

# A 4x1 O-Band MMI Power Combiner Using Silicon Nitride Slot Waveguide Technology

Netanel Katash, Salman Khateeb, Dror Malka

Faculty of Engineering, Holon Institute of Technology (HIT), Holon 5810201, Israel

Correspondence: [drorm@hit.ac.il](mailto:drorm@hit.ac.il); Tel.: +972-3-502-6648

## Abstract

Optical transceivers that function under a high-speed rate condition are demanded to have more optical power ability to overcome the power losses which is a cause of the need of using a larger RF line connected to the Mach-Zehnder modulator for fulfilling the high-speed condition. Therefore, to solve this issue, we propose a new design of a 4x1 power combiner which is based on MMI using a silicon nitride slot waveguide structure for reducing losses.

## The 4x1 laser MMI power combiner structure

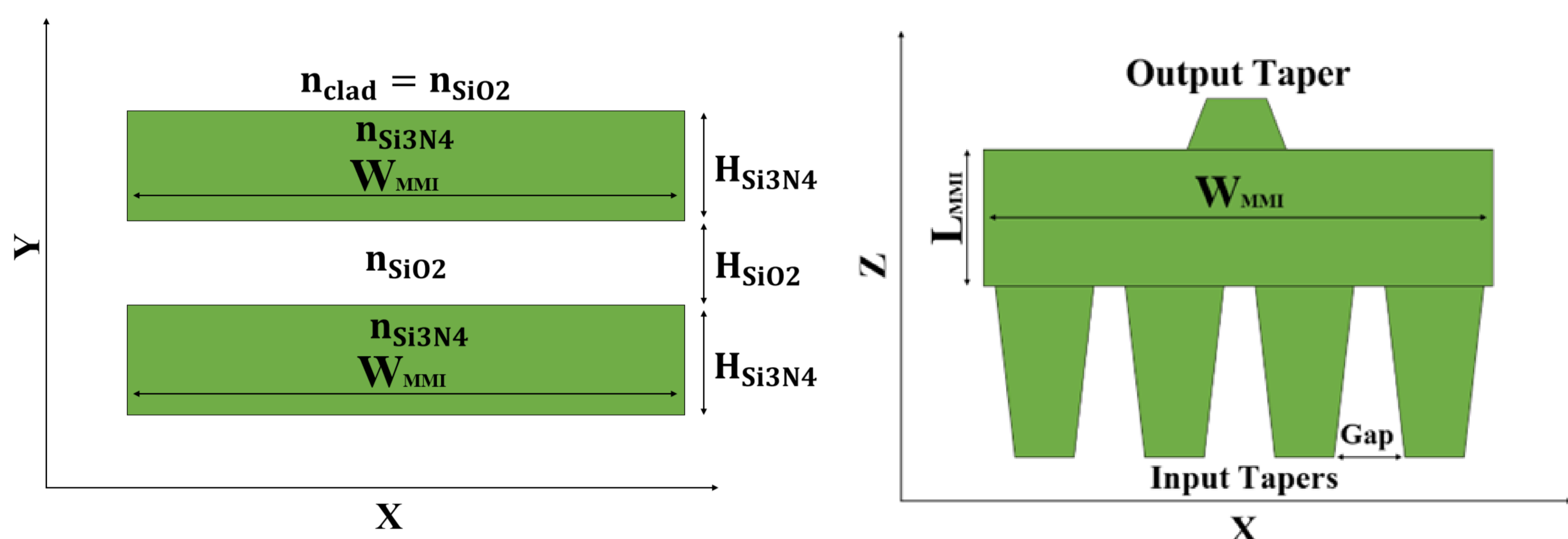


Fig. 1. Schematic illustration of the 4x1 power combiner

## Simulation results

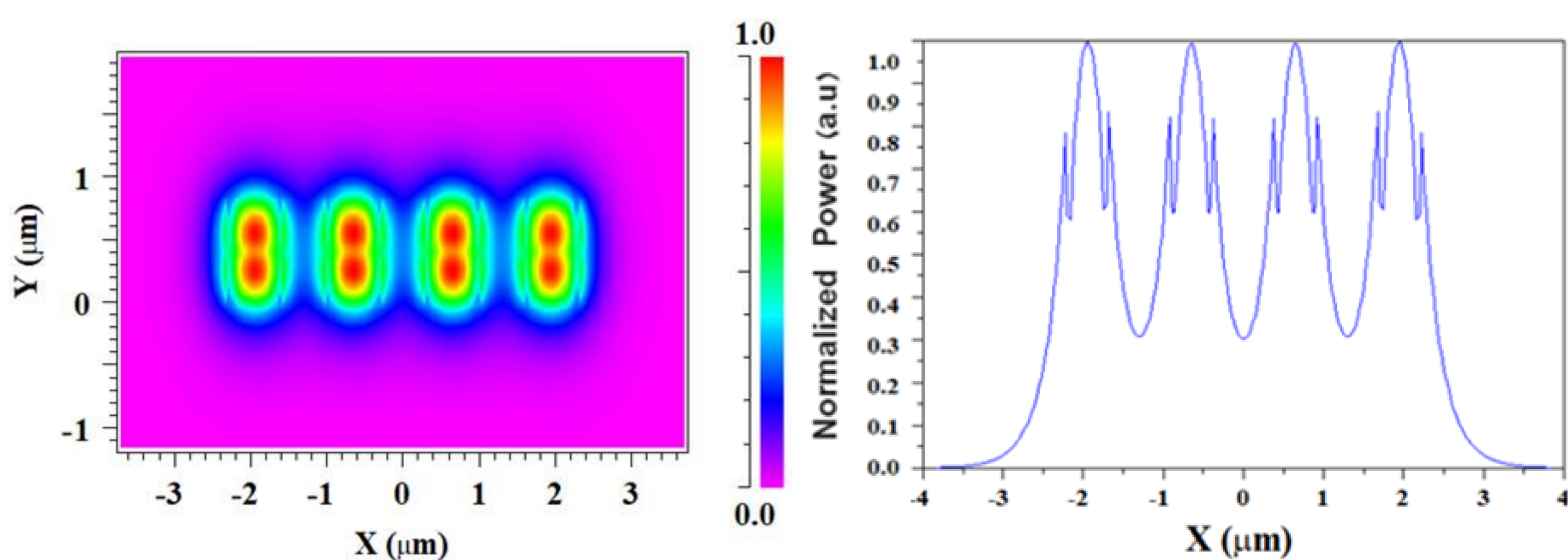


Fig. 2. TE fundamental mode solution for four slot-waveguide structures

The light propagation of four gaussian TE mode field laser sources under the operating wavelength of 1.31 μm can be combined and can reach 98.4% from the input power sources after light propagation of 28.8 μm.

