Development and applications of ultra high bit rate soliton fibre lasers

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The invention of the erbium doped fibre amplifier (EDFA) has led to a revolution in telecommunications permitting data transfer at rates previously unimaginable with conventional regenerator technology. With the problem of loss largely eliminated it is now dispersion and nonlinearity that represent the principle barriers to utilizing the enormous bandwidth offered by optical fibre. Soliton transmission in which the nonlinear and dispersive effects within the fibre can be made to balance and effectively cancel provide one means of getting access to more of that potential transmission capacity. As the field has advanced further limiting issues have been identified, e.g. Gordon Haus jitter [1], soliton interactions [2], acousto-optic interactions [3] etc., requiring more advanced solutions such as soliton control to be sought.

The rapid development of amplifier technology and associated components has also led to rapid advances in other technically relevant areas; not least in the development of a wide range of novel short pulse generation techniques. Controlled access to optical gain in conjunction with nonlinear and dispersive effects within a fibre circuit permit a wide range of possibilities for the generation of optical pulse forms. The main focus of attention has concerned actively [4] and passively mode-locked lasers [5,6] however, a number of other powerful, non resonator based pulse generation schemes based on soliton effects have been proposed and demonstrated [7,8]. Pulse repetition rates from kHz to THz, pulse durations from 30fs-10 ns and pulse energies from pJ to mJ levels have all been demonstrated illustrating the enormous versatility of the medium.

In this presentation we describe recent advances in high frequency, short pulse fibre based pulse generation and discuss their application in high speed optical communication and processing schemes.

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