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Low-loss and misalignment-tolerant fiber-to-chip edge coupler based on double-tip inverse tapers

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Fiber-to-Chip Coupler



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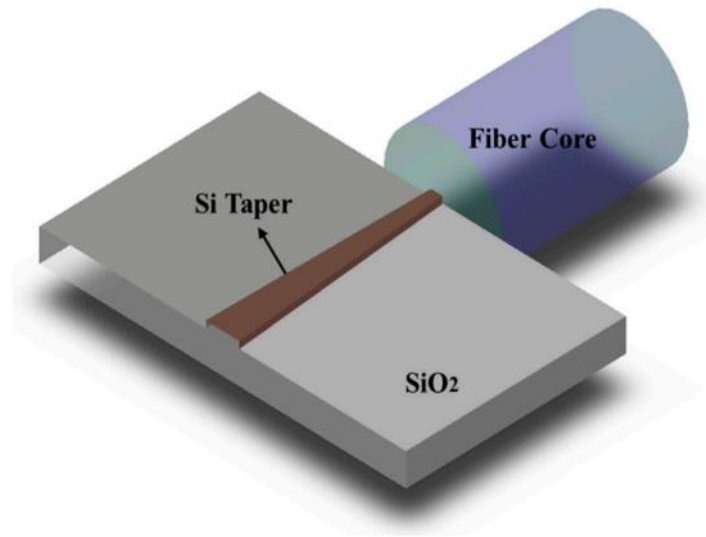


Figure 1. Schematic of optical interconnects between fiber and photonic chip.

Off-Plane Coupling

Advantages:

Compact Size, Testing Capability
Flexible Coupling Position

Disadvantages:

Low Coupling Efficiency, Narrow
Bandwidth, High-wavelength Sensitivity

In-Plane Coupling

Advantages:

High Coupling Efficiency, Broad
Bandwidth, Polarization independence

Disadvantages:

Large Footprint, Fixed Coupling Position
More Strict Requirement

Edge Coupler

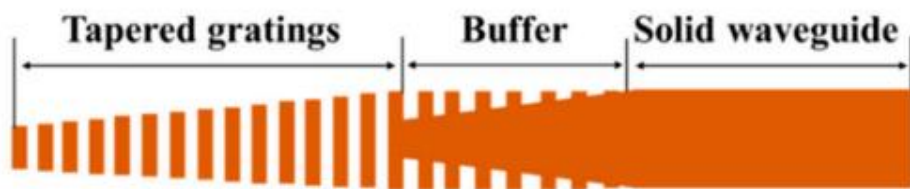
Performance:

Coupling Efficiency, Device Footprint, Operating Bandwidth, Fabrication Deviation Tolerance, and Misalignment Tolerance



Figure 3. Schematic of the (a) linear; (b) multi-sectional; (c) parabolic; and (d) exponential Si inverse tapers (top view).

Easily Fabrication but large footprint



low conversion loss and prohibits modal transition to higher-order modes

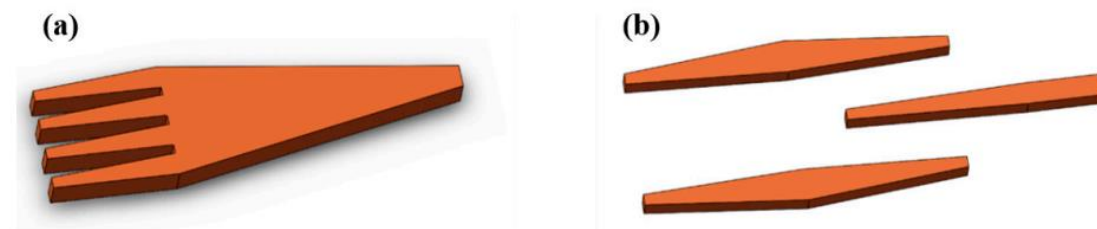


Figure 5. Schematic of Si photonic coupler based on (a) a multi-tip taper and (b) multiple tapers.

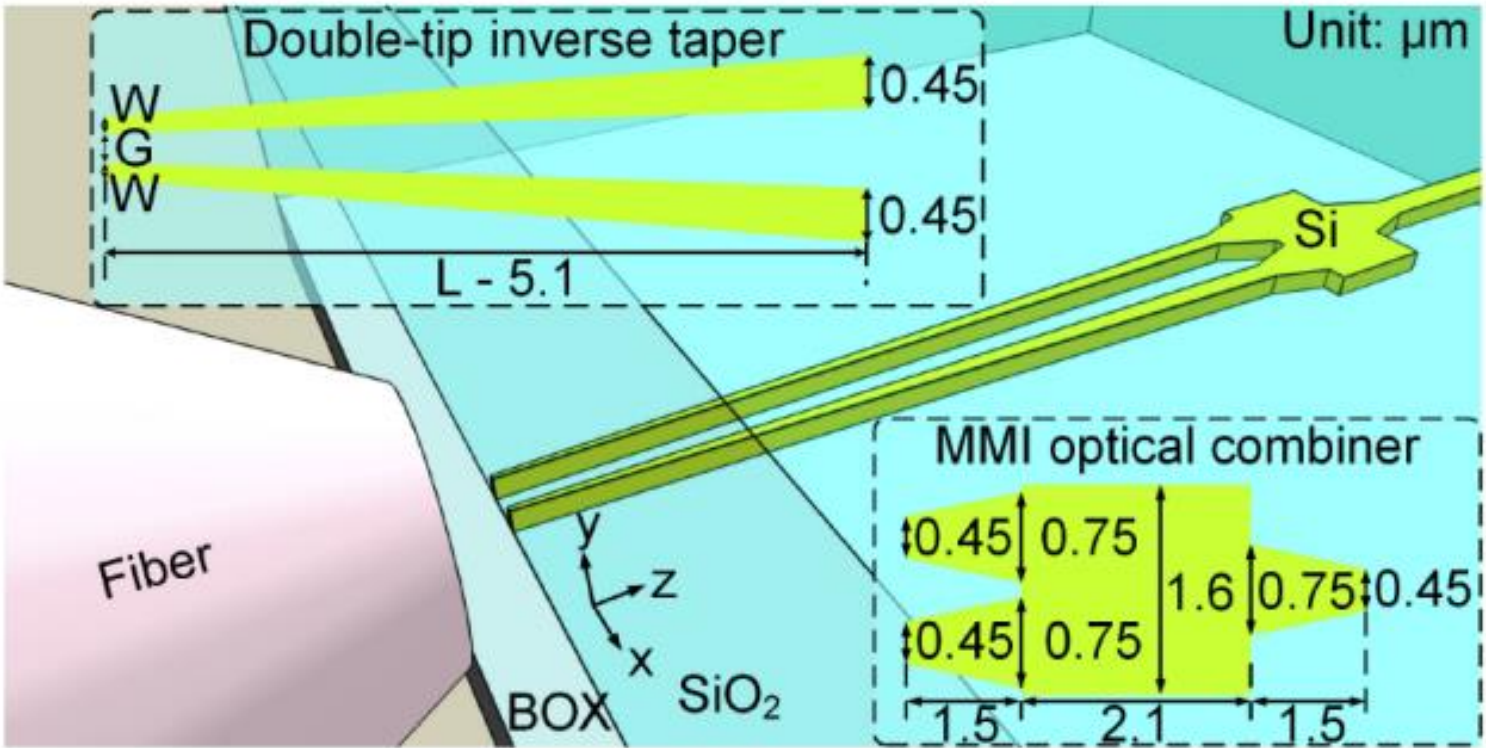
**larger misalignment tolerance,
fabrication deviation tolerance**



