Generating Incoherent Solitons in Bragg Structures

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A theoretical discovery of self-trapping of optical beams by Chiao et al. has generated a flurry of theoretical and experimental activity in the field of optical spatial solitons. Fully spatially coherent solitons were extensively studied in various nonlinear media. Recently, spatially partially coherent solitons have been experimentally realized in a noninstantaneous photorefractive medium [1], and have been theoretically investigated in materials with photorefractive, Kerr-type, saturable logarithmic as well as with thresholding nonlinearities.

The work on partially coherent solitons to date has been concerned with the solitons in homogeneous nonlinear media. Here we report preliminary results of our studies of such solitons generated in nonlinear media with the periodic dependence of linear refractive index along the direction of propagation of a soliton. The new feature of such Bragg structures is coupling between forward- and backward-propagating modes constituting incoherent Bragg solitons. The total intensity profile of any such solitons is an uncorrelated superposition of those of forward- and backward-propagating modes. We have developed, for the first time to our knowledge, a general theory of incoherent solitons in Bragg structures [2] and investigated analytically and numerically possible soliton configurations that can be supported by slow-responding periodic nonlinear media. We have also studied the domain of existence and stability of such solitons. In Figs. 1 and 2 we present the total intensity profile (side-view and front-view, respectively) of a particular partially coherent

