Trace gas detection in the Earth Atmosphere using laser spectrometers

Code S and T ROSES workshop

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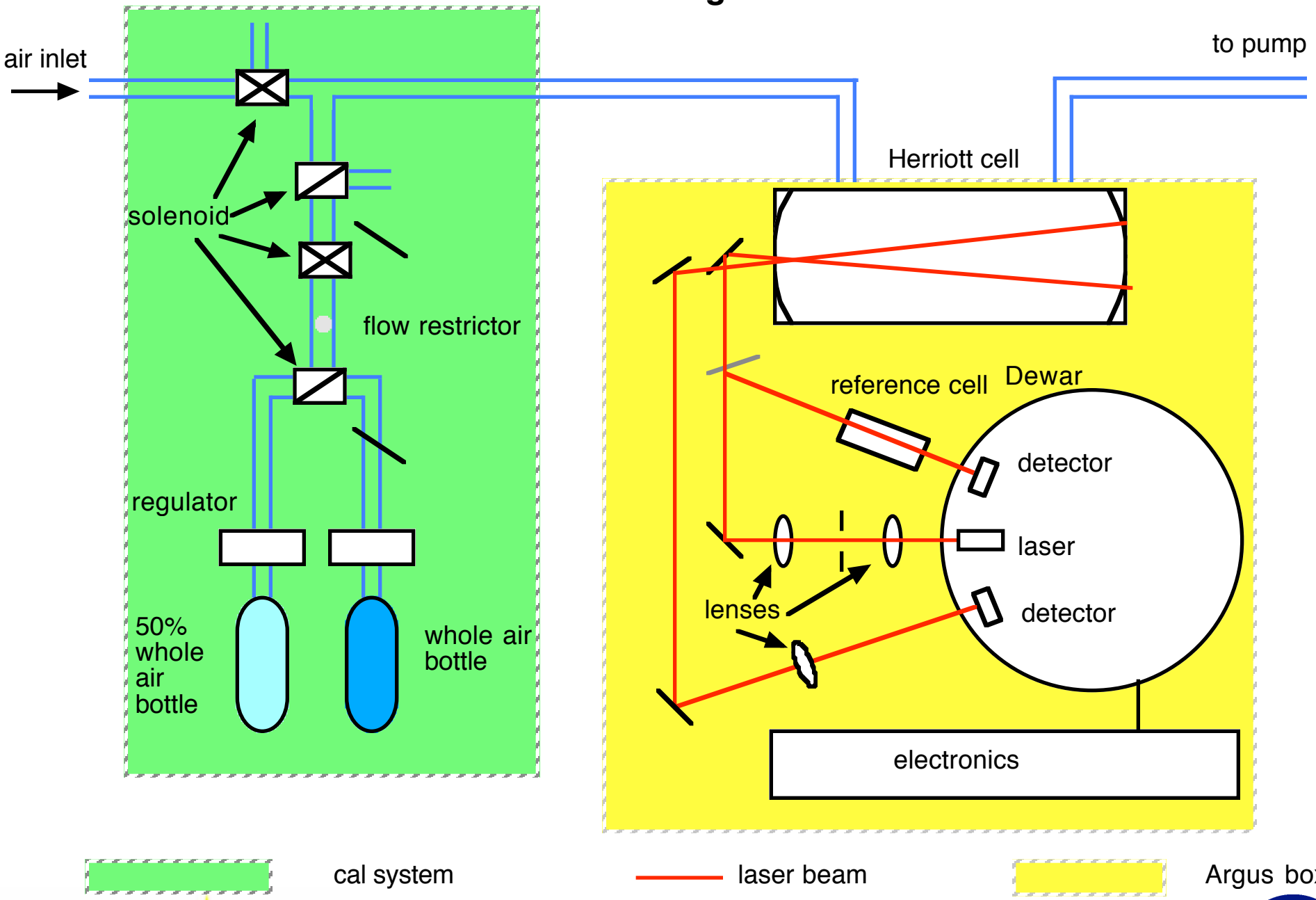
Argus Instrument