Figure 9. Schematic of (a) fork-shape coupler and (b) trident coupler assisted with subwavelength gratings structure.

**ultra-small footprint, high degree
of design freedom**

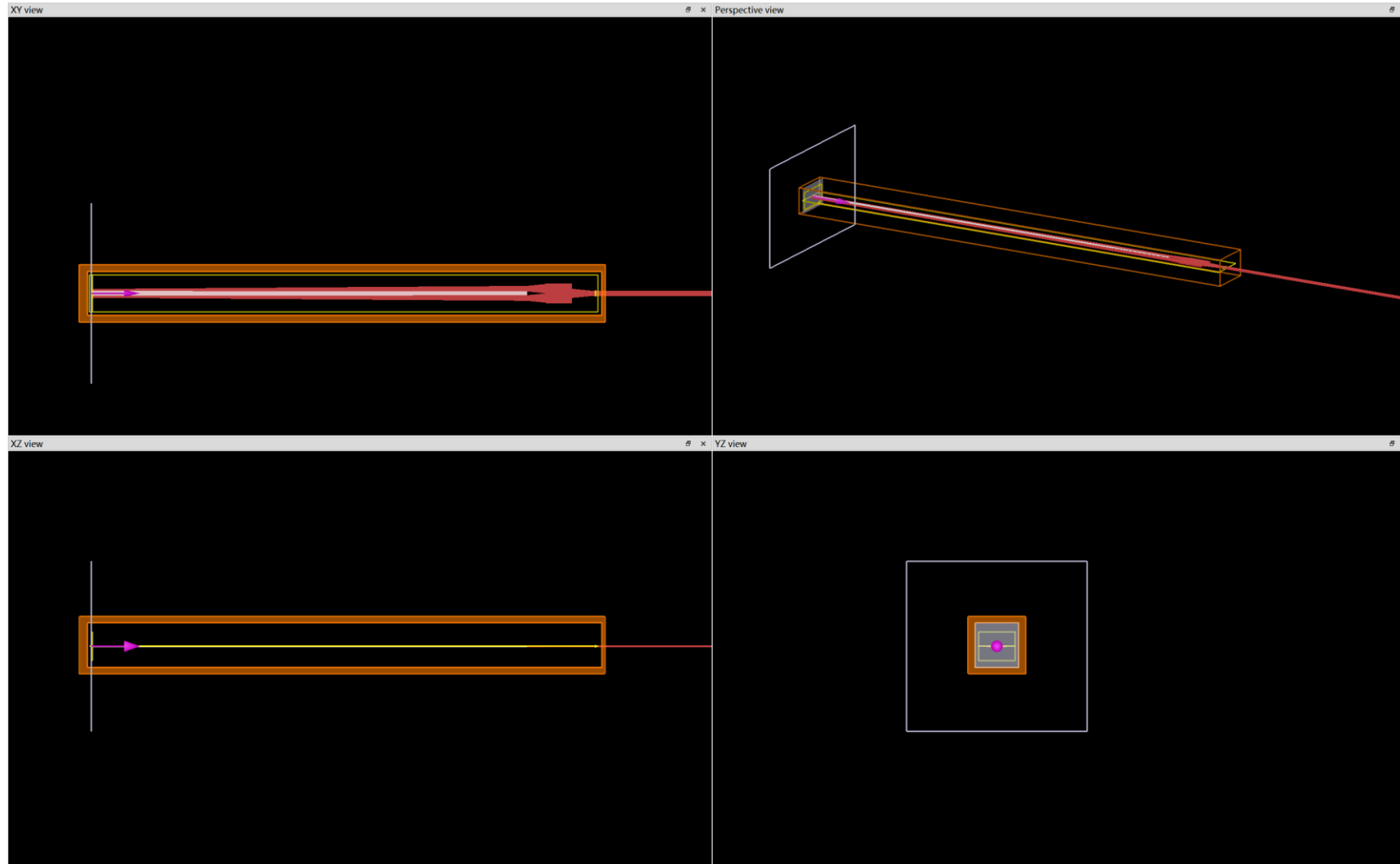
