MULTIPLY:
Development of a European HSRL airborne facility

Ioannis Binietoglou[1,2] , Vassilis Amiridis[2] , Livio Belegante[1] , Andreea Boscornea[3] , Montserrat Costa Surós [4], Panagiotis Kokkalis[2], Holger Linne[5], Doina Nicolae[1], Ilya Serikov[5] , Iwona Stachlewska[4], Sorin-Nicolae Vajaiac[3]

[1]National Institute for Research and Development in Optoelectronics, Romania

[2] Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Greece;

[3] National Institute for Aerospace Research "Elie Carafoli" (INCAS), Romania;

[4] Institute of Geophysics, Faculty of Physics, University of Warsaw, Poland;

[5] Max Planck Institute for Meteorology, Hamburg, Germany

The MULTIPLY project in a nutshell

- An airborne High Spectral Resolution Lidar (HSRL).
- It will measure aerosol optical properties at 3 wavelengths (355, 532, 1064nm).
- Main product will be aerosol extinction, backscatter, and depolarization profiles.
- Developed by a consortium of institutes in:
  Romania, Germany, Poland, Greece, and Netherlands.

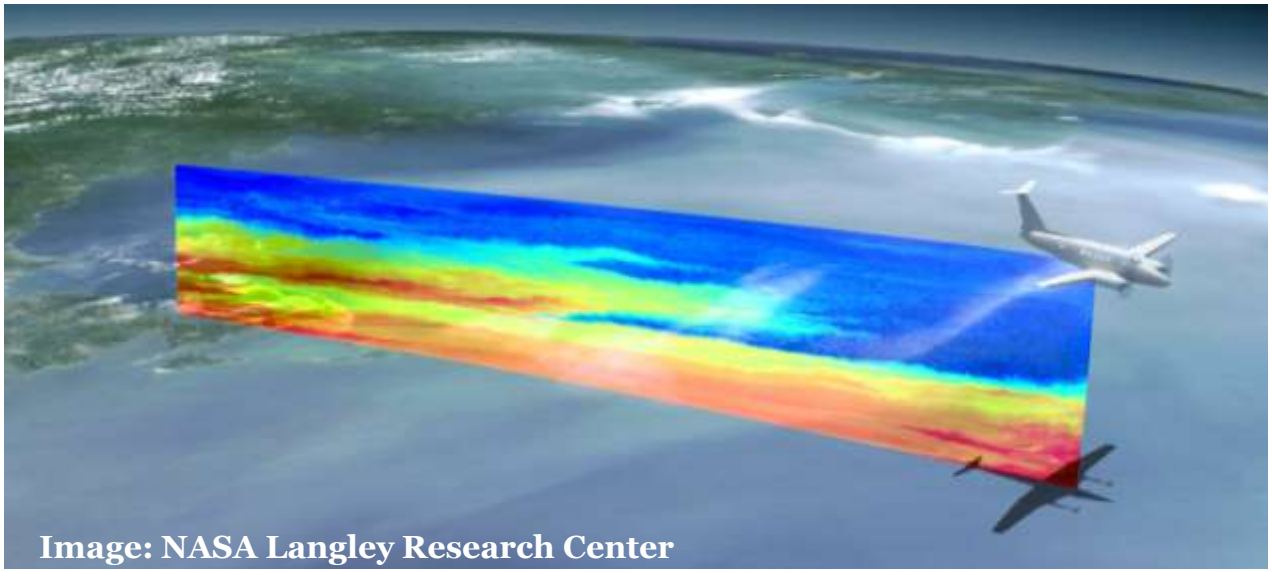
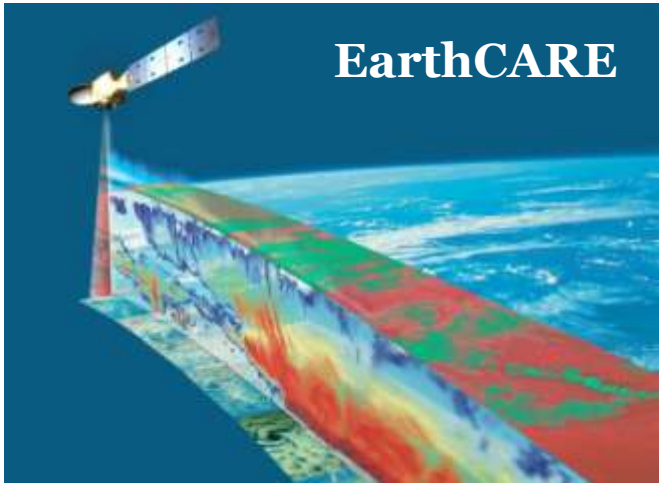


