Project Overview

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LEMON Final Public Workshop, 11 July 2023, Palaiseau, France

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 821868

lemon

Lidar **E**mitter and **M**ulti-species greenhouse gases
Observation i**N**strument

Duration: 48 months
+ 6 months extension
due to Covid-19 => 54 months

Coordination:
Myriam Raybaut (Onera)

Co-Coordination:
Atmospheric Science
Cyrille Flamant (CNRS)

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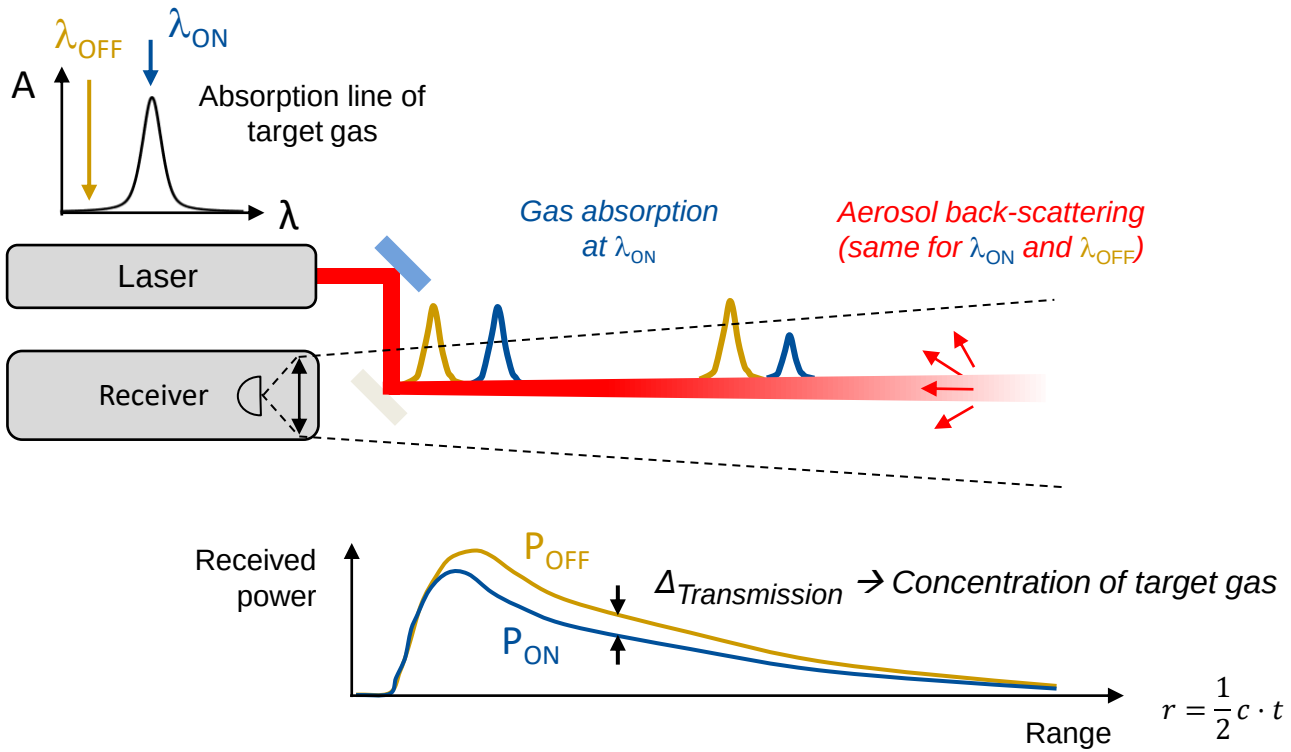
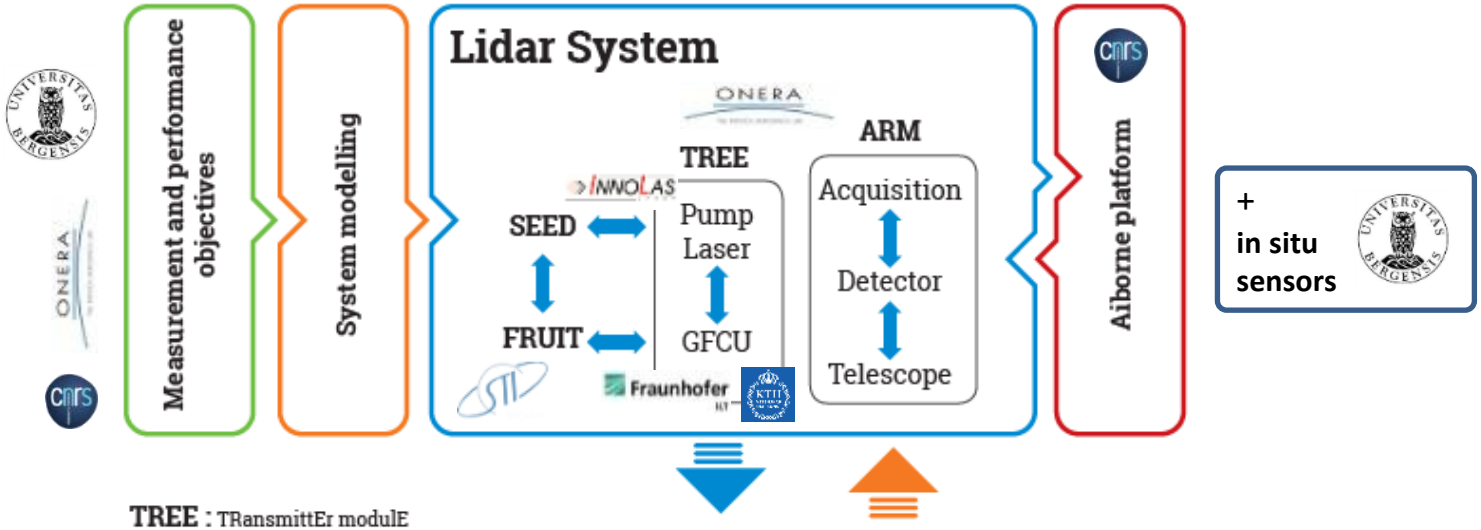
What is a Differential Absorption lidar (DIAL)?



