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# **Photoacoustic systems optimized for drone-based gas and aerosol detection**

**Bozóki Zoltán**

# The outline of the presentation

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1. Basics of photoacoustics;
2. Past achievements of our group
3. Major directions of our current R&D activities:
  - 3.1. Drone based photoacoustic measurement of **atmospheric water vapour** distribution;
  - 3.2. Drone based photoacoustic measurement of **atmospheric aerosol**;
  - 3.3. Measurement of **water droplet growth** under simulated atmospheric conditions;
4. Outlook, general comments.



# **Basics of photoacoustics**

# Basics of photoacoustics

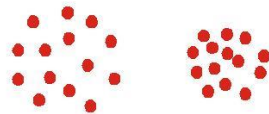
ABSORPTION OF PERIODICALLY MODULATED LIGHT



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MOLECULES IN EXCITED STATE



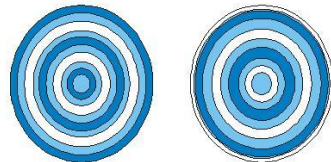
↓  
NON-RADIATIVE RELAXATION



↓  
PERIODIC VARIATION OF THE TEMPERATURE

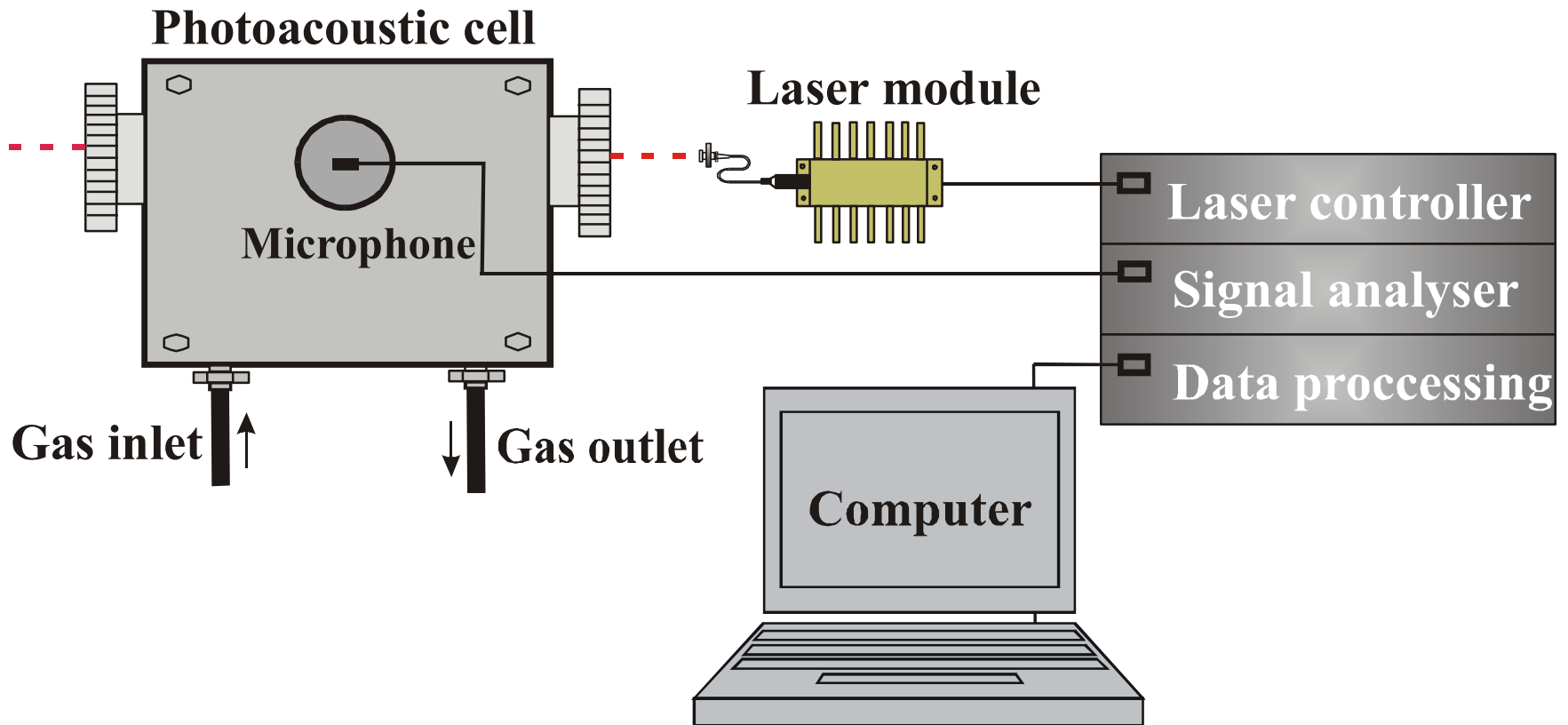


↓  
PERIODIC PRESSURE VARIATION (SOUND)



- Direct, in-situ measurement;
- Wide dynamic range;
- High sensitivity;
- Excellent selectivity;
- Simplicity;
- Short response time.

