Inter-soliton interactions mediated by dispersive waves in optical fibers

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Abstract:

In this talk we discuss how quasi-linear waves bouncing between optical soliotons in fibers with high order dispersion can lead to strong interaction between the solitons at the distances much greater than the characteristic width of the solitons. This effect was first reported in [1], however no theory explaining the effect was suggested.
To describe the dynamics of the light we use the standard approach based on the generalized nonlinear Schrodinger equation with high order dispersion. We show that the dispersive waves can get trapped between the solitons due to the cascaded resonant four-wave mixing [2] of the dispersive waves and the solitons. Under certain conditions the resonant scattering results in nearly perfect reflection of the dispersive waves off the solitons and so a pair of the solitons can form a soliton Fabry-Perot-like resonator. It is important to notice that each act of the reflection of the dispersive waves affects the parameters of the soltons [2, 3] resulting in the effective attraction between them. In its turn the change of the soliton frequencies leads to the modification of the spectrum of the trapped dispersive waves. In the present talk we develop the theory of the phenomenon and discuss the analogy between this effect and Casimir force. The importance of the reported effect for optical supercontinuum generation is also discussed.
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