Algebraic soliton refraction: new wave contexts for nonlinear Snell's law

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The refraction of light waves at planar interfaces is a problem of fundamental interest to the optics community. To date, our Snell's law-type analyses have considered only families of *hyperbolic solitons* – robust nonlinear beams that are strongly (exponentially) localized in the transverse direction [1,2]. Here, we take the first steps toward understanding refraction of waves with much weaker transverse localization: *algebraic solitons* [3]. The stability of algebraic solitons in homogeneous systems has been investigated elsewhere [4], and those earlier results have provided a guide for material-parameter regimes in which to investigate refraction phenomena. Key research highlights include the derivation of an inhomogeneous Helmholtz governing equation for describing nonlinear beam refraction at the interface between two dissimilar dual power-law optical materials. A novel Snell's law will be reported for generalized hyperbolic solitons, with the new result for algebraic solitons emerging as a limit that maps directly onto the familiar law describing plane-wave refraction at *linear interfaces*. Computer simulations have started to test theoretical predictions in fully-nonlinear regimes, and we are also investigating Goos-Hänchen shifts (see Fig. 1).

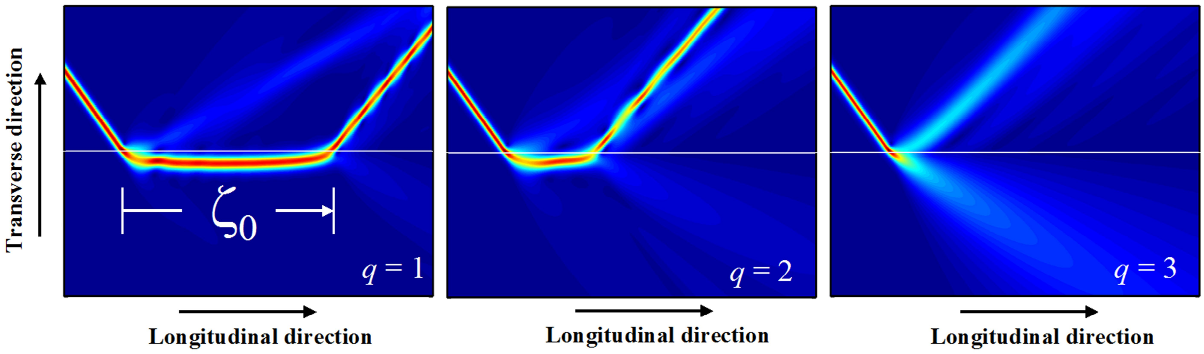

Figure 1. A selection of computer simulations illustrating the Goos-Hänchen shift (denoted by ζ_0) for hyperbolic solitons in various power-law optical materials [2] where the nonlinearity exponent q is varied but the incidence angle remains fixed.

References

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