

Simulation of Thermally Tunable Optical Rings

Rebecca Hwang

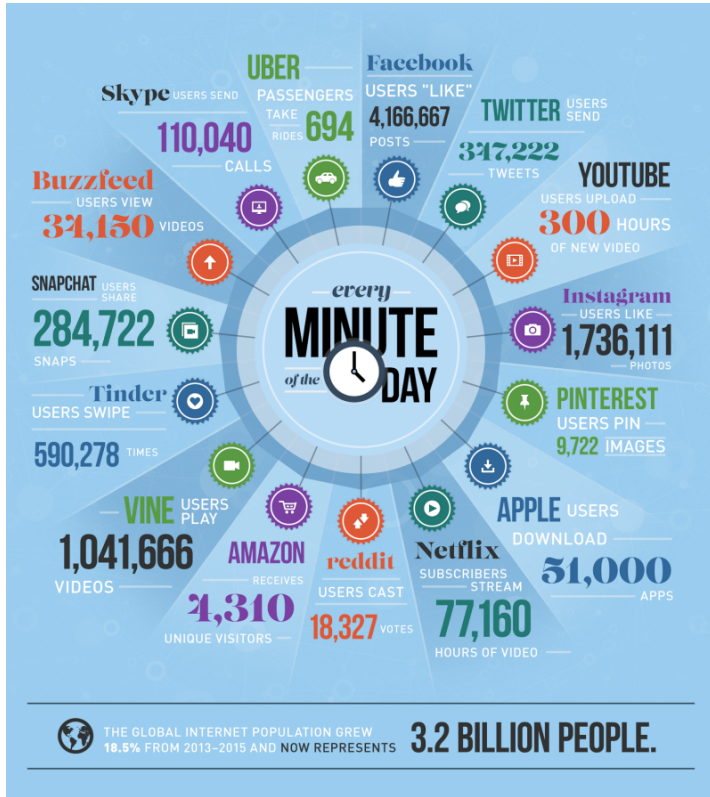
Mentor: Andrew Netherton

Principal Investigator: John Bowers

Optoelectronics Research Group



Increasing Data and Inefficient Data Centers

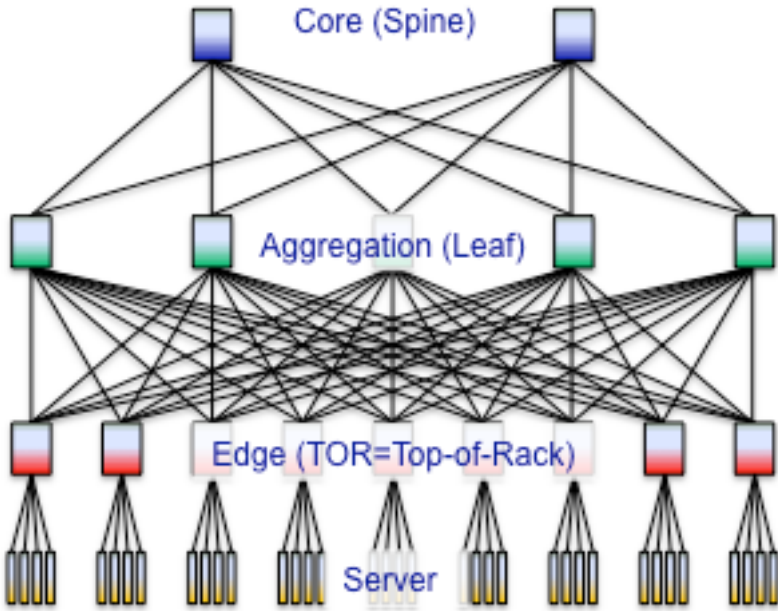
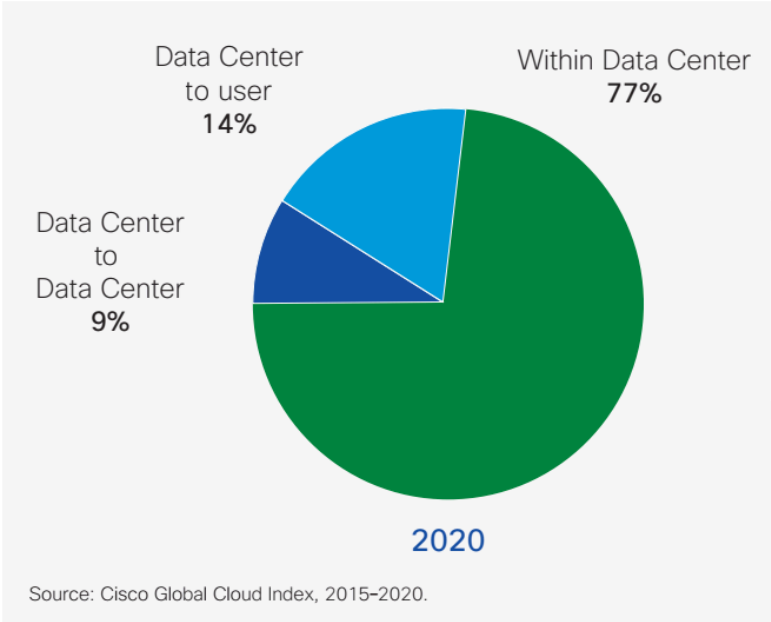