# The basic PA set-up

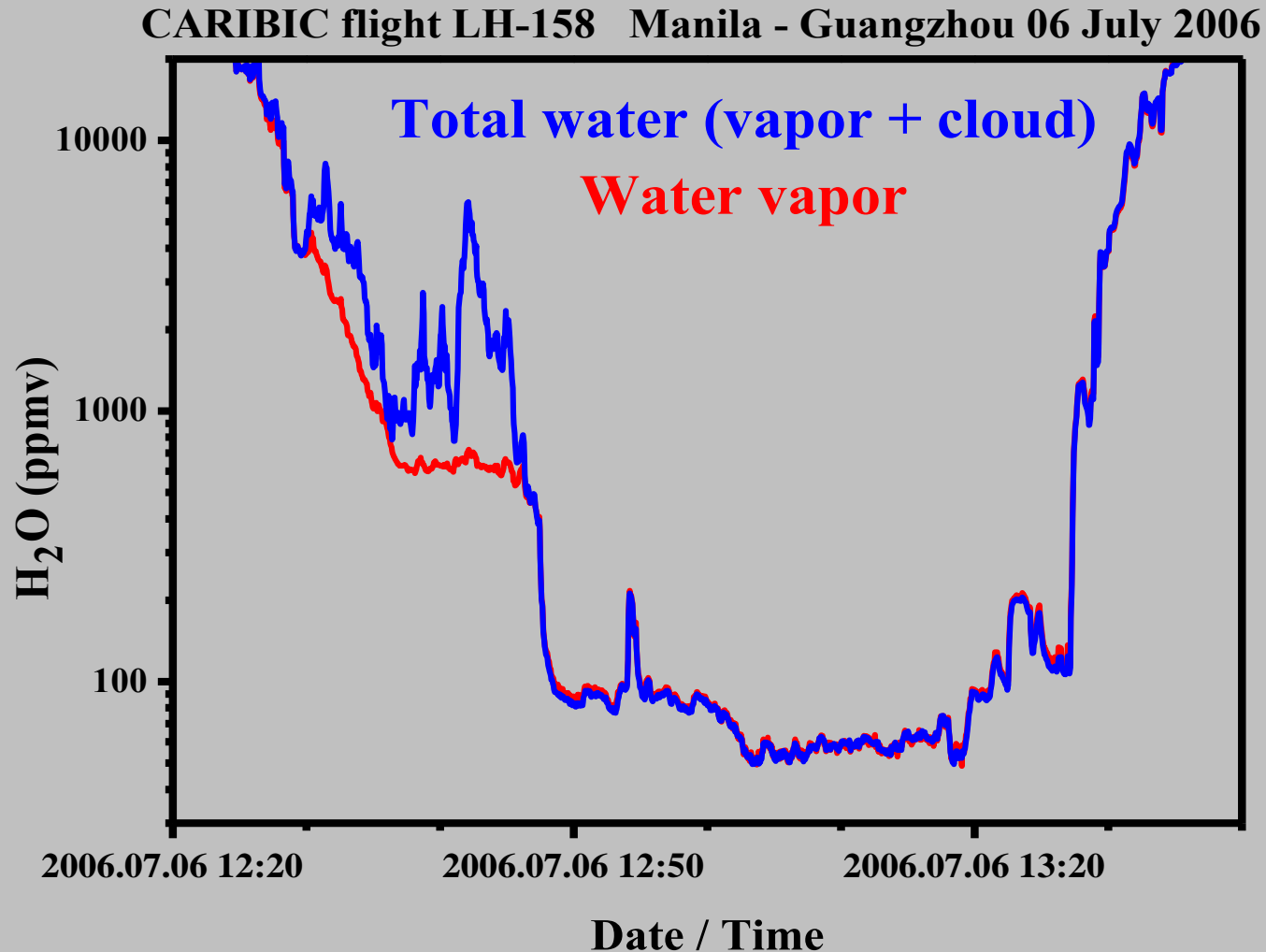




# Past achievements

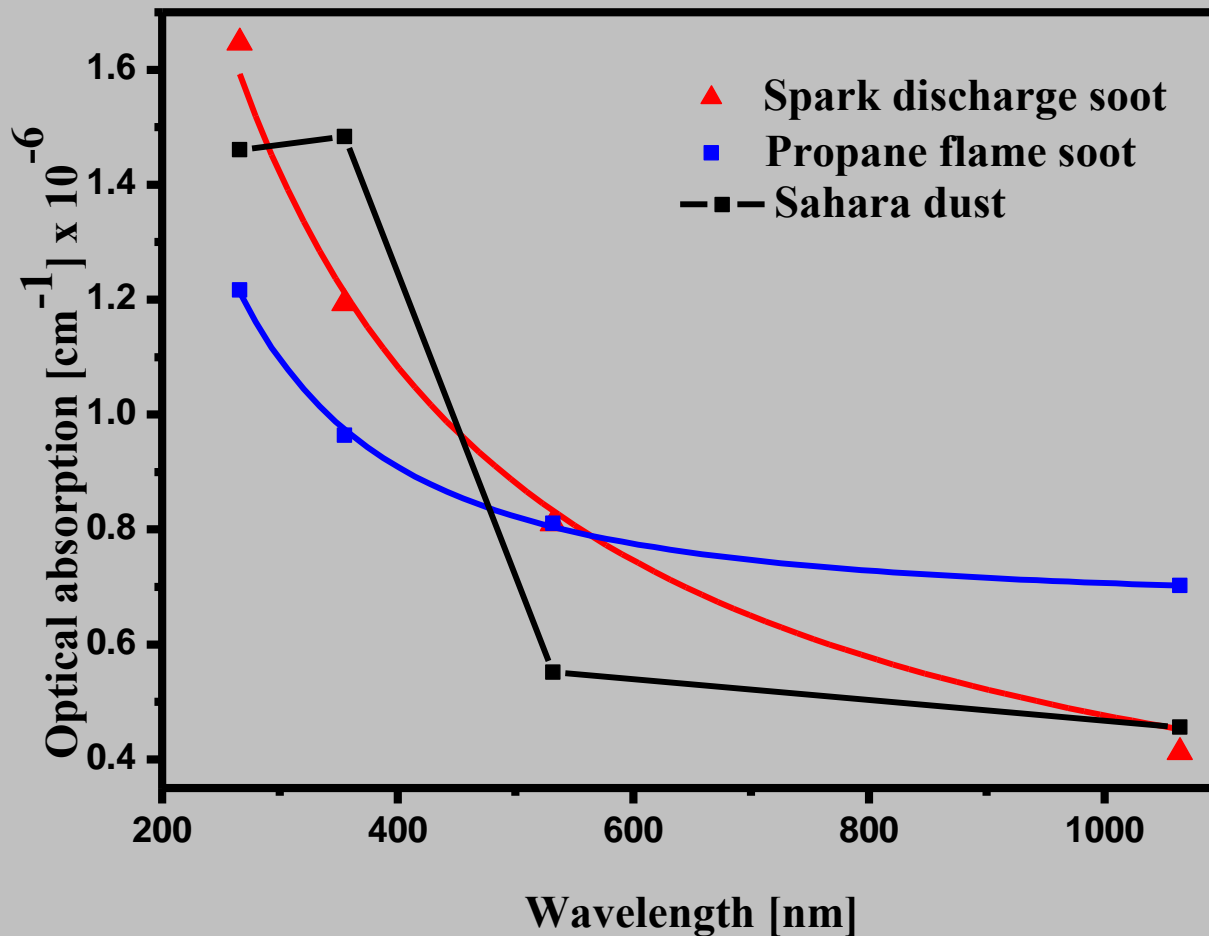


# Airborne instrument for measuring