Silicon photonic devices and integrated circuits

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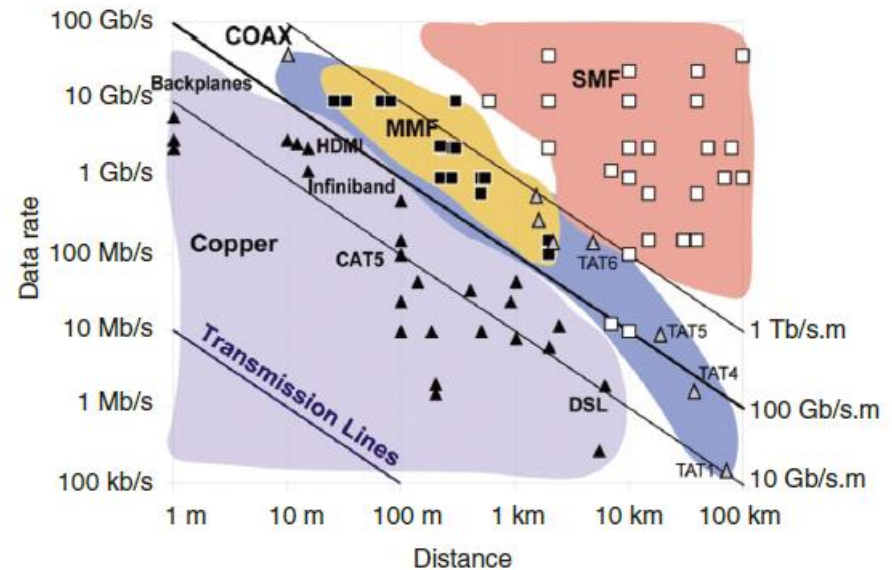
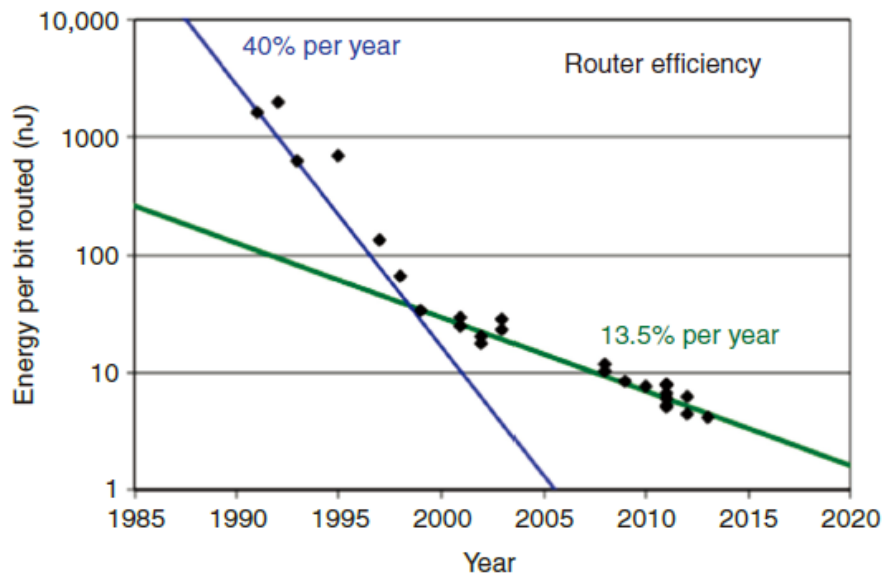   III. Datacenters and supercomputers

