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Superradiant light source for atmospheric remote sensing DMITRI VORONINE, ANDREW TRAVERSO, RODRIGO SANCHEZ-GONZALEZ, LUQI YUAN, MICHAEL GRUBB, KAI WANG, ALEXEI ZHELTIKOV, Texas A&M University, College Station, TX 77843, ARTHUR DOGARIU, JAMES MICHAEL, RICHARD MILES, Princeton University, Princeton, NJ 08544, YURI ROSTOVTSEV, University of North Texas, Denton, TX 76203, VLADIMIR SAUTENKOV, ALEXEI SOKOLOV, SIMON NORTH, MARLAN SCULLY, Texas A&M University, College Station, TX 77843 — We have studied coherent emission from ambient air and demonstrated efficient generation of laser-like beams directed both forward and backward with respect to a nanosecond ultraviolet pumping laser beam. The generated optical gain is a result of two-photon photolysis of atmospheric O2, followed by two-photon excitation of atomic oxygen. We have analyzed the temporal shapes of the emitted pulses and have thereby shown that a large atomic coherence may well be responsible for the observed temporal structures. Our results suggest that the emission process is coherence brightened in its nature, and is to be compared with ordinary lasing where atomic coherence remains small on the one hand and cooperative Dicke superradiance where atomic coherence is maximized on the other. The collective coherence in this process adds insight as to the optical emission physics. The present superradiant source holds promise for remote sensing techniques employing nonlinear spectroscopy.

Dmitri Voronine
Texas A&M University, College Station, TX 77843

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