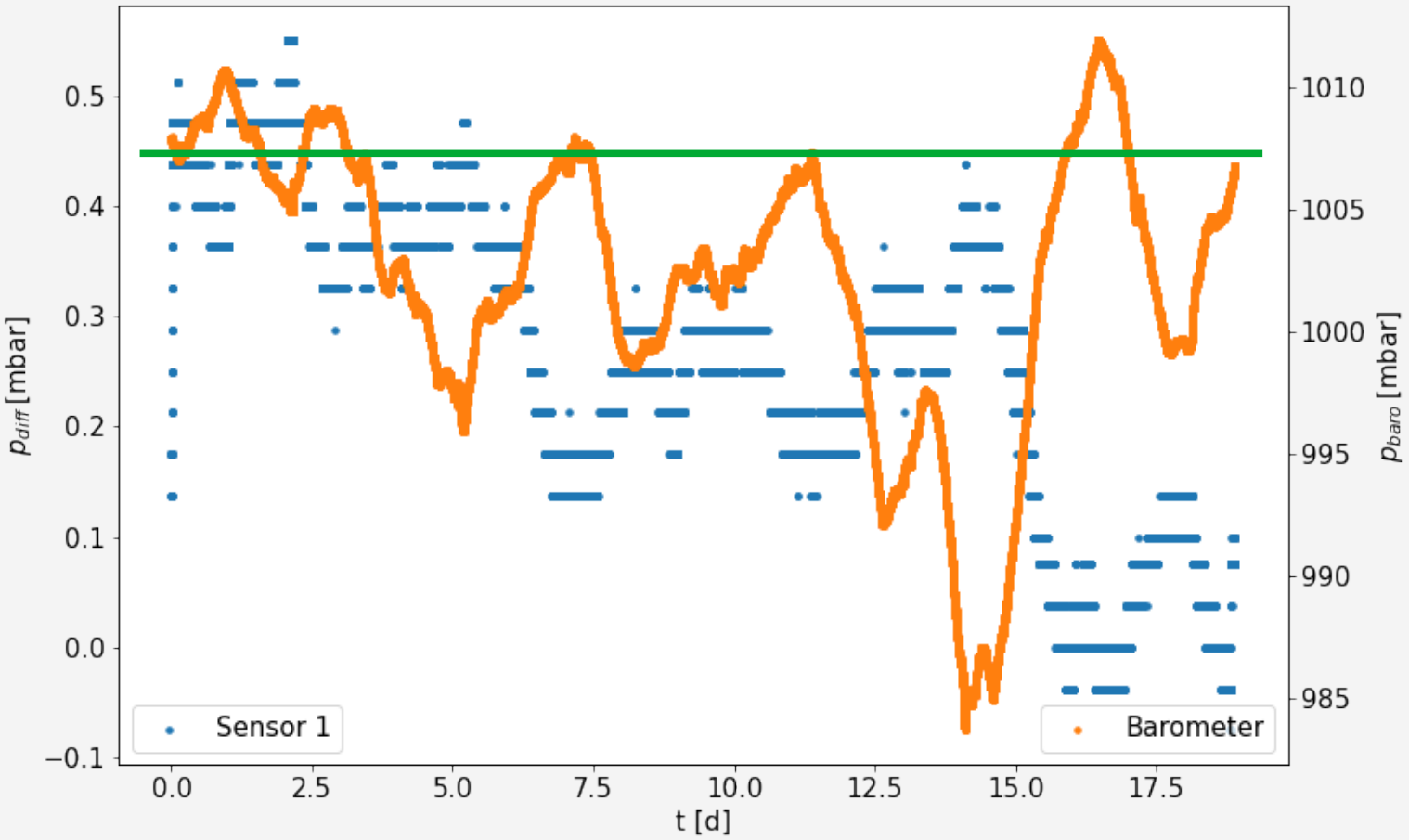
Analysis of the data

- Differential pressure set to 0.5mbar relative
  - **Measurement stopped for safety, if diff pressure > 1mbar**
- To handle change in ambient pressure, search for the same pressure at a later time



