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Keeping Light Behind Bars in Photonic Crystal Fibres

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Photonic crystal fibres (PCFs) have been the focus of increasing scientific and technological interest since the first working example was reported in 1996. Although superficially similar to a conventional optical fibre, PCF has a unique microstructure, consisting of an array of microscopic holes (i.e., channels) running along its entire length. These holes act as optical barriers or scatterers, which suitably arranged can "corral" light within a central core (either hollow or made of solid glass). The holes can range in diameter from ~25 nm to ~50 μ m. Although most PCF is formed in pure silica glass, it has also recently been made using polymers and non-silica glasses, where it is difficult to find compatible core and cladding materials suitable for conventional total internal reflection guidance. PCF supports two guidance mechanisms: total internal reflection, in which case the core must have a higher average refractive index than the holey cladding; and a two-dimensional photonic bandgap, when the index of the core is uncritical – it can be hollow or filled with material. Light can be controlled and transformed in these fibres with unprecedented freedom, allowing, for example, the guiding of light in a hollow core, the creation of highly nonlinear solid cores with anomalous dispersion in the visible and the design of fibres that support only one transverse spatial mode at all wavelengths. The PCF concept has ushered in a new and more versatile era of fibre optics, with a multitude of different applications spanning many areas of science.

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