

MEASUREMENT OF WHITE-LIGHT SUPERCONTINUUM BEAM CHARACTERISTICS USING CONFOCAL MICROSCOPY METHODS

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With the emergence of photonic crystal fibre (PCF), the creation of a spectrally broad laser source is now extremely straightforward due to the prevalence and enhancement of non-linear effects within these unique fibres. When an ultrashort-pulsed laser beam is coupled into the PCF, it is possible to create a “white-light” laser source through a process known as supercontinuum generation [1]. The wavelength emission from a supercontinuum source typically spans continuously from ultraviolet to the infrared, appearing white to the eye. This source has a broad range of applications such as metrology, spectroscopy and confocal microscopy [2, 3].

As with any laser source, characterisation and understanding the behaviour of the source is crucial for efficient integration and subsequent application. However, accurate measurement and analysis of fundamental physical properties of the supercontinuum source such as the waist, divergence and M^2 value present a series of technical challenges. Firstly, typical macroscopic measurement methods do not afford the resolution required for measurements on the microscopic scale required to measure the micron-sized fibre core. Also, many aspects of beam behaviour, for example, M^2 value, are a function of wavelength and hence when considering the white-light supercontinuum source, the method of quantification must therefore be adaptable for a very wide wavelength range.

We report a new non-destructive method for high-resolution measurement and analysis of white-light supercontinuum source emission properties and propagation behaviour at multiple wavelengths simultaneously using laser confocal microscopy. This will include an overview of the experimental geometry used and analysis methods employed for measurement of the M^2 value, beam waist and divergence of the white-light supercontinuum based source. With this configuration, we observed that the white-light supercontinuum output of the PCF possessed M^2 values close to the absolute limit of unity across the visible spectrum.

REFERENCES

1. Ranka, J.K., R.S. Windeler, and A.J. Stentz, "Visible continuum generation in air-silica microstructure optical fibers with anomalous dispersion at 800 nm". *Optics Letters*, **25**(1): p.25-27. (2000).
2. Zheltikov, A., "Nanoscale nonlinear optics in photonic-crystal fibres". *Journal of Optics a-Pure and Applied Optics*, **8**(4): p. S47-S72 (2006).
3. McConnell, G., "Confocal laser scanning fluorescence microscopy with a visible continuum source". *Optics Express*, **12**(13): p. 2844-2850 (2004).