Propagation and stability of two-colour spatial optical solitons

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Two-colour spatial solitons comprise coupled nonlinear optical beams at two distinct temporal frequencies [1]. The components (which may be bright-like and/or dark-like) are localized in space and tend to overlap, thereby allowing the interplay between diffraction and nonlinear effects to result in stationary light structures. We will propose a more complete and realistic model for describing such phenomena. A key feature of our approach is that one may access multi-colour geometries involving beam propagation at *arbitrary angles and orientations* with respect to the reference direction – such considerations are central to multiplexing and interface scenarios, but lie far outside the reach of conventional theory. The modulational instability problem can be solved in a range of physically relevant regimes, and extensive computations have confirmed theoretical predictions (see figure 1). New families of exact analytical two-colour solitons are reported, each of which has *co-propagation* and *counter-propagation* classes that are related by geometrical transformation.

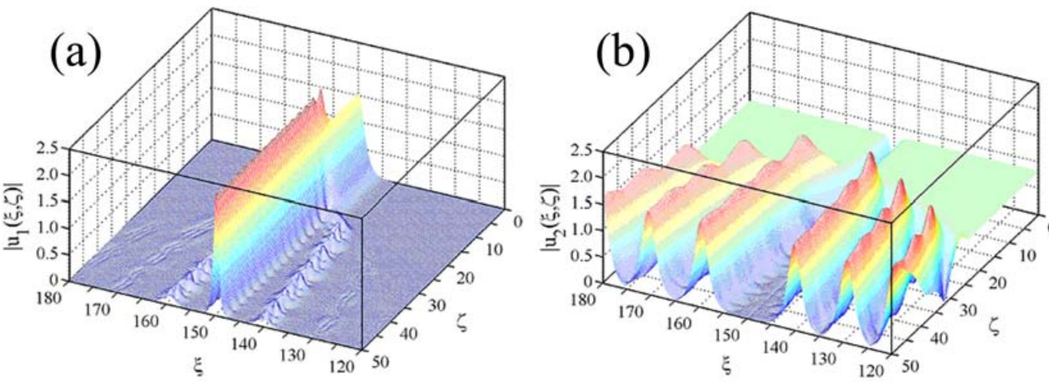

Figure 1. Modulational instability of the bright-dark soliton family – bright component in (a), dark component in (b) – in a focusing Kerr medium. Instability develops initially on the plane-wave background of the dark component, leading to filamentation. Nonlinearity provides a mechanism whereby this instability subsequently feeds through the system to destabilize the bright component.

References

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[2] M. Shalaby and A. J. Barthelemy, IEEE J. Quantum Electron. **28**, 2736–2741(1992).