Double-tip inverse tapers + MMI



Double-tip inverse tapers + MMI



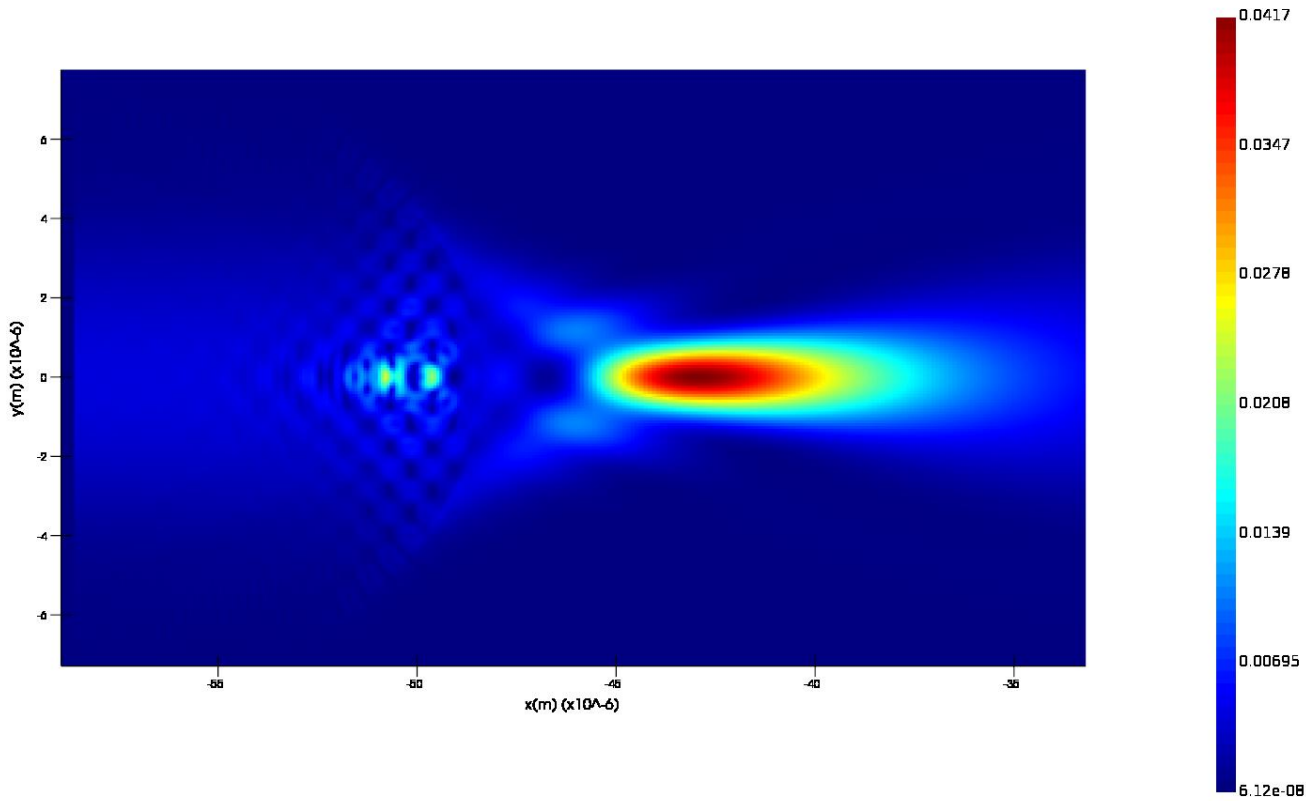
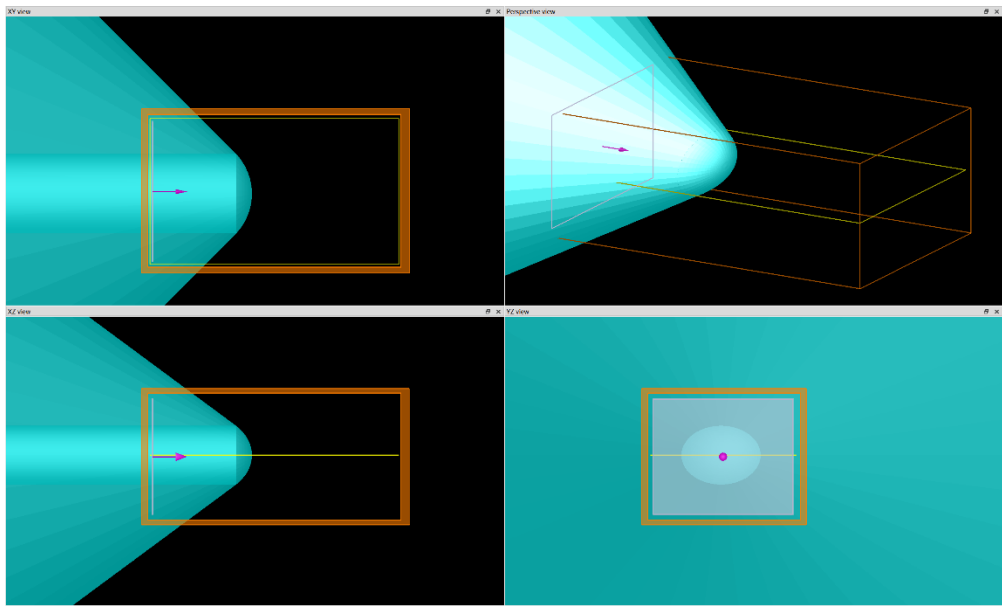
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Lensed Fiber Simulation



