Contra-directional Couplers for Wavelength Selective Switches

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UCSB

AIM photonics
AMERICAN INSTITUTE for MANUFACTURING INTEGRATED PHOTONICS

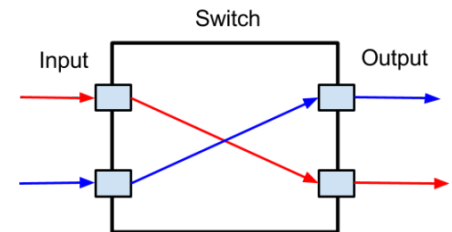# Reducing Energy Consumption in Data Centers

❖ **Electronic Switches**

  ➢ Transfer information in data centers

  ➢ Energy Inefficient, but cost effective

❖ **Optical Switches**

  ➢ Reroutes light signals between fibers

 ➢ Energy Efficient; no need to convert to electrical signal

Data Center

What is a Wavelength Selective Switch?

❖ *A type of optical switch*

❖ Accepts light input with a multitude of wavelengths

❖ Filters light output according to wavelength

❖ Flexible and cost effective in data centers

Wavelength Selective Switch

Input

Output
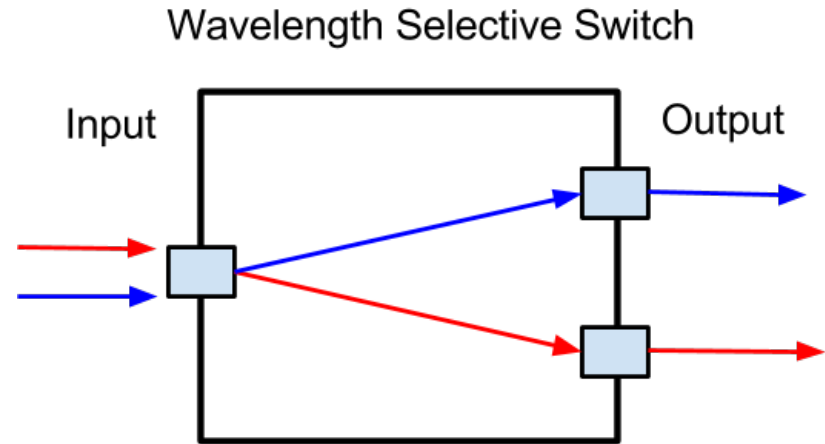
What is a Contra-directional Coupler?

❖ *The device acts as a filter*

❖ **Contra-Directional:** Light travels in opposite directions

❖ **Coupling**: Light exchanged between waveguides

❖ **Grating:** reflects light to other waveguide
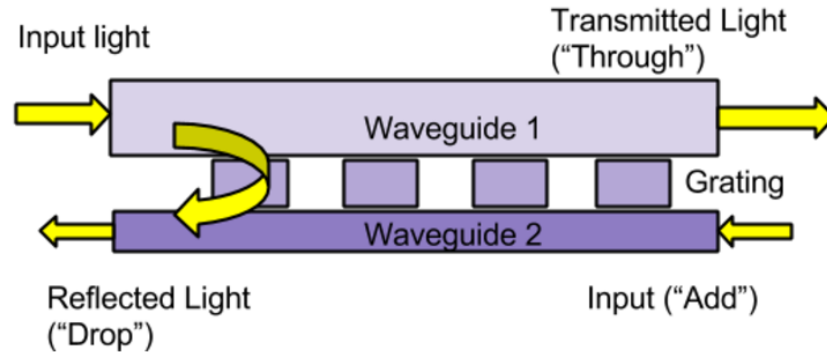
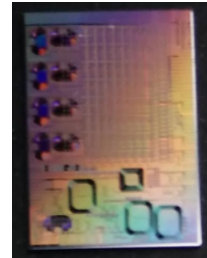# Finding Wavelength Spectrum for Different Filters