LEMON DIAL Lidar setup



TREE : TRansmittEr modulE

FRUIT : FRequency ReFerence UnIT

ARM : Acquisition and Reciever Module

SEED : Software and ElEctronics for instruments control ans Data recording

Project overview & main objectives

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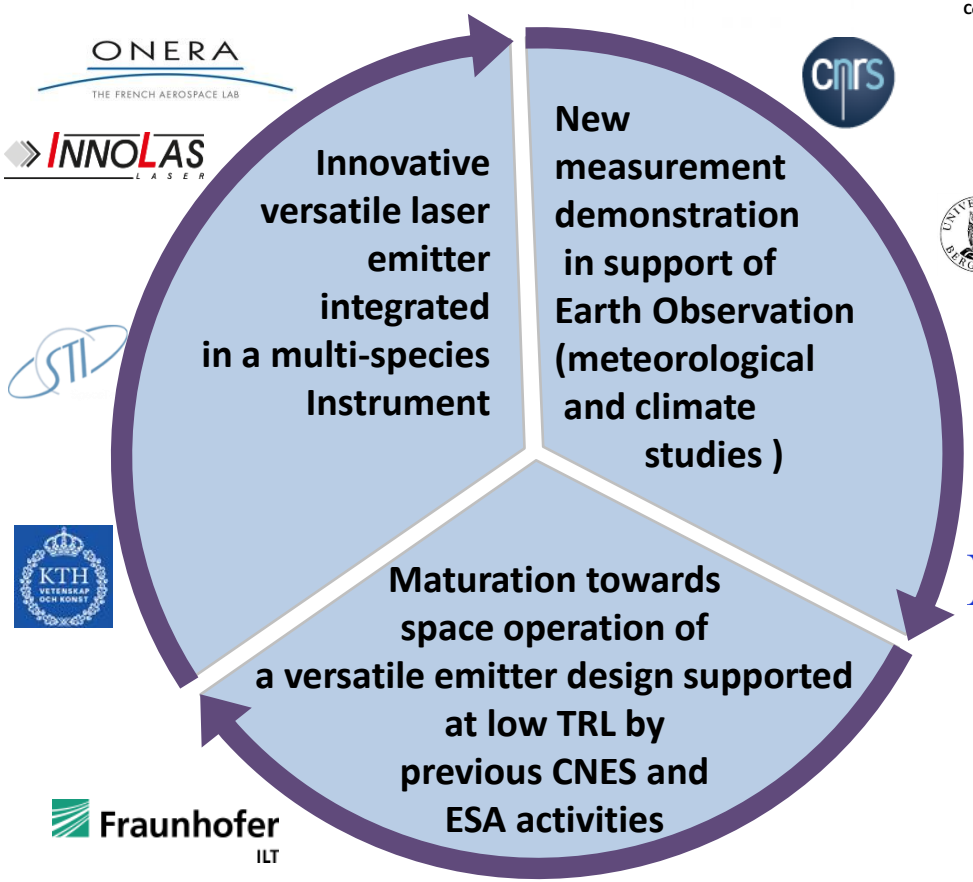