water vapour and total water

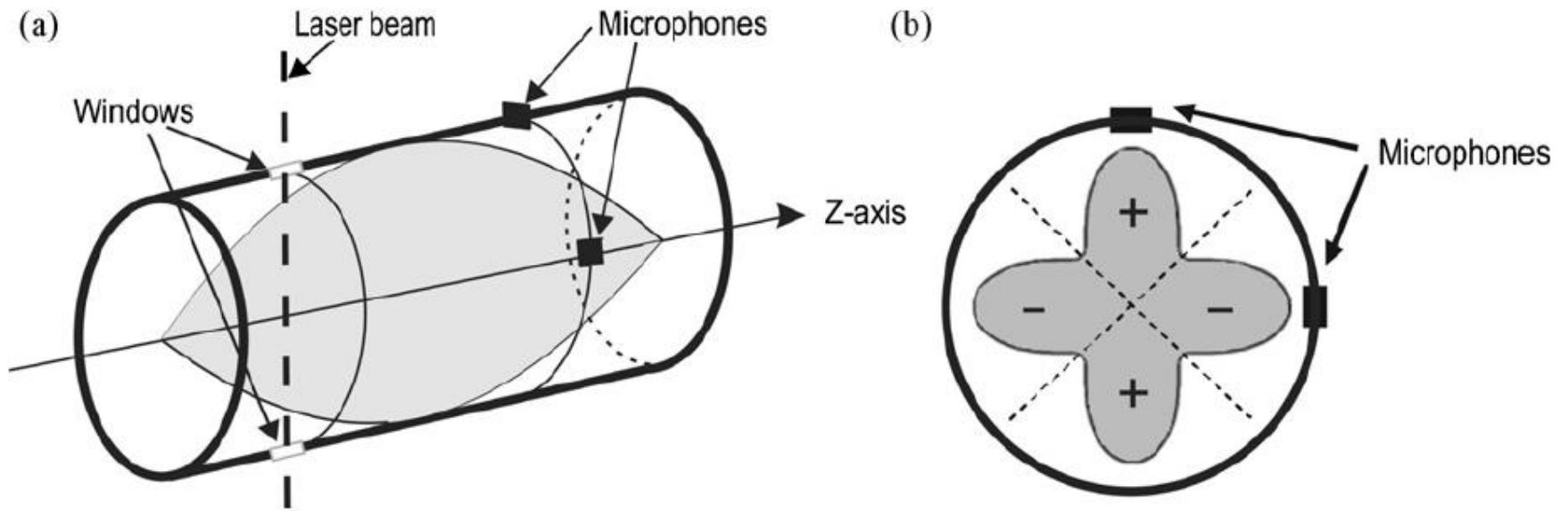




# Aerosol source apportionment by dual-wavelength PA measurements

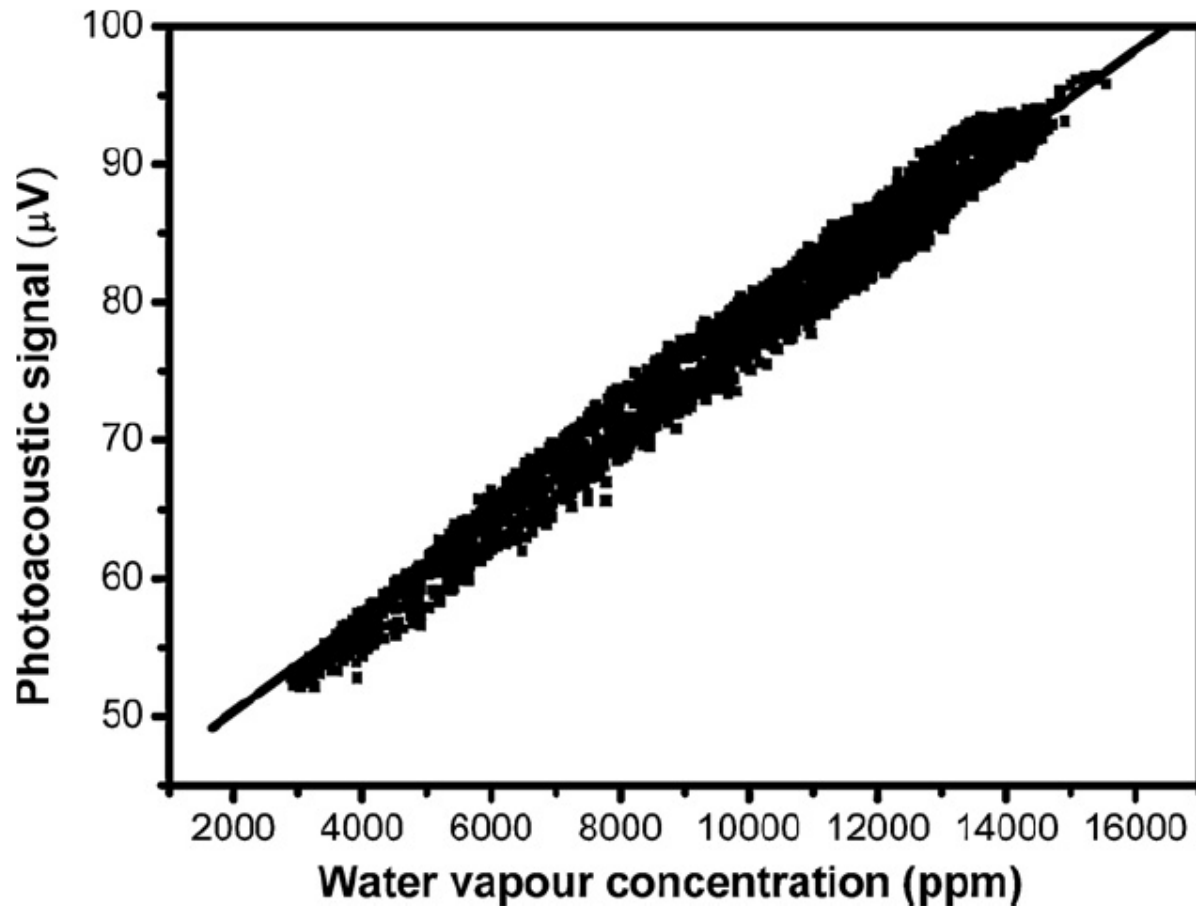