source: <https://www.domo.com>



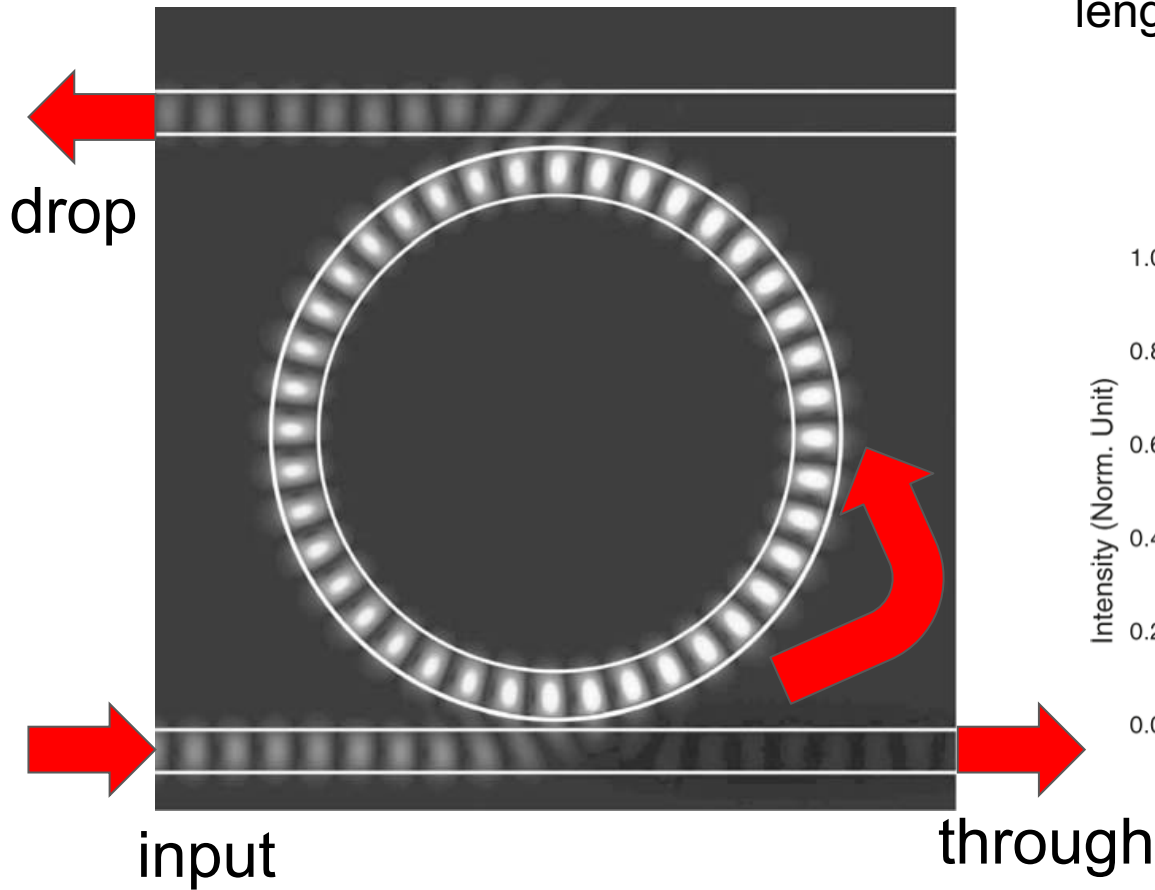
source: Google Data Center

Data Center Traffic



source: Professor Clint Schow, ECE 594 Lecture 1

Optical Rings

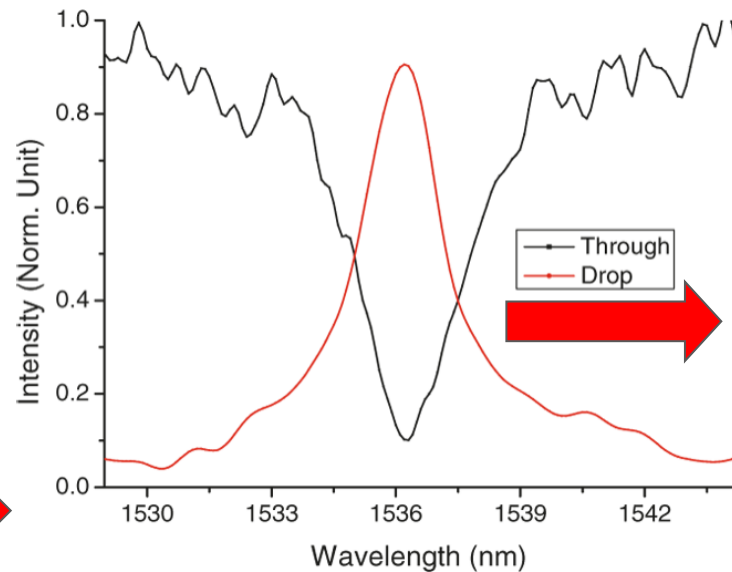


Optical path length

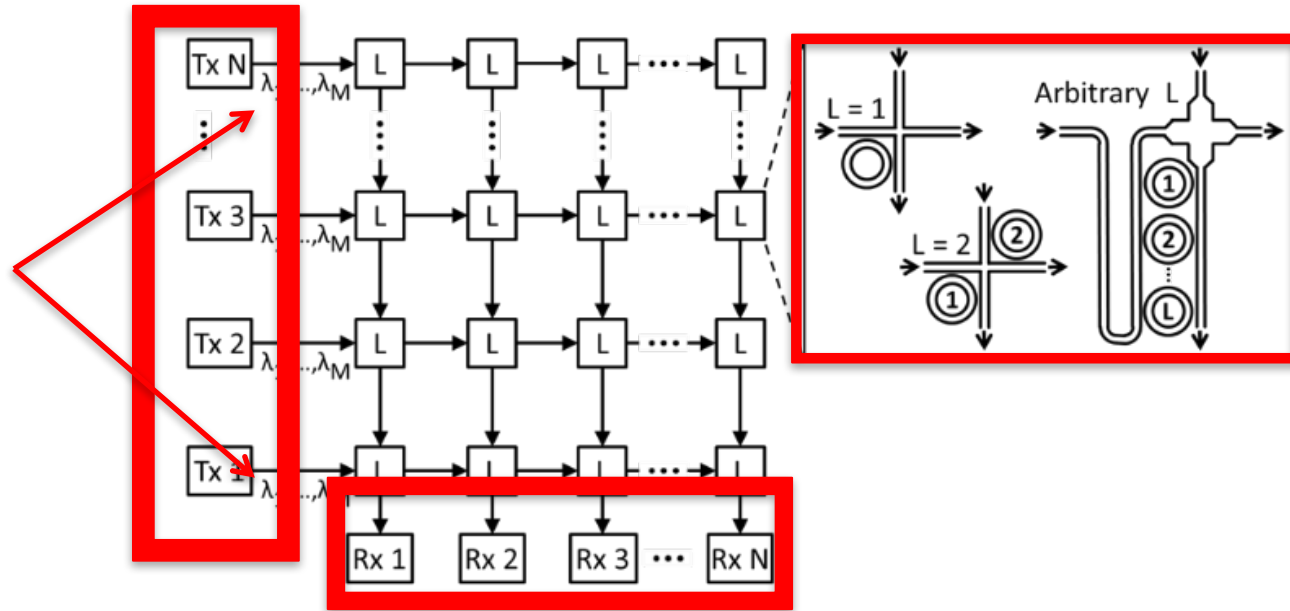
Integer multiple of resonant wavelength

$$2\pi r n_{eff} = m\lambda_m$$