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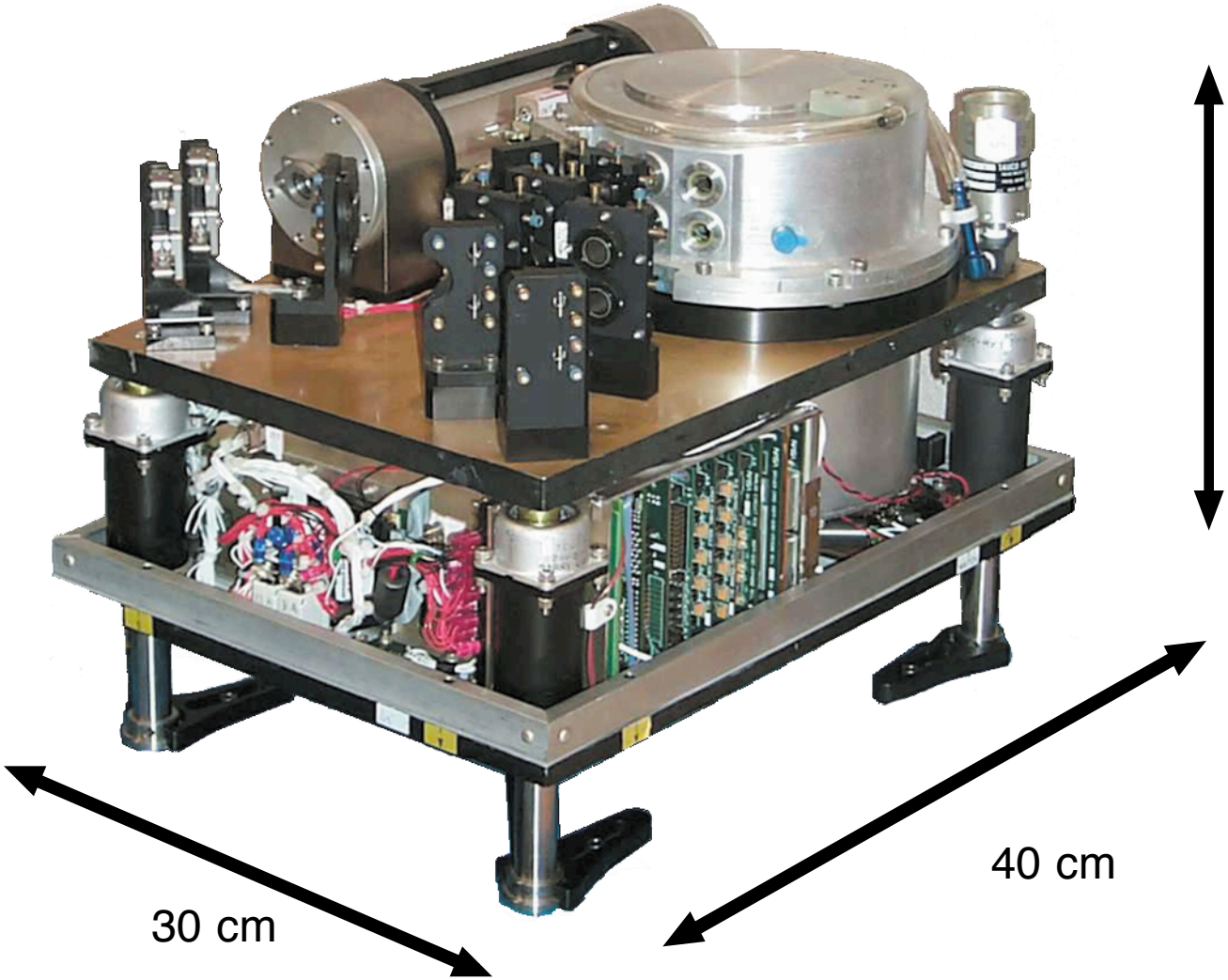
Argus Instrument



tunable diode laser

CO at 4.5 μm
CH_4 at 3.3 μm

multipass cell 36 m

20 kg

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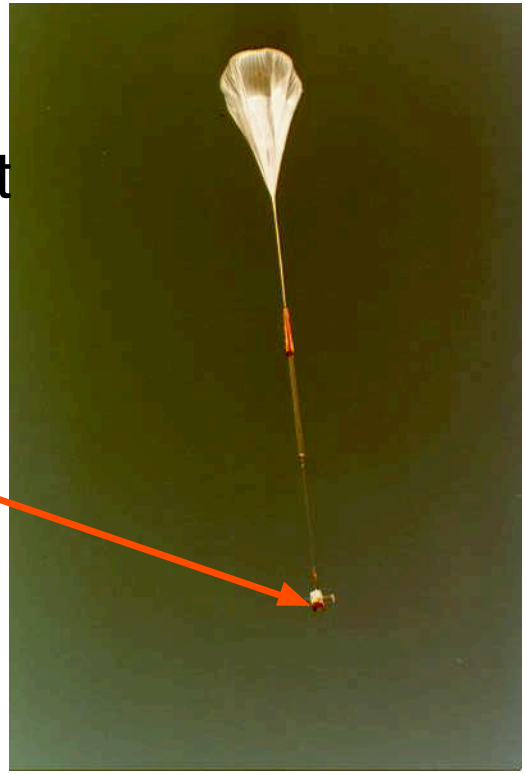
100 kft



