Remote Sensing of CH_4 under Controlled Release by Differential Absorption Light Detection and Ranging (DiAL)

Presenters:

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aemera.org

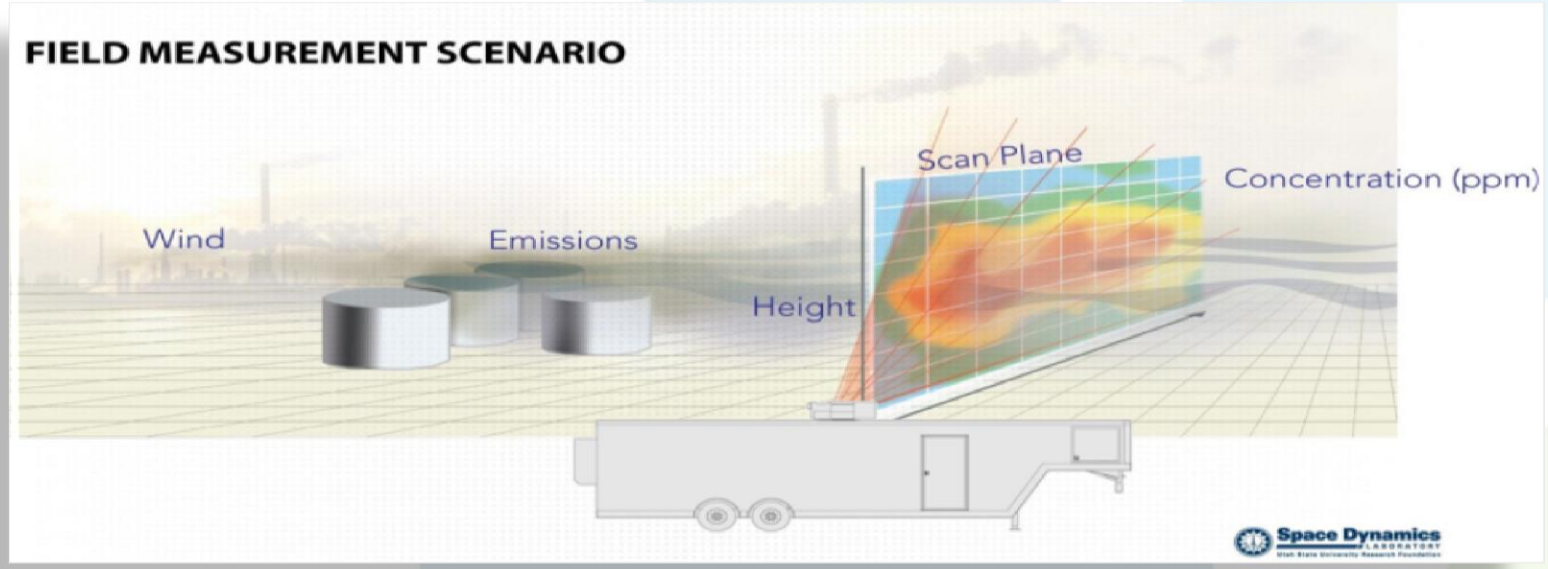
Presentation Layout

- The Alberta DiAL
- DiAL principle
- System arrangement
- Set-up for CH_4 measurement
- The real time data
- Data Processing
- Results
- Summary

The First DiAL unit in North America

- Differential Absorption LiDAR (DiAL) mobile system was the product of collaboration between Government of Alberta and the Space Dynamic Lab (SDL) of the Utah State University.
- It was delivered in March 2013

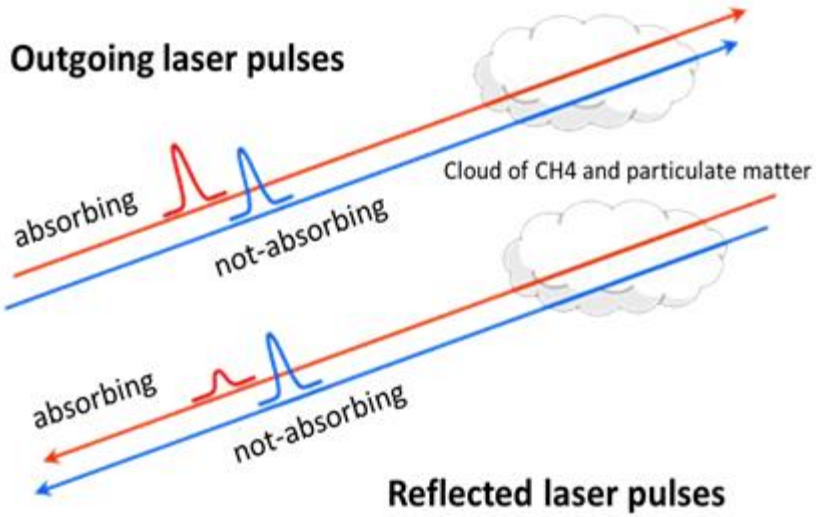
DiAL features

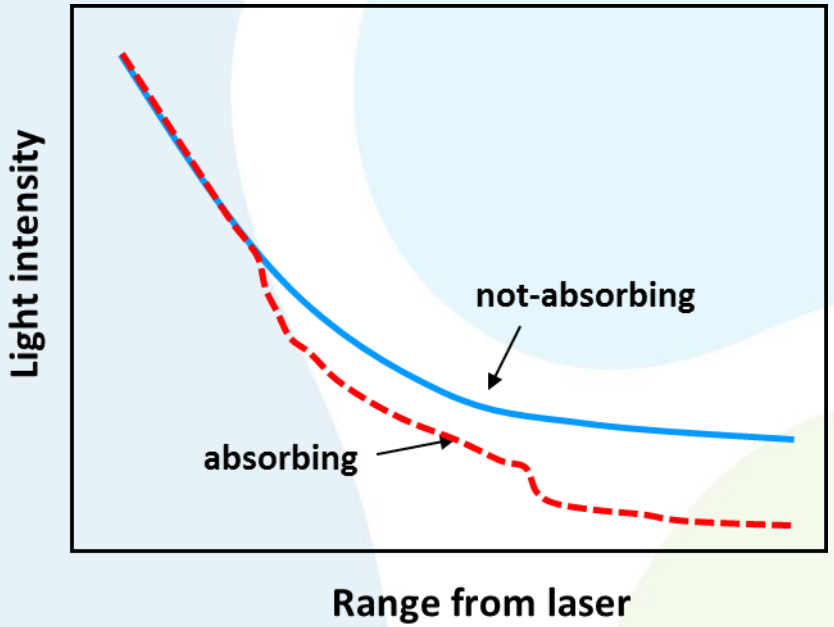


- Can travel across Alberta.
- Can map pollutants in 2D and 3D.
- Sensing of CO_2 and CH_4 in the ppm range for 2 km.
- Sensing of PM for 10 km.
- Spatial resolution of 10 m.
- Eye Safe

Particularly suited for measuring sources in oil sands region: mining site, tailings pond, industrial complex, SAGD and cold flow operations.

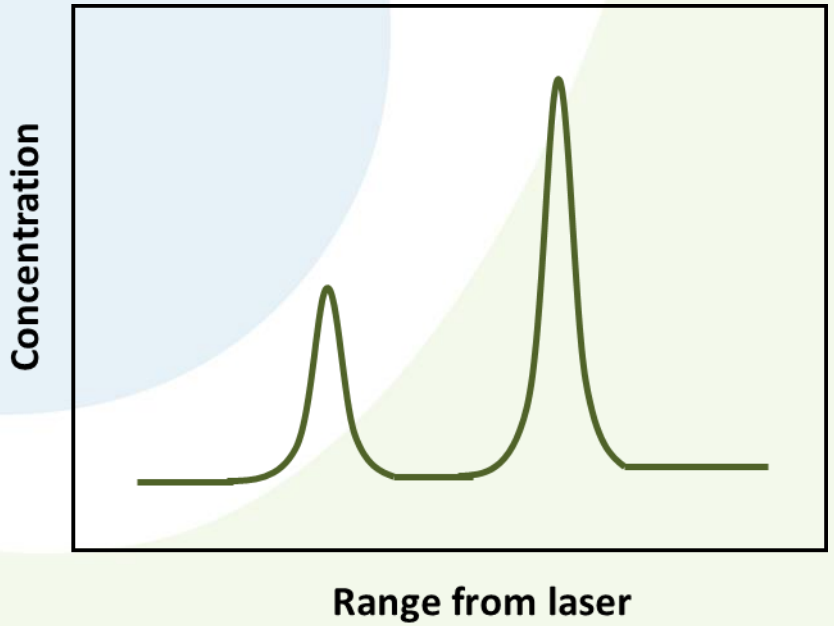
How does DiAL work?