Image: NASA Langley Research Center

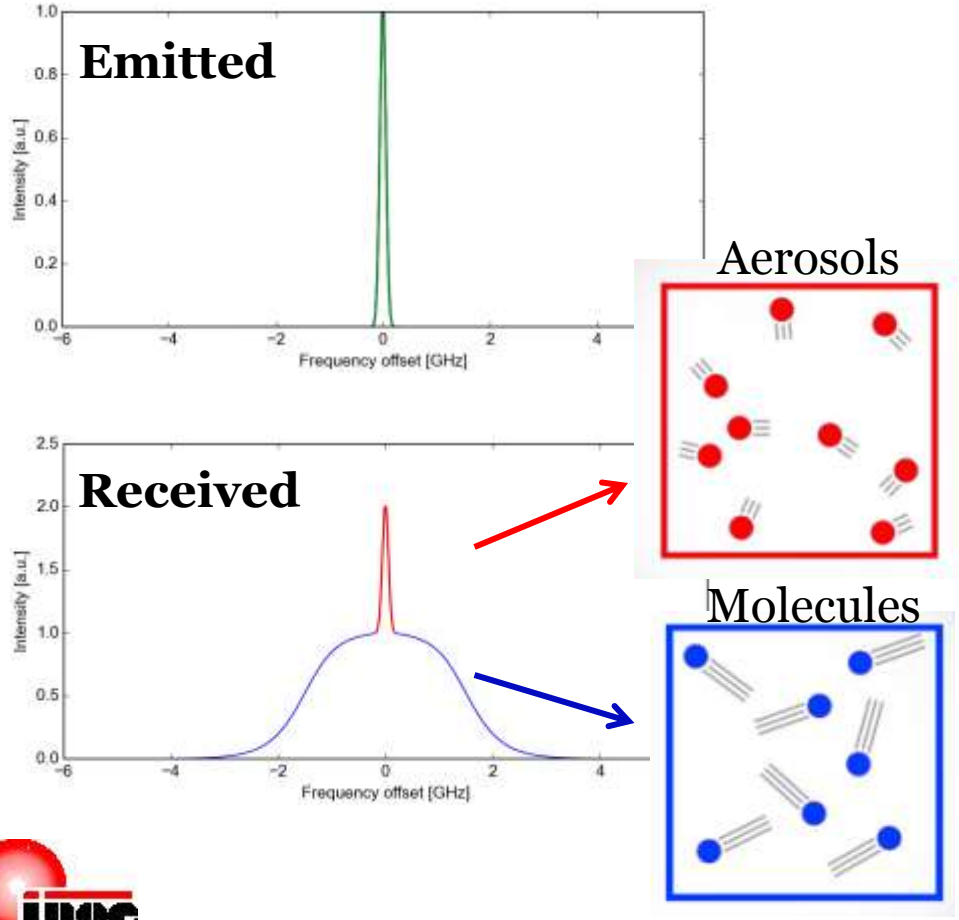
ESA aerosol missions

- ESA is planning a number for aerosol monitoring missions.
- ESA's active remote sensing missions: EarthCARE, ADM-Aeolus.
- Several Sentinels will also provide aerosols products.

There is a need for detailed validation of aerosol products, and evaluation of their uncertainties .



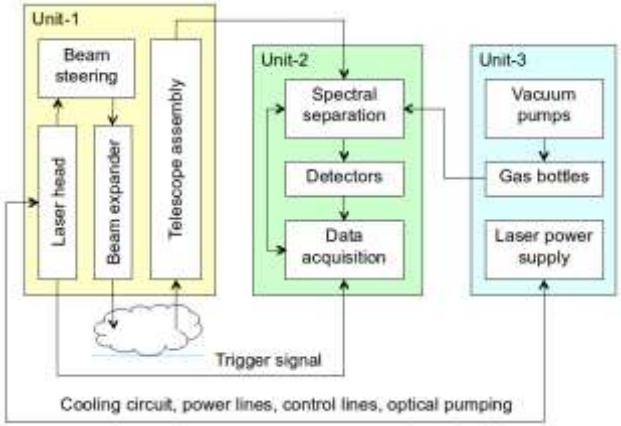
Why High Spectral Resolution?