# First version of the sampling-free, open PA cell

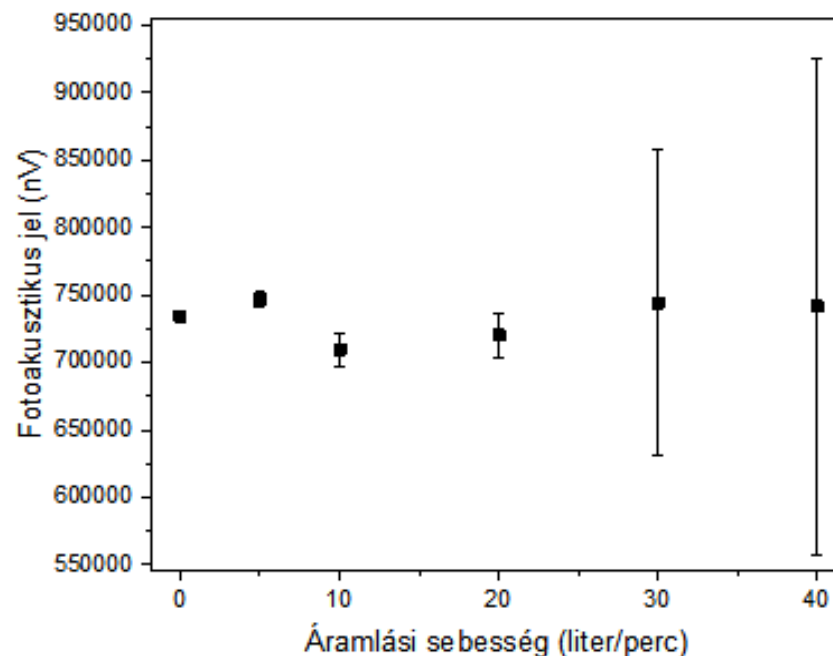
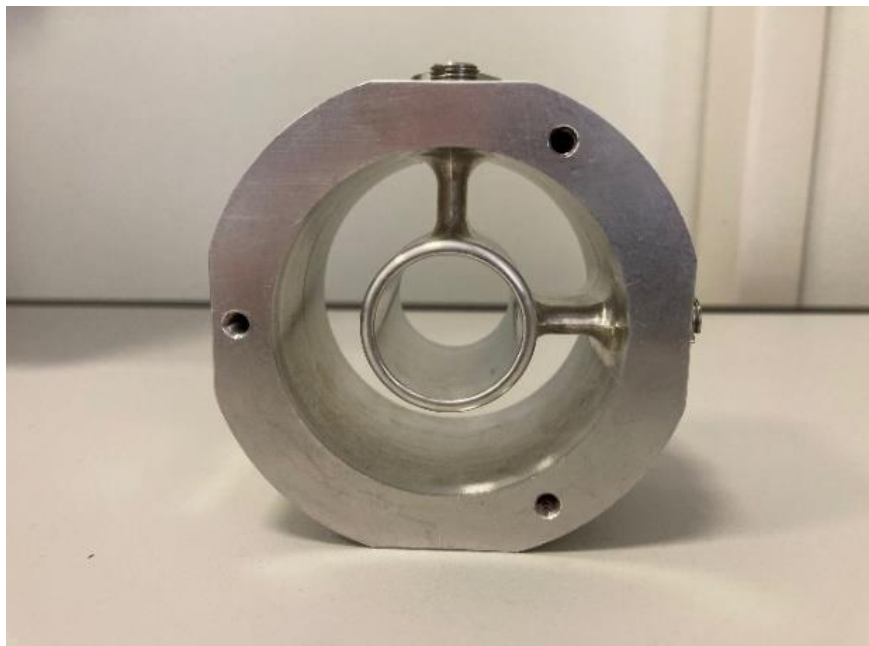


# First version of the sampling-free, open PA cell

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# An improved version with the possibility of high flow through rate



