

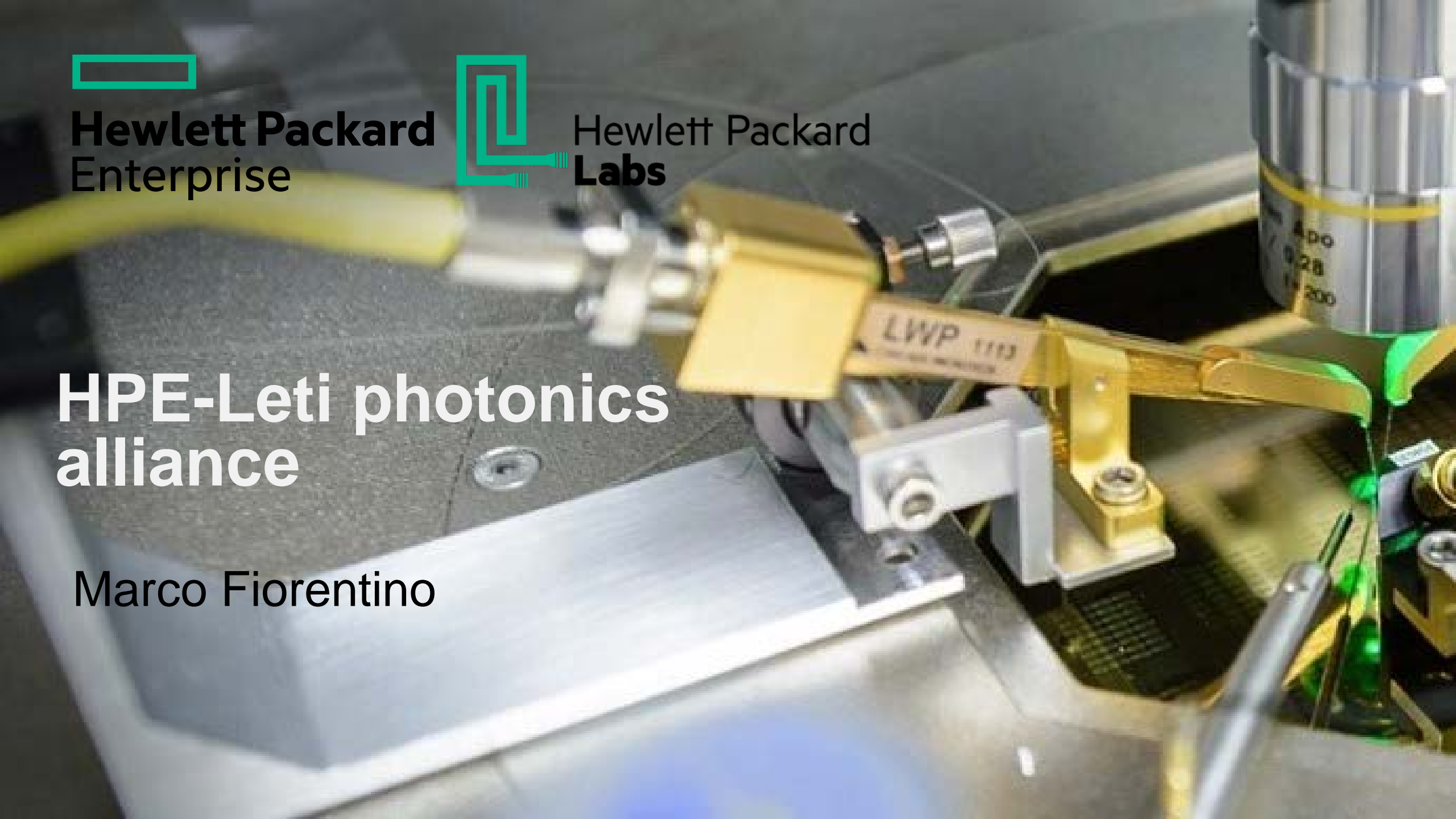
**Hewlett Packard  
Enterprise**



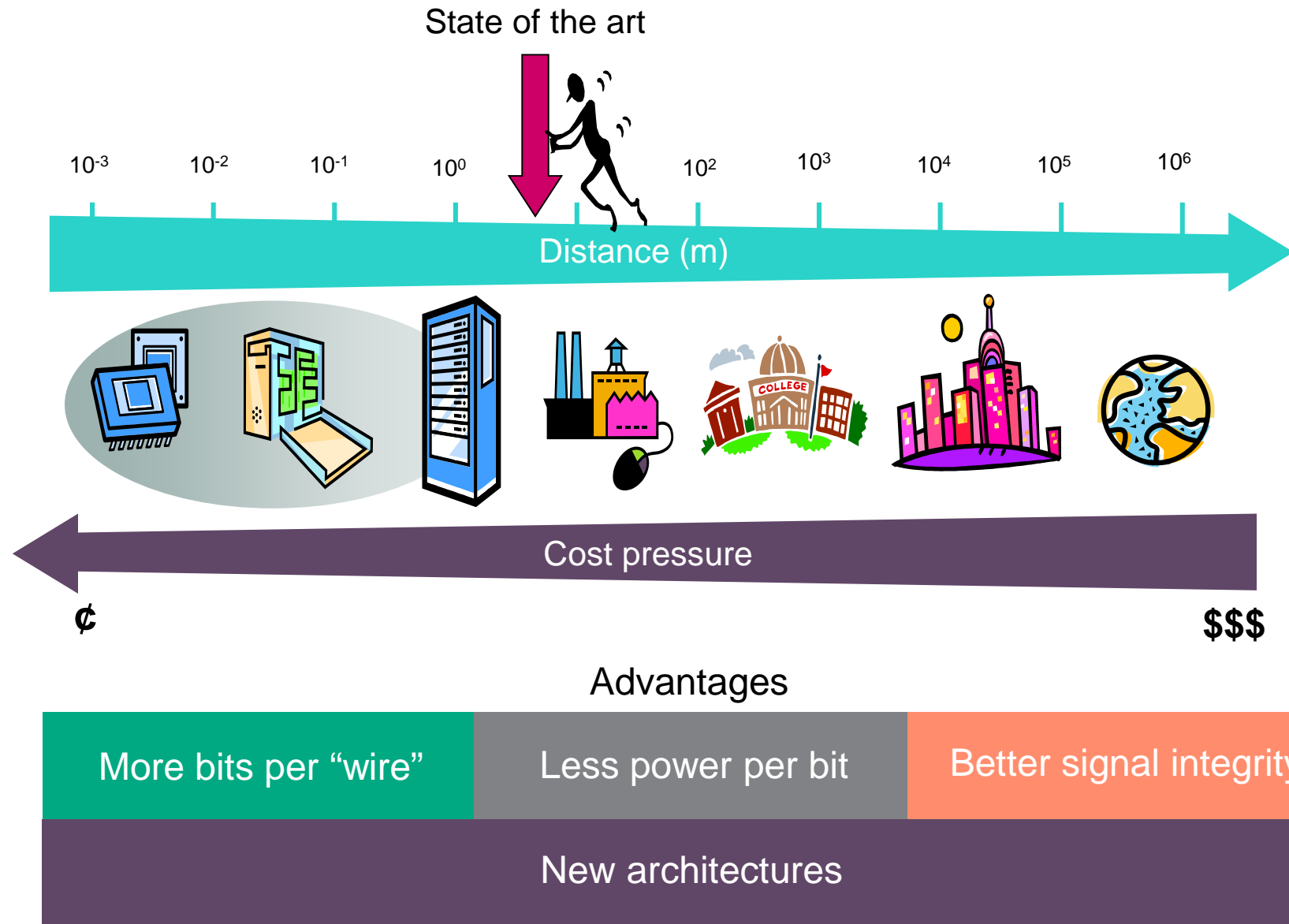
**Hewlett Packard  
Labs**

# HPE-Leti photonics alliance

Marco Fiorentino

