

1. Record Nr.	UNINA9910688495803321
Titolo	Guided-wave ptpics / / edited by Boris Malomed
Pubbl/distr/stampa	Basel, Switzerland : , : MDPI, , 2017
ISBN	3-03842-615-6
Descrizione fisica	1 online resource (v, 322 pages) : illustrations
Disciplina	621.3693
Soggetti	Integrated optics Optical wave guides
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	About the Special Issue Editor -- Boris A. Malomed Editorial: Guided-Wave Optics Reprinted from: Appl. Sci. 2017 -- Orazio Descalzi and Carlos Cartes Stochastic and Higher-Order Effects on Exploding Pulses Reprinted from: Appl. Sci. 2017 -- Sheng-Chih Yang, Yue-Jing He and Yi-Jyun Wun Designing a Novel High-Performance FBG-OADM Based on Finite Element and Eigenmode Expansion Methods Reprinted from: Appl. Sci. 2017 -- Kihwan Moon, Tae-Woo Lee, Young Jin Lee and Soon-Hong Kwon A Metal-Insulator-Metal Deep Subwavelength Cavity Based on Cutoff Frequency Modulation Reprinted from: Appl. Sci. 2017 -- Evgeny N. Bulgakov, Almas F. Sadreev and Dmitrii N. Maksimov Light Trapping above the Light Cone in One-Dimensional Arrays of Dielectric Spheres Reprinted from: Appl. Sci. 2017 -- Jennie D'Ambroise and Panayotis G. Kevrekidis Existence, Stability and Dynamics of Nonlinear Modes in a 2D PartiallyPT Symmetric Potential Reprinted from: Appl. Sci. 2017 -- Zhijie Mai, Haitao Xu, Fang Lin, Yan Liu, Shenhe Fu and Yongyao Li Dark Solitons and Grey Solitons in Waveguide Arrays with Long-Range Linear Coupling Effects Reprinted from: Appl. Sci. 2017 -- Jorge Fujioka, Alfredo Go´mez-Rodri´guez and A´urea Espinosa-Cero´n Pulse Propagation Models with Bands of Forbidden Frequencies or Forbidden Wavenumbers: A Consequence of Abandoning the Slowly Varying Envelope Approximation and Taking into Account Higher-Order Dispersion Reprinted from: Appl. Sci. 2017 -- Yiqi Zhang, Hua Zhong, Milivoj R. Belic´ and Yanpeng Zhang Guided Self-Accelerating Airy Beams-A Mini-Review Reprinted from: Appl. Sci. 2017 -- Garyfallia

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Sommario/riassunto

The topic of guided wave (GW) propagation comprises a vast research area overlapping with photonics, matter waves in macroscopic quantum media (ultracold gases of bosonic and fermionic atoms, condensates of quasiparticles, such as excitons-polaritons, magnons, and cavity photons), hydrodynamics, acoustics, plasma physics, etc. In many situations, tightly confined GWs naturally acquire high amplitudes, which gives rise to a plenty of fascinating nonlinear effects. In particular, waveguides often provide a combination of nonlinearity, group-velocity dispersion, and low losses which is necessary for the creation of solitons (robust solitary waves). In optics, experimental and theoretical work with GWs is a vast research area, with great significance both for fundamental studies and numerous applications, which are realized in linear and nonlinear forms alike, including long-haul telecommunications, all-optical data-processing schemes, and generation of powerful laser beams, especially in fiber lasers. More recently, new artificially created optical media have been made available, such as photonic crystals, metamaterials, photonic topological insulators, PT-symmetric waveguides, and others, which opens a way to implement GW propagation regimes with features that were not known previously - e.g., the propagation immune to scattering on defects, or light diodes, admitting strictly unidirectional transmission. Closely related to optical waveguides are their plasmonic counterparts, which admit the implementation of the GW transmission on much smaller scales, by using surface-plasmon-polaritonic waves with small wavelengths. Completely new perspectives for the exploration and application of GWs emerge in the area of nanophotonics, with the guided propagation carried out in photonic

nanowires whose confinement length is essentially smaller than the optical wavelength.