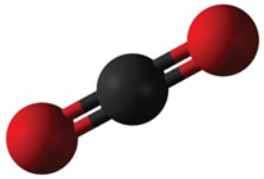
- Two laser beams are sent out with slightly different wavelengths: one corresponds to the absorption peak of the pollutant gas of interest and the other one corresponds to the non-absorbing background.

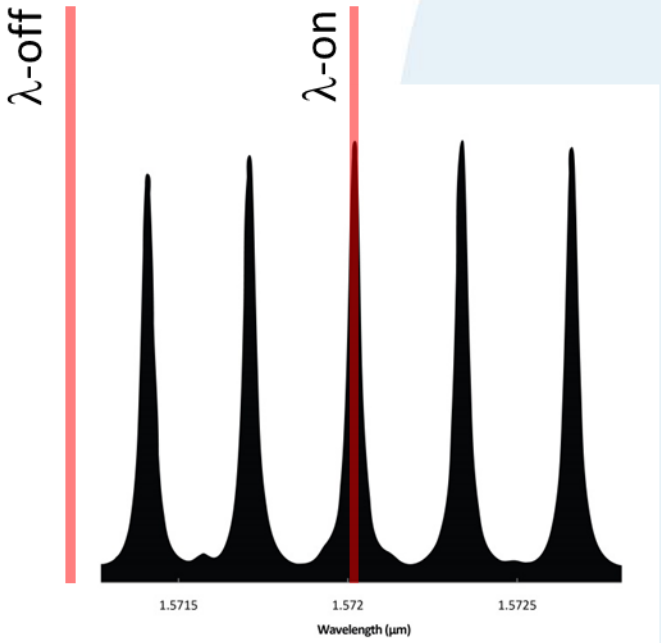
- The difference between the two signals corresponds to the gas concentration.



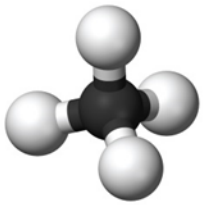
Gases of Present Interest

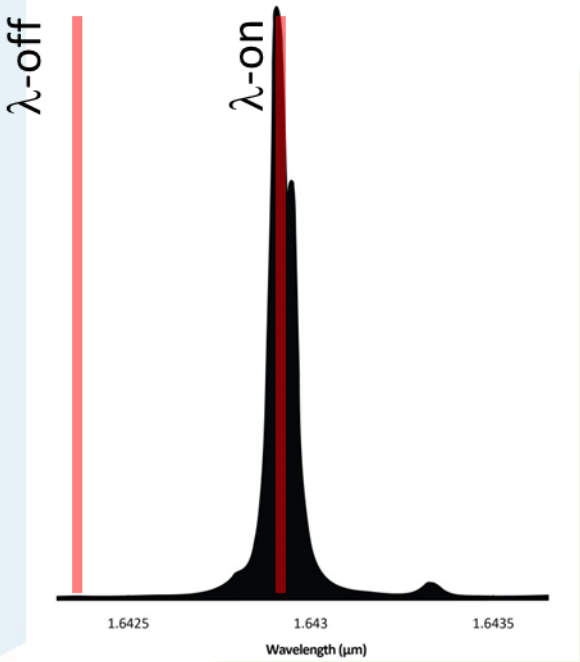
Carbon Dioxide (CO_2)



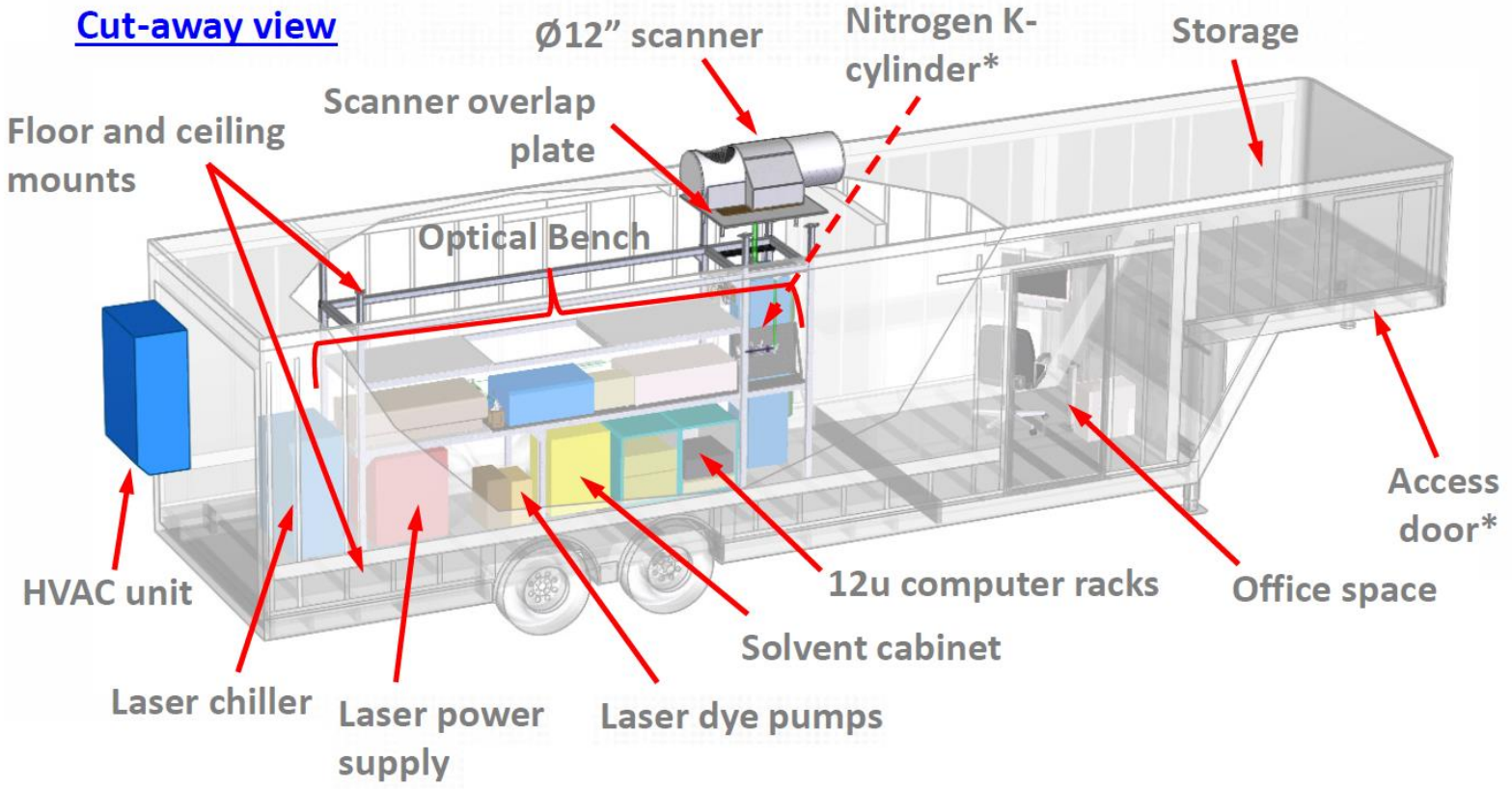


Methane (CH_4)