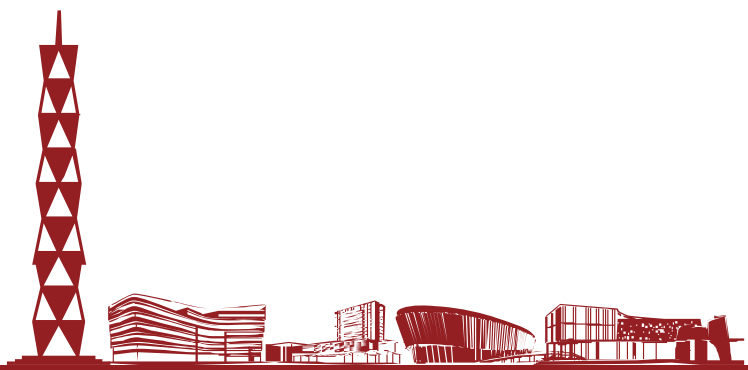
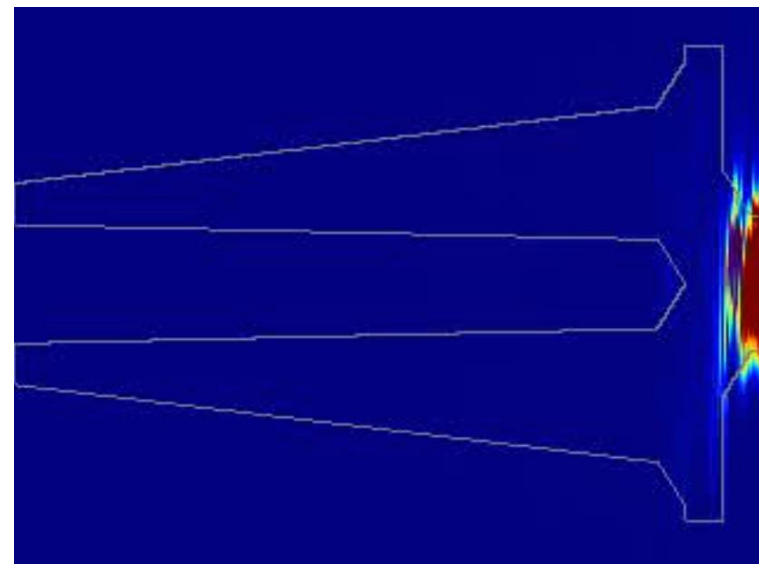
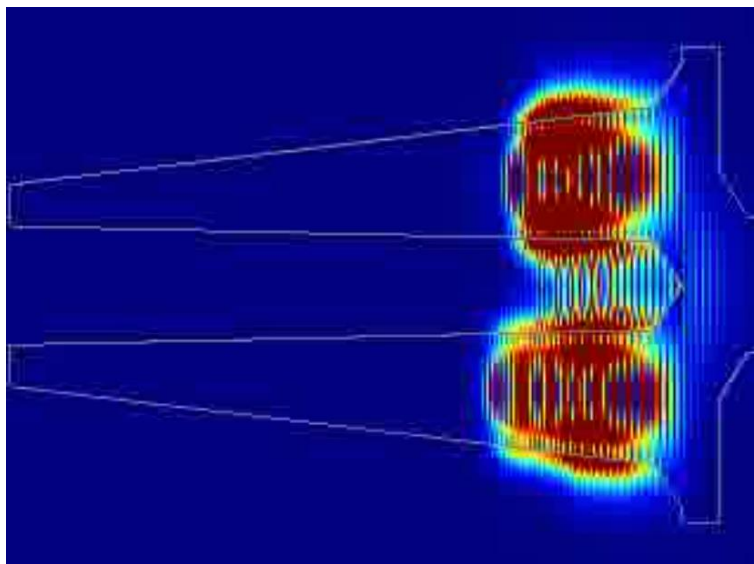
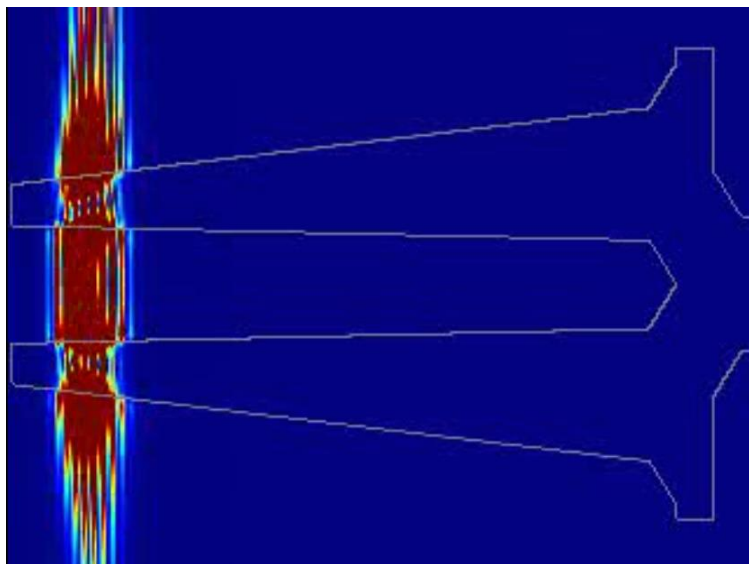