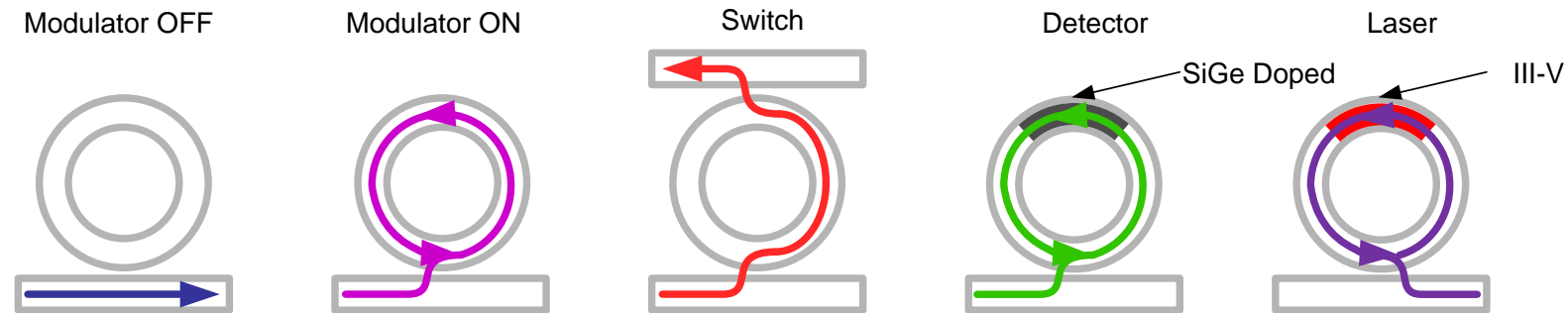


# Optical interconnects

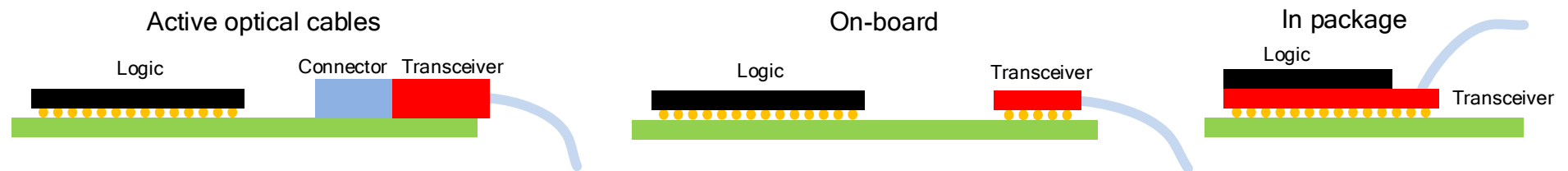


# Technology requirements

- DWDM: bandwidth density
