

Communication

# Theoretical Investigation of Bandwidth in Multimode Step-Index Silica Photonic Crystal Fibers

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**Abstract:** Solving the time-dependent power flow equation (PFE) provides a useful method to study the transmission bandwidth of step-index silica photonic crystal fibers (SI SPCFs). The transmission bandwidth of these kinds of fibers is determined for different air-hole structures (different numerical apertures (NAs)) and different distribution widths of the Gaussian launch beam. The results indicate that the lower the NA of SI SPCFs, the higher the bandwidth (for example, for a lower NA of SI SPCFs, a bandwidth that is eight times larger is obtained at a fiber length of 3500 m). The narrower launch beam at short fiber lengths results in a wider bandwidth. The longer the fiber (>300 m), the much less the effect of the launch beam width on the bandwidth. The bandwidth becomes independent of the width of the launch beam distribution at the fiber length at which a steady-state distribution (SSD) is reached. These results are useful for some potential applications, such as high capacity transmission optical fiber systems.

**Keywords:** photonic crystal fiber; bandwidth; multimode optical fiber; step-index fiber; power flow equation

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