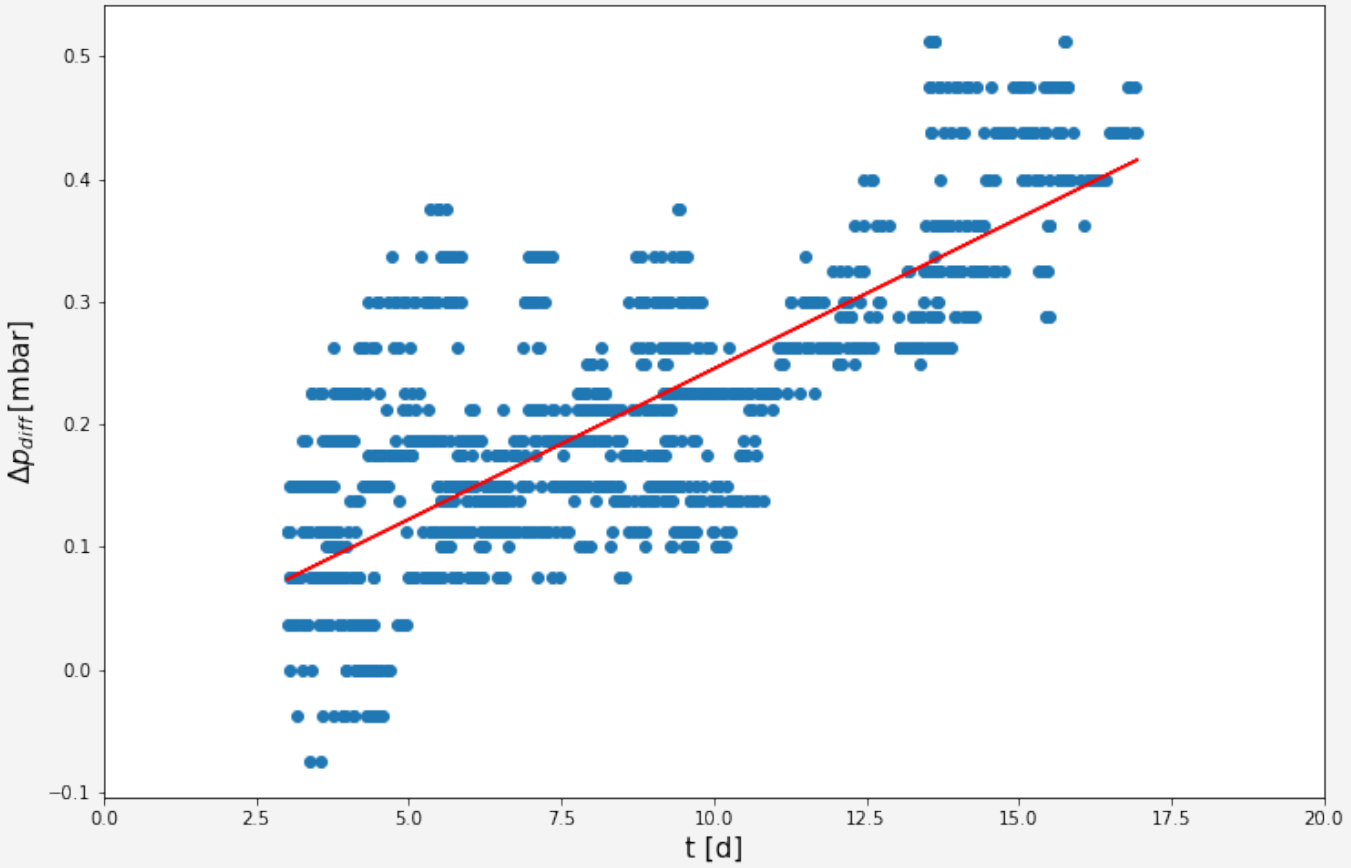
Change in Ambient pressure

- Calculating the relative pressure difference for two points → pressure loss per time
- Only one value per hour taken into account to avoid falsification by noise



