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Title:Understanding THz pulse propagation in the atmosphere

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Abstract:In this paper, we have extracted the THz refractivity of water vapor ($n(\omega)-1$) from the complex spectra of the precise coherent THz-TDS absorption measurement with a 6.18 m long sample path . We fit the new refractivity and the previous absorption measurements to the sum of the contributions from all of the water vapor lines (with the same van-Vleck Weisskopf lineshape) in the JPL, Pasadena, CA, database from 0 to 10 THz. The precision of the resulting theoretical absorption and refractivity is demonstrated by the good agreement between the calculated THz output pulse and the measured output pulse, both having the same THz input pulse. Using this capability, we have calculated the transmitted THz pulses through the atmosphere at specified humidity and temperature for a variety of input pulses for the distances of 500, 1000, and 2000 m. We have also tested the predicted stable propagation of the proposed "ideal THz bit pulse" [2], and showed that this pulse evolves into two overlapping pulses after 2000 m of propagation. We showed these two new pulses I and II to be transform-limited THz bit pulses with stable propagation to 2000 m. THz bit pulses I and II span the spectral ranges of 0.13-0.18 THz and 0.18-0.33 THz, respectively, and can support the bit rate distance products of 20 and 40 (Gb/s) km, respectively. © 2012 IEEE.

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Main heading:Terahertz spectroscopy

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