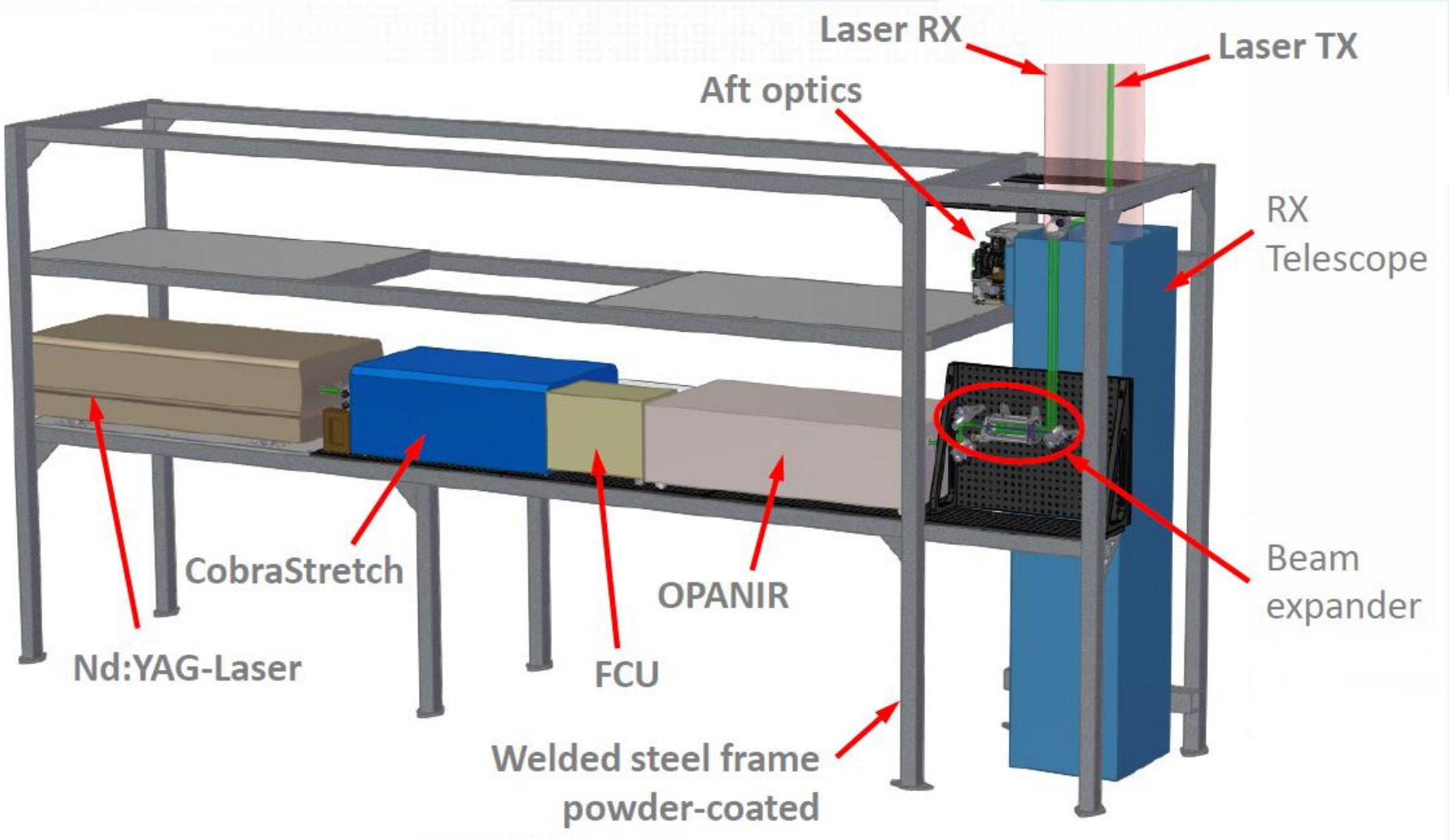




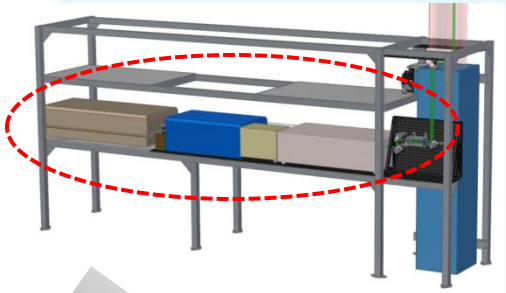
AEMERA's DiAL unit

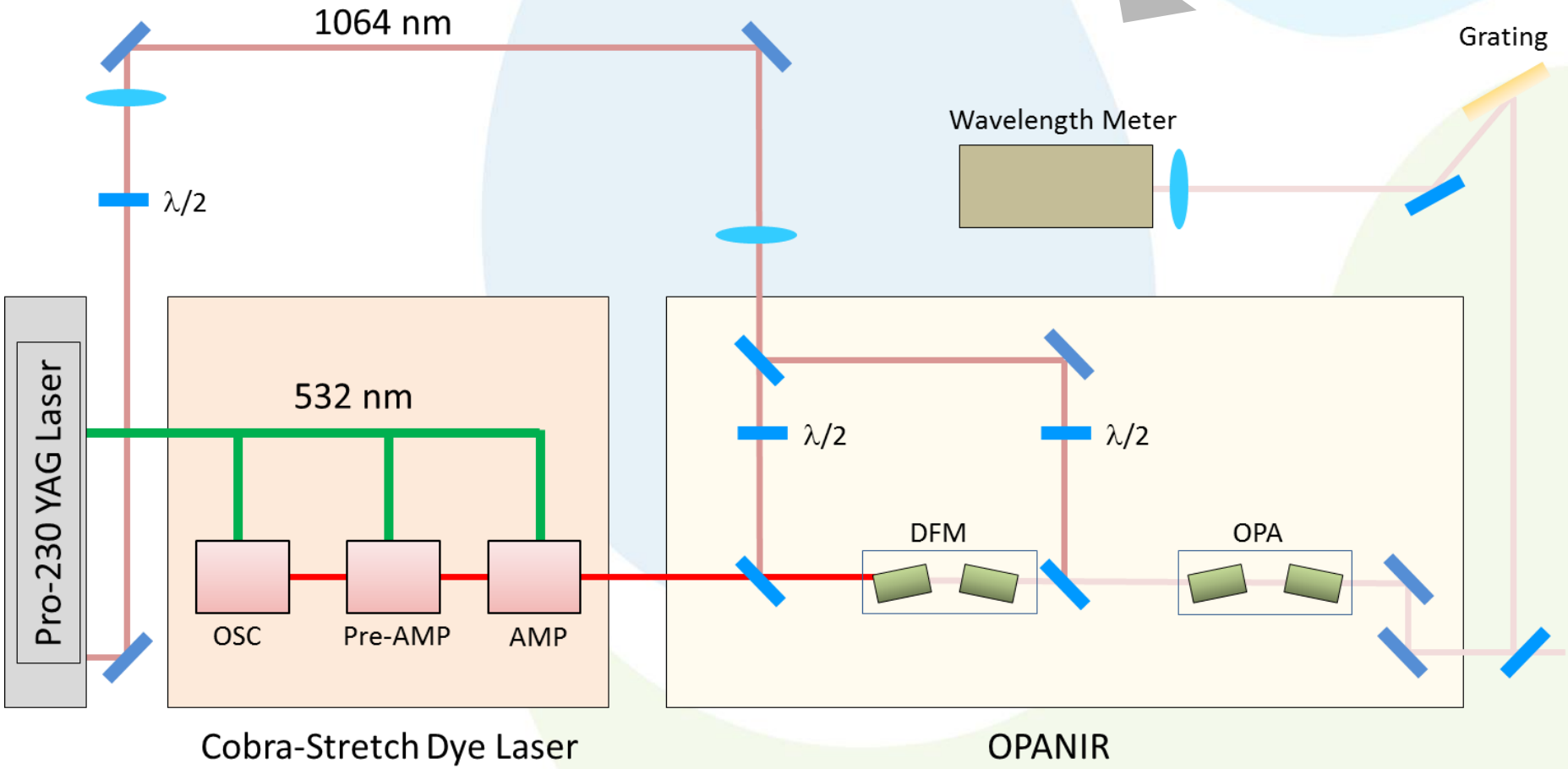


Optical system in DiAL

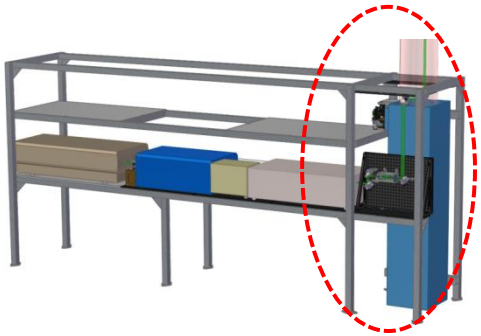


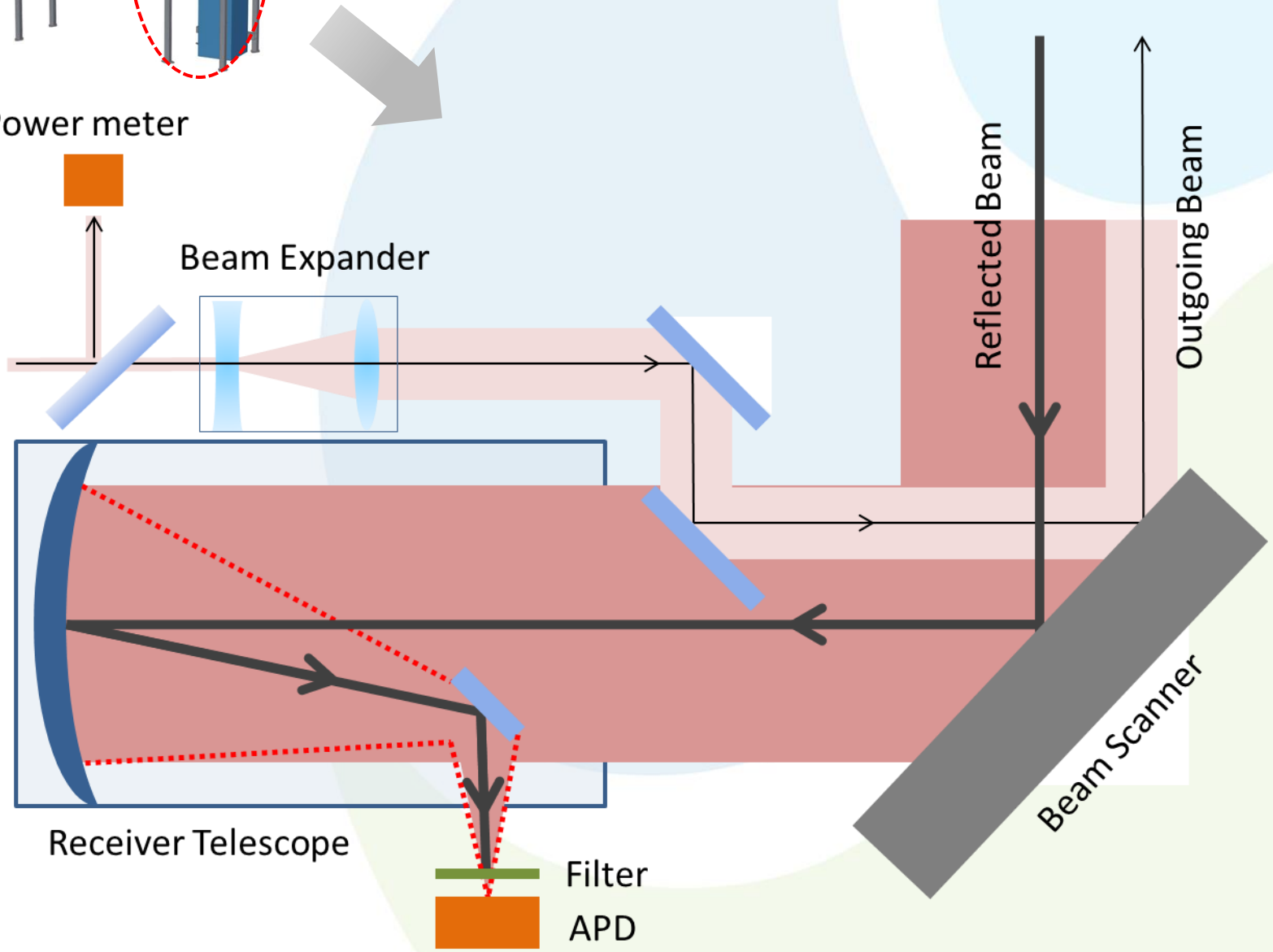
Optical system in DiAL — Laser system





Optical system in DiAL — Beam TX & RX system