8 hrs

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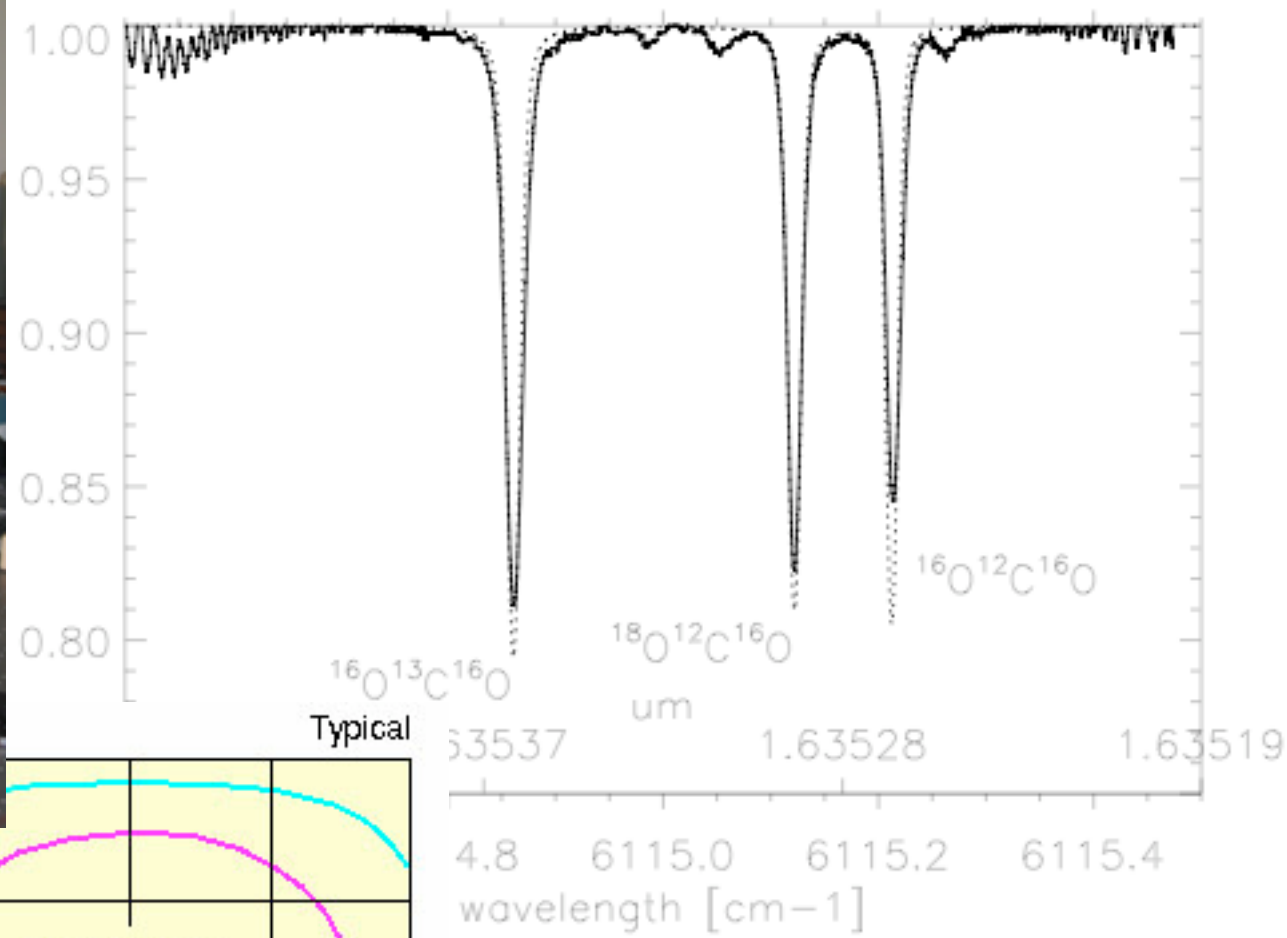
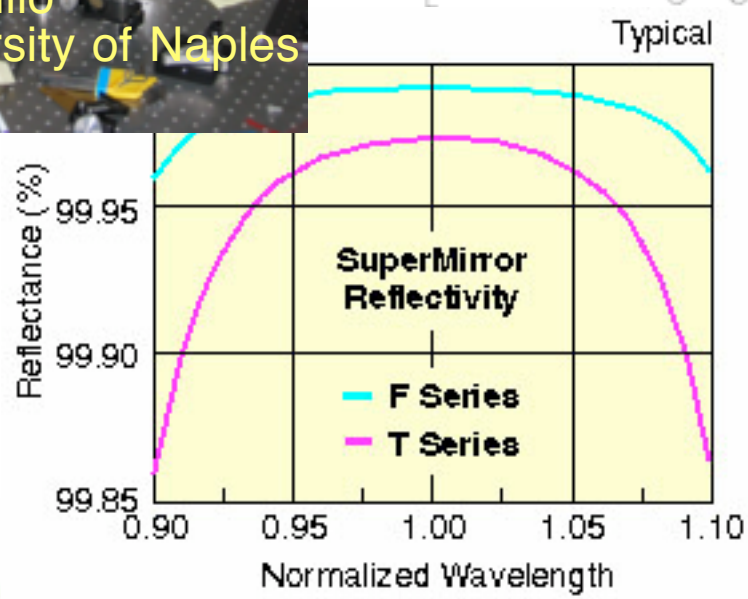
Carbon and Oxygen isotope measurements in CO_2





