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This presentation will cover a few very basic aspects of our latest research into how laser beams behave when they travel through some types of materials. In particular, we are interested in the properties of overlapping light beams with different colours when they are confined to a, technologically very common, type of material structure called an "optical waveguide" (a three-layered 'sandwich' that is able to trap, and hence guide, the light in the middle layer). The intrinsic properties of the materials we consider allow each beam to 'see' and 'talk to' the other beam. Indeed, this (vector) pair of beams can interact in quite a complicated way, giving rise to a range of interesting and potentially useful effects.

The earliest work in this general field was undertaken within a collaboration between researchers in France and Spain in the early 1990s [1, 2]. The model equations they used were relatively simple, and involved a type of assumption (or "approximation") that restricted the validity of their results in some quite crucial ways. Using our new (Helmholtz) techniques, we can now solve the full equations exactly (in other words, we no longer have to make the same type of approximation as earlier researchers). We can now make lots of new predictions about the properties and behaviour of this technologically-important type of multi-colour optical system.

References

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[2] M. Shalaby and A. J. Barthelemy, IEEE Journal of Quantum Electronics, vol. 28(12), pp. 2736–2741 (1992).