P5124: Multispectrum Rotational states Distribution Thermometry

R. Gotti, T. Puppe, Y. Mayzlin, J. Robinson-Tait, S. Wójtewicz, D. Gatti, B. Alsaif, M. Lamperti, P. Laporta, F. Rohde, R. Wilk, P. Leisching, W.G. Kaenders and M. Marangoni

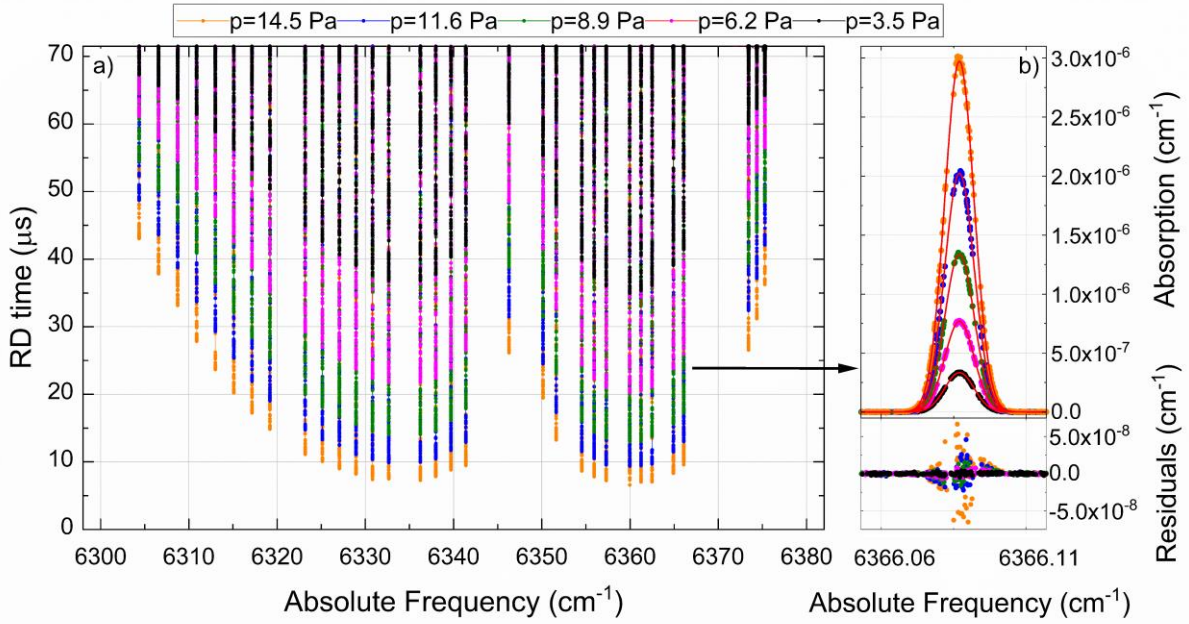
MRDT is a **primary thermometry technique** based on:

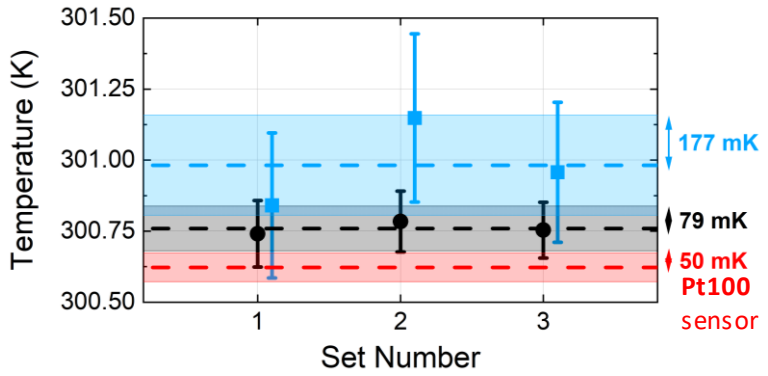
- the temperature-dependence of the **line-strengths** of multiple transitions;
- the inclusion of speed-dependent collisional effects in the fitting of the experimental spectra;
- a global fit routine over all transitions and pressures (strongly reducing the correlations between fitting parameters).

$$S_m(T) = S_m(T_{REF}) \frac{Q(T_{REF})}{Q(T)} \frac{\exp\left(\frac{-E''_m}{k_B T}\right)}{\exp\left(\frac{-E''_m}{k_B T_{REF}}\right)} \frac{1-\exp\left(\frac{-h\nu_{0m}}{k_B T}\right)}{1-\exp\left(\frac{-h\nu_{0m}}{k_B T_{REF}}\right)}$$

Fixed from accurate theoretical or experimental models

MRDT tested on ~3THz large CRDS spectra of $3\nu_1+\nu_3$ band of CO_2 around 1577nm (32 transitions selected for the global fitting)





Three independent sets

- **MRDT** precision is 2 times better than **DBT**.
- **MRDT** is less sensitive to the line-shape model used for the fitting of the spectra.

Different models for $S_m(T_{REF})$

- With the two most accurate models **MRDT** provided temperatures within 30 ppm.
- **MRDT** can be used as a testbed for intensity models when applied on a gas of well-known temperature.