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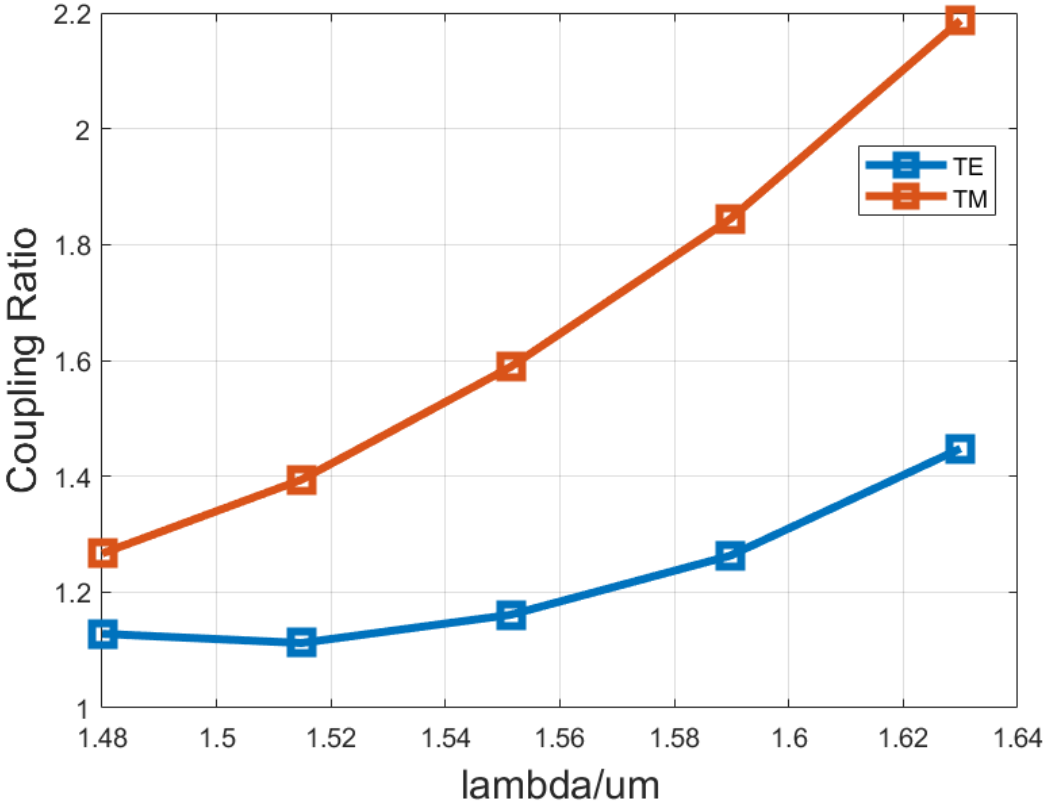
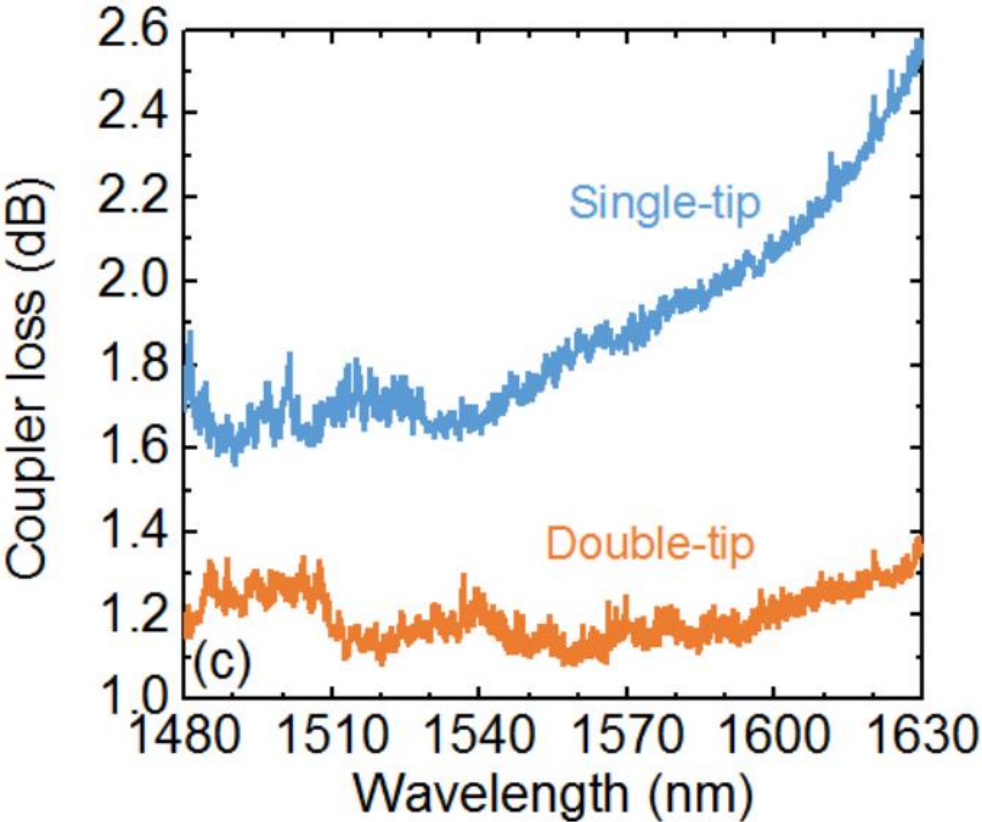
Lensed Fiber Simulation