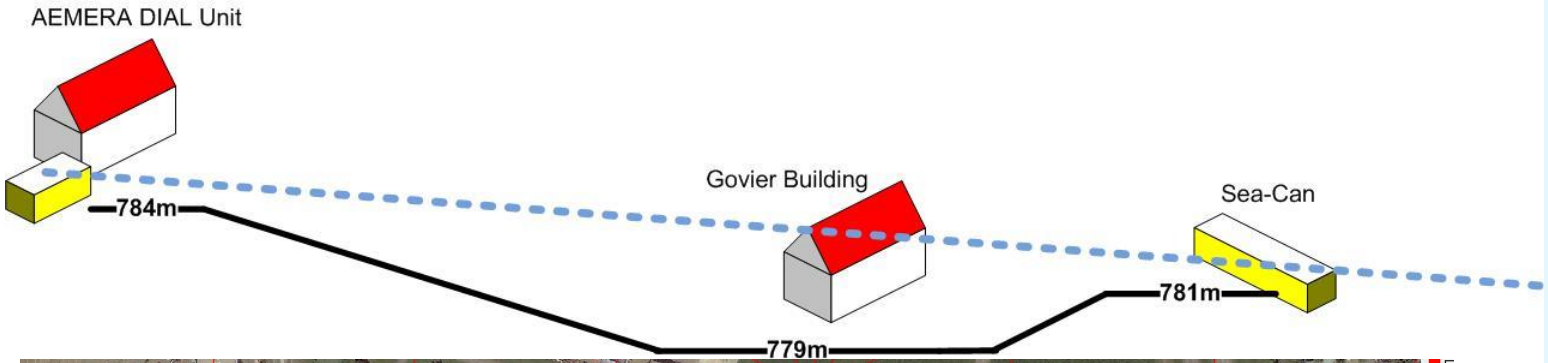


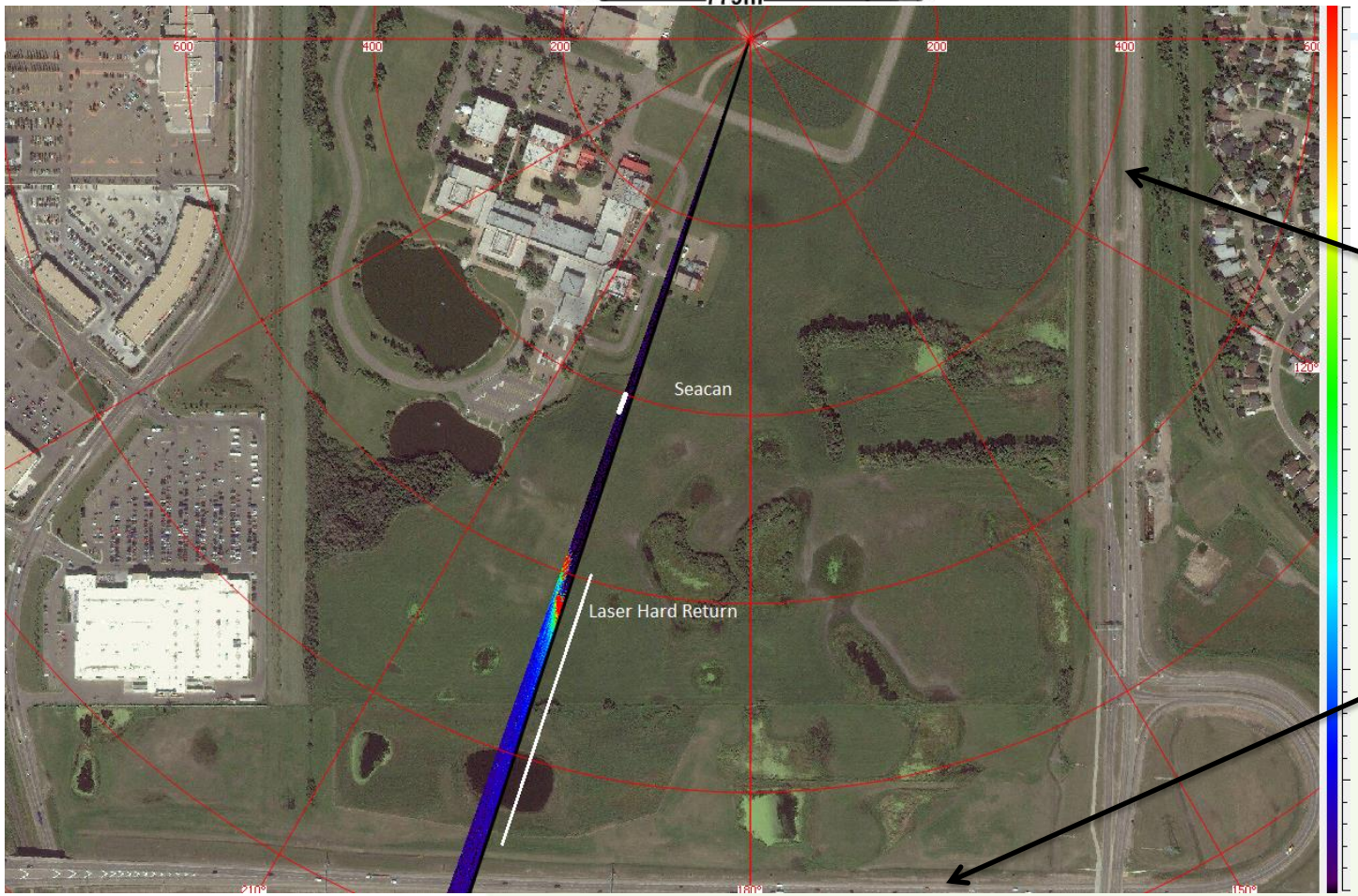


Setup for Gas Sensing

The 40 feet Sea-Can

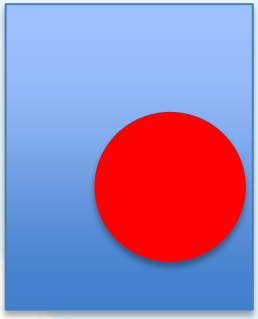
Laser Beam Alignment



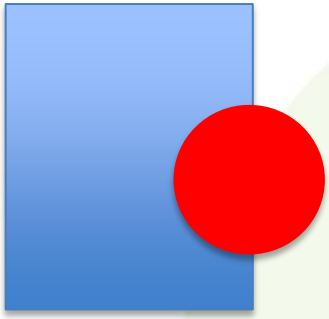


Laser Beam Profiling

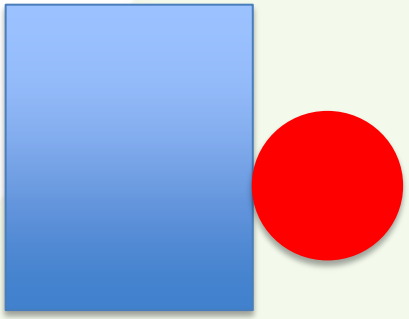
Laser hitting the edge of a hard target