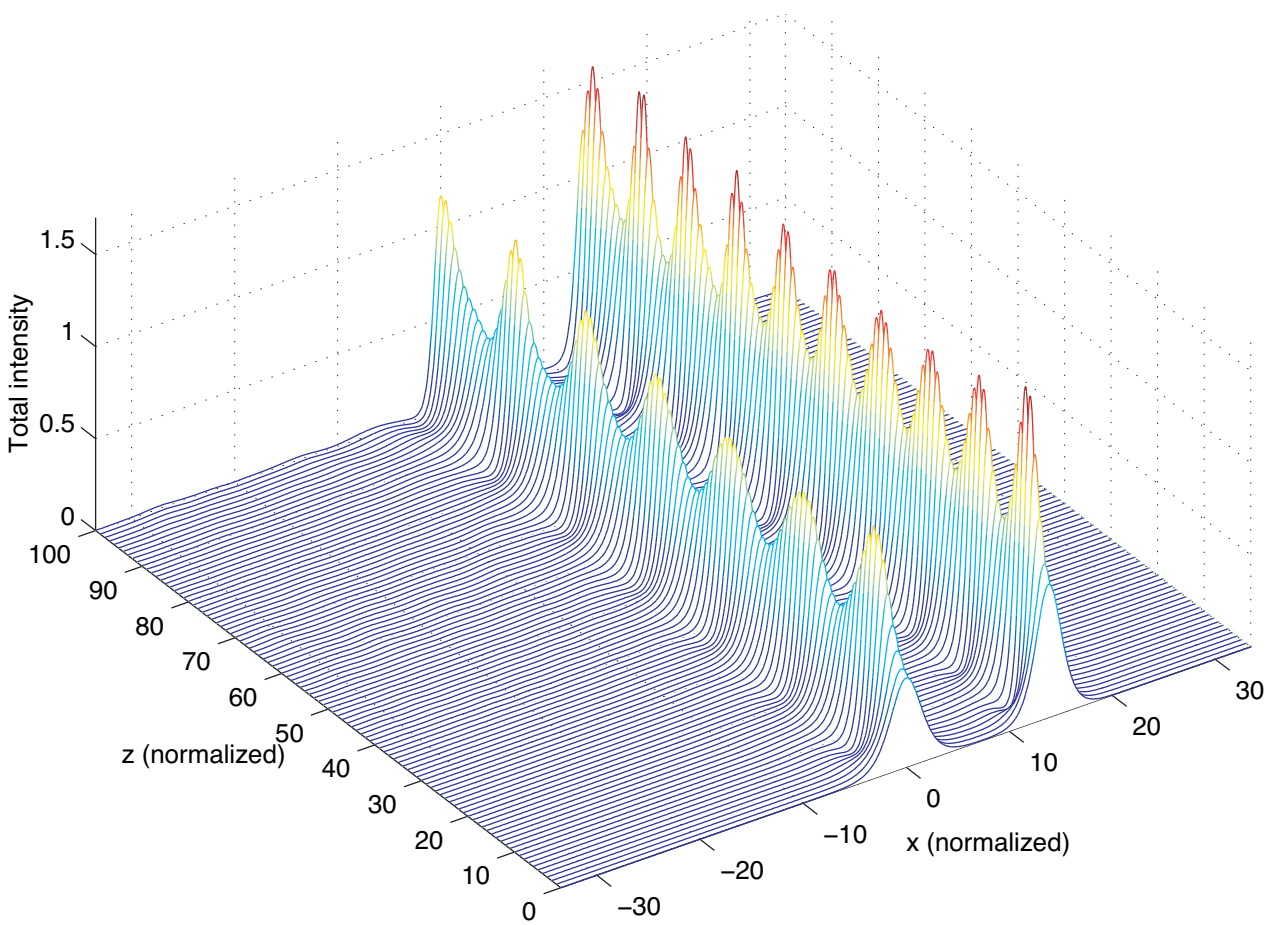
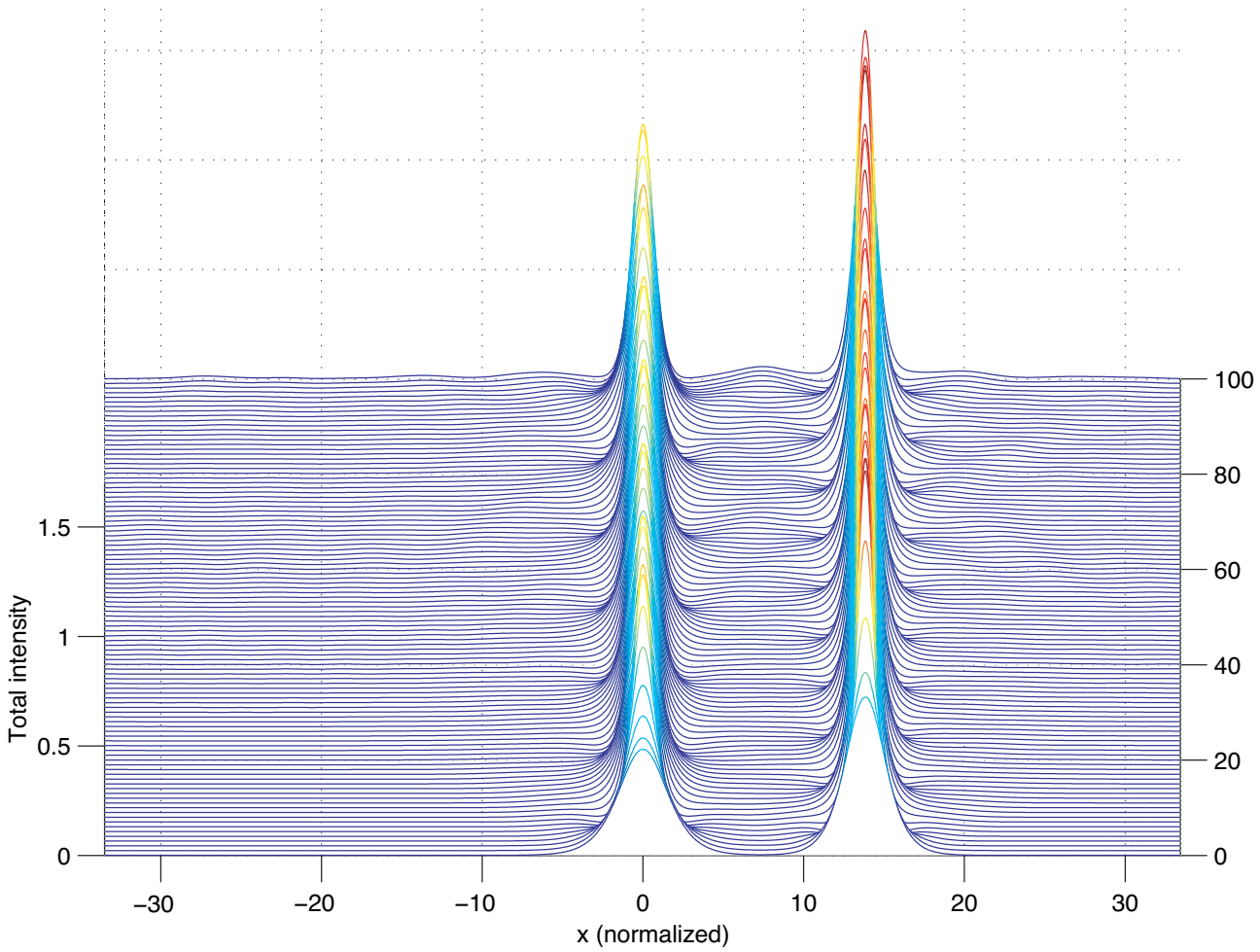


Figure 1— ***Side-view of the total intensity profile of a multimode incoherent Bragg soliton complex.***



Bragg "breather" soliton, which is a stable multi-soliton complex whose intensity profile oscillates ("breathes") with a given period.

[1] M. Mitchell and M. Segev, *Nature* **387**, 880 (1997).
[2] S.A. Ponomarenko, N.M. Litchinitser, E. Poutrina, and G.P. Agrawal, to be submitted to *Phys. Rev. Lett.*

Figure 2—
Front-view of the same structure.