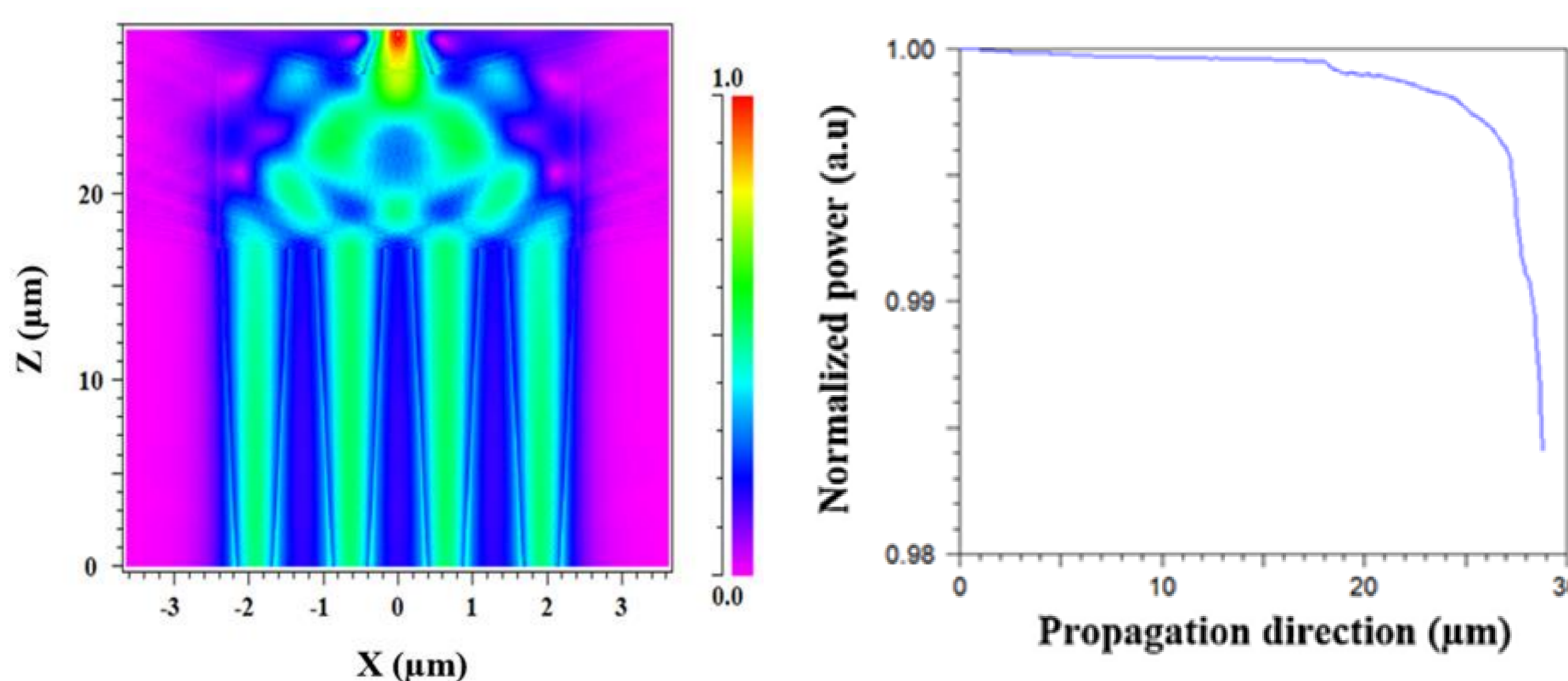


Fig. 3. Intensity light propagation profile for the 4 x 1 MMI power combiner

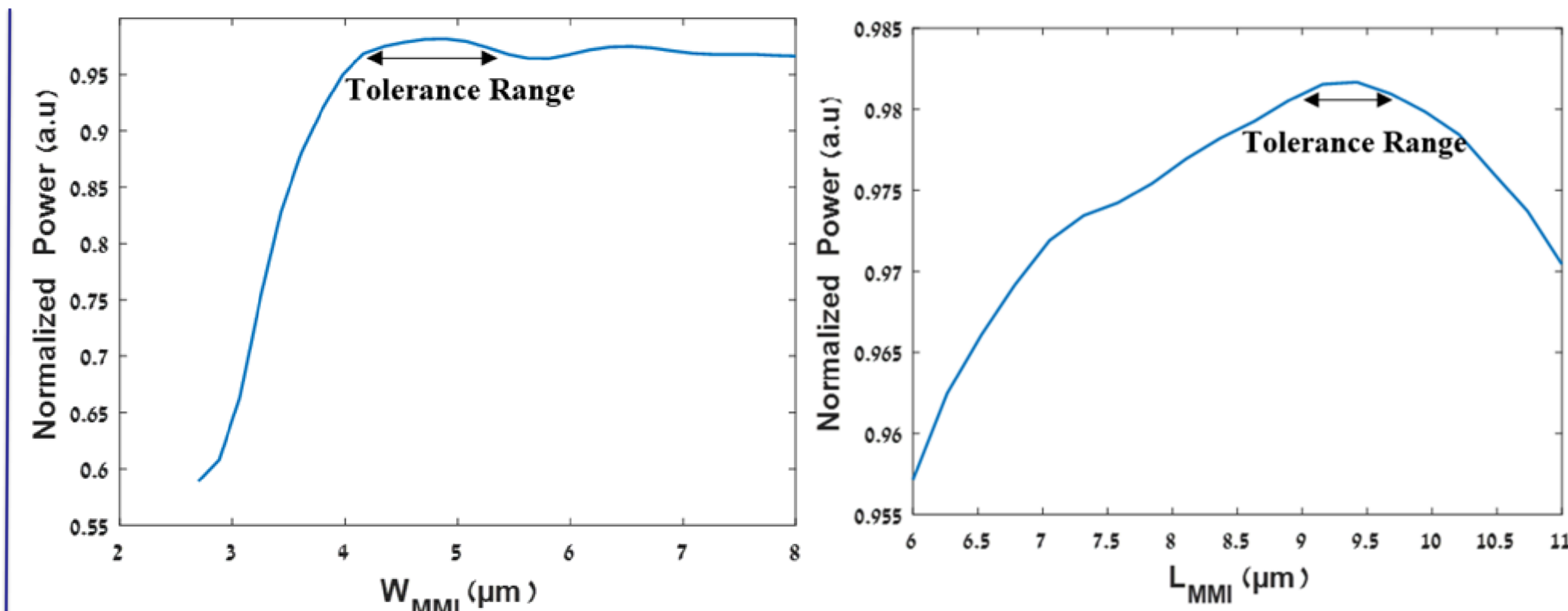


Fig. 4. Normalized power as a function of the MMI coupler geometrical parameters

