Soliton-driven Photonics

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Preface

It is ironic that the ideas of Newton, which described a beam of light as a stream of particles made it difficult for him to explain things like thin film interference. Yet these particles, called 'photons', have caused the adjective 'photonic' to gain common usage, when referring to optical phenomena. The purist might argue that only when we are confronted by the particle nature of light should we use the word photonics. Equally, the argument goes on, only when we are face-to-face with an integrable system, i.e. one that possesses an infinite number of conserved quantities, should we say *soliton* rather than *solitary* wave. Scientists and engineers are pragmatic, however, and they are happy to use the word 'soliton' to describe what appears to be an excitation that is humped, multi-humped, or localised long enough for some use to be made of it. The fact that such 'solitons' may stick to each other (fuse) upon collision is often something to celebrate for an application, rather than just evidence that, after all, these are not really solitons, in the classic sense. 'Soliton', therefore, is a widely used term with the qualification that we are constantly looking out for deviant behaviour that draws our attention to its solitary wave character.

In the same spirit, 'photonics' is a useful generic cover-all noun, even when 'electromagnetic theory' or 'optics' would suffice. Indeed, remarkably few photons are needed to permit Maxwell's equations to be used, allowing us to focus upon continuum electric and magnetic field behaviour. Nevertheless, we are always using real materials and any nonlinearity owes its form and roots to the details of the photonic processes.

There is now considerable current momentum in soliton-driven photonics research and it embraces a very broad set of objectives. These can include understanding how materials influence outcomes through, for example, photorefractive, or magnetooptic behaviour. In addition, new mathematical results, or simulation outcomes, or strange results from using higher dimensions, or cavities, or vortices, are all contributing to the excitement level. It was felt, therefore, that a NATO ASI under the title of this book would provide a forum for some global leaders to give overviews that emphasised the common features. The aim was to unite an audience of doctoral and post-doctoral workers into a common frame of mind, regardless of the material being discussed.

These intentions were realised and the Directors are extremely grateful for the beautiful set of lectures delivered on such a catholic range of topics. Each delivery transmitted the hands-on experience of the lecturer. The material was mainly focused upon *spatial solitons* because this is an area of growth and high activity, stimulated by the desire to use 'chip-level' photonics for information processing. Although the mathematics is often the same as in the temporal area,

the physical descriptions and the applications are diffraction-based, which sets spatial solitons aside from temporal ones.

As always, the blend of topics emphasised the need not only to accumulate some knowledge of basic theory but also a working knowledge of materials and what they are capable of. Again the vision of all-optical switching, or some other kind of signal processing application was ever present in our thinking. To achieve all of this, the ASI was conducted as a School and what a great School it was. With so much expertise from all over the world being concentrated in one place, this NATO ASI was hugely successful.

No set of Directors can undertake an enterprise like this alone, however. They need help, and a lot of it! To be honest, without the fantastic work of Lynn Clarke in Salford and the great care put into the local arrangements by Ewa Weinert-Raczka, in Poland, the School would have been a logistical failure. On the Committee side, we are, as always, particularly indebted to George Stegeman for his help and guidance at every stage of the event. The Directors are extremely grateful to the NATO Science Committee for the substantial financial award that made it possible to attract 75 participants from so many countries.

The School was located in Swinoujscie, a magnificent place on the Baltic coast, and the ambience of the hotel, which housed the School, was superb. We were looked after extremely well and everybody enjoyed both the work and the relaxation periods. We believe that we have a classic collection of material in this book, which we hope will stand the test of time. We wish everybody health and happiness and we have a real desire to maintain contact with everybody we met in Poland.

Allan Boardman
Anatoly Sukhorukov