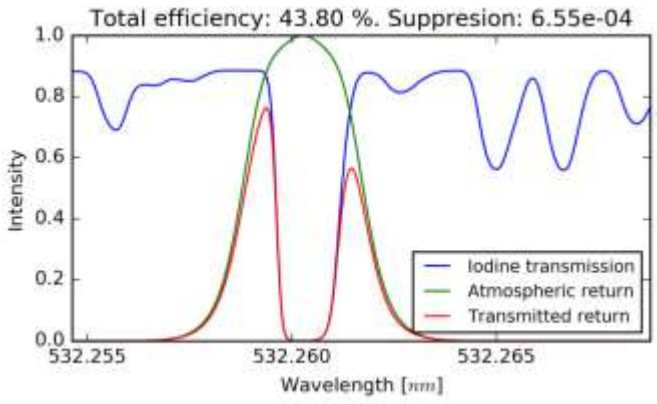
- Laser light is monochromatic.
- Light scattered in the atmosphere is broadened by the movement of aerosols and molecules.
- Aerosol move slower than molecules -> different spectrum.
- The difference is very small (~1pm) so we need high spectral resolution to detect this.
- If we do, we can separate aerosol and molecular scattering, and gain detailed information on aerosol properties.

How it works

System schematics



Iodine filter simulation

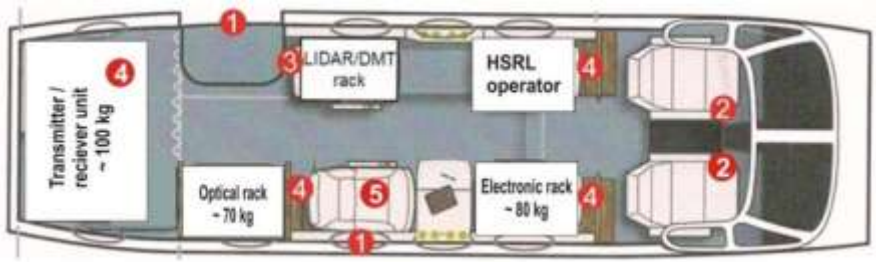


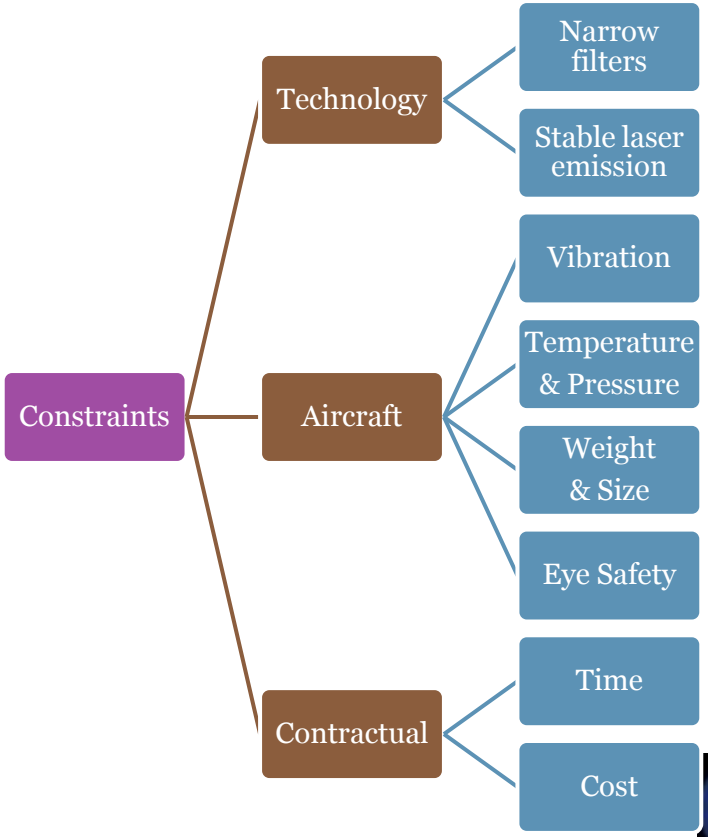
- A laser beam is emitted in the atmosphere.
- Light is scattered on molecules and aerosols.
- A telescopes observes the light that is backscattered towards the system.
- 3 laser wavelengths are emitted and detected in the same time.
- High spectral separation is done with either Fabry-Perot interferometers (355, 1064nm) or Iodine filters (532nm).

Simulation based on Forkey et al., Applied Optics, 1997, doi: 10.1364/AO.36.006729

Tight project constraints

- Multiply is a challenging project with many constraints.
- For its success, we need to push the state of the art in system design.





Project partners & Responsibilities

MULTIPLY project covers the complete design and development of the system, including hardware design, software development, and testing.

INOE, Romania
Coordination, Algorithm & Software, Procurements

Max Planck Institute for Meteorology, Germany
Hardware design and development

National Observatory of Athens, Greece
Instrument Simulations

University of Warsaw, Poland
Testing/Quality assurance

National Institute of Aerospace Research (INCAS), Romania
Aircraft requirements, validation

National Aerospace Laboratory, Netherlands
Aircraft requirements