Abdalrahman Fouda 202001261

Plasmonic Liquid Photonic Crystal Fiber: Phase 3

The coupling length (Lc) in PCF couplers is a key factor, defining the shortest necessary length for power transfer between cores. It is given by the formula $Lc = \frac{\lambda}{2(n_{odd} - n_{even})}$. This equation highlights that Lc inversely correlates with the difference in the real parts of the effective indices of the odd and even super modes $Re(n_{odd}) - Re(n_{even})$. The variation of Lc with wavelength is shown in Figure 1, with parameters d1, d2, and dc set to 3.75, 2, 3.437, and 2 um, respectively, under a constant temperature of 25 °C and NLC rotation angle of ϕ = 90°.

Figure 1 demonstrates that Lc decreases as the wavelength increases, attributed to diminished mode confinement in the core regions. At the resonance wavelength of 1.161 um, Lc notably drops, signifying strong phase alignment between the x-polarized odd mode and SP2 mode. The figure's inset shows Lc dropping from 753 um at λ= 1.3 um to 325 um at λ = 1.6 um. The ability to control the coupling length ratio at λ = 1.3 um and λ = 1.55 um allows the HPLC-PCF coupler to act as a multiplexer-demultiplexer (MUX-DEMUX), efficiently separating wavelengths of 1.3 um and 1.55 um with a compact design.

The confinement of the x-polarized mode is higher at λ = 1.3 um than at λ = 1.55 um across the core, resulting in a longer Lc at λ = 1.3 um, as confirmed by Fig 2. The optimum MUX-DEMUX design is achieved when the coupling ratio (gamma) is 2.0 (LC 1.3 / LC 1.55). Introducing x-polarized modes at λ= 1.3 um and 1.55 um into the left core leads to the x-polarized mode at λ = 1.3 um emerging in the right core, while the mode at λ= 1.55 um transfers from the left core to the right and then back to the left core.

1. Validating Fig6 in the paper

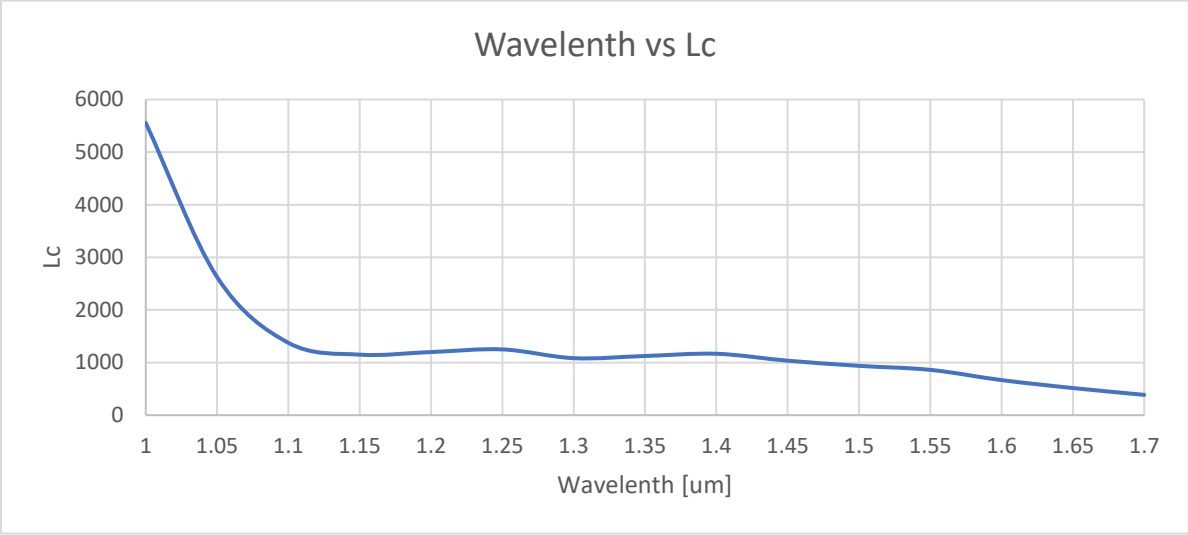

Figure 1 The coupling length (Lc) varies with the wavelength, while other parameters are set at d1 = 2 µm, d2 = 3.437 µm, dc = 2 µm, temperature at 25 °C, and φ at 90°.

2. Validating Fig7 in the paper

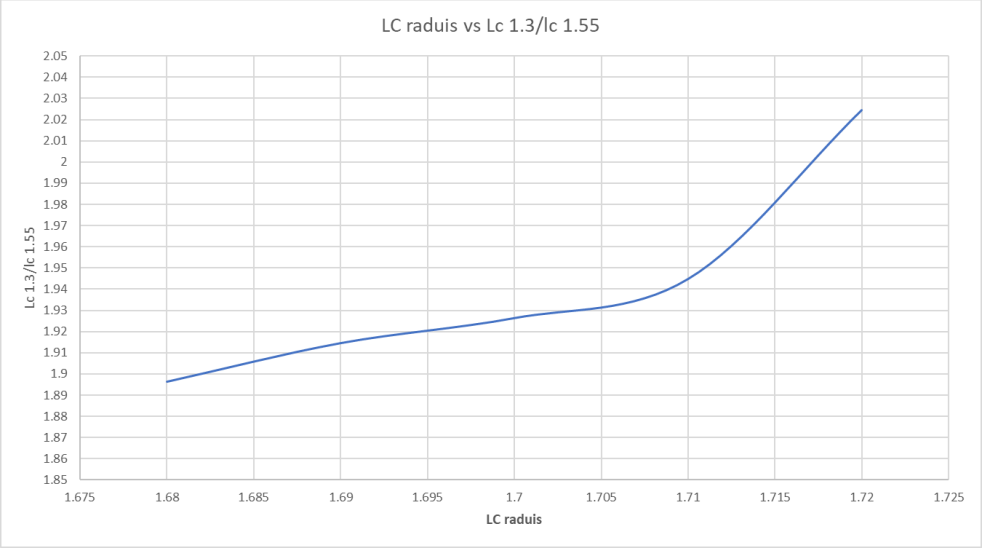

Figure 2 The coupling ratio (LC 1.3/LC 1.55) varies with the NLC core radius, while other parameters such as Λ (3.75 µm), d1 (2 µm), dc (2 µm), temperature (25 °C), and φ (90°) are kept constant.