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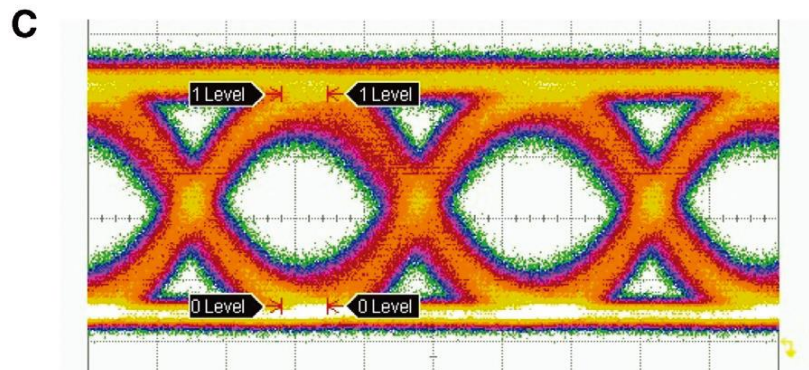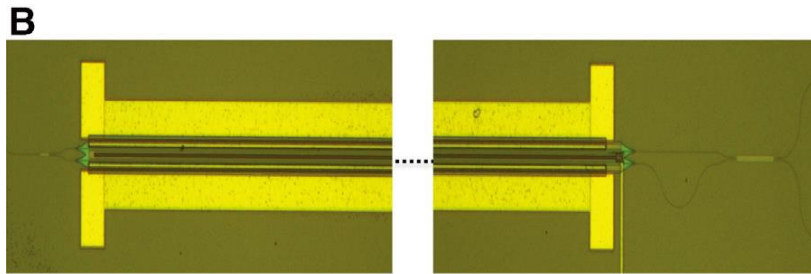
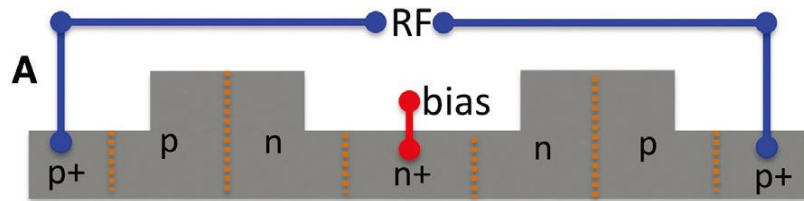III. **Conclusions**