- 1.6 μm
- Off-Axis Integrated Cavity Output Spectroscopy (path length 3 km)
- simultaneous $\delta^{13}C$ and $\delta^{18}O$
- few per mil

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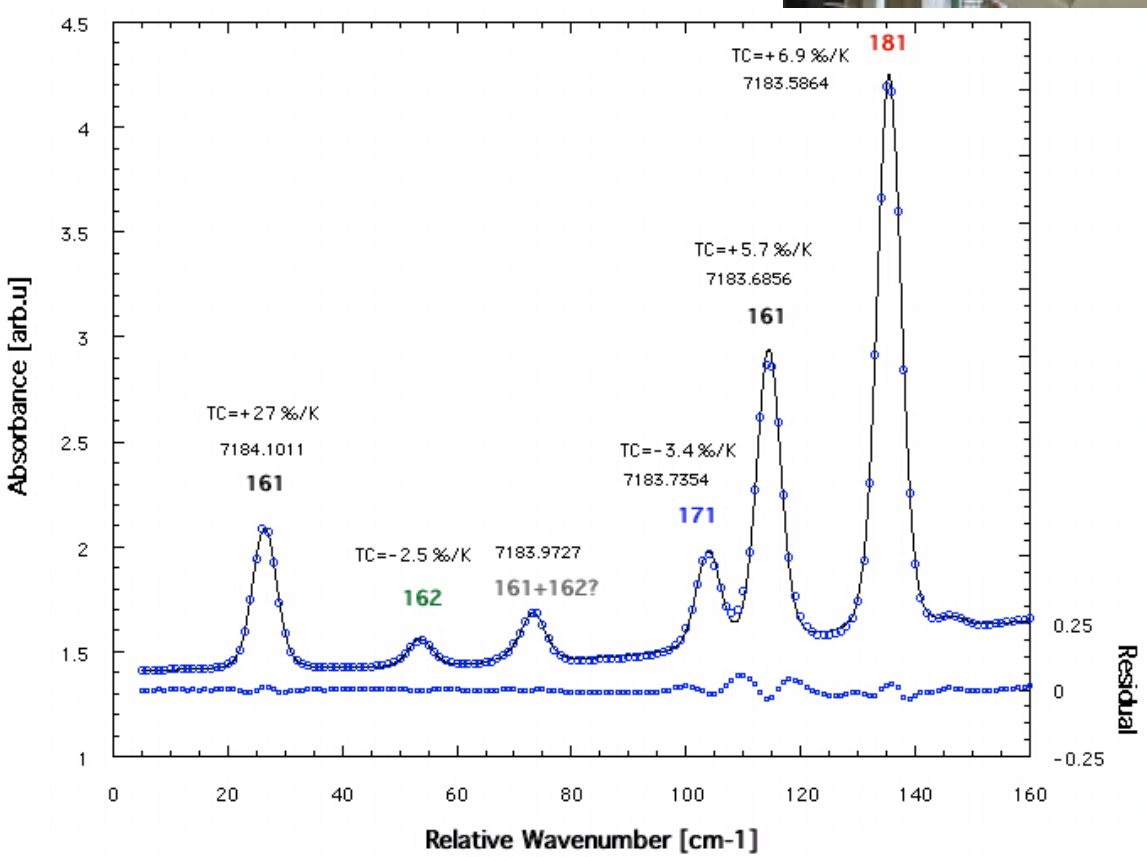
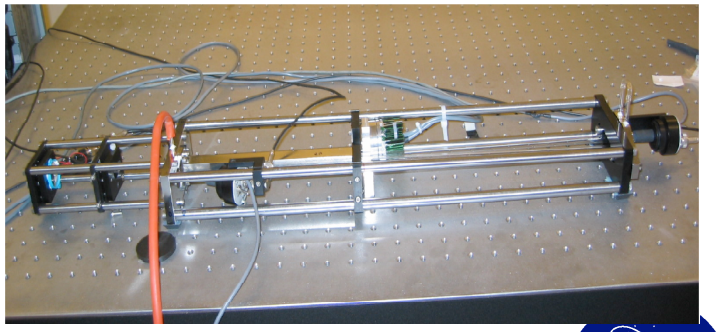
Water Isotope Ratio Measurements

