



Models of few optical cycle solitons beyond the slowly varying envelope approximation

Submitted by Hervé Leblond on Wed, 12/03/2014 - 09:57

Titre Models of few optical cycle solitons beyond the slowly varying envelope approximation

Type de publication Article de revue

Auteur Leblond, Hervé [1], Mihalache, Dumitru [2]

Editeur Elsevier

Type Article scientifique dans une revue à comité de lecture

Année 2013

Langue Anglais

Date Jan-02-2013

Numéro 2

Pagination 61-126

Volume 523

Titre de la revue Physics Reports

ISSN 0370-1573

Mots-clés Circular polarization [3], complex modified Korteweg-de Vries equation [4], density matrix [5], few-cycle dissipative solitons [6], few-cycle light bullets [7], Few-cycle pulses [8], few-optical-cycle solitons [9], generalized Kadomtsev-Petviashvili equation [10], half-cycle optical solitons [11], linear polarization [12], long-wave approximation [13], Maxwell-Bloch equations [14], Modified Korteweg-de Vries equation [15], reductive perturbation method [16], short-wave approximation [17], sine-Gordon equation [18], two-level atoms [19], unipolar pulses [20]

In the past years there was a huge interest in experimental and theoretical studies in the area of few-optical-cycle pulses and in the broader fast growing field of the so-called extreme nonlinear optics. This review concentrates on theoretical studies performed in the past decade concerning the description of few optical cycle solitons beyond the slowly varying envelope approximation (SVEA). Here we systematically use the powerful reductive expansion method (alias multiscale analysis) in order to derive simple integrable and nonintegrable evolution models describing both nonlinear wave propagation and interaction of ultrashort (femtosecond) pulses. To this aim we perform the multiple scale analysis on the Maxwell-Bloch equations and the corresponding Schrödinger-von Neumann equation for the density matrix of two-level atoms. We analyze in detail both long-wave and short-wave propagation models. The propagation of ultrashort few-optical-cycle solitons in quadratic and cubic nonlinear media are adequately described by generic integrable and nonintegrable nonlinear evolution equations such as the Korteweg-de Vries equation, the modified

Korteweg-de Vries equation, the complex modified Korteweg-de Vries equation, the sine-Gordon equation, the cubic generalized Kadomtsev-Petviashvili equation, and the two-dimensional sine-Gordon equation. Moreover, we consider the propagation of few-cycle optical solitons in both (1 + 1)- and (2 + 1)-dimensional physical settings. A generalized modified Korteweg-de Vries equation is introduced in order to describe robust few-optical-cycle dissipative solitons. We investigate in detail the existence and robustness of both linearly polarized and circularly polarized few-cycle solitons, that is, we also take into account the effect of the vectorial nature of the electric field. Some of these results concerning the systematic use of the reductive expansion method beyond the SVEA can be relatively easily extended to few-cycle solitons in the general case of multilevel atoms. Prospects of the studies overviewed in this work are given in the conclusions.

Résumé en anglais

URL de la notice

<http://okina.univ-angers.fr/publications/ua5735> [21]

DOI

10.1016/j.physrep.2012.10.006 [22]

Lien vers le document

<http://www.sciencedirect.com/science/article/pii/S0370157312003511> [23]

Titre abrégé

Physics Reports

Liens

- [1] <http://okina.univ-angers.fr/herve.leblond/publications>
- [2] [http://okina.univ-angers.fr/publications?f\[author\]=8696](http://okina.univ-angers.fr/publications?f[author]=8696)
- [3] [http://okina.univ-angers.fr/publications?f\[keyword\]=9609](http://okina.univ-angers.fr/publications?f[keyword]=9609)
- [4] [http://okina.univ-angers.fr/publications?f\[keyword\]=10375](http://okina.univ-angers.fr/publications?f[keyword]=10375)
- [5] [http://okina.univ-angers.fr/publications?f\[keyword\]=10370](http://okina.univ-angers.fr/publications?f[keyword]=10370)
- [6] [http://okina.univ-angers.fr/publications?f\[keyword\]=10376](http://okina.univ-angers.fr/publications?f[keyword]=10376)
- [7] [http://okina.univ-angers.fr/publications?f\[keyword\]=10378](http://okina.univ-angers.fr/publications?f[keyword]=10378)
- [8] [http://okina.univ-angers.fr/publications?f\[keyword\]=9610](http://okina.univ-angers.fr/publications?f[keyword]=9610)
- [9] [http://okina.univ-angers.fr/publications?f\[keyword\]=10366](http://okina.univ-angers.fr/publications?f[keyword]=10366)
- [10] [http://okina.univ-angers.fr/publications?f\[keyword\]=10377](http://okina.univ-angers.fr/publications?f[keyword]=10377)
- [11] [http://okina.univ-angers.fr/publications?f\[keyword\]=10367](http://okina.univ-angers.fr/publications?f[keyword]=10367)
- [12] [http://okina.univ-angers.fr/publications?f\[keyword\]=10380](http://okina.univ-angers.fr/publications?f[keyword]=10380)
- [13] [http://okina.univ-angers.fr/publications?f\[keyword\]=10372](http://okina.univ-angers.fr/publications?f[keyword]=10372)
- [14] [http://okina.univ-angers.fr/publications?f\[keyword\]=10369](http://okina.univ-angers.fr/publications?f[keyword]=10369)
- [15] [http://okina.univ-angers.fr/publications?f\[keyword\]=9642](http://okina.univ-angers.fr/publications?f[keyword]=9642)
- [16] [http://okina.univ-angers.fr/publications?f\[keyword\]=10368](http://okina.univ-angers.fr/publications?f[keyword]=10368)
- [17] [http://okina.univ-angers.fr/publications?f\[keyword\]=10373](http://okina.univ-angers.fr/publications?f[keyword]=10373)

- [18] [http://okina.univ-angers.fr/publications?f\[keyword\]=10374](http://okina.univ-angers.fr/publications?f[keyword]=10374)
- [19] [http://okina.univ-angers.fr/publications?f\[keyword\]=10371](http://okina.univ-angers.fr/publications?f[keyword]=10371)
- [20] [http://okina.univ-angers.fr/publications?f\[keyword\]=10379](http://okina.univ-angers.fr/publications?f[keyword]=10379)
- [21] <http://okina.univ-angers.fr/publications/ua5735>
- [22] <http://dx.doi.org/10.1016/j.physrep.2012.10.006>
- [23] <http://www.sciencedirect.com/science/article/pii/S0370157312003511>

Publié sur *Okina* (<http://okina.univ-angers.fr>)