The equation $2\pi r n_{eff} = m\lambda_m$ is shown with an orange oval around the left side and an orange box around the right side. An orange arrow points from the box to the text "Integer multiple of resonant wavelength".

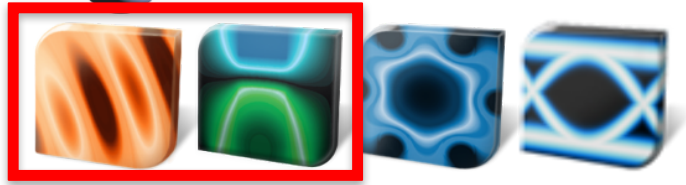


Optical Circuit Switch

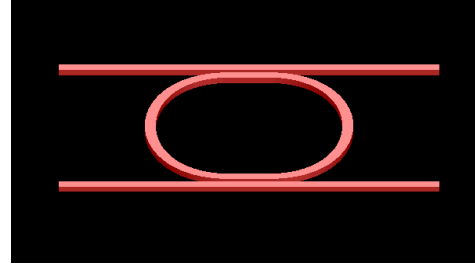


Source: A. S. P. Khope, et al., "Elastic WDM crossbar switch for data centers", in IEEE Optical Interconnects Conference (OI), (2016).

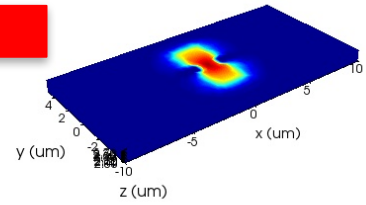
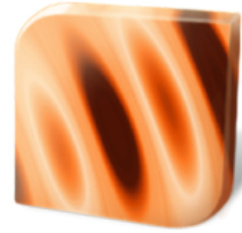
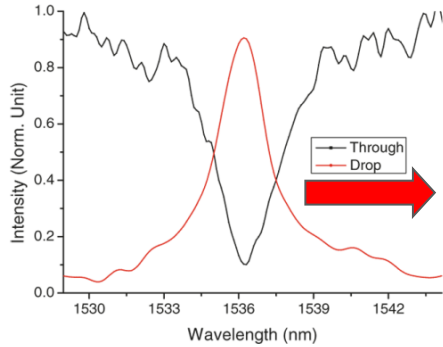
Photonic Simulation Software



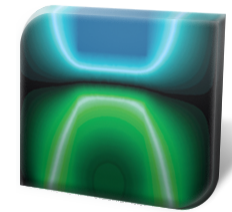
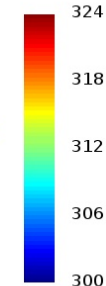
FDTD DEVICE MODE INTERCONNECT