- 1.4 μm
- optical feedback cavity enhanced spectroscopy
- simultaneous δD, δ17O, δ18O
- per mil precision





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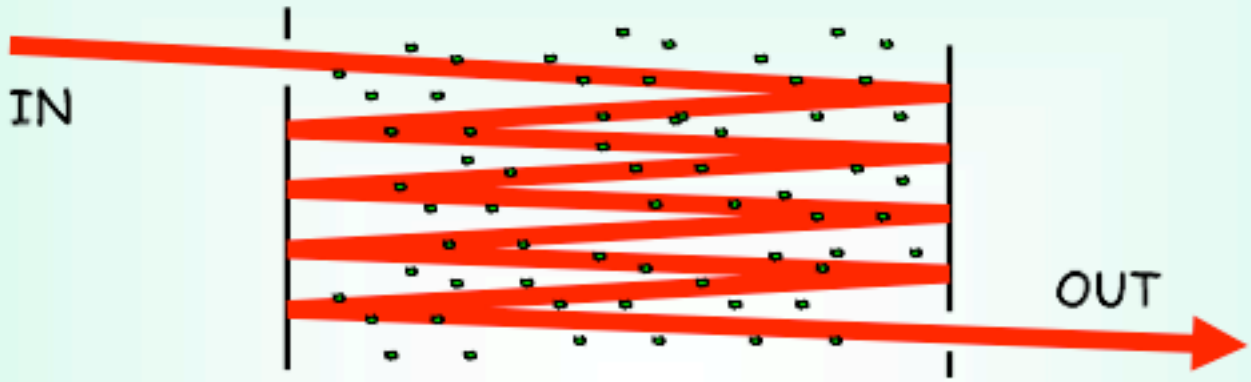
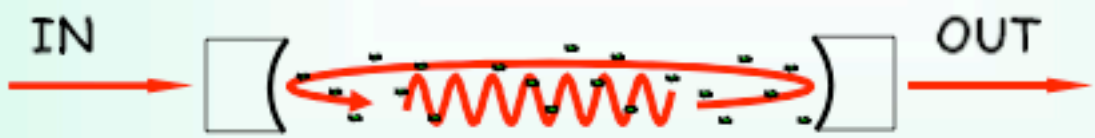
How to increase the absorption path...

Multi-pass cell (standard method)



Optical cavity (our solution)



R = 1-T- Losses ~ 99,999%

High finesse cavity : 100 x more passes + 100 x less volume !