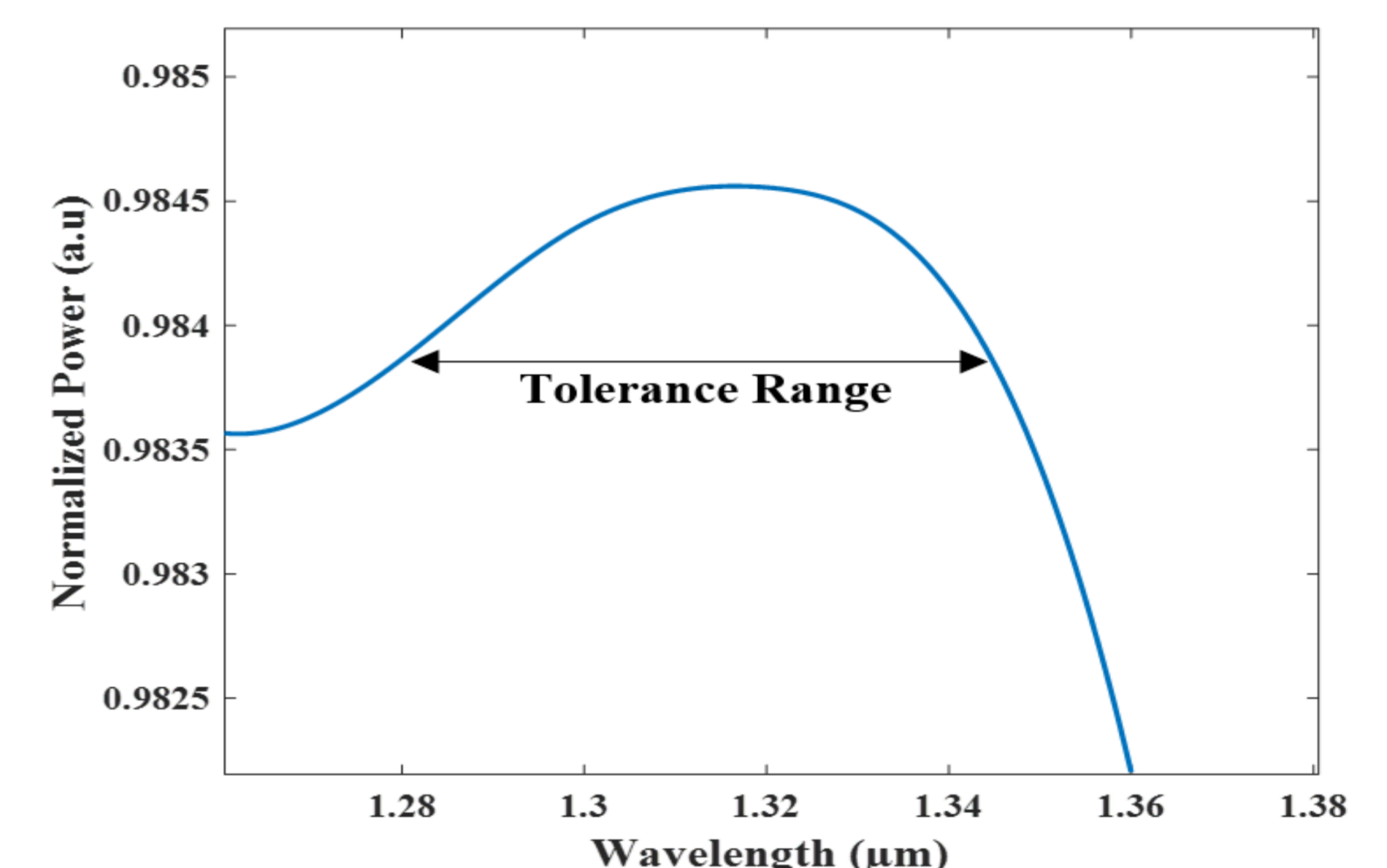


Fig. 5. The normalized power over the O-band spectrum

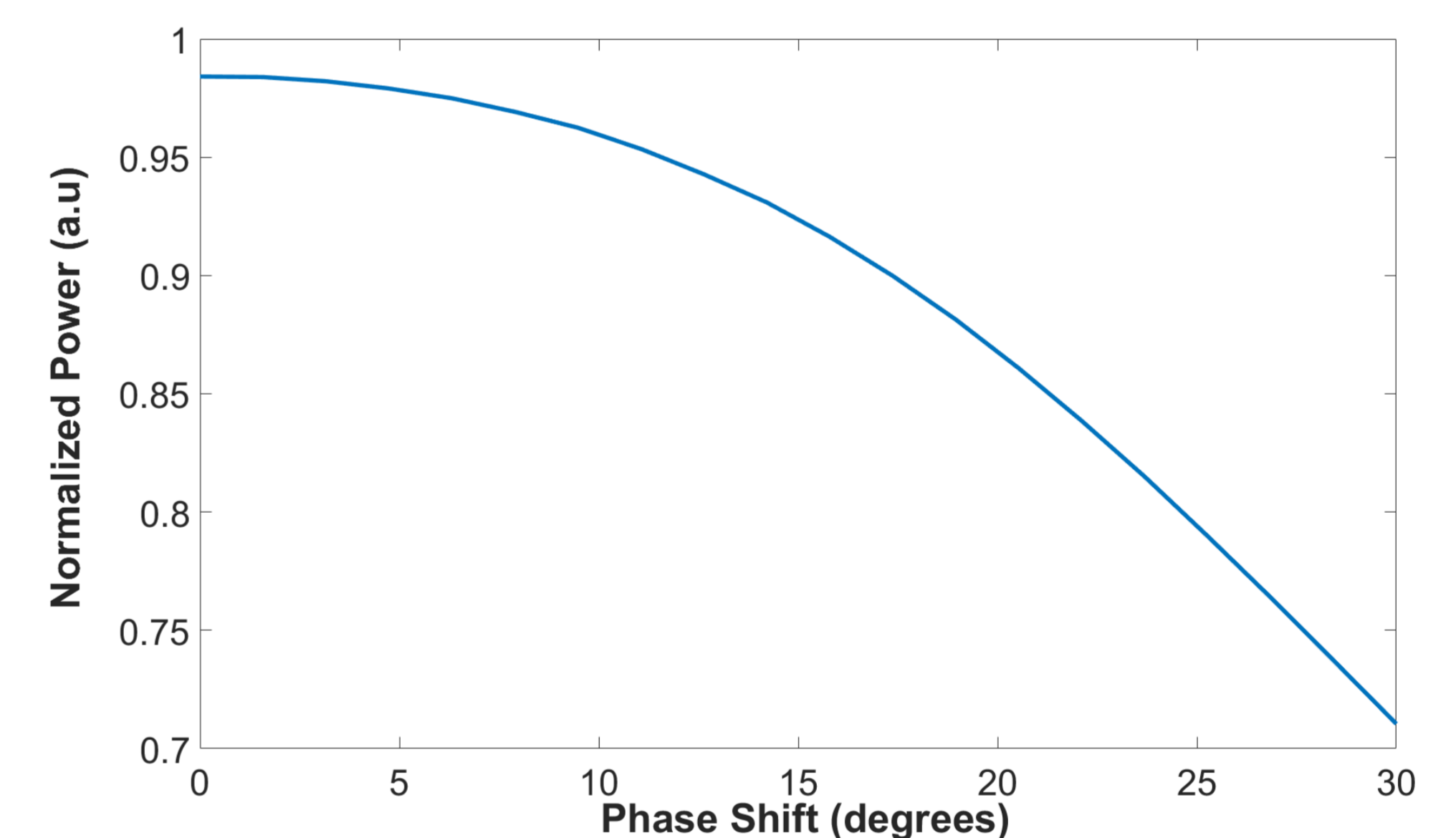


Fig. 6. The normalized power as function of the