Optical Simulation

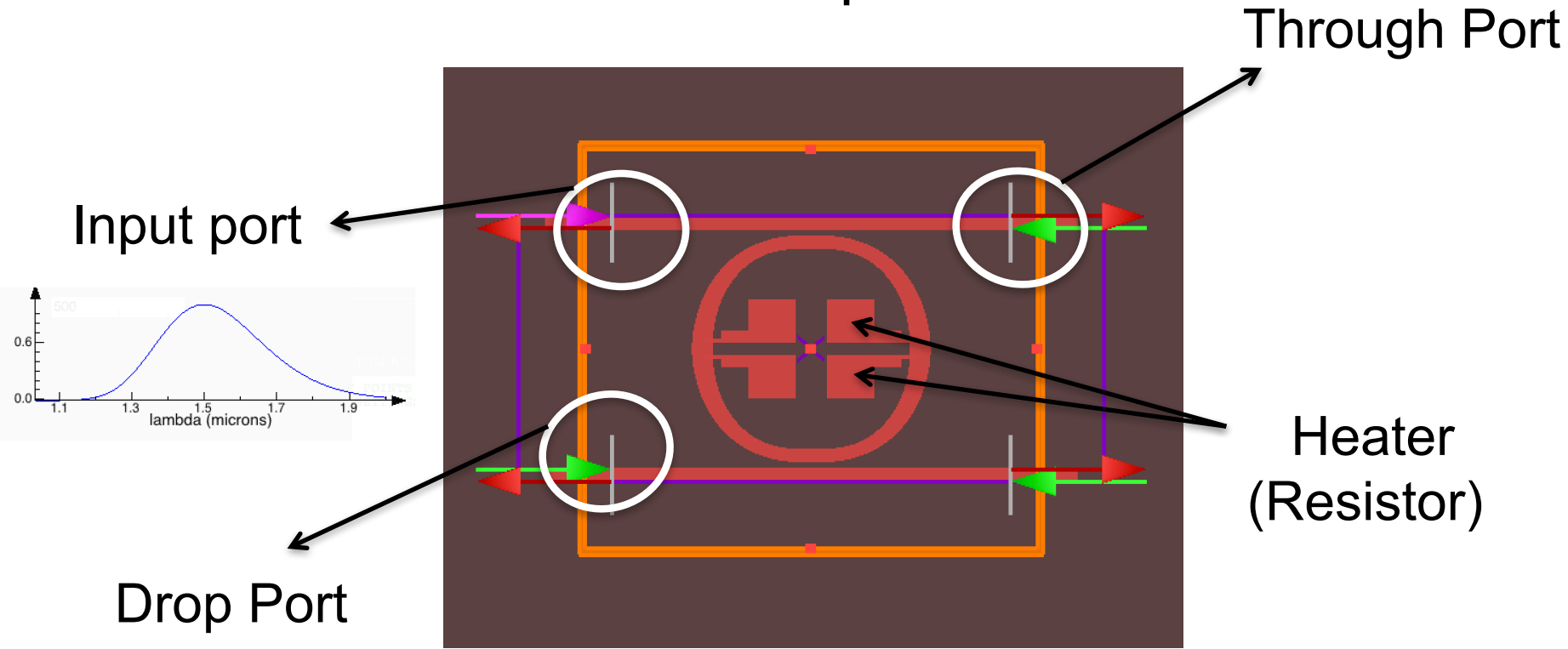


Thermal Simulation

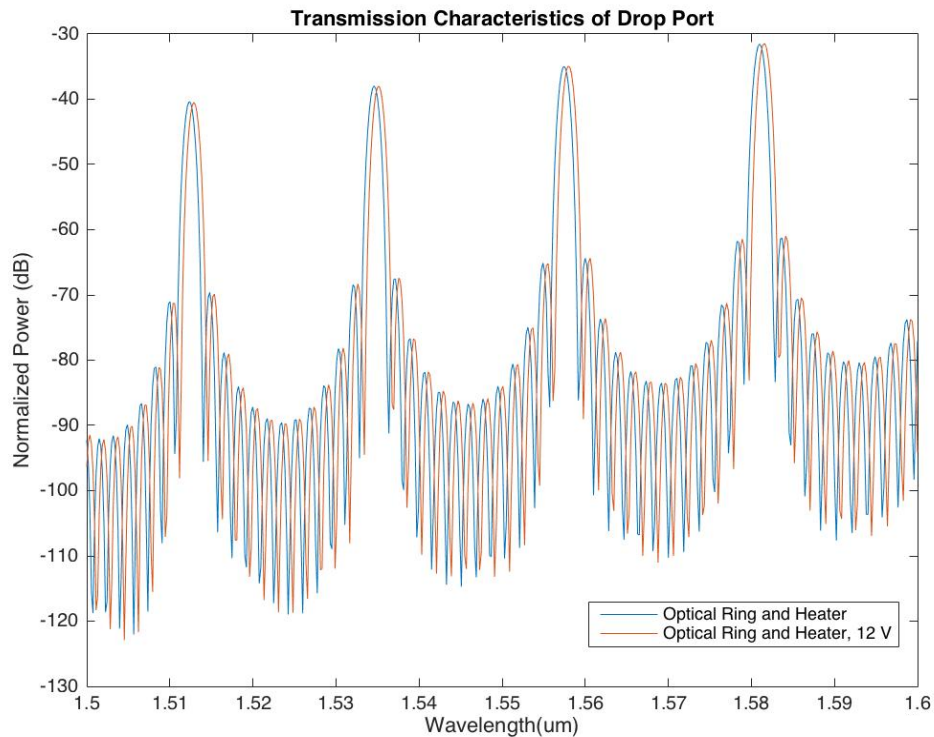


Heat Transport Solver

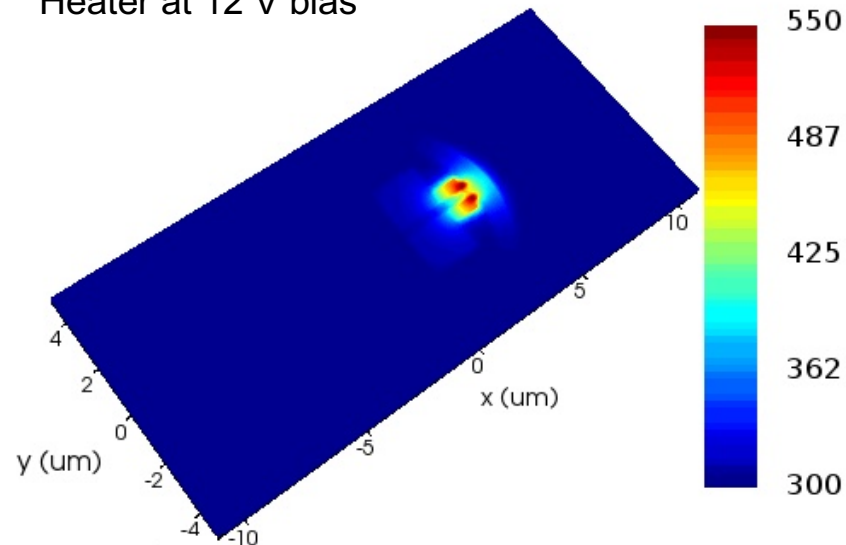
Lumerical Simulation Set Up



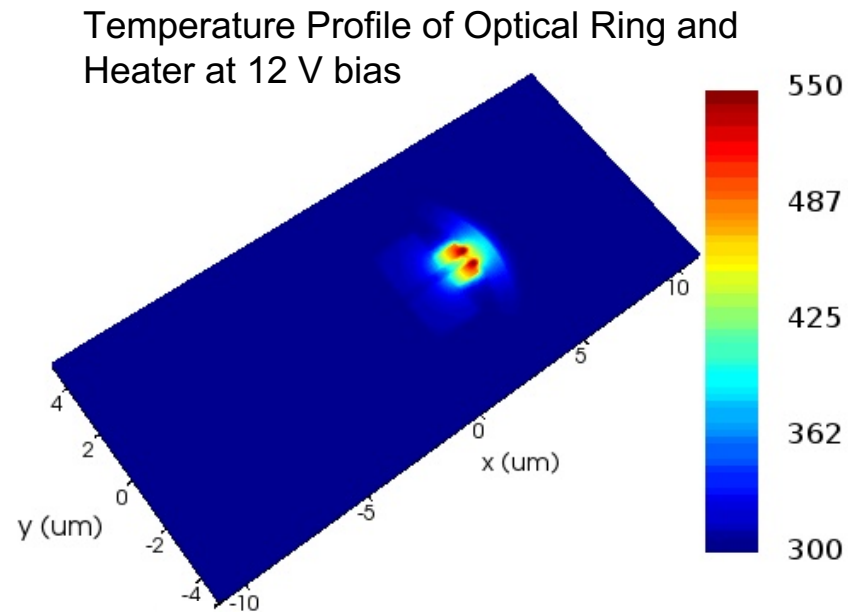