(~10 ml volume -> very fast sample exchange time)

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courtesy D. Romanini

Near-IR sensitivity of OF-CEAS

Species	1Hz detection limit [ppb]	laser ? [nm]
Carbon dioxide CO_2	300	1600
Carbon monoxide CO	300	1566
H_2S	100	1600
Ethylene C_2H_4	50	1620
Methane, CH_4	1	1660
Ammonia, NH_3	2	1530
Water vapor H_2O	1	1390
Chloridric Acid HCl	1	1742
Fluoridric Acid HF	0.5	1312

courtesy D. Romanini

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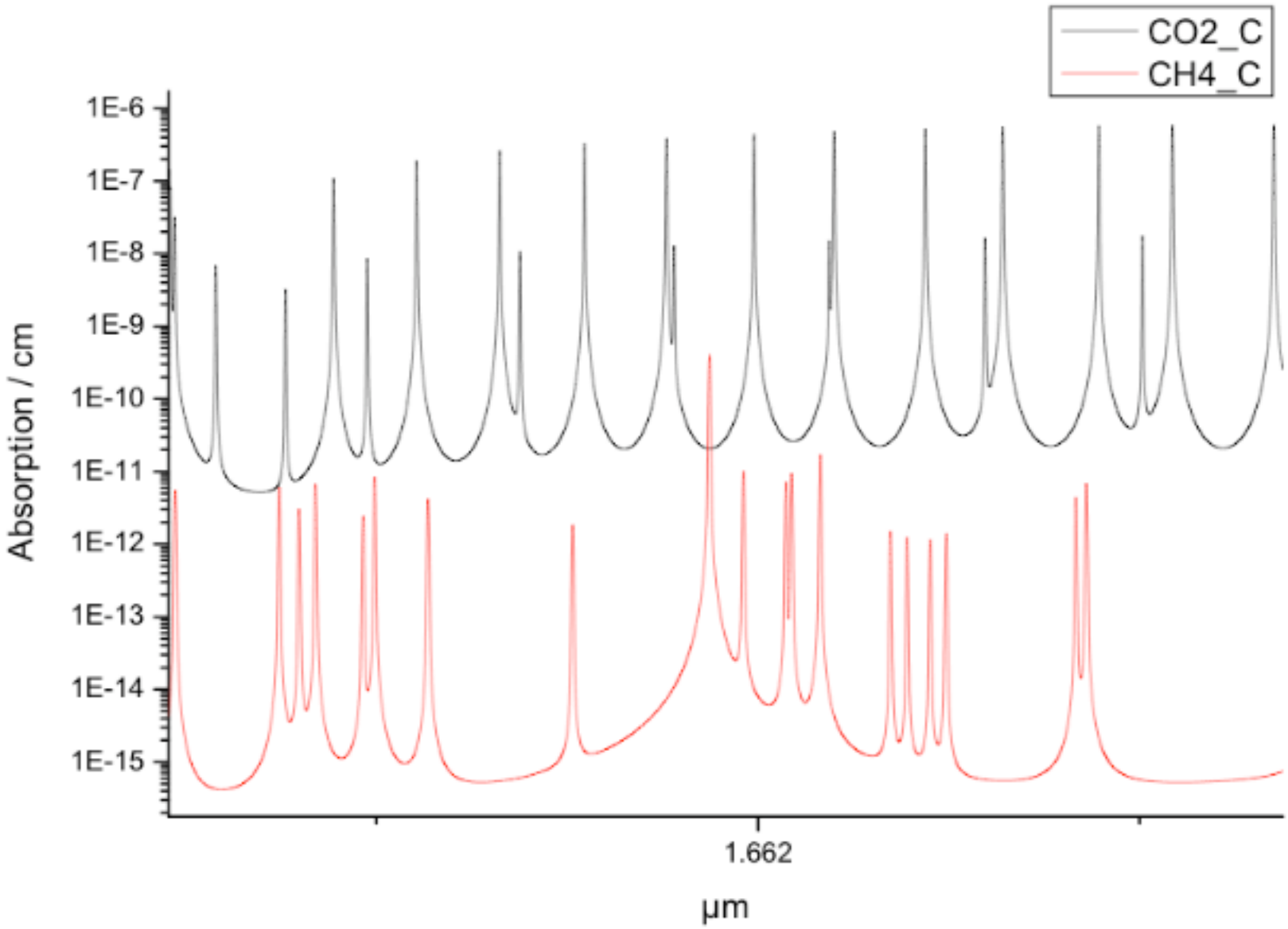
Near-IR sensitivity for Mars CH4



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What's next?

We would like to collaborate on instrument development for planetary atmosphere in-situ probes or where else our technology is applicable.

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