Spatial solitons at interfaces: nonparaxial refraction & giant Goos-Hänchen shifts

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The behaviour of light at interfaces underpins, in an essential way, the entire field of optics: almost all technological device designs and architectures rely on the interplay between material mismatches (that define the interface) and the 'degree of obliqueness' of the incident, reflected, and refracted waves. 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 all angles (relative to the interface) were constrained to be near-negligibly small. Our Group has been developing new mathematical and computational tools to describe *arbitrary-angle* refraction of similar beams [2]. The most recent research has been considering more general material aspects (e.g., from non-Kerr nonlinearities) and also giant Goos-Hänchen (GH) shifts [2,3]. Close to a critical point (which depends upon a complicated interplay between finite-beam characteristics and material mismatches), the GH shift shows a remarkable sensitivity to incidence angle, and also to medium nonlinearity (see figure 1). Indeed, we believe we have uncovered GH shifts that are unprecedented in magnitude, perhaps the largest ever predicted. A universal Snell's law describing beam refraction has also been tested directly against full numerical calculations.

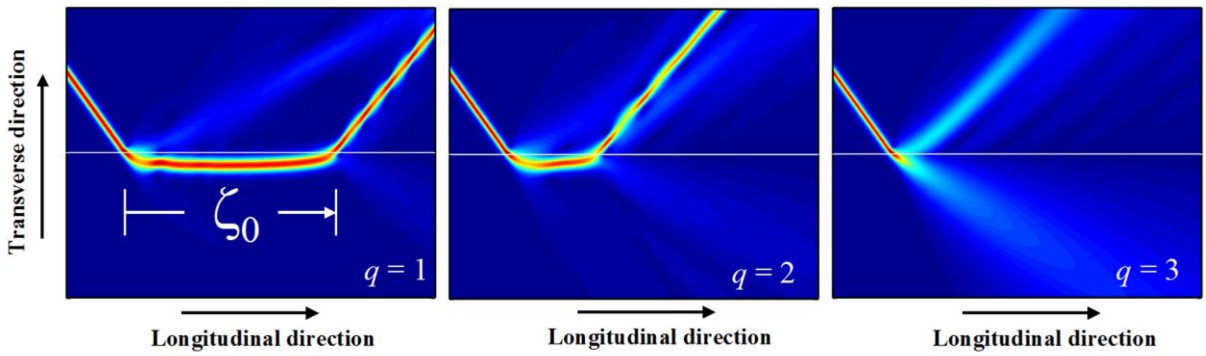

Figure 1. A selection of computer simulations illustrating the Goos-Hänchen shift (denoted by ζ_0) in various power-law optical materials where the nonlinearity exponent q is varied but the incidence angle remains fixed.

References

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