❖ **Computer Simulations**

   ➢ Generate the wavelength spectrum for different contra-directional couplers

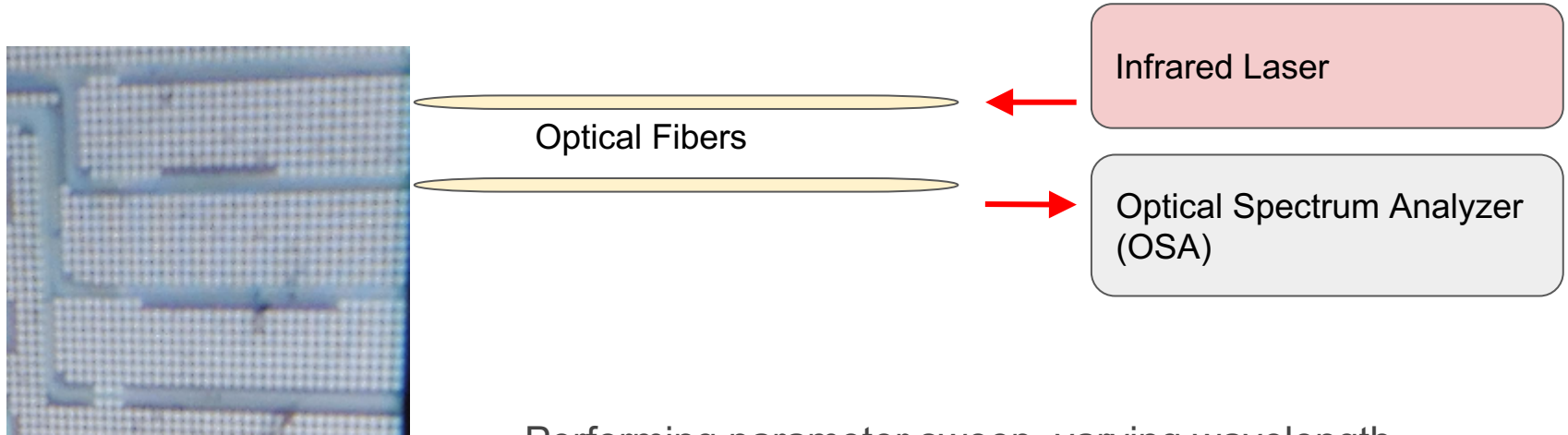   ➢ Use simulations to analyze experimental data

❖ **Optical Testing**

   ➢ Measure the spectrum of test structures in the laboratory

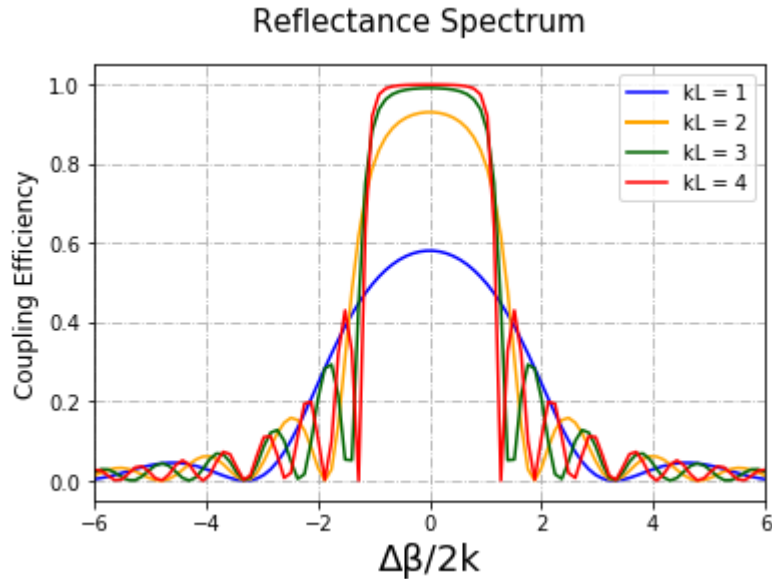   ➢ Examine how grating length affects spectrum

Lab Set-up for Optical Testing

Optical Fibers

Filter Ports

Infrared Laser

Optical Spectrum Analyzer (OSA)

-Performing parameter sweep, varying wavelength.

-Measuring power response in each port.

Simulations to Analyze Contra-directional Couplers

Reflectance Spectrum
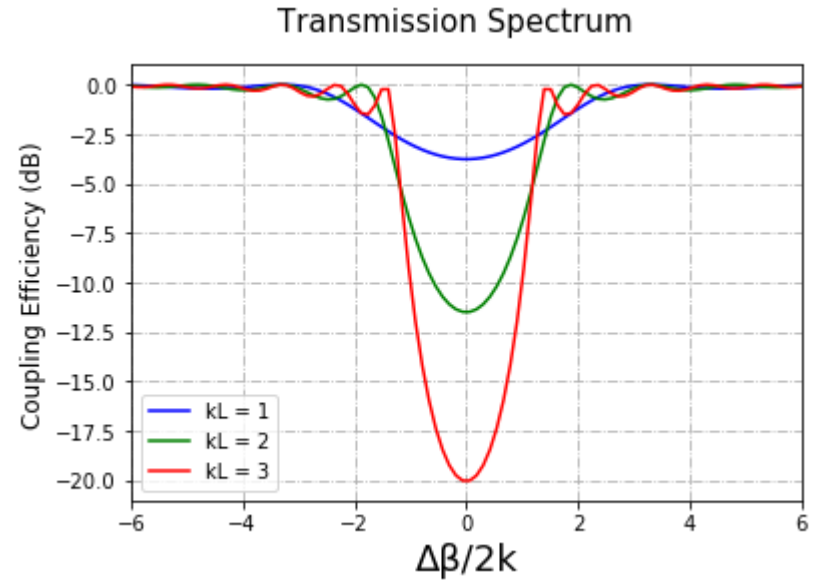
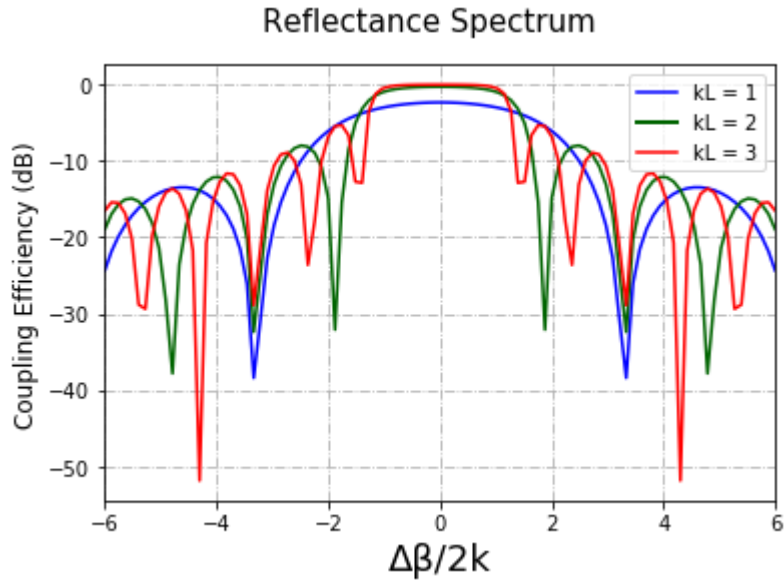k = coupling constant