Applications

☐ Long-haul/metro coherent optical networks

☐ Optical interconnects for routers and switches

☐ Datacenters and supercomputers

Silicon Photonic devices

☐ Single-drive push-pull silicon MZMs

☐ Hybrid silicon/III-V lasers

☐ On-chip polarization elements
  ☐ SiN-assisted polarization rotators

Single-drive push-pull silicon MZMs
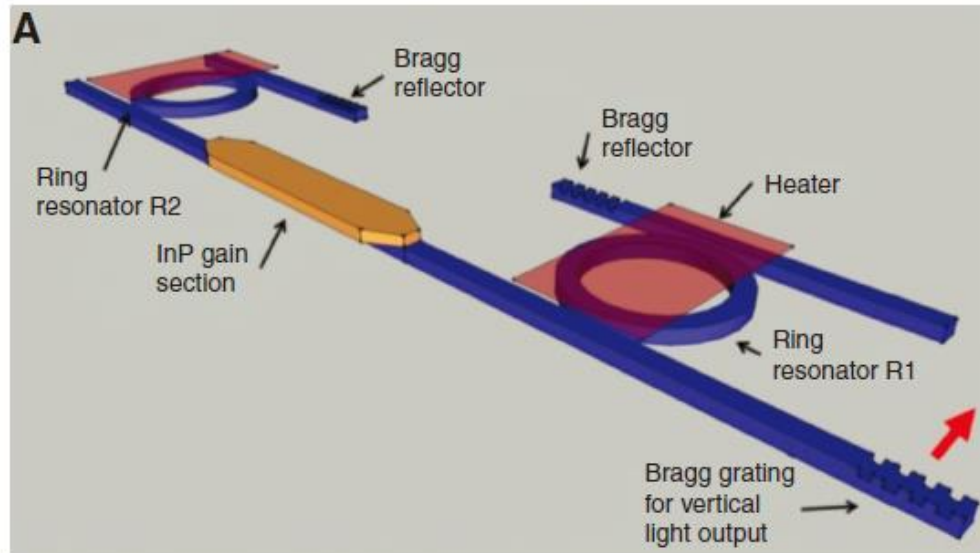

- ☐ MZM performance parameter
  - ■ Bandwidth
  - ■ Vpi
  - ■ Insertion loss

- ☐ free-carrier induced index change

- ☐ Series configuration of junction capacitors
  - ■ Reduced load capacitance

Hybrid silicon/III-V lasers
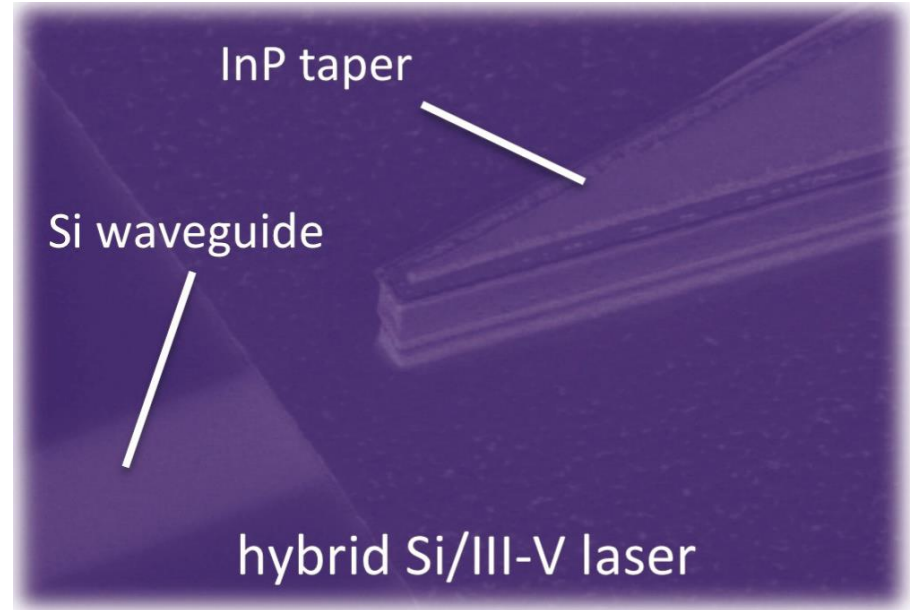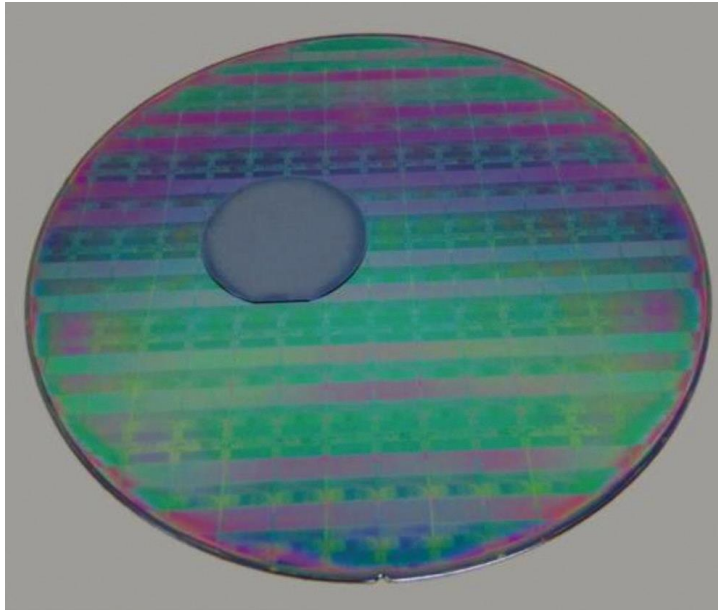
- ☐ On-chip laser source is important block on PICs.
- ☐ Adhesive and molecular wafer bonding techniques
- ☐ Reported by Dong et al. from Bell Labs

Hybrid silicon/III-V lasers

A

Bragg reflector

Bragg reflector

Heater

Ring resonator R2

InP gain section

Ring resonator R1

Bragg grating for vertical light output

- ☐ Wavelength tunable laser
  - ■ InP-based amplification
  - ■ Tapers
    - ☐ the modal transfer between III-V and Si
  - ■ two ring resonators
    - ☐ single mode selection
  - ■ Metal heaters
    - ☐ Thermal wavelength tuning
  - ■ Bragg gratings
    - ☐ Reflection
    - ☐ Output fiber coupling

Hybrid silicon/III-V lasers

- ☐ laser emission spectra
- ☐ Ring1: transmission dips
- ☐ Ring2: transmission peaks
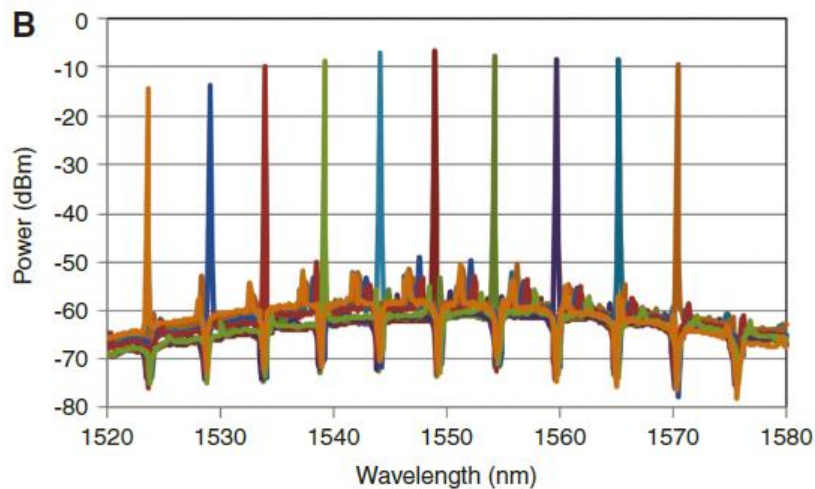
- ☐ Combined power: <400mW
- ☐ side mode suppression: >40dB

