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Creating optical waveguides in air using ultrashort laser pulses

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We show that intense ultrashort optical pulses can be used to create optical waveguides in the air [1]. By harnessing the acoustic and thermal response of the gas to the nonlinear deposition of energy by the laser beam, we have created optical waveguides with lifetimes of milliseconds. We have used these to guide high average power laser beams and to collect and guide fluorescence, useful in many remote sensing schemes [2]. We find that two-photon rotational absorption is an important channel for energy deposition by ultrashort pulses in air and, using quantum control of molecular rotational states, we have shown that this rotational absorption can be greatly enhanced [3]. [1] N. Jhajj, E. W. Rosenthal, R. Birnbaum, J. K. Wahlstrand, and H. M. Milchberg, Phys. Rev. X 4, 011027 (2014). [2] E. W. Rosenthal, N. Jhajj, J. K. Wahlstrand, and H. M. Milchberg, Optica 1, 5 (2014). [3] S. Zahedpour, J. K. Wahlstrand, and H. M. Milchberg, Phys. Rev. Lett. 112, 143601 (2014).

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