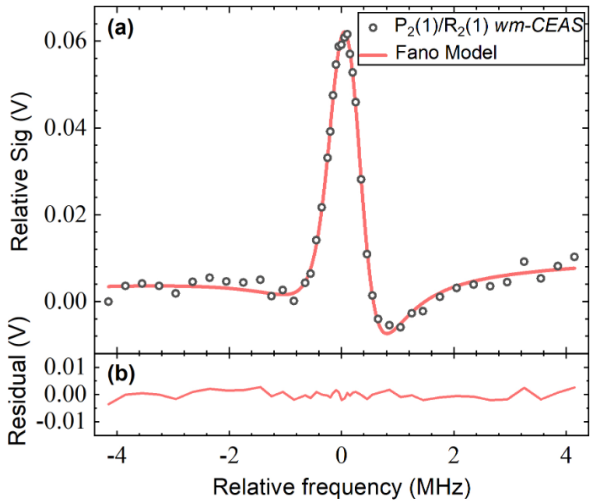
Cavity-enhanced double resonance spectroscopy of HD

Qian-Hao Liu,[1] Cun-Feng Cheng,[1,†] and Shui-Ming Hu[1,*]

[1] *Department of Chemical Physics, University of Science and Technology of China, Hefei 230026 China.*
[†]*cfcheng@ustc.edu.cn* **smhu@ustc.edu.cn*

Precision spectroscopy of molecular hydrogen and its isotopes, combined with accurate calculations, allows us to test the fundamental quantum chemistry theory and to determine the fundamental physical constants such as the proton-to-electron mass ratio[1,2]. In general, high overtone transitions may allow for measurements with a better fractional accuracy. However, direct measurement of high overtones, for example, the v = 4 − 0 one, turns out to be difficult because the transition moment is extremely small. It is possible to access the v = 4 state with two-photon spectroscopy, in which two-step excitation is involved.

Here we present the low-temperature comb-lock Cavity-enhanced system to determine highly-excited rotation-vibration energies of HD with high precision. As a demonstration, the V-type double resonance spectroscopy of HD is measured by pumping the P(1) (2 − 0) line and probing the R(1) line in the same overtone band[3]. In the future, we propose to use this method to determine the rotationless overtone band center (4-0) of HD. The DR method is feasible to determine the pure vibrational frequency $E_{v=4} - E_{v=0}$ (J = 0) with an accuracy of a few kHz, which allows for a test of the high-order ab initio calculation.



References

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