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**Trapping and destruction of long range high intensity optical/plasma filaments by molecular quantum wakes in air**[1]

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The propagation of few millijoule femtosecond laser pulses through gases routinely drives a large nonlinear response in the constituent atoms and molecules. This response is central to the extremely long range filamentary propagation of ultrashort optical pulses in the atmosphere [1]. Long range filaments are accompanied by plasma generation and co-propagating coherent white light generation. A femtosecond laser pulse can also drive gas molecules into alignment [2], even in thermal samples at high pressure [3]. The beating of quantum rotational wavepackets excited in each molecule causes alignment to recur at regular intervals well after the pulse. The recurrent alignment propagates behind the laser pulse as a refractive index wake. Here, we demonstrate that the alignment quantum wake inside a pump pulse filament dramatically affects an intense probe pulse filament [4]. We find, depending on femtosecond timescale delays, that wake either transversely pulls and focuses the probe filament into the pump filament path, or destroys it. We also confirm that for pulse lengths >50 fs, the dominant air nonlinearity in single pulse filamentation is rotational. Probe filament spectral measurements are also consistent with quantum wake trapping. Our results demonstrate that long range filamentary propagation can be controlled by exploiting the coherent temporal and spatial response of air molecules. [1] A. Couairon and A. Mysyrowicz. Physics Reports 441, 47 (2007) and references therein. [2] H. Stapelfeldt and T. Seideman, Rev. Mod. Phys. 75, 543 (2003). [3] Y.-H. Chen, S. Varma, A. York, and H.M. Milchberg, Opt. Express 15, 11341 (2007) [4] S. Varma, Y.-H. Chen, and H.M. Milchberg, submitted for publication.

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