TRL 6 instrument validation

- Ground-based RR-DIAL (CO_2, H_2O, HDO)
- Airborne demonstration (H_20/HDO – CO_2 if enough flight time)

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Impact

- Dissemination
- Exploitation

Toward a spaceborne DIAL

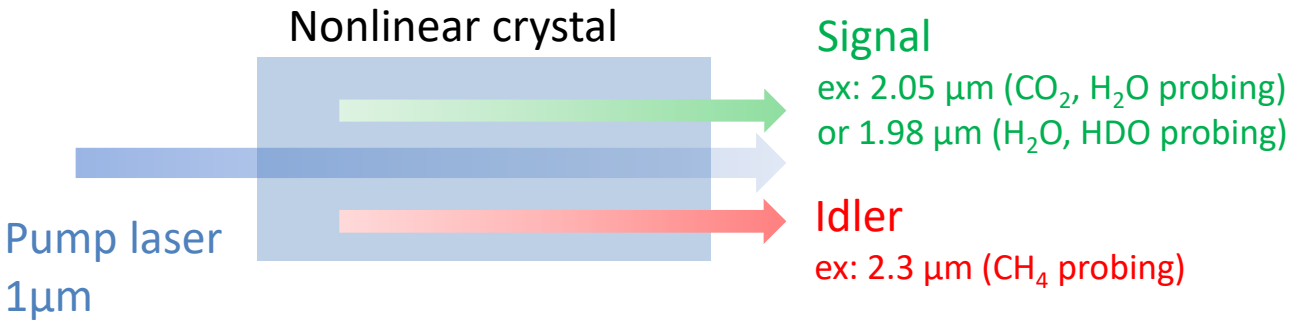
- Emitter specs. (CO_2, H_2O, CH_4)
- Roadmaps analysis
- Sub-units environmental testing
- Critical comp. radiation testing
- Future mission proposals

Project overview & main objectives

Based on **nonlinear frequency conversion in nonlinear crystals (OPO, OPA)**

Innovative versatile laser emitter integrated in a multi-species Instrument

- Wide wavelength tunability (necessary to target the desired gas species absorption lines)
- Could be coupled in the future with existing 1µm space laser development platforms



