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3D Optical Many Cores

3D Many-Core Architectures based on Optical Network-on-Chip

Selective coupling functionalities for on-chip mode-division multiplexing

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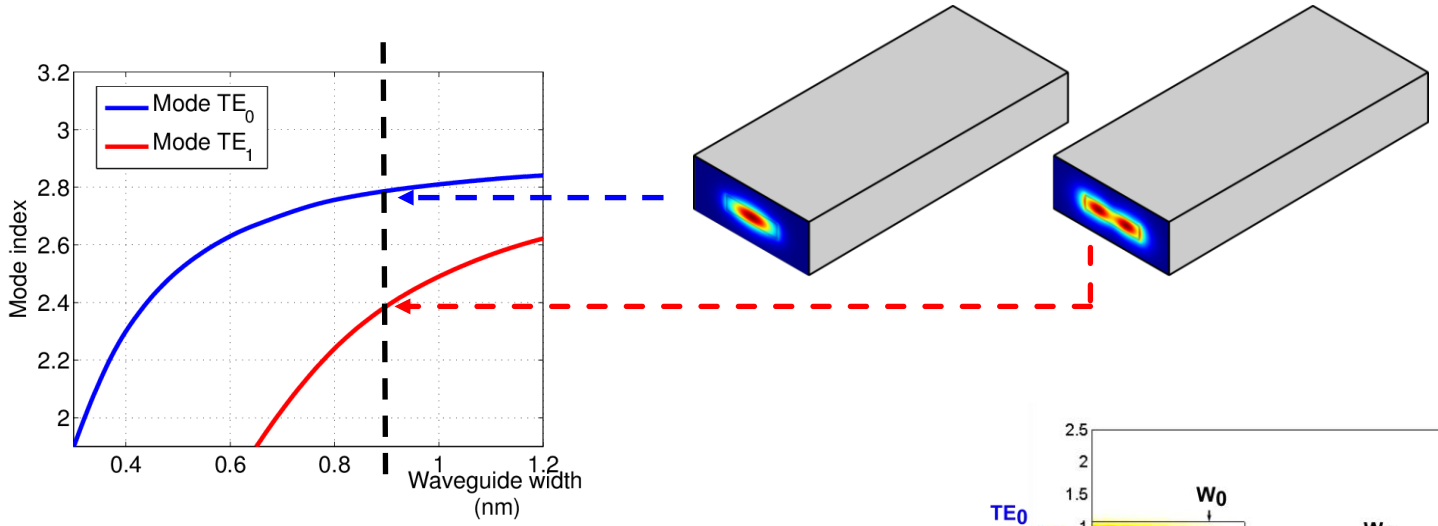
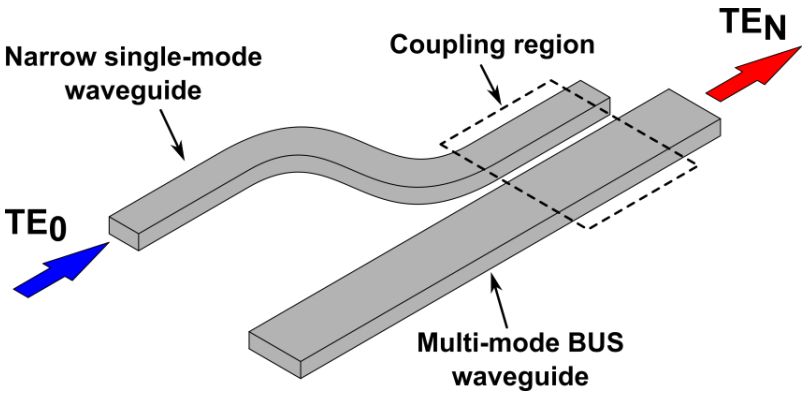
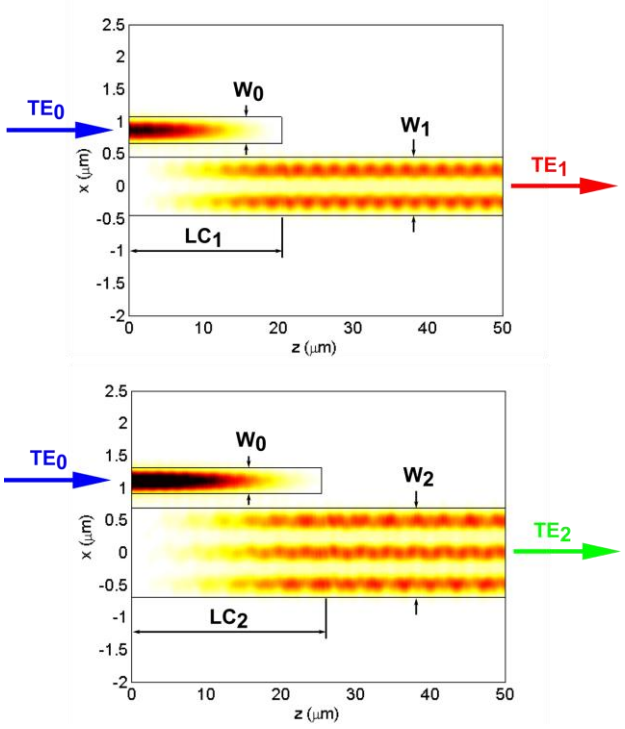
On-chip mode division multiplexing (MDM)