On-chip polarization elements

☐ Sub-um Si waveguides characteristics
- different mode fields for TE and TM modes
- effective indexes for TE and TM modes

☐ Solution: Polarization-diversified circuits
- on-chip polarization elements are required
  - ☐ polarization rotators
  - ☐ polarization beam combiners/splitters

SiN-assisted polarization rotators
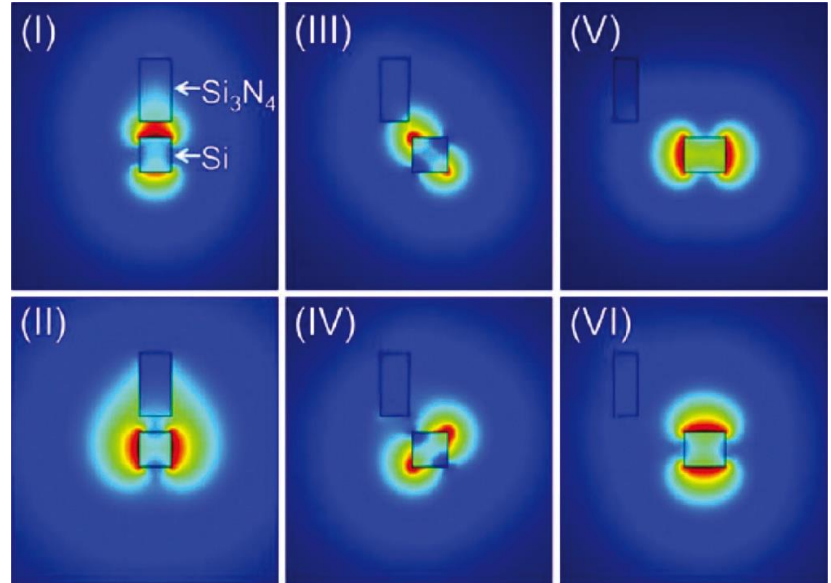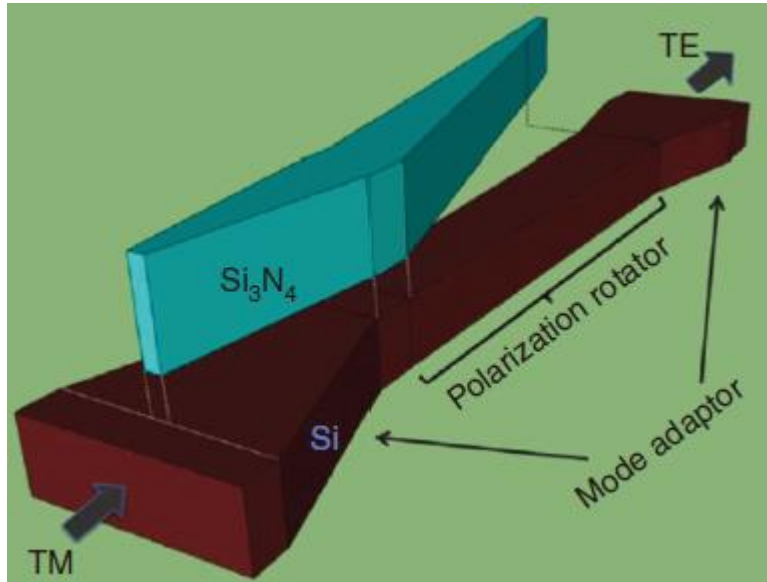
- ☐ Adiabatic mode evolution
- ☐ >95% coupling efficiency for TM mode
- ☐ < 5% coupling efficiency for TE mode

Conclusions

☐ Applications

- Long-haul/metro coherent optical networks

- Optical interconnects for routers and switches

- Datacenters and supercomputers

☐ Devices

- On-chip Modulators – Single-drive push-pull Si MZMs

- On-chip Lasers – Si/III-V lasers

- On-chip Polarization elements - SiN-assisted polarization rotators