**Docket #:** S24-211

# Integrated Wavelength Division Technology with Optimized Bragg Gratings for Advanced Optical Communications

Stanford researchers have developed a novel, inverse-designed wavelength division multiplexer (WDM) that integrates high-performance Bragg gratings for use in optical communication systems. This co-optimized platform enables efficient routing of multiple light signals across different wavelengths within a compact physical footprint while maintaining low crosstalk, addressing longstanding challenges in integrated photonics.

As modern data centers and fiber-optic telecommunications networks face rising bandwidth demands for data transmission, there is a critical need for WDMs that achieve narrowband signal separation with minimal interference or crosstalk. Traditional wavelength division technologies that separate light signals, such as arrayed waveguide gratings, suffer from large size requirements, poor spectral resolution and high signal loss, which degrade communication system performance.

The inventors' technology leverages advanced computational optimization to design photonic structures that efficiently direct different wavelengths while overcoming the notorious back-reflection problems typically associated with Bragg gratings. By enabling sharp spectral filtering and intelligently re-routing reflected light to prevent interference, the system achieves significantly narrower channel separation than conventional approaches while maintaining high signal integrity. The result is a compact, material-agnostic component with sub-40 nm resolution and exceptional signal fidelity, designed for seamless integration with existing chip fabrication processes.

**Figure**

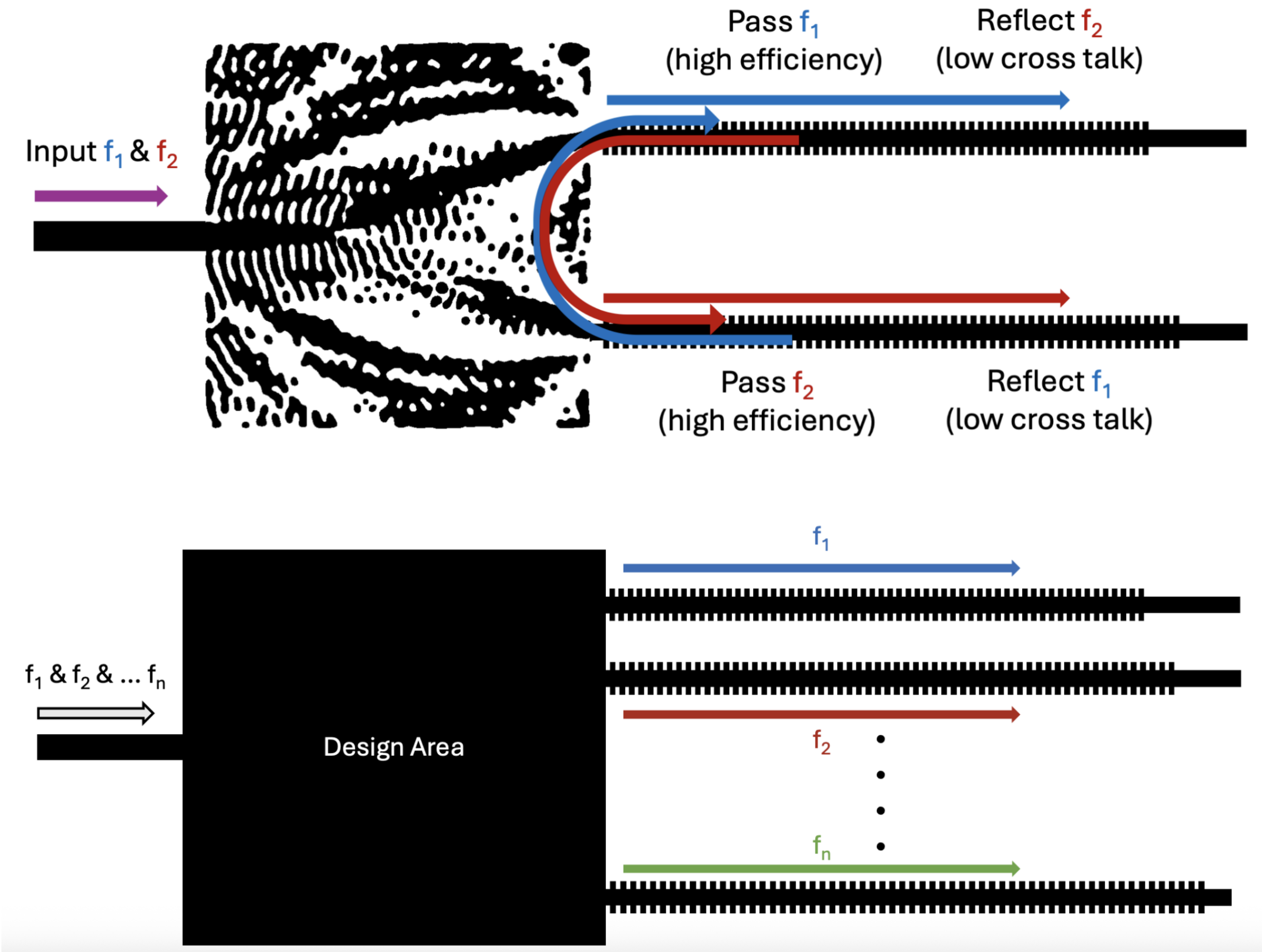


*Figure Description:* Schematic of inverse-designed, computationally optimized WDM component with smart wavelength division and routing (*top*), permitting robust multiplexing of optical signals (*bottom*).

**Stage of Development**

Currently the device design has been fabricated and experimentally demonstrated and the performance aligns with the simulation.

## Applications

- Optical transceivers for high-speed, high-capacity data centers
- On-chip optical interconnects for bandwidth-intensive applications, including artificial intelligence and high-performance computing

- Photonic integrated circuits (PICs) designed for efficient wavelength routing and compatibility with scalable manufacturing processes
- Next-generation telecommunications networks with dense wavelength multiplexing for advanced data transmission

## Advantages

- Compact design with markedly reduced physical size relative to conventional arrayed waveguide gratings (AWGs)
- Enables narrow channel separation (40 nm) with low signal interference for high-performance wavelength multiplexing
- Compatible with Bragg gratings while minimizing signal degradation and optical transmission loss
- Material-agnostic and scalable to various manufacturing platforms and optical channel counts
    - Enables easy integration with existing photonic platforms, reducing development time and costs
- Supports a wide range of wavelength routing and output configurations to accommodate diverse system architectures

## Patents

- Published Application: WO2026010978

## Innovators

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