Beam on Target

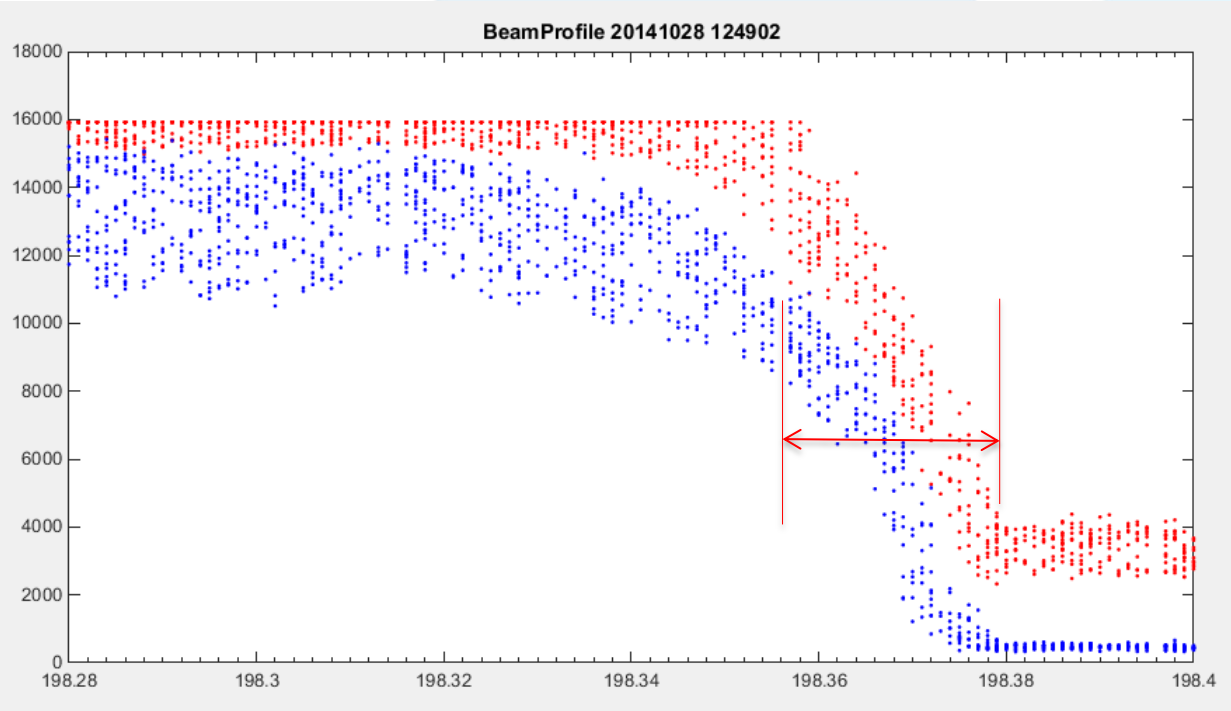


Beam partially on Target



Beam off the Target

Estimation of Beam Divergence



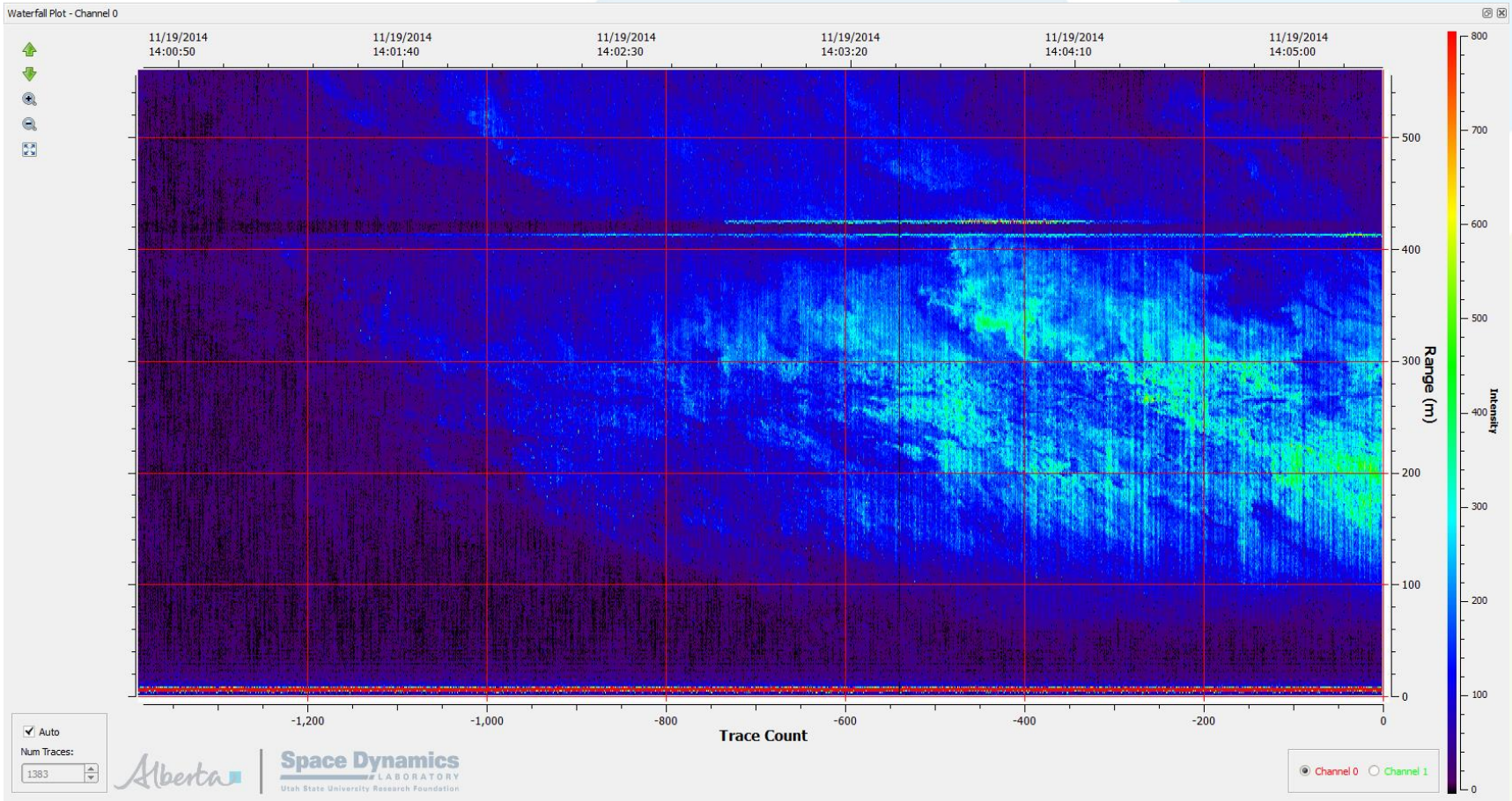
Target Distance= 400 m

On line Divergence= 0.035°; Beam size= **24.4 cm**

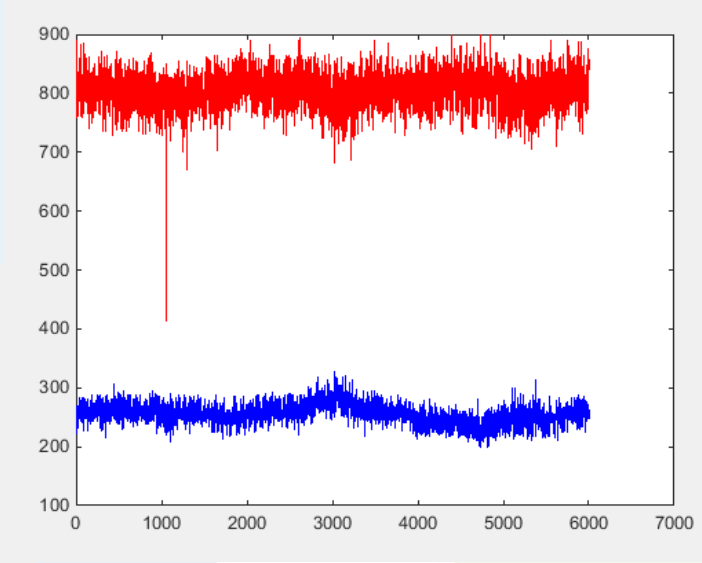
Off line Divergence= 0.062°; Beam size= **43.3 cm**

