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Arbitrary-angle scattering of spatial solitons from dielectric optical interfaces

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Wave–interface phenomena appear throughout Nature and are intrinsically angular in character. For instance, the behaviour of light waves at material boundaries underpins the entire field of optics. The seminal works on nonlinear beam refraction [1] considered scalar bright spatial solitons impinging on the interface between two Kerr-type media with different dielectric parameters, but where angles of incidence, reflection and refraction (relative to the interface) were constrained to be near-negligibly small. Our Group has recently been developing new mathematical and computational tools to describe *arbitrary-angle* refraction of similar beams [2]. We will report our latest research involving higher-order material effects (e.g., quintic-type nonlinearity). A generalized Snell's law describing beam refraction will be detailed and tested directly against fully-numerical calculations [see figure 1(a)]. New effects are also uncovered, through simulations, in both small- and large-angle regimes [e.g., see figure 1(b)].

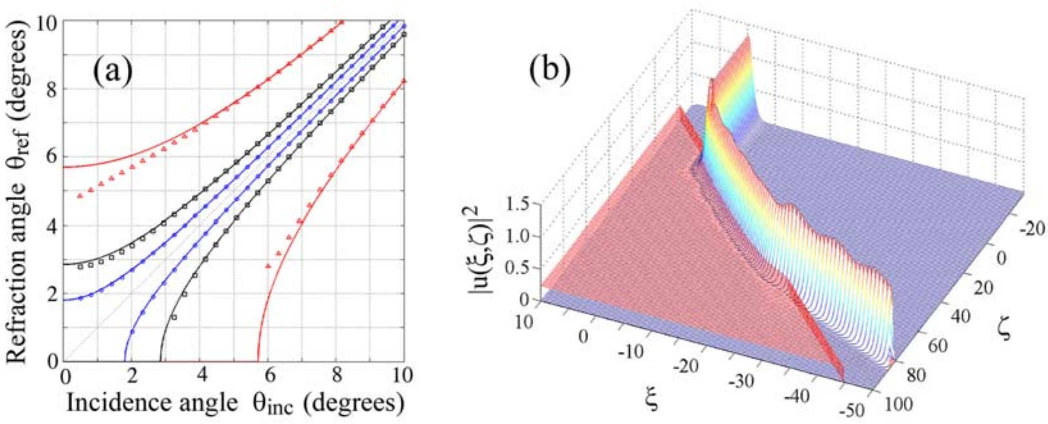

Figure 1. (a) Comparison of theoretical Snell's-Law predictions (solid lines) against full numerical computations (points) for a range of interface parameters. (b) Simulation showing a non-trivial Goos-Hänchen shift for an incident Helmholtz spatial soliton that is close to the critical angle.

References

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[2] J. Sánchez-Curto, P. Chamorro-Posada, and G. S. McDonald, J. Opt. A: Pure Appl. Opt. **11** art. no. 054015 (2009); Opt. Lett. **32**, 1126–1128 (2007).