Project overview & main objectives

Based on **nonlinear frequency conversion in nonlinear crystals (OPO, OPA)**

Innovative versatile laser emitter integrated in a multi-species Instrument

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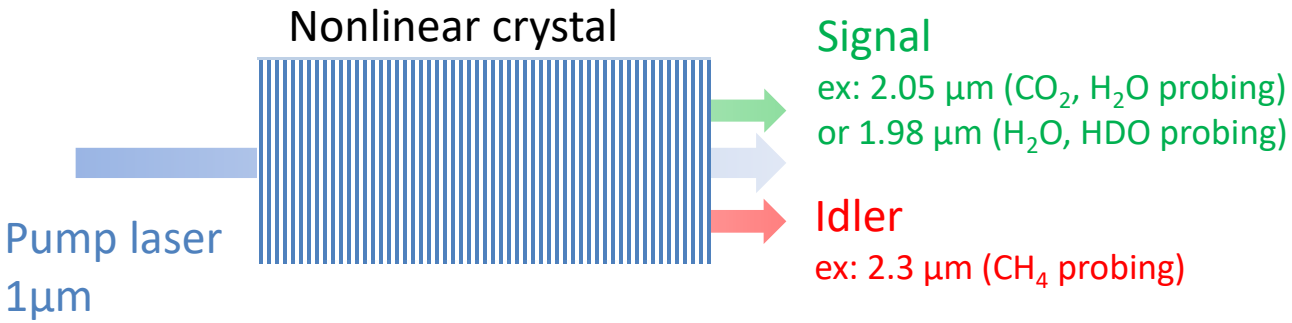
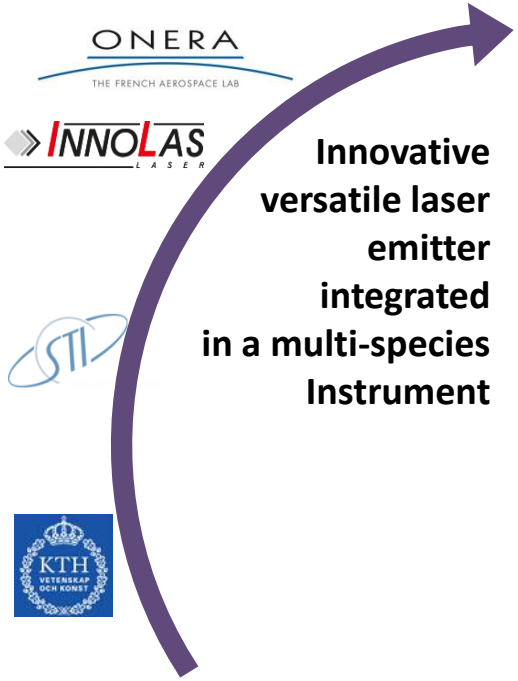


- Source based on **periodically poled nonlinear materials**
  - Higer efficiency compared to usual birefringence based nonlinear material (highest nonlinear coefficient)
  - No need to turn them to get the phase-matching
  - No walk-off (better beam quality & efficiency)

Project overview & main objectives

Solutions investigated:



- A multi-species approach based on a NesCOPO/OPA
  - No additional injection source for the OPO necessary to obtain single frequency

  => Less components than usual ns OPOs
  - MOPA (Master Oscillator/Power amplifier approach)

  => High energy & good beam quality
  - Multispecies capability (CO_2/H_2O or H_2O/HDO)
  - Previously supported by ESA & CNES funding for low TRL
- A lower TRL new approach based on BWOPO
  - New approach
  - Promising for space: no injection & no cavity
- A new wideband frequency measurement schemes
  - Frequency comb beating based approach

External collab: LCF

Refer to Workshop presentation n°3 by Jean-Baptiste Dherbecourt

Project overview & main objectives

Refer to Workshop presentation n°4 by Hanjo Schäfer

- Radiation testing of components
  - Especially nonlinear components
- Preliminary vibration testing of some sub-units
  - For space
  - For airborne operation
- Identification of new solutions with potential for space
  - Low TRL BWOPO testing
  - New frequency referencing (Comb-based frequency reference, new componenst tesing (PIC))
- Roadmap towards space

Maturation towards space operation of a versatile emitter design supported at low TRL by previous CNES and ESA activities

Impact

- Dissemination
- Exploitation
- **Toward a spaceborne DIAL**
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Project overview & main objectives

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Refer to Workshop presentation n°2 by Cyrille Flamant

New measurement demonstration in support of Earth Observation (meteorological and climate studies)

TRL 6 instrument validation

- Ground-based RR-DIAL (CO_2, H_2O, HDO)
- Airborne demonstration (H_2O/HDO – CO_2 if enough flight time)

- First DIAL tests using a laboratory lidar breadboard (WAVIL) built using a French ANR equipment funding
  - Laboratory NesCOPO/OPA emitter & lidar => 1st world H_2O & HDO lidar sensing
- LEMON instrument PoC tests
  - Laboratory PoC range-resolved DIAL
  - 1st airborne integration, certification & IP-DIAL test
- In situ commercial CRDS instrument calibration setup and protocol
  - Airborne integration & science campaign

If you want to know more

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