Spatial misalignment= 0.006°; Spatial separation= **4.2 cm**

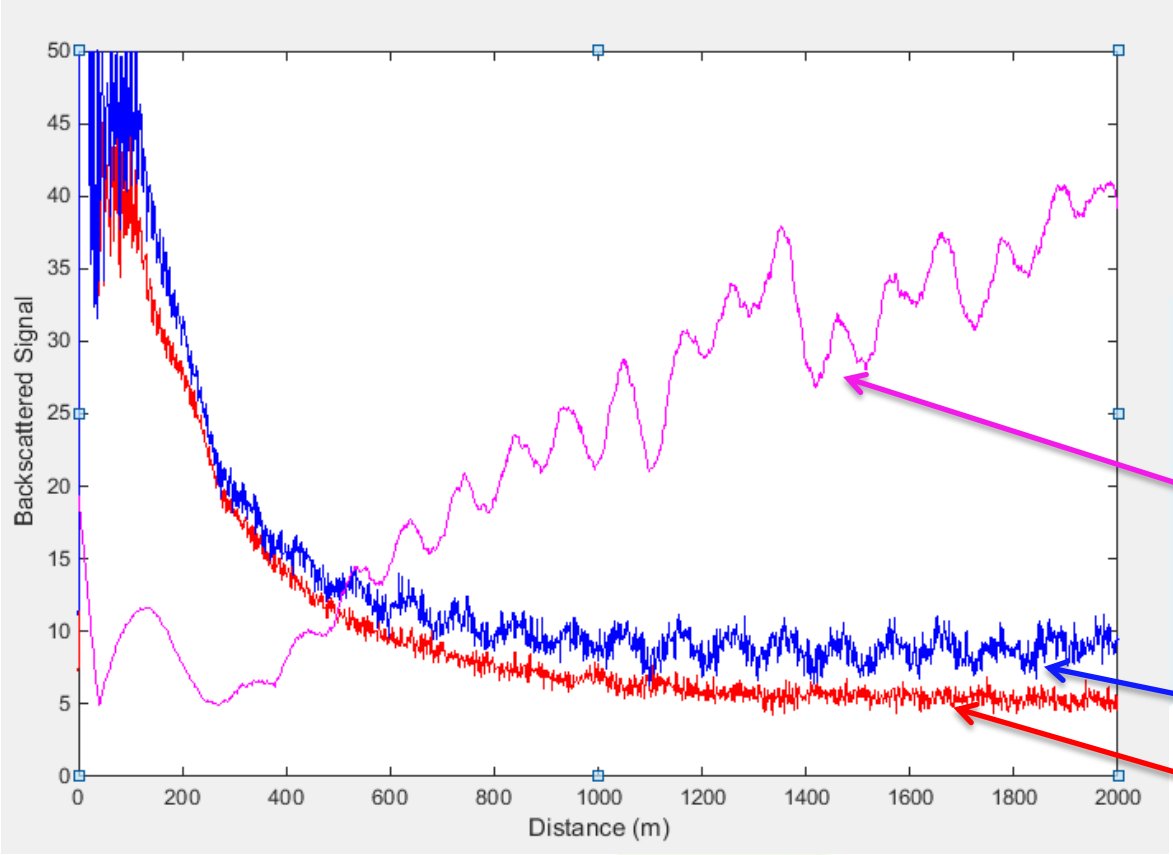
Real Time PM Waterfall Plot



Data Extraction and Processing



Laser power profile

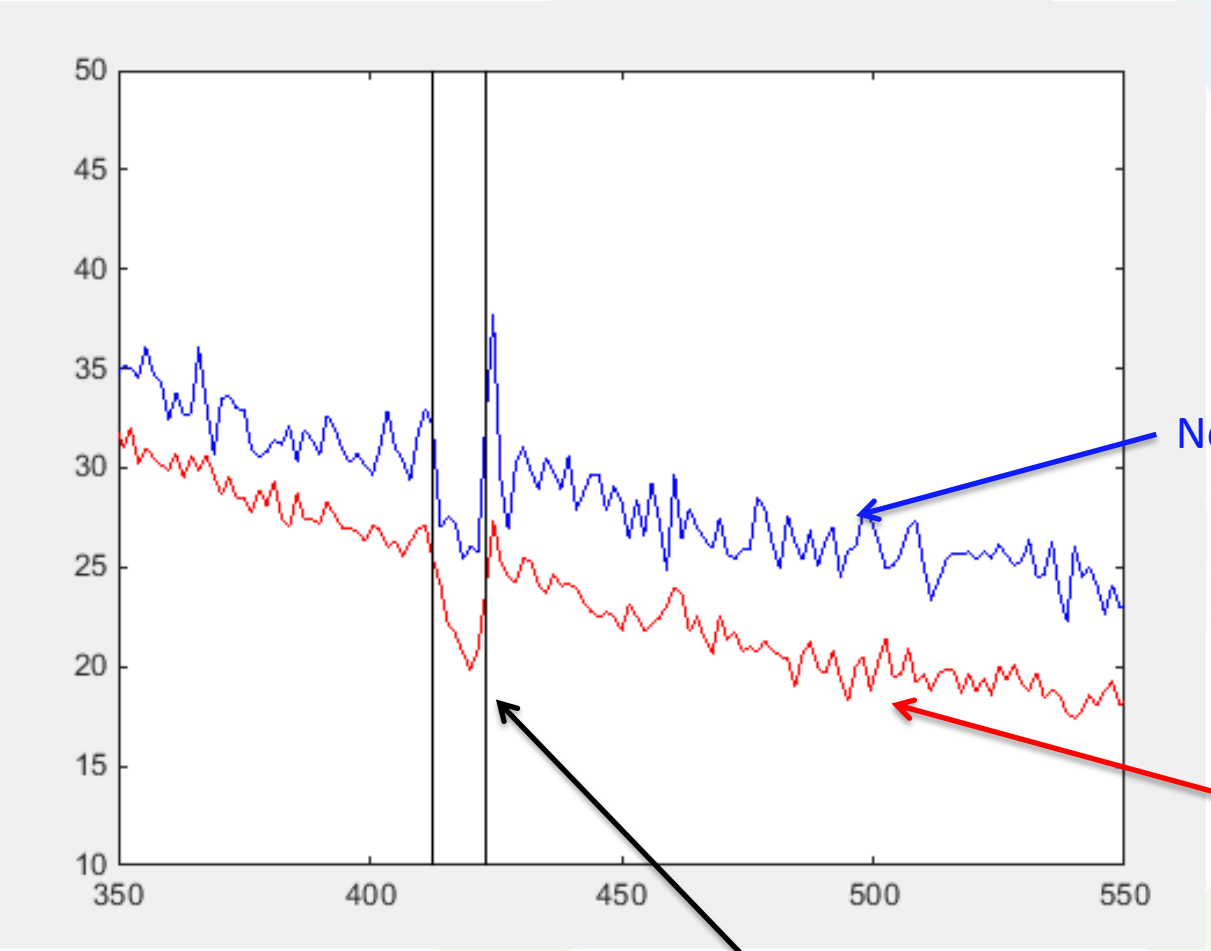


Path-integrated concentration

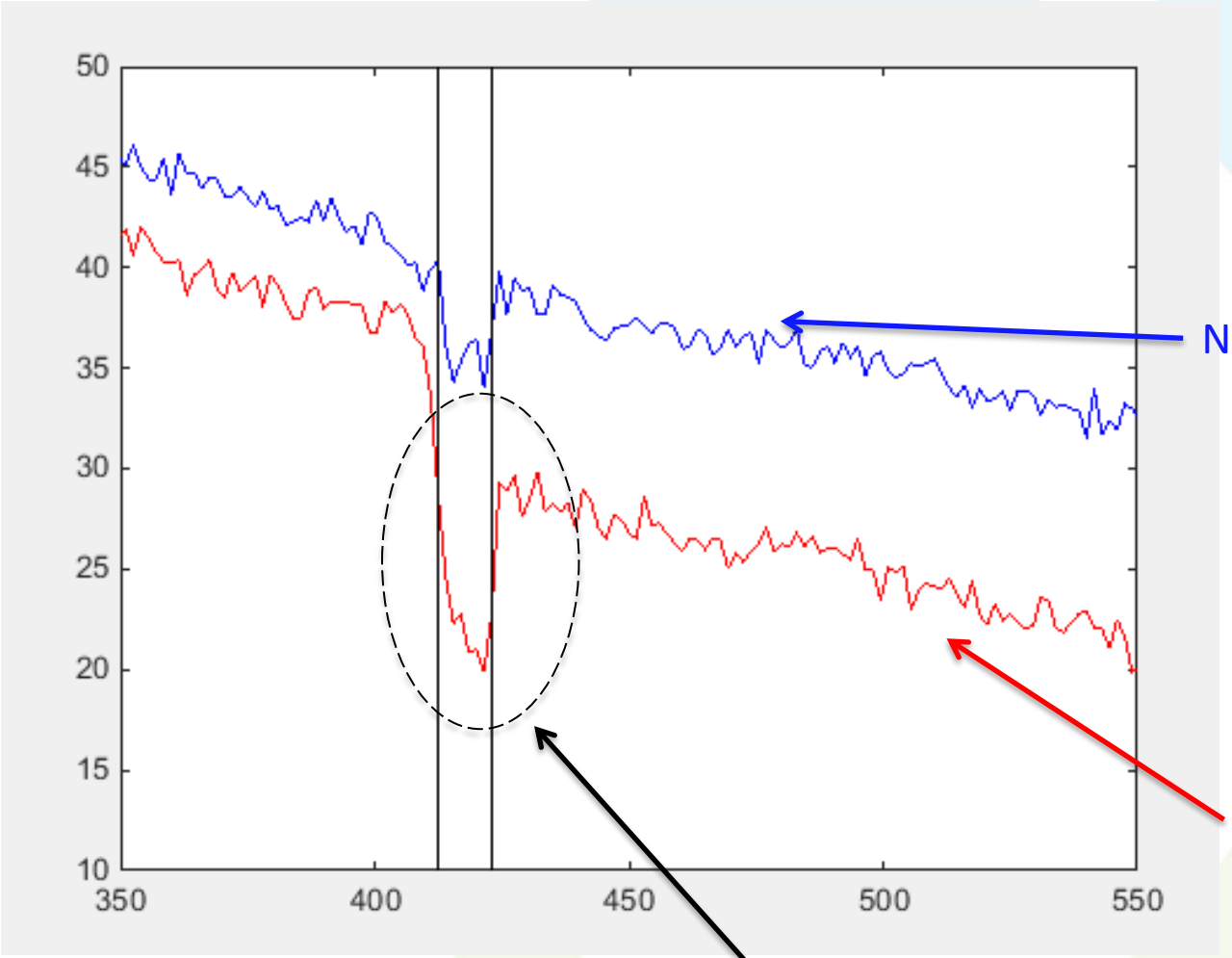
Non-absorbing ‘Off’ data

Absorbing ‘On’ data

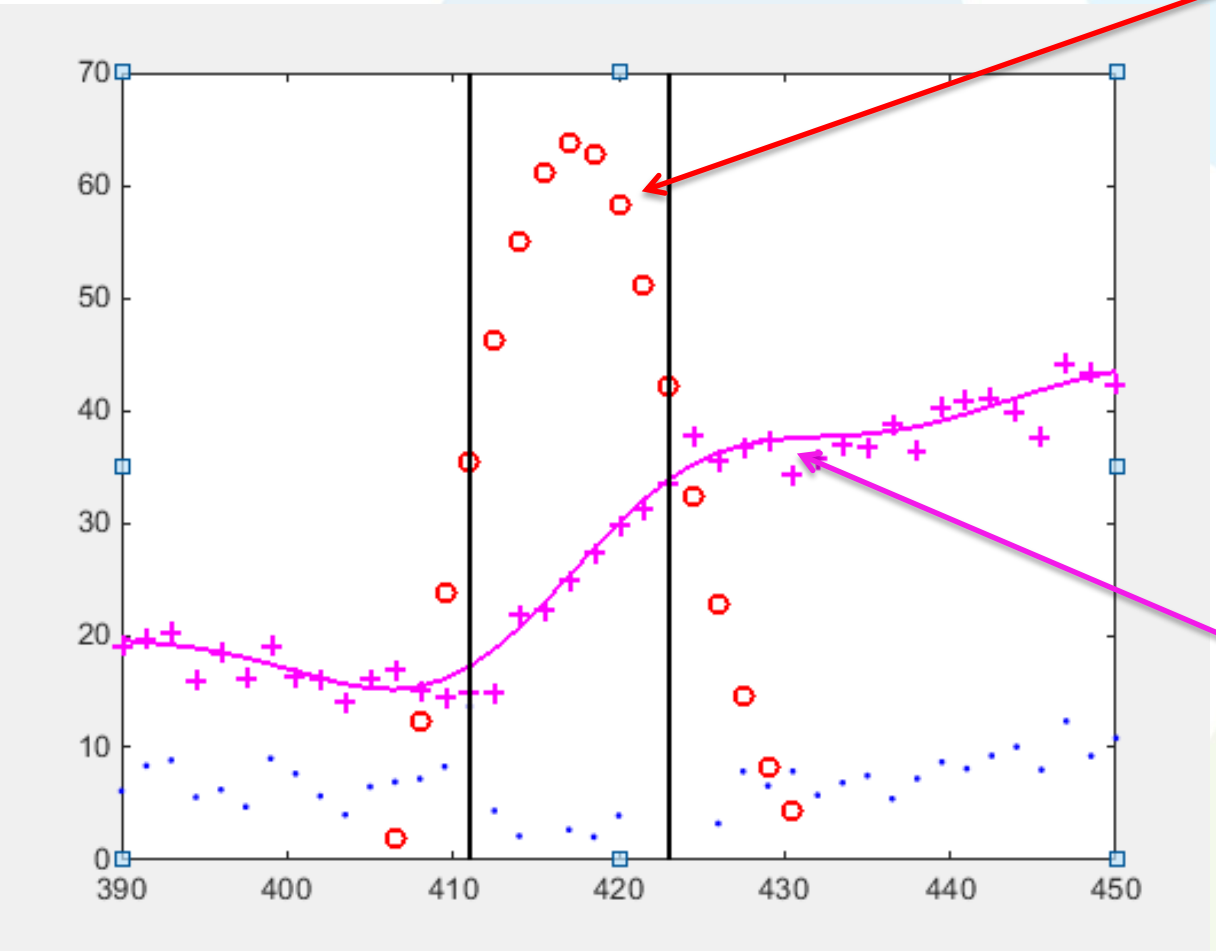