L = interaction length

Phase matching:

$$\Delta\beta = (n_a + n_b)\left(\frac{2\pi}{\lambda} - \frac{2\pi}{\lambda_0}\right)$$
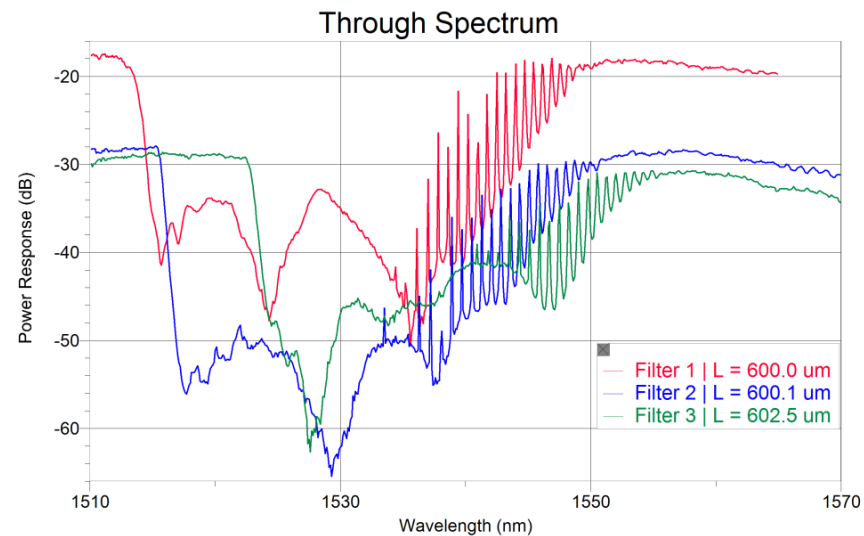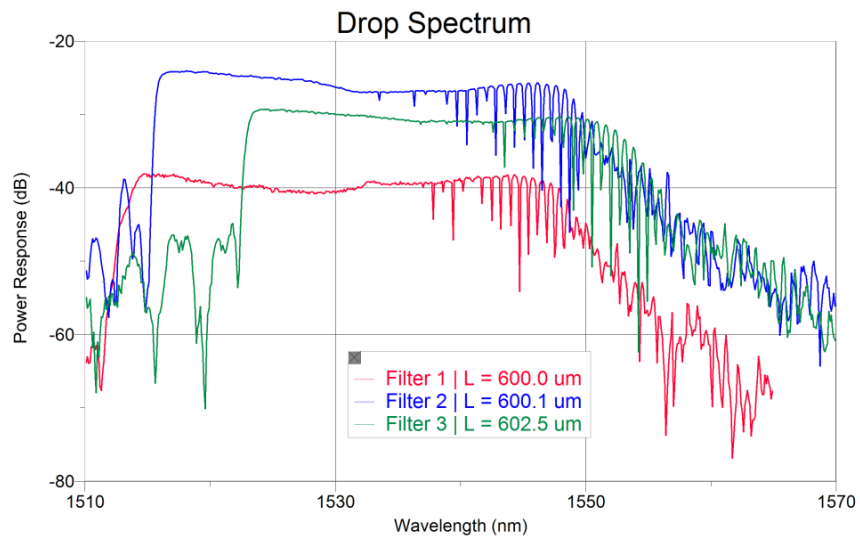
Indices of Refraction

Wavelength varies

Filter Simulation for Transmission and Reflection

Reflectance Spectrum

Transmission Spectrum

$$\Delta\beta = (n_a + n_b)(\frac{2\pi}{\lambda} - \frac{2\pi}{\lambda_0})$$

Indices of Refraction

Wavelength varies

Measured Spectrum of Contra-directional Couplers

Future Plans

❖ Test more contra-directional couplers

❖ Run sophisticated simulations for data analysis

❖ Determine coupling constant ("k")

❖ Design new contra-directional couplers using results

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