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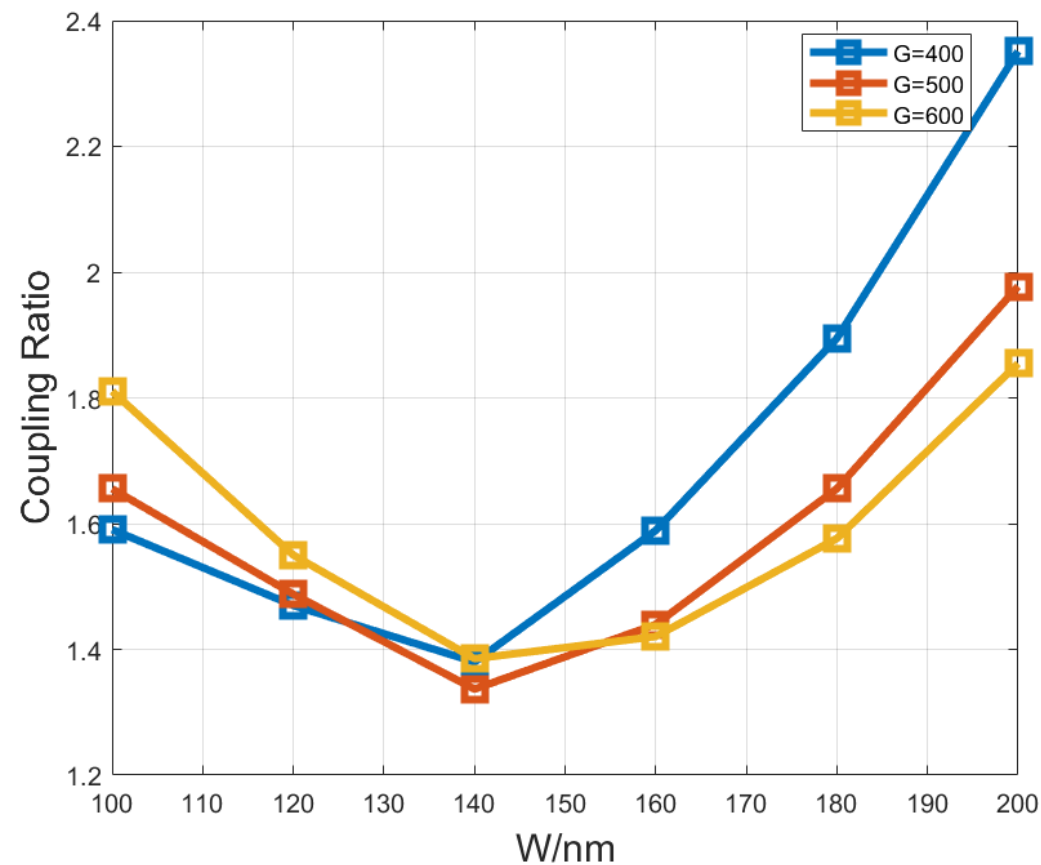
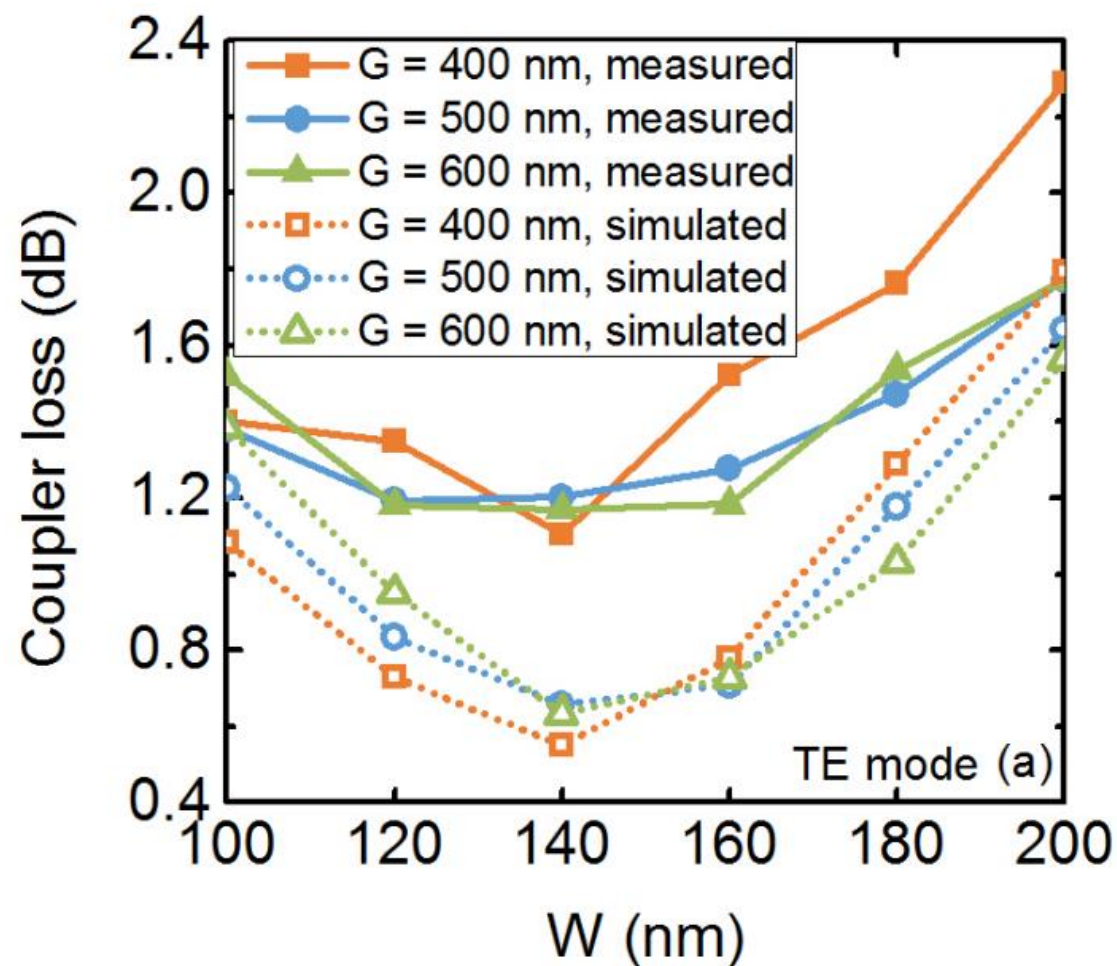
Bandwidth