An optical waveguide with a “wide” cross-section section can guide, at a given frequency, several transverse spatial configurations for the propagating field (the modes). Each mode can carry information

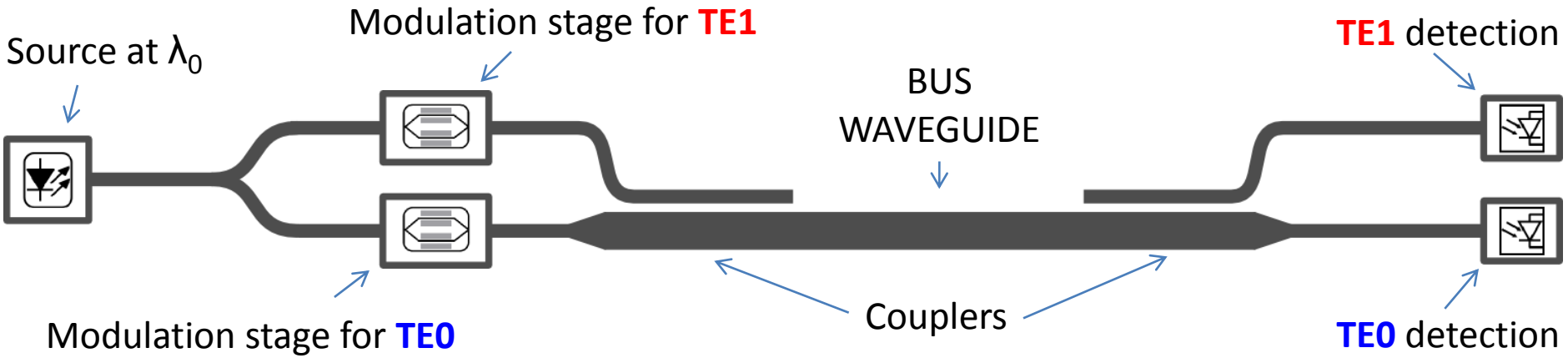


Waveguides with different cross-sections can exchange power via the matching of the mode indices. Therefore modes (and channels) can be multiplexed/demultiplexed

