

Primary Spectrometric Thermometry for Gases

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Motivation

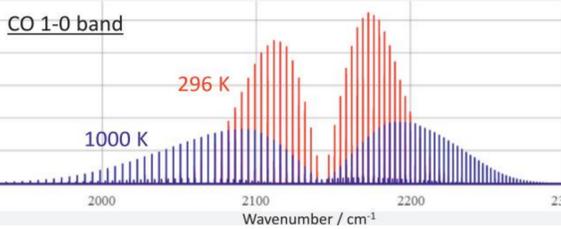
Challenges for contact thermometers for Gases

- 01 Large self-heating
- 02 Low heat capacity for gases
- 03 Sensitive to radiation
- 04 Bias up to 200 mK for PT100
- 05 Bias up to 600 mK for Radiosonde



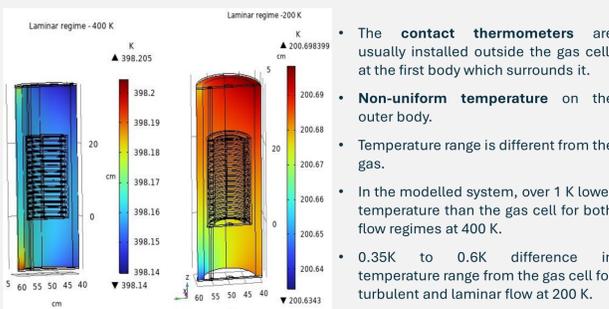
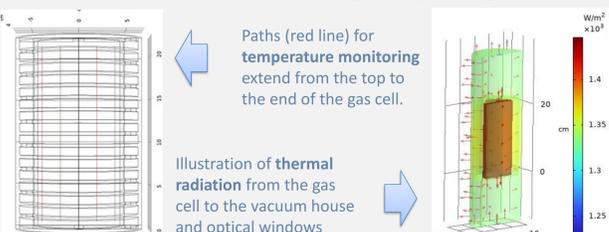
Temperature dependence of molecular line intensity

Rotational line intensity distribution of CO 1-0 band



Thermodynamic simulation

JV utilized Finite Element Method (FEM) to analyse the thermal behaviour of newly designed optical gas cell.



22IEM03 PriSpecTemp workpackage structure

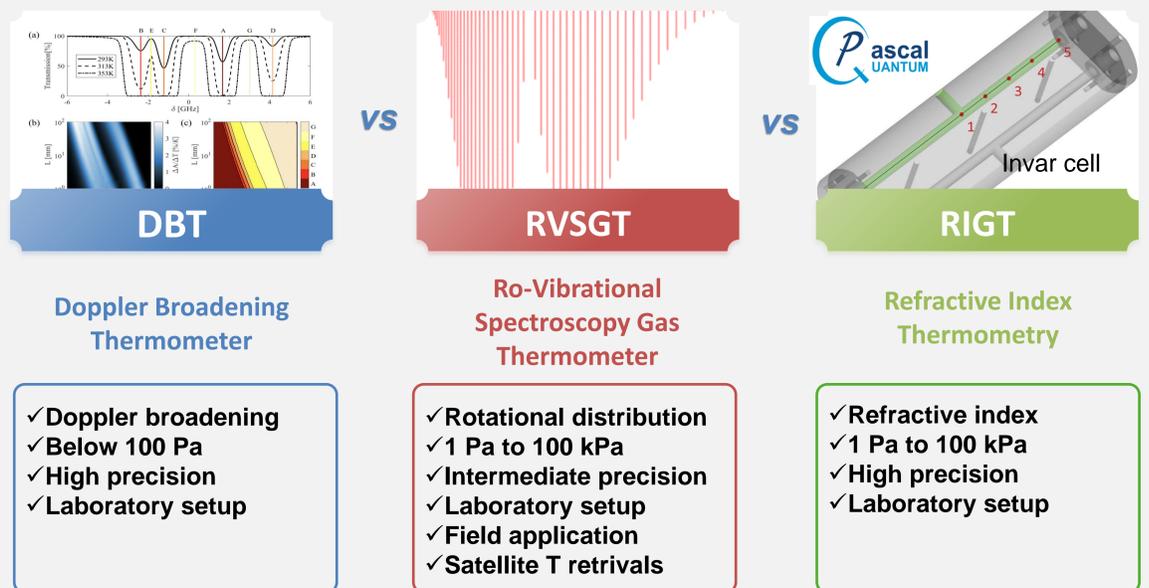


WP1 High accuracy spectral line data (CO, CO₂, O₂, up to 0.1% uncertainty) for spectrometric gas thermometry

