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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.