overall phase shift of the four laser sources

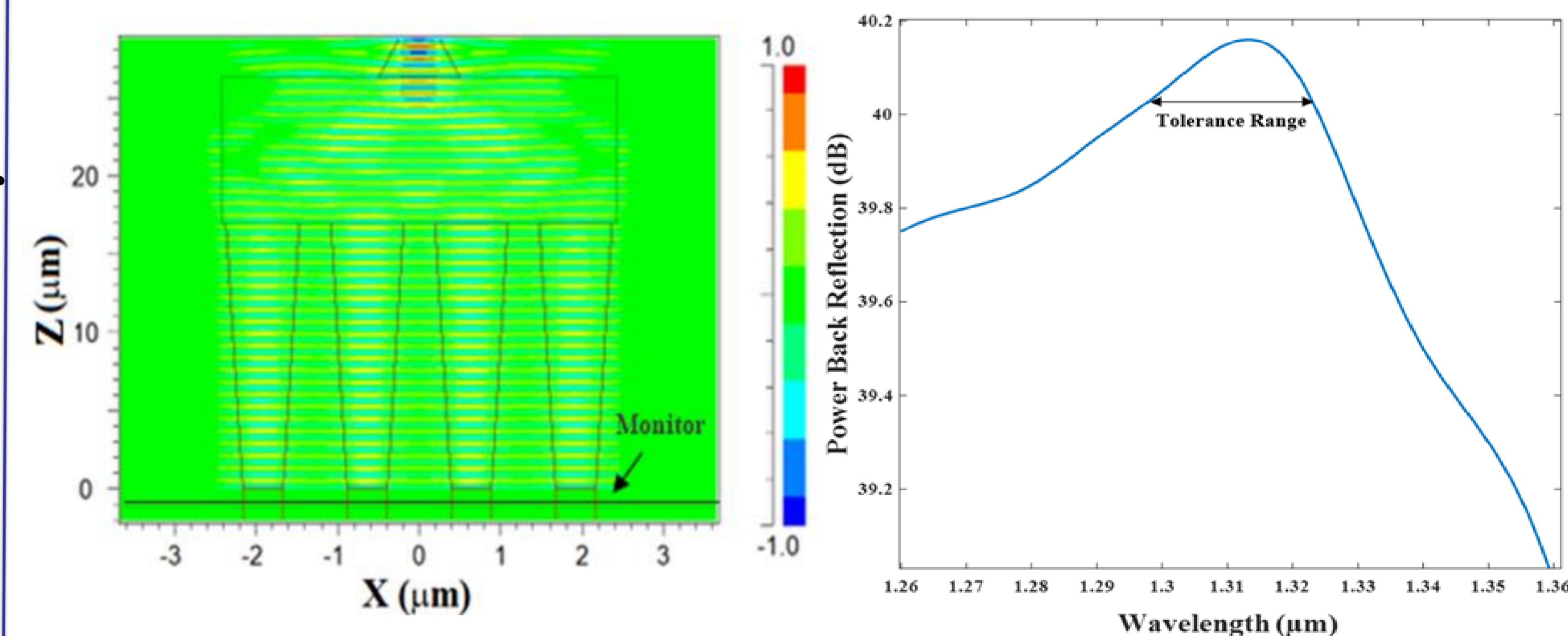


Fig. 7. Back reflection over the O-band spectrum

## Conclusions and discussions

- We have demonstrated that a silicon nitride MMI combiner in a slot waveguide structure can be used to achieve a higher power level
- This work can be used to better understand how to combine various laser sources at the O-band spectrum to boost transmitter system power