WP2 Development of spectrometric gas thermometry at 200 K - 400 K with target uncertainty of 25 mK

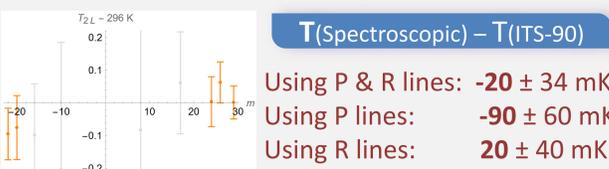
WP3 Metrological validation: cross-validation of RVS-GT, DBT, and RIGT with ITS-90

Comparison of the spectrometric gas thermometry



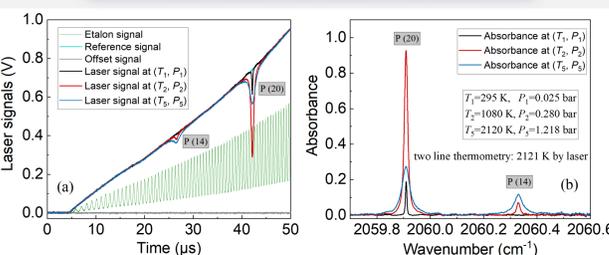
Multi-line gas thermometry

NCU measured line intensities of 10 lines from the CO (3-0) band with 0.8-1.1 ‰ standard uncertainties using the cavity mode dispersion spectroscopy (CMDS).



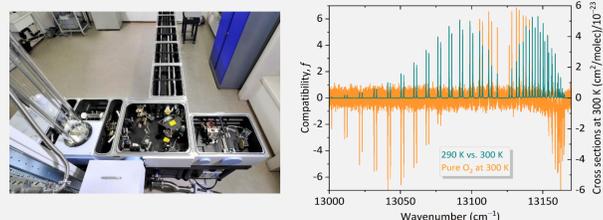
PTB measured line intensities of two lines from the CO (1-0) band at 295 K, 1080 K, and 2120 K.

MIR laser : 295 K vs. 1080 K vs. 2120 K

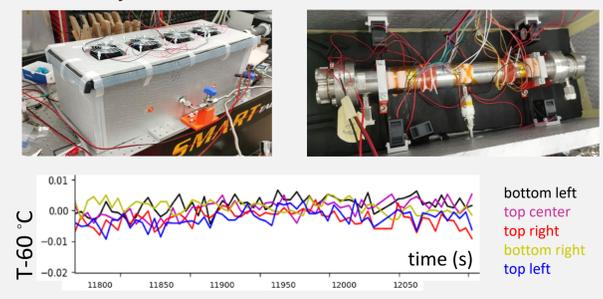


Rovibrational gas thermometry

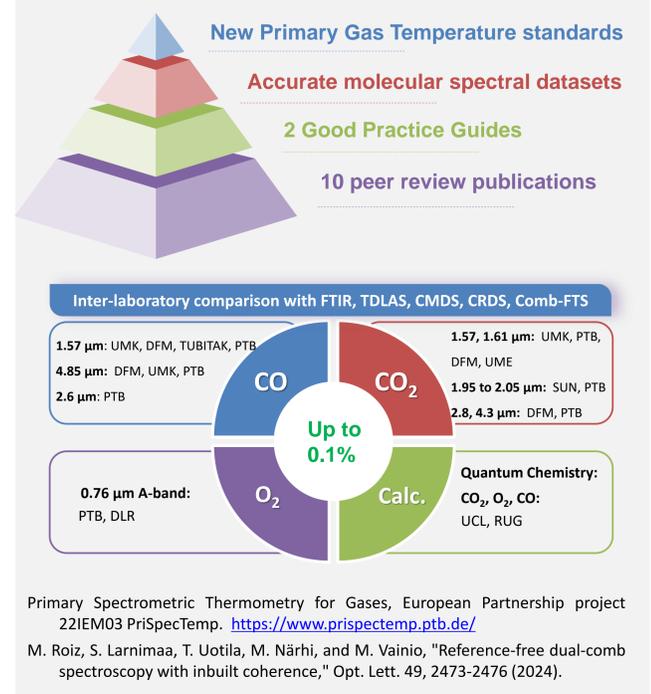
PTB measured a set of FTIR absorption spectra of neat oxygen at 300 K and 296 K.



NCU prepared a frequency Comb-based OPO spectrometer with a multi-pass cell temperature stabilized with 10 mK uncertainty to measure CO 1-0 band.



Outlook



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