

# Free induction decay and field-free orientation of molecules induced by single-cycle THz pulses

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We investigate experimentally and theoretically the interaction between single-cycle terahertz (THz) pulses and molecules of different symmetry. The terahertz pulses are generated by focusing two-color femtosecond laser pulses in air and show a temporal shape close to a single-cycle pulse. We present two applications of the experimental apparatus. First, field-free orientation of the symmetric-top molecule CH<sub>3</sub>I is observed by focusing the THz pulses in a short gas cell and measuring the free induction decay (FID) with the electro-optical detection (EOD) technique. The degree of orientation is deduced from numerical simulations [1]. Secondly, we measured the FID of the asymmetric-top molecule H<sub>2</sub>O in atmospheric air with both EOD and terahertz field-induced second harmonic generation (TFISH) techniques [2]. Experimental results and simulated signals are compared directly in the time domain for short and long propagation length, leading to a good agreement between them in both cases (see Fig.1). Finally, we discuss the advantages/disadvantages of the two experimental techniques.

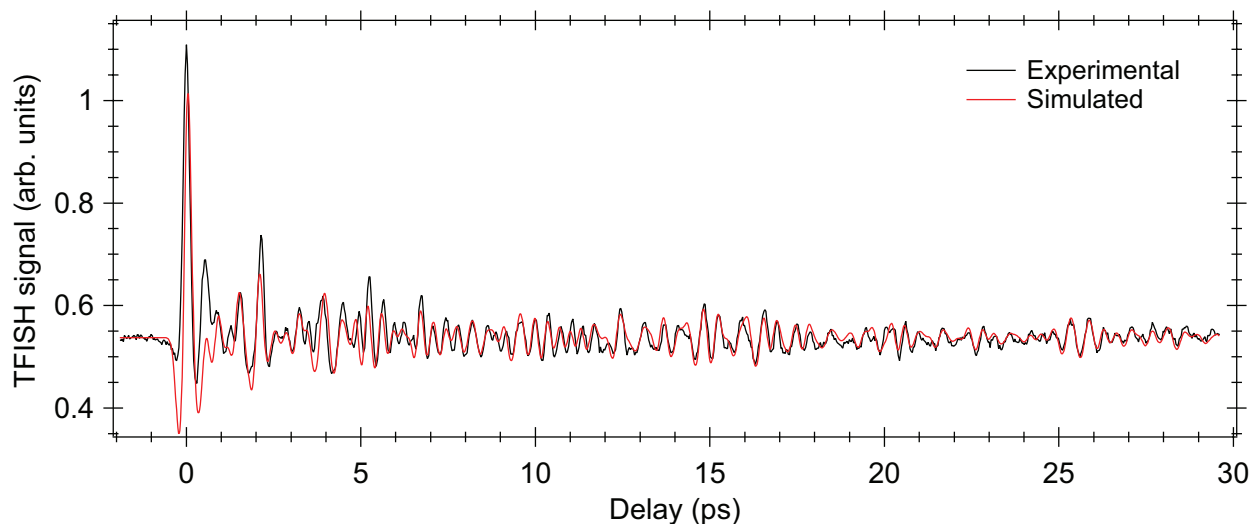


Fig.1. Free induction decay in water molecules of atmospheric air measured with terahertz field-induced second harmonic generation

## References

- [1] P. Babilotte, K. Hamraoui, F. Billard, E. Hertz, B. Lavorel, O. Faucher, and D. Sugny, *Phys. Rev. A* **94** (2016) 043403
- [2] P. Babilotte, L. H. Coudert, F. Billard, E. Hertz, O. Faucher, and B. Lavorel, *Submitted to Phys. Rev. A*