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High-*Q* photonic crystal ring resonator-based ultra-compact 6-channel C-band demultiplexer with low crosstalk

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Abstract

Ultra-compact and high-performance photonic crystal ring resonator-based demux may achieve low crosstalk, high Q-factor, and effective multichannel operation in the C-band. In this study, we propose a novel 6-channel dense wavelength division demultiplexer based on photonic crystal hexagonal ring resonators is designed and analyzed. To obtain the linearity in the intensity of demux, a novel technique of tuning holes is incorporated. By adjusting the radii of resonator holes and monitor holes – collectively known as special holes, the resonating wavelengths are precisely adjusted. Six asymmetrical hexagonal ring resonators are used in the suggested demux to accomplish effective channel separation. The Finite-Difference Time-Domain Method approach is used to examine the device performance, while the Plane Wave Expansion Method is employed to derive the photonic bandgap structure. For short-haul optical communication systems, the design maintains a channel spacing of 0.8 nm in accordance with ITU-T specifications. The suggested demux achieves crosstalk levels between -17.23 dB and -23.97 dB and a quality factor of 12,875 spanning a wavelength range of 1,544 nm–1,550 nm in the C-band. Compact design and improved selectivity for Dense Wavelength Division Multiplexing applications are achieved by using an asymmetrical hexagonal resonator with optimal hole tuning.

Keywords: [photonic crystal](#); [DWDM](#); [finite difference time domain method](#); [demultiplexer](#); [hexagonal ring](#); [C band](#)

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Research ethics: This research does not involve human participants, human biological material, or animals. Therefore, ethical approval from an Institutional Review Board or equivalent ethics committee was not required.

Informed consent: Not applicable, as this study does not involve human participants.

Author contributions: All authors contributed to the conception and design of the study, analysis and interpretation of the results, and preparation and revision of the manuscript. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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