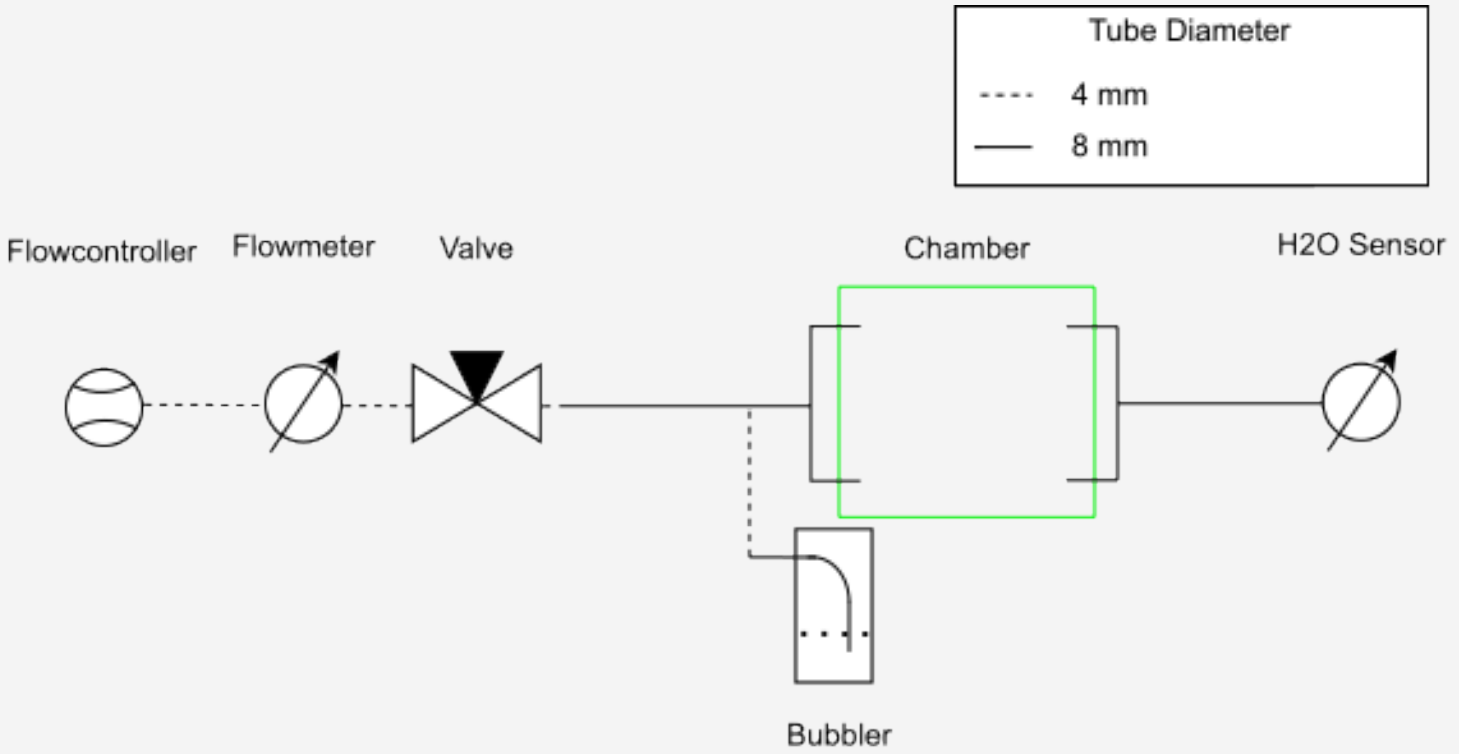
Gas loss per day

- Loss per day: 19.797 ml/d ± 7.8697 ml/d
- Loss per hour: 0.82486 ml/h ± 0.3279 ml/d