Coupling Loss for Different W and G



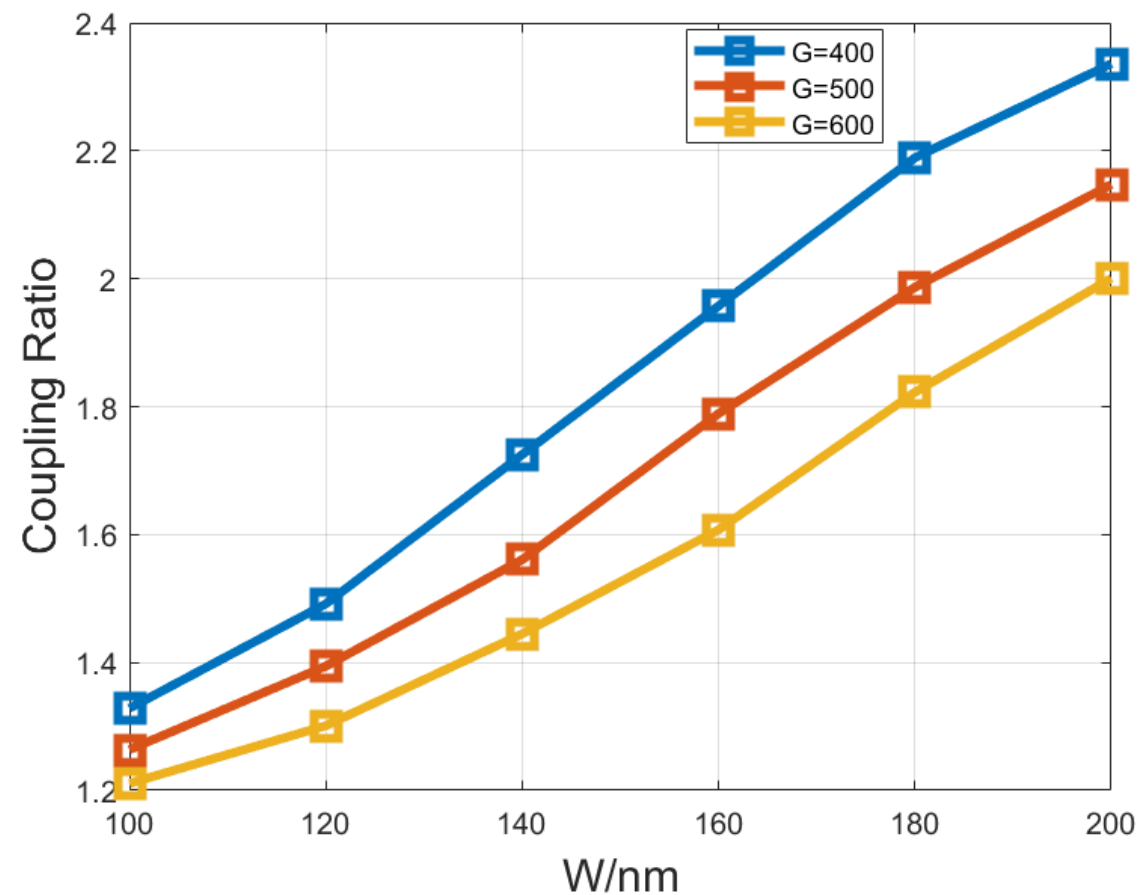
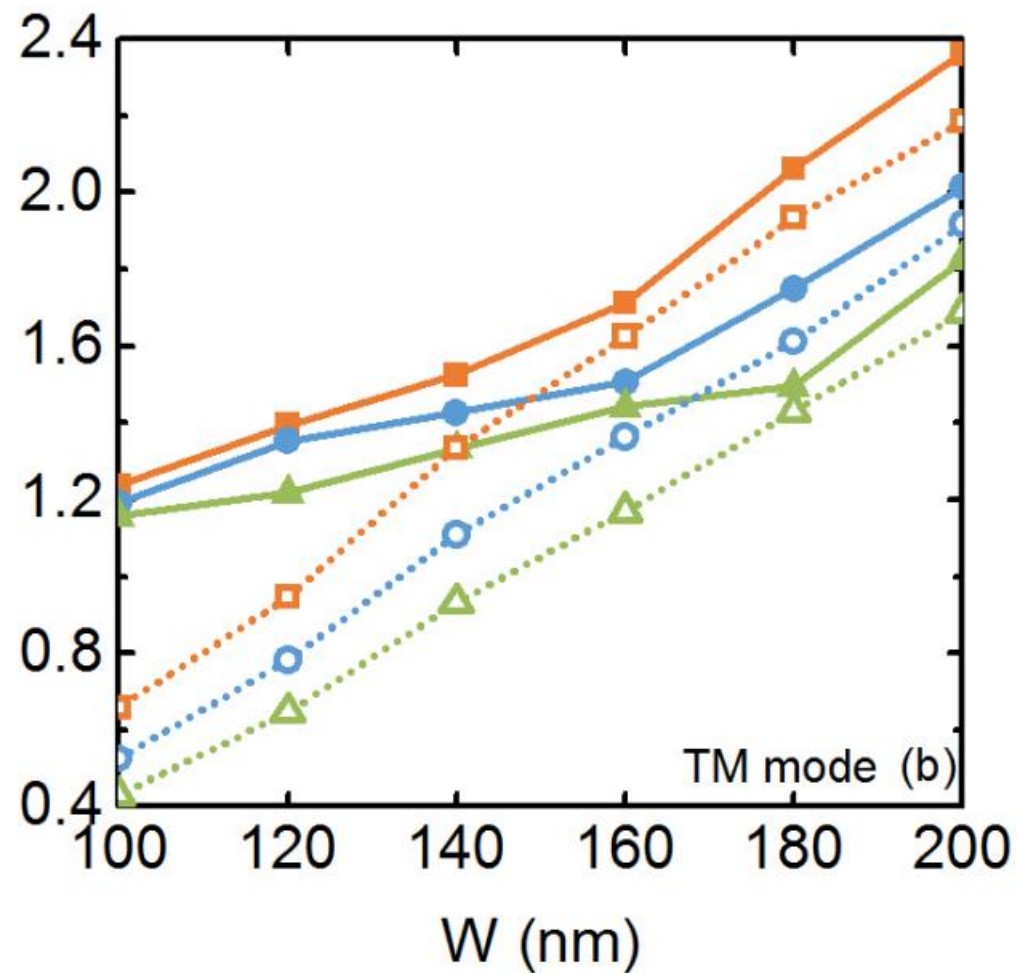
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Coupling Loss for Different W and G