PA signal as a function of gas flow rate through the PA cell

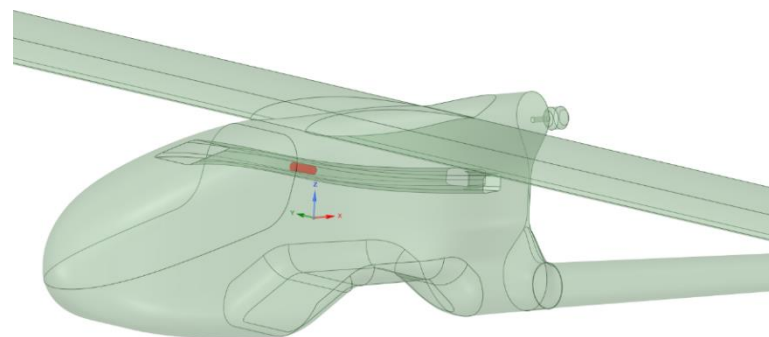


# **Major directions of our current R&D activities**

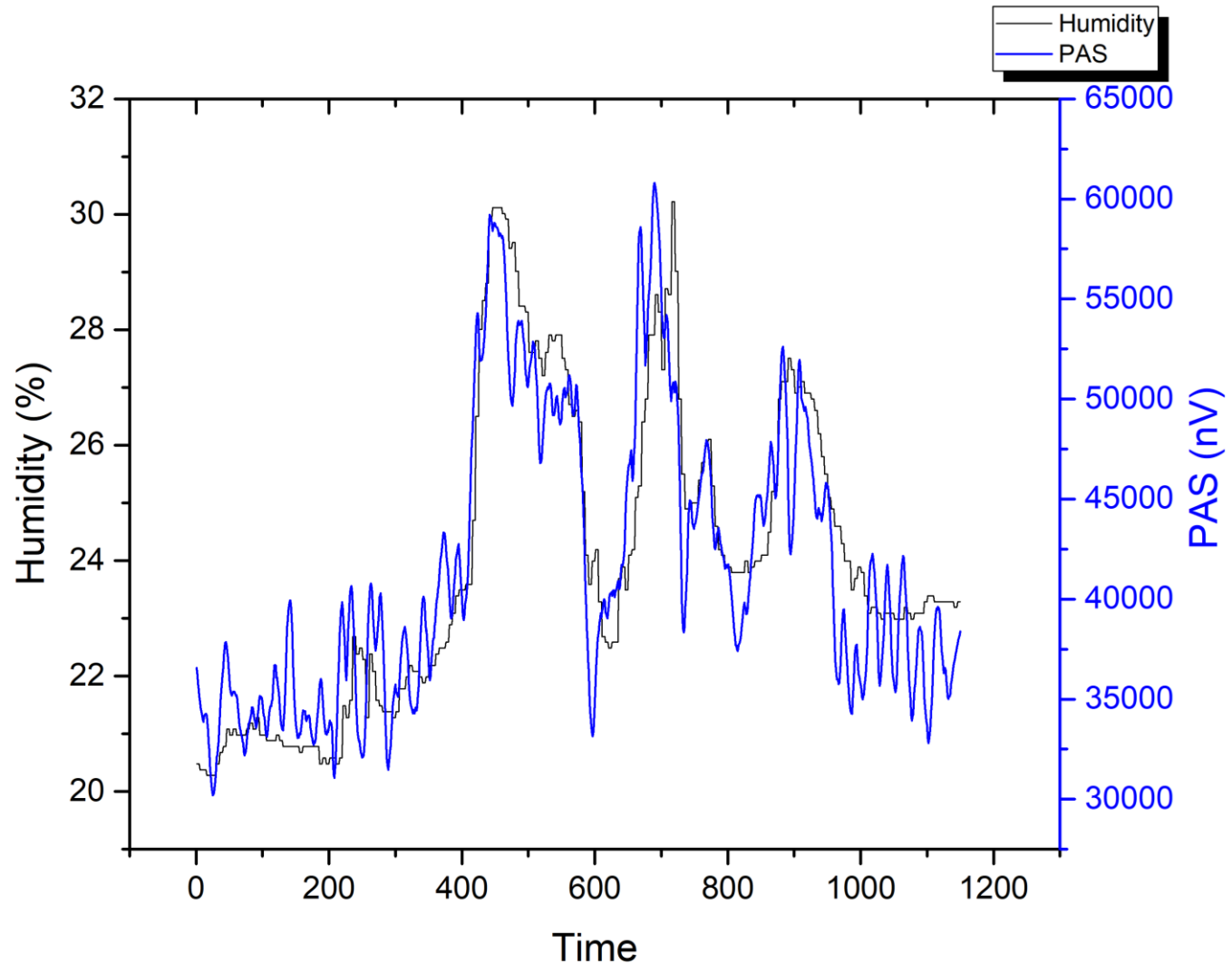
# Our project plan for drone based humidity profile measurements

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- Ground based inter-comparison measurements;
- Vertical humidity profiles with a copter;
- Horizontal humidity profiles with a copter (reference method: balloon borne measurements);
- Horizontal humidity profiles with a drone (after further improvement of the PA cell).



# First results: laboratory inter-comparison



# Other activities

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Drone based measurement of aerosols from savanna fire in South-Africa;  
Water droplet growth dynamics studied by the open PA cell.





# **Outlook and general comments**

# The future of photoacoustics is bright!

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Nowadays photoacoustics is a standard method in very critical applications:

- Process control for the oil and natural gas industry;
- Breath analysis.

True mass production: photoacoustic smoke detector from Infineon by VHLL technology.



**Let's be part of the success story of photoacoustics!**



**Thank you for your attention!**  
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