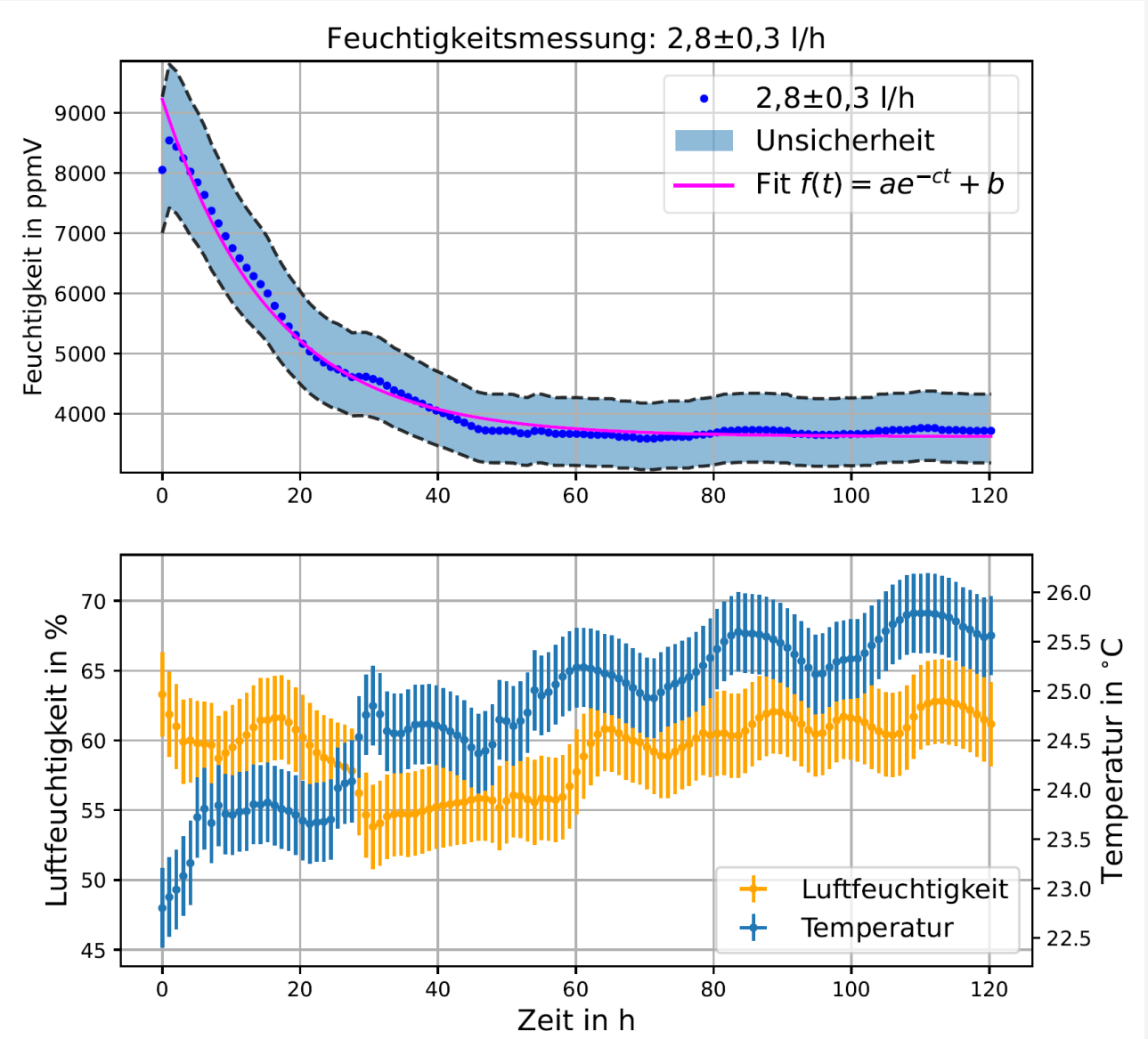
Moisture Measurement

- Moisture contamination in new chambers from two sources:
  - **Drying of the chamber**
  - **Diffusion through the entrance window**
- Long term measurements till the measured moisture content converges



Moisture Measurement

- Different gas flows through the tested chamber
- Maybe correlated with the ambient temperature, air humidity and pressure



