Cavity-Assisted Velocity-selected Optical Double-resonance Spectroscopy of molecules with continuous-wave lasers

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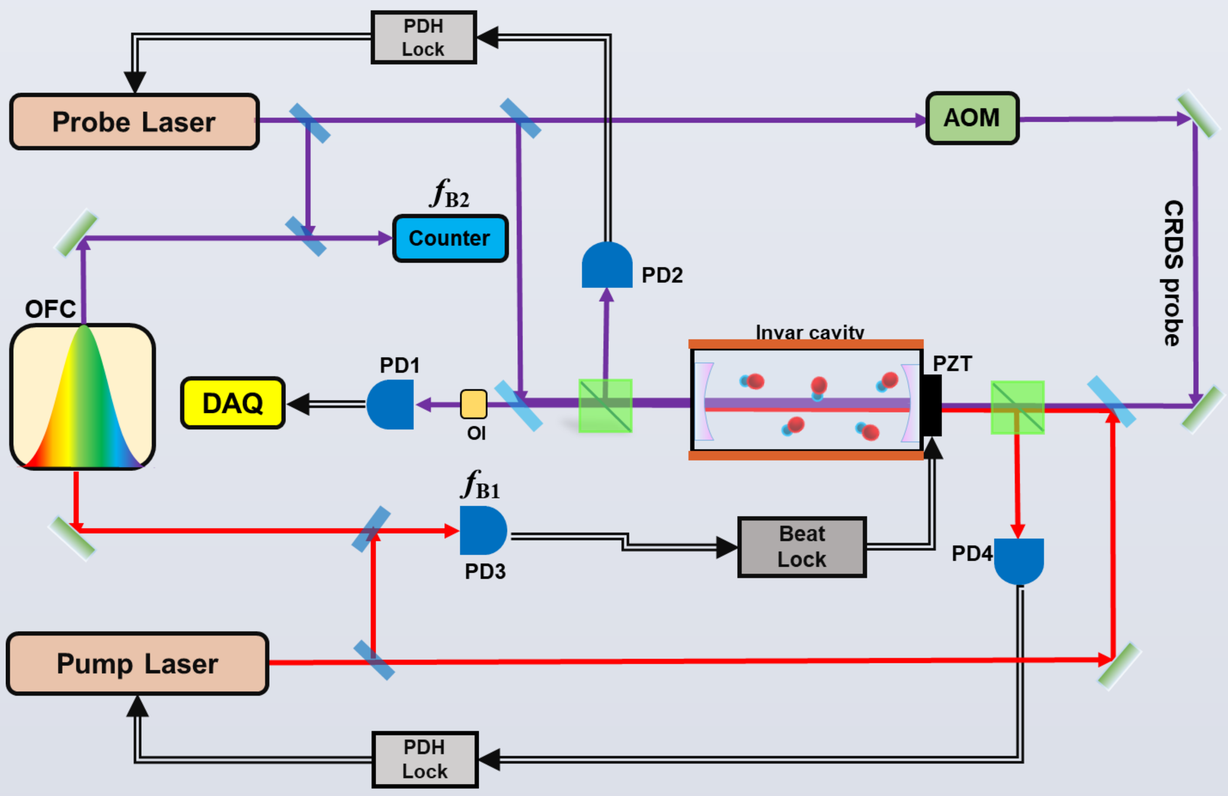
Abstract

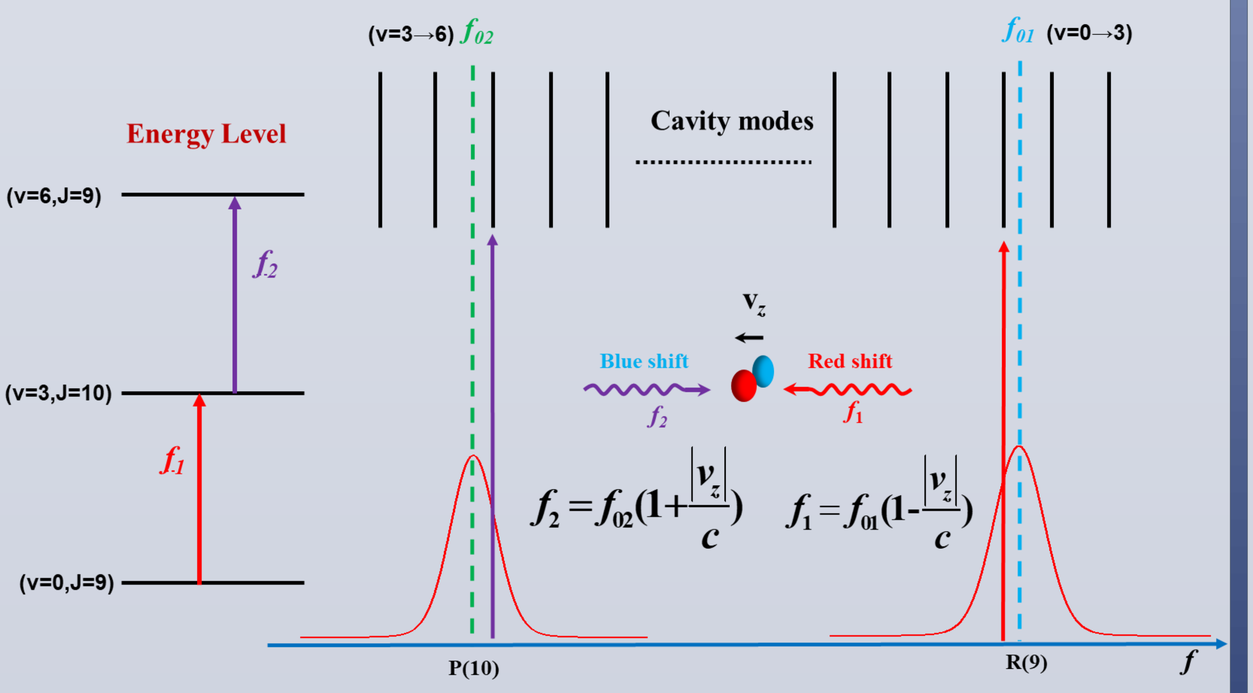
Double resonance spectroscopy was frequently used in study of dynamics and molecular spectroscopy, due to its high selectivity of transitions. Optical resonant cavities can be used to enhance the effective absorption path length, and the laser power inside the cavity as well to saturate very weak ro-vibrational transitions of molecules.

