Daniele Faccio

UNIVERSITY OF INSUBRIA

Printable Version

Contact data

Assistant Professor
Department of Physics and Mathematics
University of Insubria
Via Valleggio 11
22100 Como
Tel: 031 2386221
Fax: 031 2386209
E-mail: daniele.faccio@uninsubria.it

Biography

Born in 1973, London, UK, I moved to Italy at the age of 12. After graduating at the scientific high school, I studied Physics at the University of Milan. During these years of study I developed a passion for mountaineering that eventually led me to participate in 1998 to an expedition to climb Cho Oyu (8201 mt) in Tibet. After two year in UK at the ORC researching on novel devices for telecomm systems, I moved back to Italy where I have been since then. In 2003 I had the possibility to work at MIT, Boston, with Prof. H. Haus within the framework of a project financed by Pirelli Labs on nanostructured telecomm devices. At my return I was appointed a permanent position as Researcher at the University of Insubria.

Qualifications and awards

2001: Mphil – Optoelectronics Research Center (ORC), Southampton University, UK.

1998: Physics degree, 110/110 cum laude, University of Milan, Italy

Research interests

Nonlinear Optics, optical pulse filamentation, telecomm devices and nanostructured materials.

Laser pulse filamentation and conical waves: Since the invention of the laser in the early '60s, light filamentation and in general optical wave collapse in nonlinear media have attracted much interest. This is partly due to the implications for damage control in optical materials but also to the possibility to verify the validity of certain equations (in particular the nonlinear Schrodinger equation) and assumptions that have applications in many other important fields of physics such as Langmuir waves in plasmas and Bose-Einstein condensates.

The nonlinear optical processes group in Como is actively working in this area in close collaboration with other research groups. In particular we have a long-standing collaboration with Vilnius and Pavia University. This "enlarged" research group is consistently trying to re-interpret much of the physics related to optical wave collapse by abbandoning the classically used quantities such as frequency or spatial spectrum, group velocity, spatial profile etc. These are either purely spatial or purely temporal quantities and, in the presence of strong space-time coupling, should be substituted with more general concepts such as, for example, the k-w spectrum or the full x-y-z-t profiles.

This reasoning has led to the introduction of conical waves as the paradigm for the interpretation of the complicated pulse shapes that arise from the interplay of self-phase modulation, wave collapse, plasma generation and other nonlinear effects. In normal dispersion the pulse shape reflects the underlying hyperbolic modulational instability (MI) gain profile and we find nonlinear X-waves. In anomalous dispersion the MI gain space-time profile is elliptic and we find what we have called O-waves. Current research is aimed at describing the physical processes in terms of X, O and, in general, Bessel-like beams.

PBG's and telecomm devices: Photonic bandgap (PBG) materials have many exotic and exciting properties and through these, much has been learned about fundamental physical concepts concerning materials or systems that have a well defined periodicity. The Bloch theorem has many profound consequences, in particular, the formation of certain eigenstates that have the same wave-vector but are localized mainly in the high density (high refractive index) layers or in the low density layers. These two states will thus have different energies and a band gap will form, i.e. a frequency region for which light transmission is forbidden. Real systems have a finite length so that laser pulses with frequency in the PBG will be reflected.

However frequencies very near the band-edge, although transmitted, suffer from severe phase and group velocity modification and a large mode density enhancement. All these effects may be employed to enhance processes such as lasing or nonlinear ferquency conversion. Much study has been carried out in this sense - our contribution is the formulation of a theory based on Bloch modes that allowed us to pin-point a new quasi-phase matching mechanism that may be applied to materials that are otherwise very difficult to engineer, such as AlGaAs.

Note also that a perfectly periodic structure is a particular extreme case of the larger group of completely random systems. Although there are fundamental differences between solidstate physics and optics, Anderson localization of waves has been demonstrated in both systems. Currently we are investigating Anderson localization as a possibility for obtaining efficient nonlinear frequency conversion.

Teaching experience and appointments

Second year physics lab course: Michelson interferometer, prism spectrometer, Hertz experiment for em wave generation, measurement of e/m, Zeeman effect, signal transmission in air and optical fibers, optical ray tracing (numerical), chaotic systems (numerical)

Fourth year Optoelectronics course: the course covers topics ranging from basic em waveguide theory, integrated lasers, optical filters, nanostructured materials, PBG's to optical fiber solitons.

