244
Accession number:20120614751349
Title:Advances in intense femtosecond laser filamentation in air
Authors:Chin, S.L. (1); Wang, T.-J. (1); Marceau, C. (1); Wu, J. (2); Liu, J.S. (3); Kosareva, O. (4); Panov, N. (4); Chen, Y.P. (1); Daigle, J.-F. (1); Yuan, S. (1); Azarm, A. (1); Liu, W.W. (5); Seideman, T. (6); Zeng, H.P. (2); Richardson, M. (7); Li, R. (3); Xu, Z.Z. (3)
Author affiliation:(1) Center for Optics, Photonics and Laser (COPL), Laval University, Quebec City, QC G1 V 0A6, Canada; (2) State Key Laboratory of Precision Spectroscopy, East China Normal University, Shanghai 200062, China; (3) Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences, Jiading, Shanghai, China; (4) International Laser Center, Dept. of Physics, Moscow State University, Moscow, Russia; (5) Institute of Modern Optics, Nankai University, Tianjin, China; (6) Department of Chemistry, Northwestern University, 2145 Sheridan Road, Evanston, IL 60208-3113, United States; (7) Townes Laser Institute, CREOL College of Optics and Photonics, University of Central Florida, Orlando, FL, United States
Corresponding author:Chin, S.L.
Source title:Laser Physics
Abbreviated source title:Laser Phys.
Volume:22
Issue:1
Issue date:January 2012
Publication year:2012
Pages:1-53
Language:English
ISSN:1054660X
E-ISSN:15556611
Document type:Journal article (JA)
Publisher:Maik Nauka-Interperiodica Publishing, Profsoyuznaya Ul 90, Moscow, 117997, Russia
Abstract:This is a review of some recent development in femtosecond filamentation science with emphasis on our collective work. Previously reviewed work in the field will not be discussed. We thus start with a very brief description of the fundamental physics of single filamentation of powerful femtosecond laser pulses in air. Intensity clamping is emphasized. One consequence is that the peak intensity inside one or more filaments would not increase significantly even if one focuses the pulse at very high peak power even up to the peta-watt level. Another is that the clamped intensity is independent of pressure. One interesting outcome of the high intensity inside a filament is filament fusion which comes from the nonlinear change of index of refraction inside the filament leading to cross beam focusing. Because of the high intensity inside the filament, one can envisage nonlinear phenomena taking place inside a filament such as a new type of Raman red shift and the generation of very broad band supercontinuum into the infrared through four-wave-mixing. This is what we call by filamentation nonlinear optics. It includes also terahertz generation from inside the filament. The latter is discussed separately because of its special importance to those working in the field of safety and security in recent years. When the filamenting pulse is linearly polarized, the isotropic nature of air becomes birefringent both electronically (instantaneous) and through molecular wave packet rotation and revival (delayed). Such birefringence is discussed in detailed. Because, in principle, a filament can be projected to a

long distance in air, applications to pollution measurement as well as other atmospheric science could be earned out. We call this filamentation atmospheric science. Thus, the following subjects are discussed briefly, namely, lightning control, rain making, remote measurement of electric field, microwave guidance and remote sensing of pollutants. A discussion on the higher order Kerr effect on the physics of filamentation is also given. This is a new hot subject of current debate. This review ends on giving our view of the prospect of progress of this field of filamentation in the future. We believe it hinges upon the development of the laser technology based upon the physical understanding of filamentation and on the reduction in price of the laser system. © 2012 Pleiades Publishing, Ltd.
Number of references:272
Main heading:Ultrashort pulses
Controlled terms:Birefringence - Four wave mixing - Pollution - Refractive index - Remote sensing - Supercontinuum generation - Ultrafast lasers
Uncontrolled terms:Atmospheric science - Beam focusing - Broad bands - Femtosecond filamentation - Femtosecond laser filamentation - Filamentation - Fundamental physics - High intensity - High peak power - Higher order - Index of refraction - Laser systems - Laser technologies - Lightning control - Linearly polarized - Long distances - Molecular wave packets - Non-linear phenomena - Nonlinear changes - Peak intensity - Pollution measurement - Red shift - Remote measurement - Supercontinuum - Terahertz generation
Classification code:454.2 Environmental Impact and Protection - 731.1 Control Systems - 741.1 Light/Optics - 741.1.1 Nonlinear Optics - 744.1 Lasers, General
DOI:10.1134/S1054660X11190054
Database:Compendex