We combined double resonant absorption with cavity ring-down spectroscopy and got a high precision transition frequency of carbon monoxide molecule. The energy difference between the J = 9 levels in the ground and V = 6 states of CO was measured through double resonance using the (J = 10, V = 3) level as the intermediate level, and was determined to be 375 371 090 941.6kHz ±2 kHz ($\delta\nu / \nu = 4 \times 10^{-12}$).

Experimental setup



Schematic representation of the experiment



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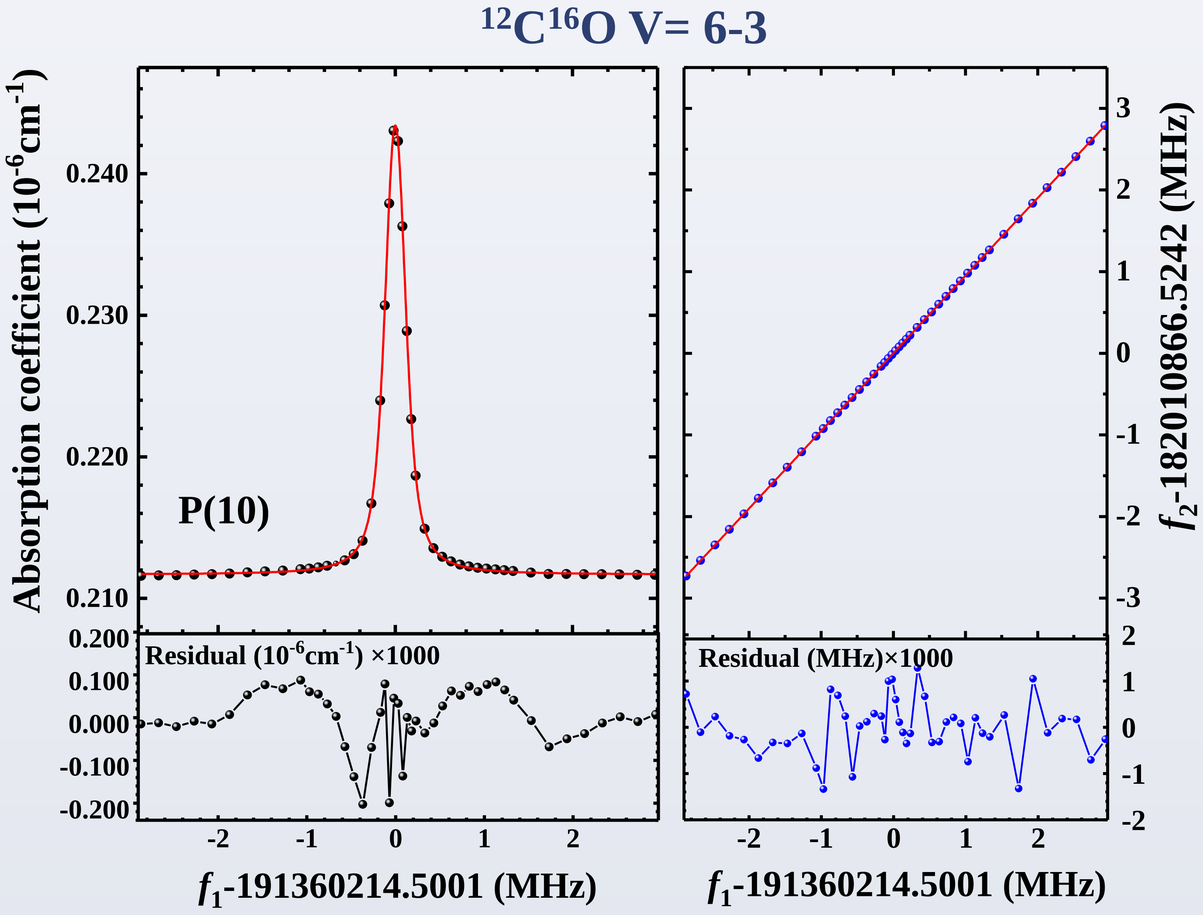
Results



Uncertainty Budget

Source of Error $P_{\{6-3\}}(10)$	Frequency (kHz)	Uncertainty (kHz,1σ)
Statistic		1.0
Frequency comb		0.4
Line asymmetric		1.5
Cavity locking servo		0.5
Recoil shift	-0.26	<0.01
Second Doppler shift	-0.5	<0.02
ULE drift	0.4	0.04
Total	182 010 878 178.2	1.9

References

[1] Wang, J, *et al. J. Chem. Phys.* 2017, 147: 091103.
[2] Karhu J, *et al. Optics express*, 2017, 25(5): 4688-4699.
[3] Tan Y, *et al. J. Quant. Spectrosc. Radiat. Trans.* , 2017, 187: 274-279.

Acknowledgement

NSFC National Natural Science Foundation of China

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