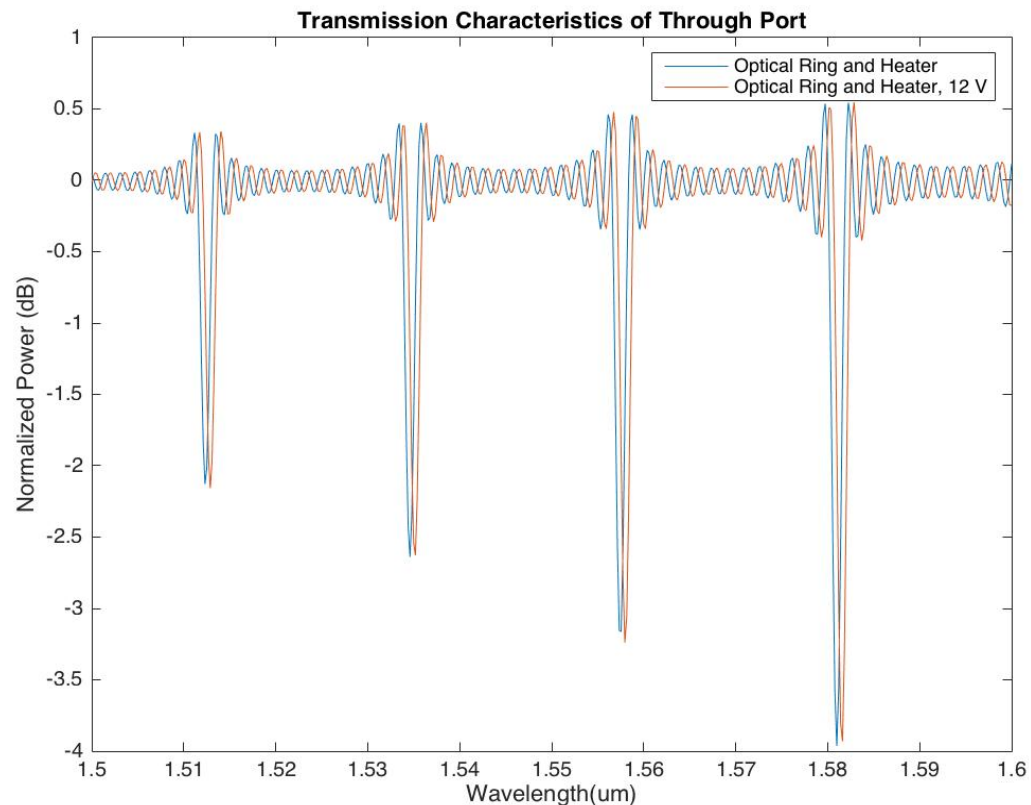
Drop Port: Thermal Tuning Effects



Temperature Profile of Optical Ring and Heater at 12 V bias



Through Port: Thermal Tuning Effects



Future Work

- Design a more effective heater
- Refine simulation framework to test new heater designs
- Fabricate thermally tunable optical ring, building block of optical switch circuit

Special Thanks To:

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PI: Professor John Bowers

Professor Clint Schow

Program Coordinators: Wendy Ibsen and Jens-Uwe Kuhn