Laser Beam Through Sea-Can



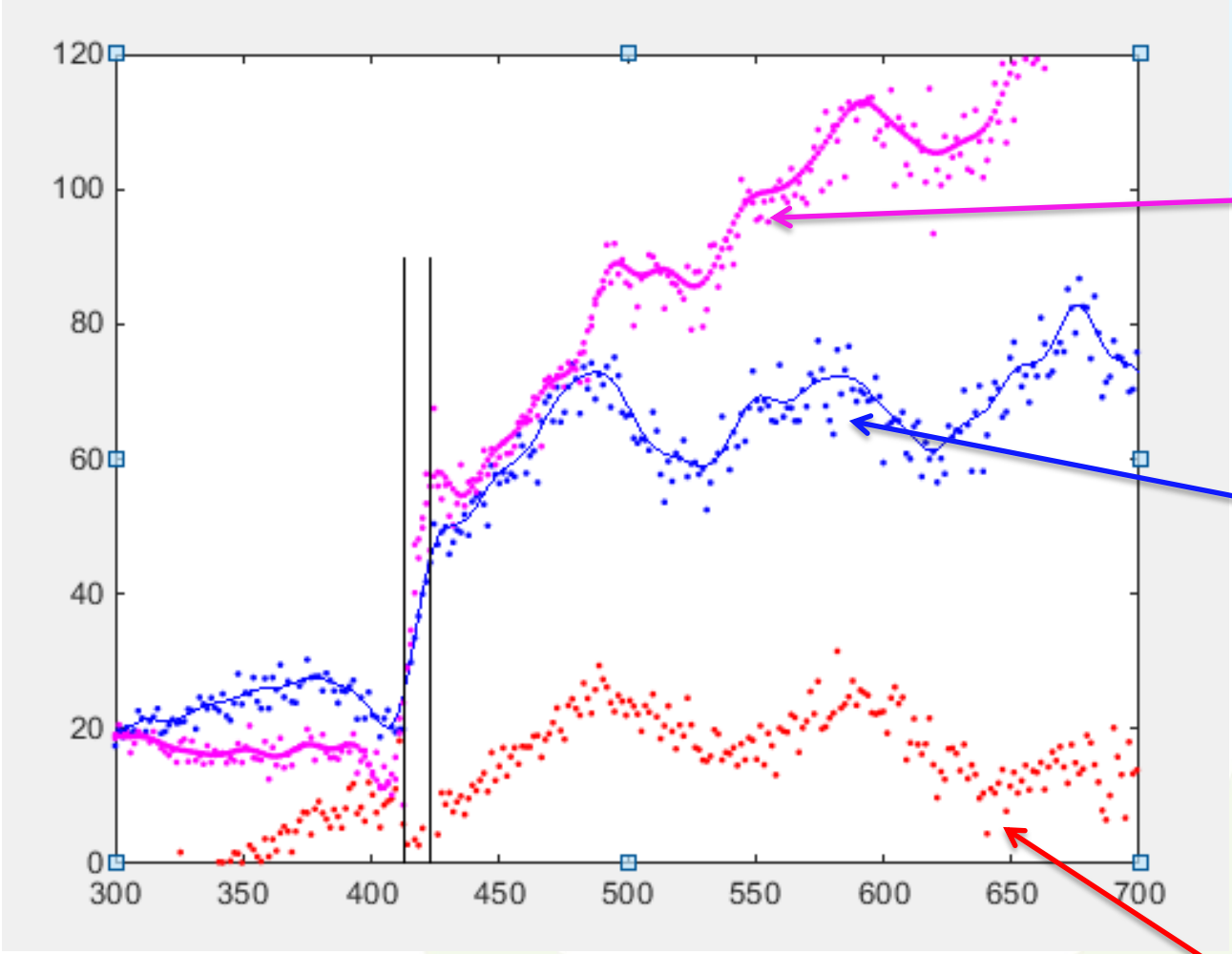
Laser Beam Through Sea-Can on Gas Release



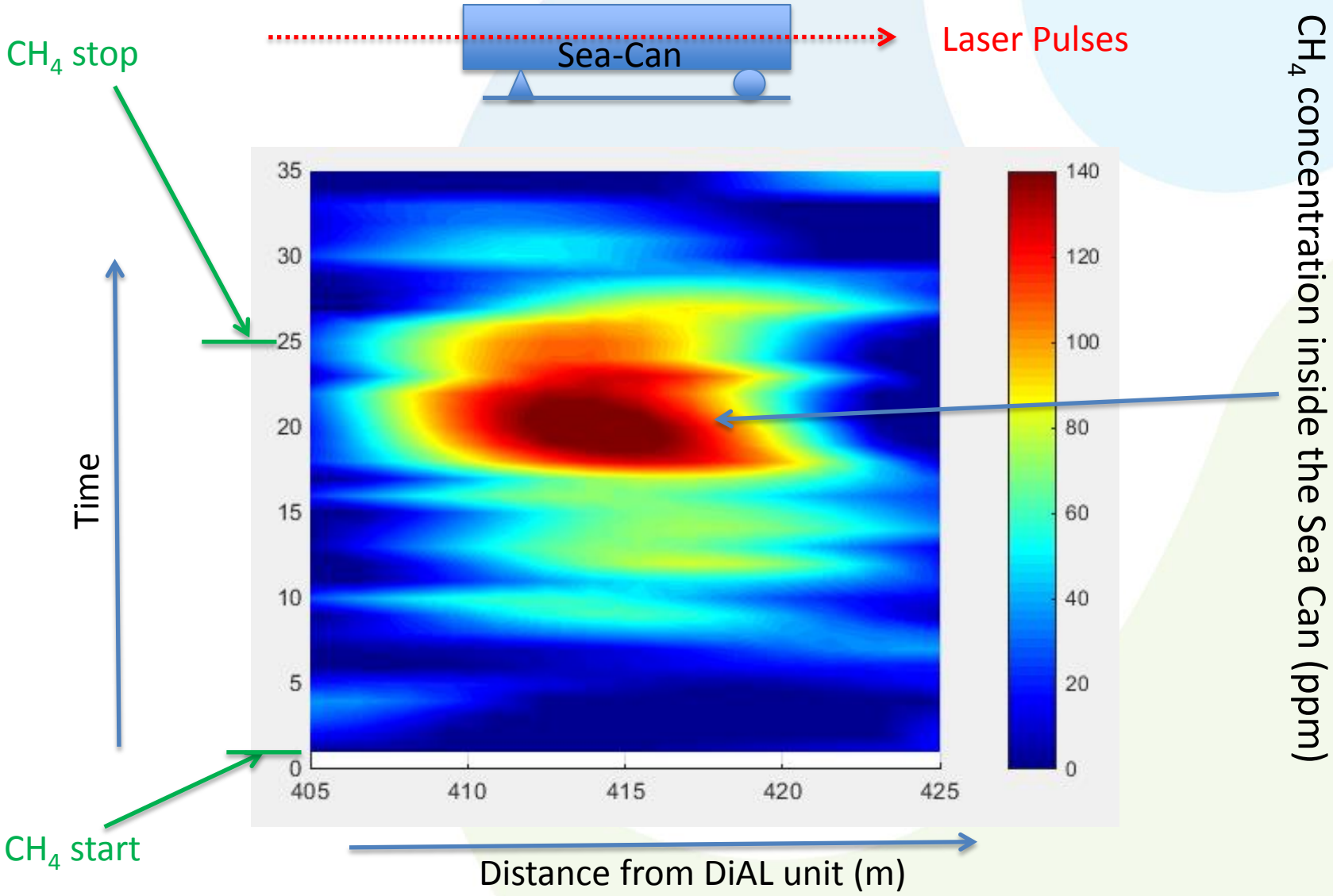
Concentration Profile of CH_4 inside the Sea Can



Path-Integrated CH_4 Concentration



Waterfall Plot of CH_4 Concentration under Controlled Release



Summary

- DiAL can be used as a powerful remote sensing tool for selected gas elements.
- Detection is achieved without a hard reflector.
- Detection of controlled release of CH_4 at a distance of 400m is demonstrated.
- Gas concentration is profiled along a length of 12 meter with a spatial resolution of 1.5 meter.
- Temporal variation of gas concentration is monitored and profiled.

Participants

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Thanks!