

A composite background image showing a snowy mountain range. In the foreground, there are wind turbines on a rocky outcrop. To the left, a large ship is in the water. In the distance, a city skyline is visible. A satellite is in the sky on the right, and an airplane is flying in the center. The scene is set against a blue sky with clouds.

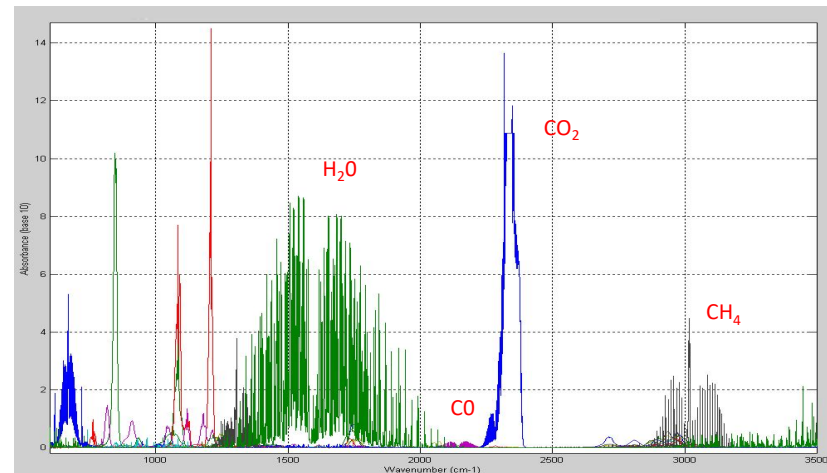
FTIR/ANITA: SHORT PRESENTATION

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FTIR for multi-gas measurement

- FTIR records **high-quality spectral information** with high resolution over a wide wavelength range in one measurement
- Multi-gas mixtures are still **difficult to analyse**, owing to spectral interference between gases, baseline drift, optical saturation, and non-linear response
- Using detailed knowledge of the response of the FTIR instrument, SINTEF has developed a **unique calibration technique** for solving these difficulties
- Provides a unique ability to perform multi-gas measurements with
 - High sensitivity
 - High specificity
 - High accuracy
 - High reliability



FTIR for multi-gas measurement – ANITA (1)

- ANITA1 performed air quality monitoring at the ISS (International Space Station) in 2007-8
 - Quasi-continuous measurements
 - First instrument to measure multiple trace gases with high time resolution at the ISS
 - 31 trace gases with sub-ppm detection limits
 - Automatic detection of unexpected gases
 - The calibration could be updated from ground to include additional gases
 - ANITA1 revealed very useful new information on the presence of trace gases and on trace gas dynamics in the ISS air



Photos: NASA



FTIR for multi-gas measurement – ANITA (2)

- ANITA2 is monitoring the cabin air quality at the ISS since March 2022
 - Further improved optical performance and analysis software
 - High gas sensitivity and specificity
 - Uniquely high accuracy, precision, and reliability
 - Calibrated pre-flight for 37 gases, stepwise extensions later
 - ANITA2 has discovered a few new gases
 - Special on-board events have added need to measure other gases
 - Since late in 2023, ANITA2 is monitoring 48 gases
 - In June 2024, ANITA2 was formally upgraded from a Technology Demonstrator to be a regular ISS system
 - According to NASA, ANITA2 "is adding greatly to our understanding of the space station atmosphere"

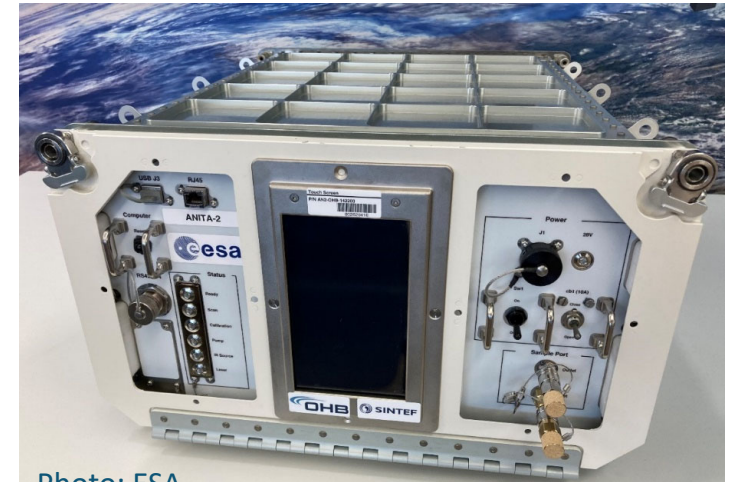


Photo: ESA

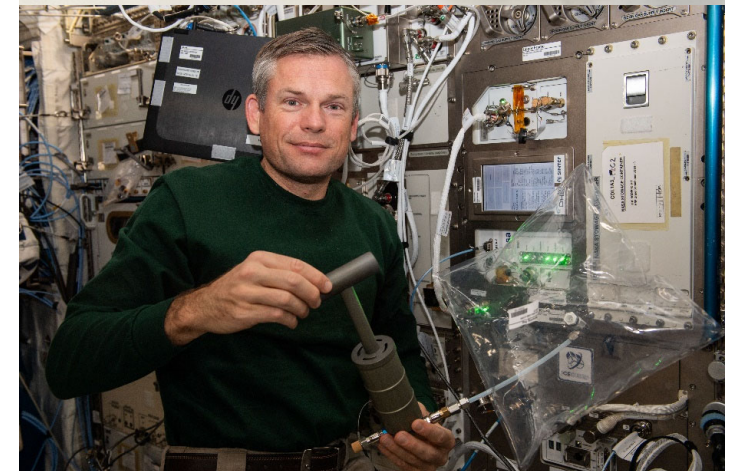


Photo: ESA/NASA

FTIR for multi-gas measurement – ANITA (3)

- Future of ANITA2 on the ISS
 - NASA and ESA want ANITA2 running until 2030, or even end of ISS
 - Life-limiting components (Infra-Red source, air sampling pump) show very promising development over time
 - Currently, ANITA2 Ground Model (residing at SINTEF) is flight spare
 - A more modular ANITA2b is planned, with replaceable components
- ANITA3 for the Lunar Gateway
 - An ANITA system has been selected, design details under discussion
 - Main problem: Higher radiation load than at the ISS
 - Planned launch with the I-HAB module on Artemis IV in Sept. 2028
- Lunar base, Mars transit, Mars base, ...
 - ANITA systems are clear candidates



Illustration of Lunar Gateway: NASA 

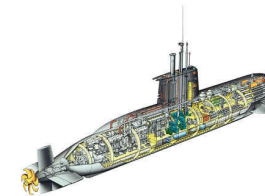
FTIR for multi-gas measurement

- Compared to GC and GC/MS, SINTEF's FTIR measurements are:
 - Much more accurate and reproducible
 - Much faster, allowing inline measurements
 - Well suited for automatic measurements
 - Can measure most gases, including small molecules and reactive gases
 - No consumption of sample gas
 - Permanent calibration: Normally no need for re-calibration or calibration checking (Calibration for unexpected gases can be introduced as a software update)
- Compared to laser-based measurements, our FTIR measurements are:
 - Suitable for multiple gases in parallel
 - Suitable also for larger molecules, including most VOCs (Volatile Organic Compounds)

FTIR for multi-gas measurement

Multiple non-space areas of application, e.g.:

- Air quality monitoring:
 - Diving systems
 - Submarines
 - Airplanes
 - Hospitals
 - Laboratories
 - Environmental monitoring, industrial emissions, ...
- Industrial process monitoring
- Agriculture (emission of nitrous gases)





Teknologi for et bedre samfunn