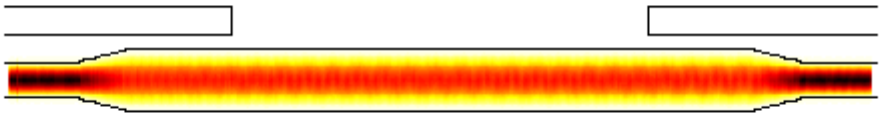




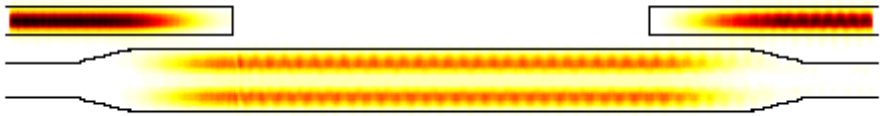
Two-mode MDM point-to-point link



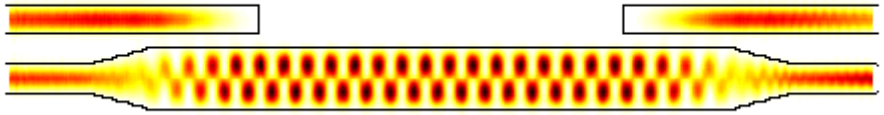
Communication on TE_0



Communication on TE_1

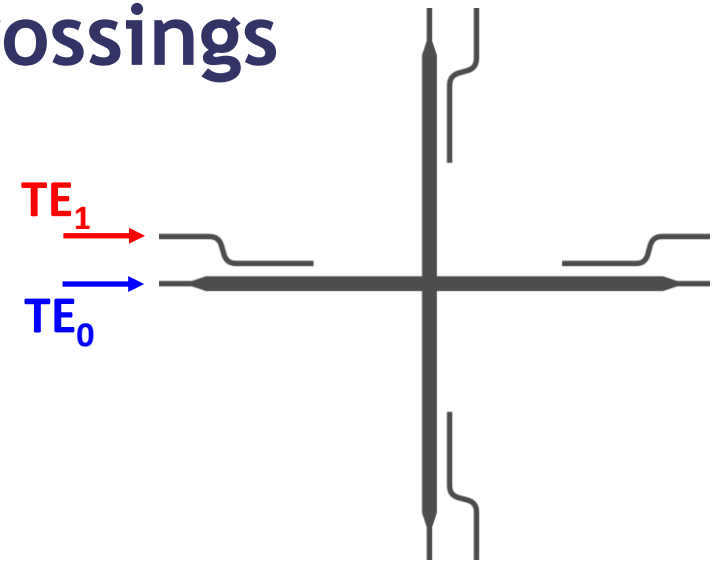


Communication on **TE_0** &**TE_1**

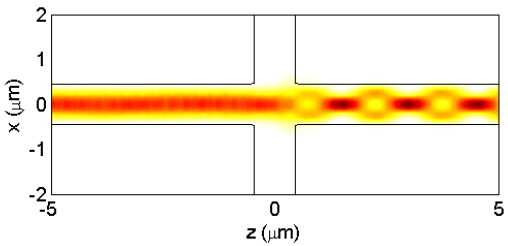


Building blocks for MDM

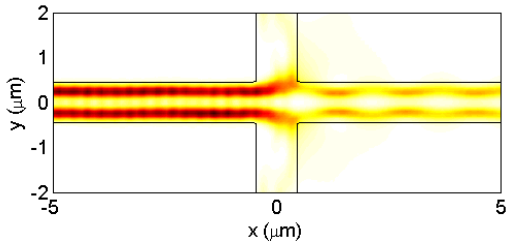
Crossings



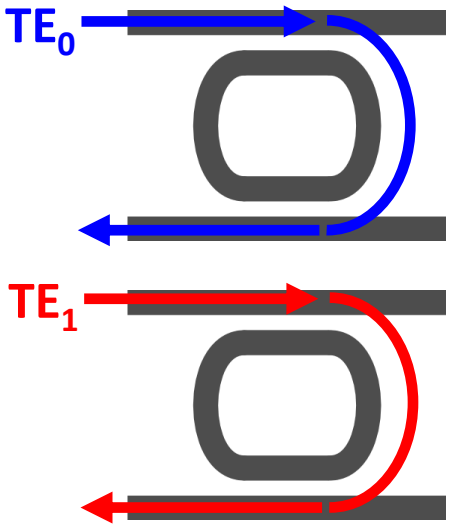
Crossing on TE_0 mode

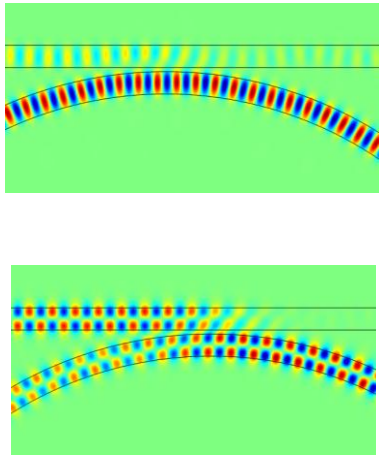


Crossing on TE_1 mode

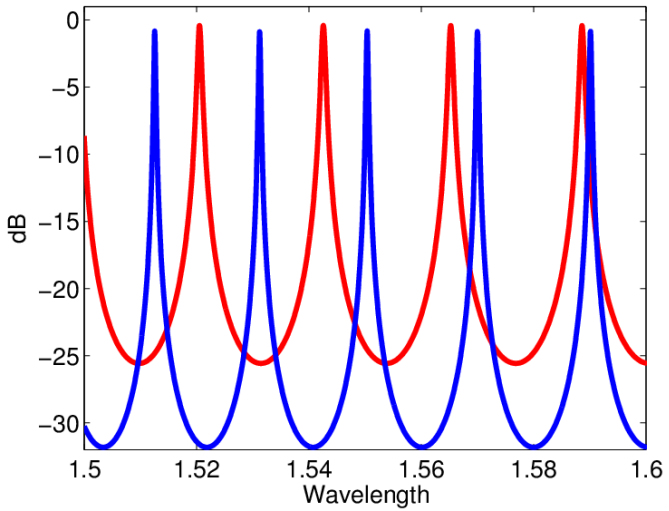


Microrings





Routing of both TE_0 and TE_1



On-Chip MDM : Perspectives and challenges

Many challenges need to be addressed in order to exploit on-chip mode multiplexing

- **Propagation loss** : Higher loss expected for higher-order modes due to surface roughness
- **Crossings** : Losses versus mode order / tapers optimization
- **Bends** : Multimode propagation (MMI effects?)
- **Rejection of mux/demux couplers** : coherent crosstalk
- **Polarization**
- **WDM versus or in conjunction with MDM ?**