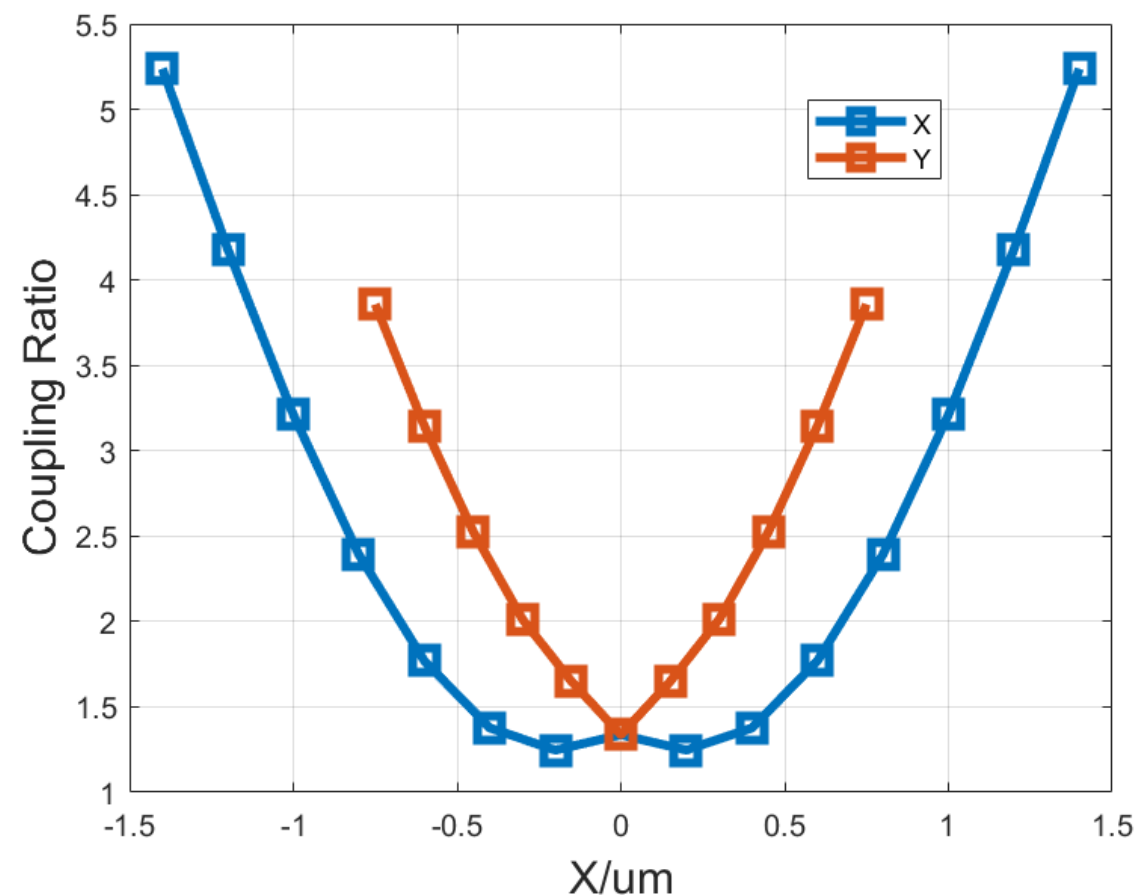
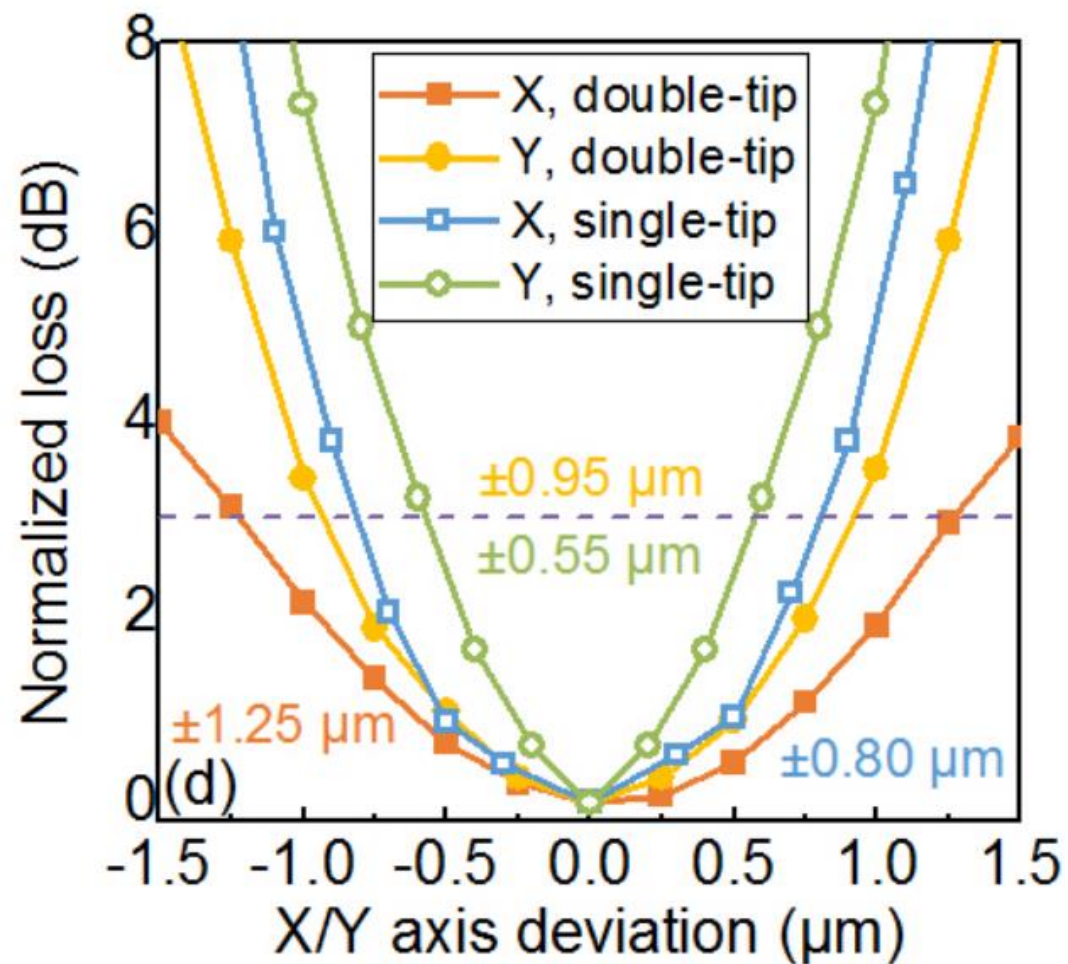
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Misalignment Tolerance



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Difference Analysis