Representative publications

2005

1. Localization of light and second-order nonlinearity enhancement in

weakly-disordered one-dimensional photonic crystals, D. Faccio and F. Bragheri, Phys. Rev. E, 22, p.057602 (2005)

2. Far-field spectral characterization of conical emission and filamentation in Kerr media, D. Faccio, P. Di Trapani, S. Minardi, A. Bramati, F. Bragheri, C. Liberale, V. Degiorgio, , JOSA B, 22(4), pp.862-869 (2005)

3. Near and Far-Field evolution of laser pulse filaments in Kerr media, D. Faccio, A. Matijosius, A. Dubietis, R. Piskarkas, A. Varanavicius, E. Gaizauskas, A. Piskarkas, A. Couairon and P. Di Trapani, Phys. Rev. E, 72, pp. 037601-4

4. Time-Gated Spectral characterization of ultrashort laser pulses, F. Bragheri, C. Liberale, V. Degiorgio, D. Faccio, A. Matijosius, G. Tamosauskas, A. Varanavicius, P. Di Trapani, Opt. Commun

5. From X- to O-shaped spatiotemporal spectra of light filaments in water, M. Porras, A. Dubietis, E. Kucinskas, F. Bragheri, A. Couairon, D. Faccio, P. Di Trapani, Opt. Lett.

6. High localization, focal depth and contrast by means of nonlinear Bessel Beams, P. Polesana, D. Faccio, P. Di Trapani, A. Dubietis, A. Piskarskas, A. Couairon, M. Porras, Opt. Express, 13(16), pp. 6160-6167

7. Nonlinear X-wave formation by femtosecond filamentation in Kerr media, A. Couairon, E. Gaizauskas, D. Faccio, A. Dubietis, P. Di Trapani, PRE

2004

1. Effects of random and systematic peturbations in a one dimensional photonic crystal wavelength converter, F. Bragheri, D. Faccio, M. Romagnoli, T. Krauss, J. Roberts, Phys. Rev. E, 70, p. 017601 (2004)

2. Optical Bloch mode induced quasi phase matching of quadratic interactions, D. Faccio, F. Bragheri, M. Cherchi, J. Opt. Soc. Am. B, 21 (2), p. 296 (2004)

3. Nonlinear unbalanced Bessel beams: Stationary conical waves supported by nonlinear losses, M. Porras, A. Parola, D. Faccio, A. Dubietis, P. Di Trapani, Phys. Rev. Lett. 93(15), p. 153902-1 (2004)

4. Optical Bloch mode induced quasi phase matching of quadratic interactions, D. Faccio, F. Bragheri, M. Cherchi, Virtual J. Nanoscale Sci. Technol., 9(9) (2004)

5. Effects of random and systematic peturbations in a one dimensional photonic crystal wavelength converter, F. Bragheri, D. Faccio, M. Romagnoli, T. Krauss, J. Roberts, Virtual J. Nanoscale Sci. Technol. (2004)

2003

1. Electro-optic dynamics in thermally poled Ge core doped silica fiber, A. Busacca, D. Faccio, Electron. Lett., 39(1), p.28 (2003)

2. Phase matched nonlinear interactions in a holey fiber starting from the super continuum generation by infrared pulses, L. Tartara, I. Cristiani, V. Degiorgio, F. Carbone, D. Faccio, Opt. Commun., 215, p191 (2003)

2002

1. Nonlinear propagation of ultrashort laser pulses in a microstructured fiber, L. Tartara, I. Cristiani, V. Degiorgio, F. Carbone, D. Faccio, M. Romagnoli, J. Nonlin. Opt. Phys. Mat., 11(4), pp. 409-419 (2002)

2001

1. Broad-band second harmonic generation in holey optical fibers, T.M. Monro, V. Pruneri, N.G.R. Broderick, D. Faccio, P.G. Kazansky, D.J. Richardson, IEEE Photon. Tech. Lett., 13(9), p. 981 (2001)

2. Thermally poled silica samples are structurally heterogeneous: electron diffraction evidence of partial crystallization, C. Cabrillo, F.J. Barmejo, J.M. Gibson, J.A. Johnson, D. Faccio, V. Pruneri, P.G. Kazanasky, Appl. Phys. Lett., 78(14), p.1991 (2001)

3. Demonstration of thermal poling in holey fibres, D. Faccio, A. Busacca, W. Belardi, V. Pruneri, P.G. Kazanasky, T.M. Monro, D.J. Richardson, B. Grappe, M. Cooper, C.N. Pannell, Electron. Lett., 37(2), p. 107 (2001)

4. Dynamics of the second order nonlinearity in thermally poled silica glass, D. Faccio, V. Pruneri, P.G. Kazansky, Appl. Phys. Lett., 79(17), p. 2687 (2001)

2000

1. Noncollinear Makers Fringe measurements of second order nonlinear layers, D. Faccio, V. Pruneri, P.G. Kazansky, Opt. Lett., 25 (18), pp. 1376-1378 (2000)

1998

1. Measurement of the third order nonlinear susceptibility of Ag nanoparticles in glass in a wide spectral range, D. Faccio, P. Di Trapani, E. Borsella, F. Gonella, P. Mazzoldi, A.M. Malvezzi, Europhys. Lett., 43(2), pp. 213-218 (1998)