Moisture Measurement

- Different gas flows through the tested chamber
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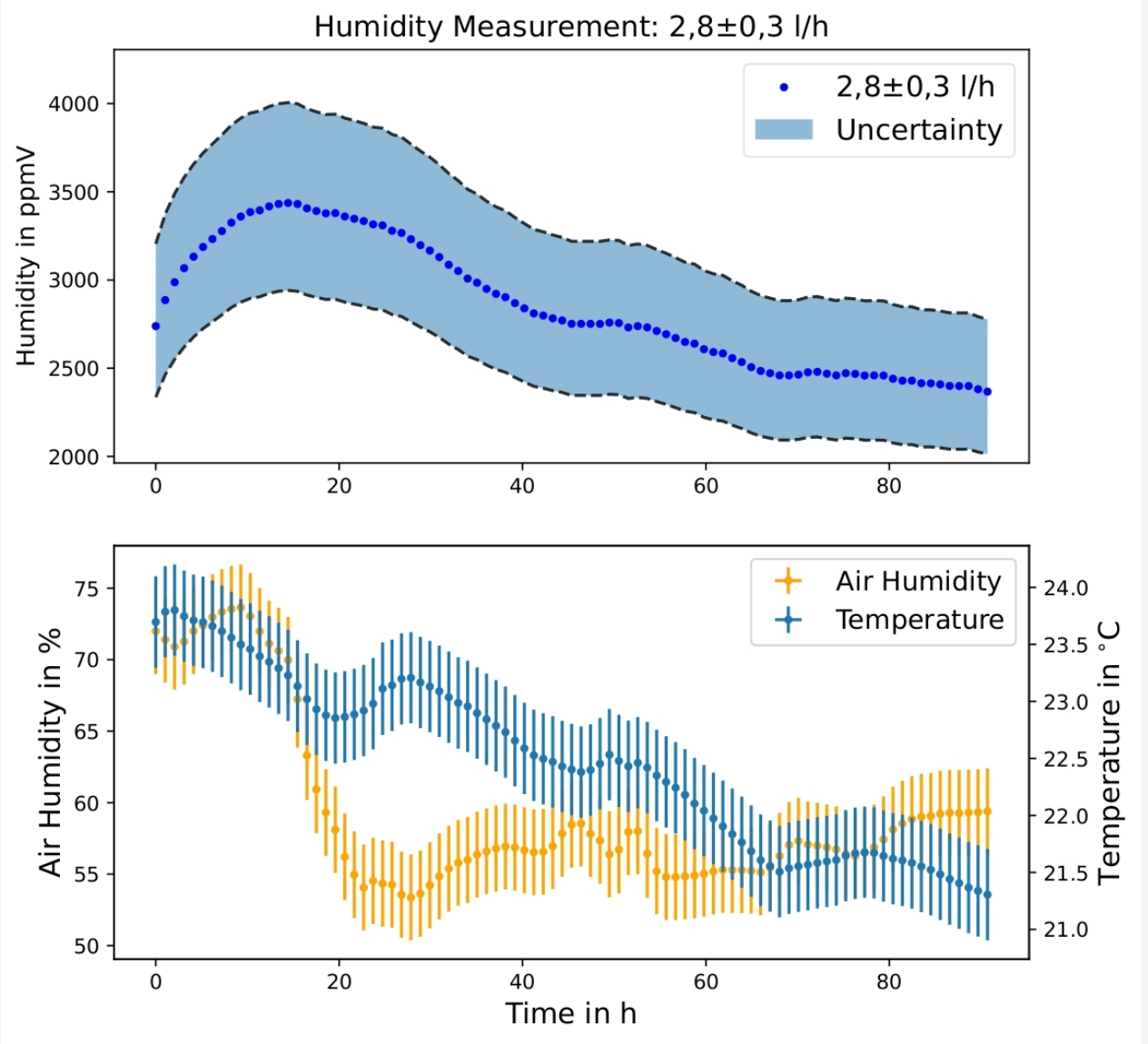
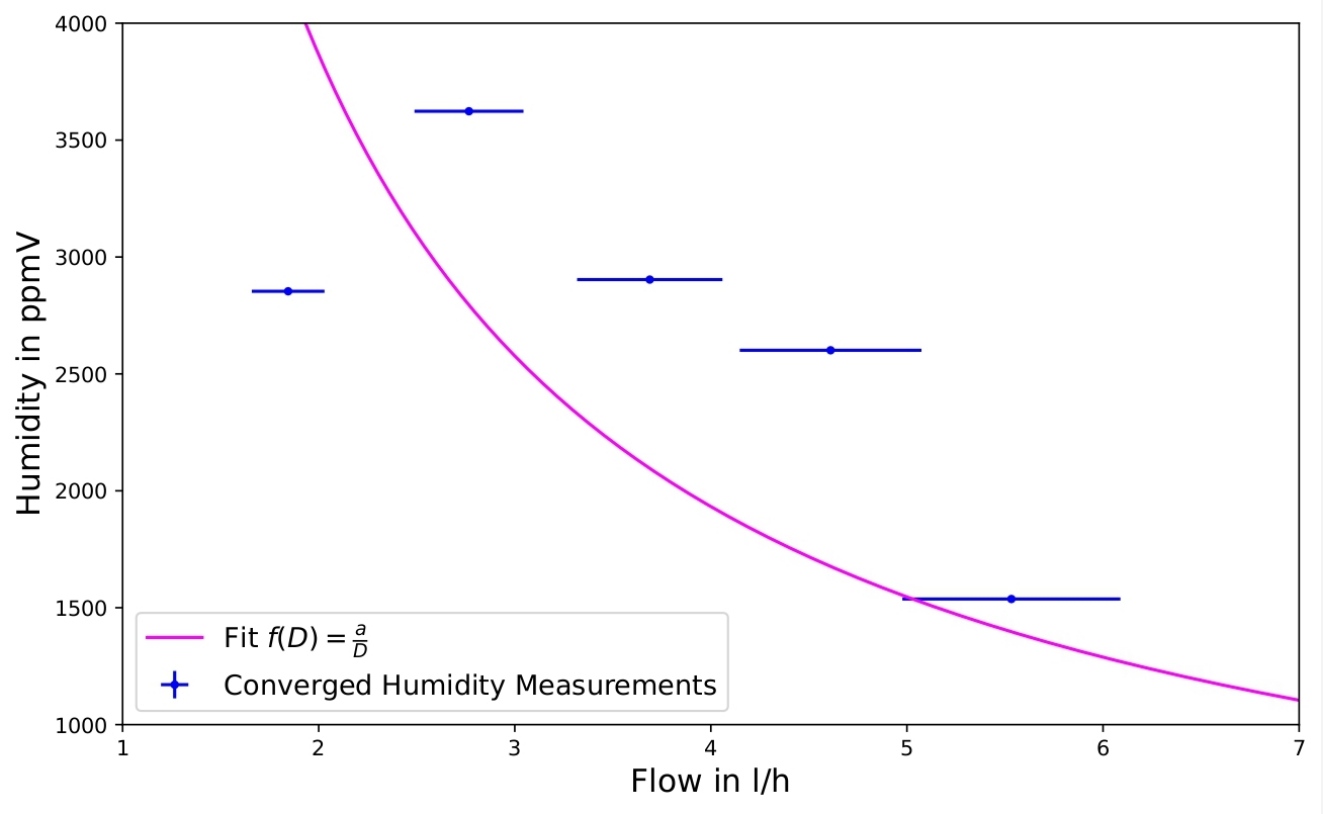
  → **Measurement in a controlled environment (clean room)**



Moisture Measurement

- Converged humidity values should be describable with an anti proportional function
- Higher flows required, but the small diameter of the humidity sensor limits the flow (pressure rises in the detector)



Summary

- Tightness measurements for a first prototype has been performed
  - **Loss: 0.82486 ml/h ± 0.3279 ml/d**
- New chambers can be tested for gas tightness with the same procedure
- Test of one chamber took around 20 days for good performance
  - **Easy and cheap scalable system to test more chambers in parallel**
- Moisture measurements performed

  → Improvements needed