- Silicon photonics: cost and scalability
  - “Open source” development kit
- Ring resonators: technology of choice

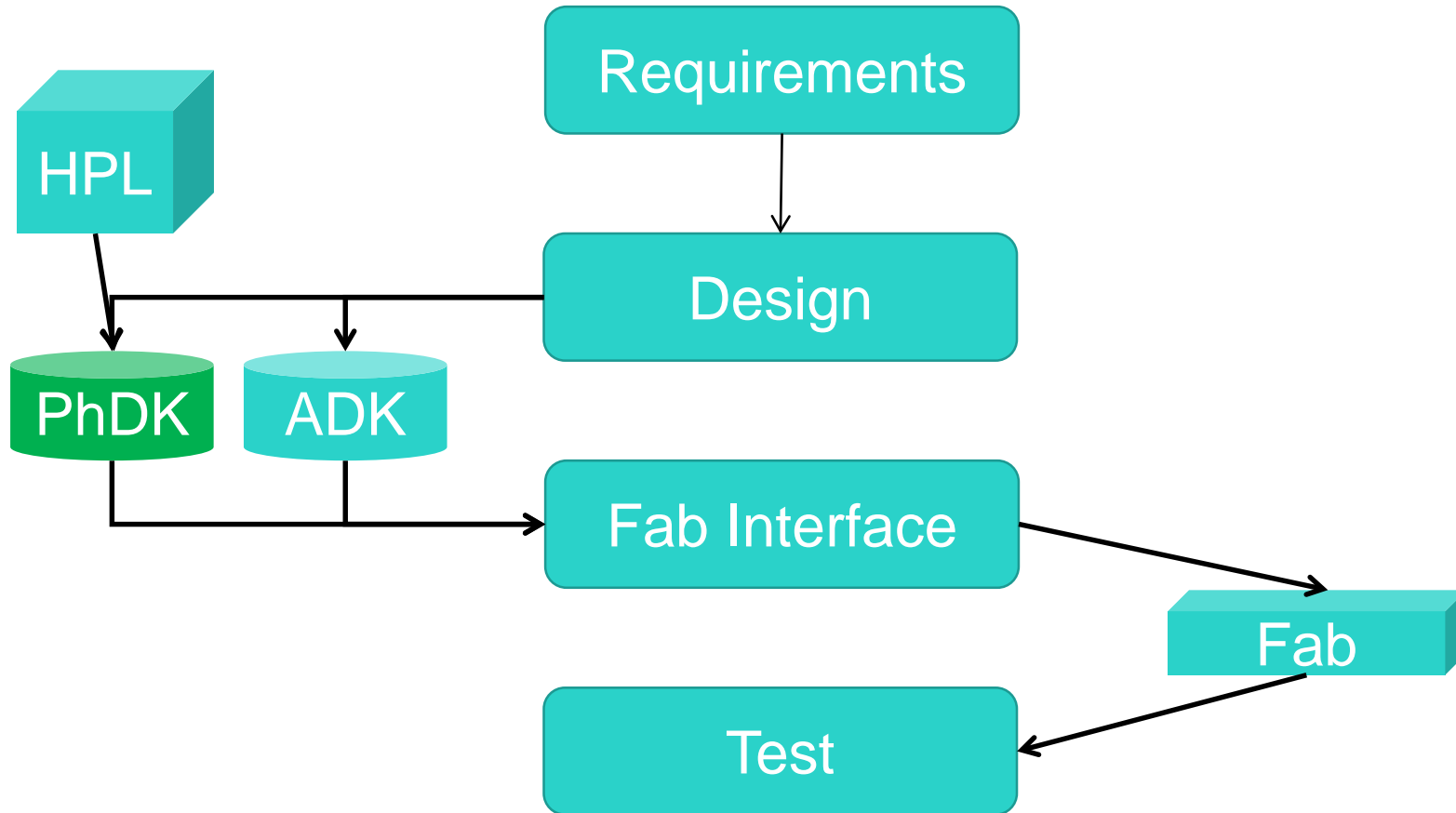


- Packaging evolution



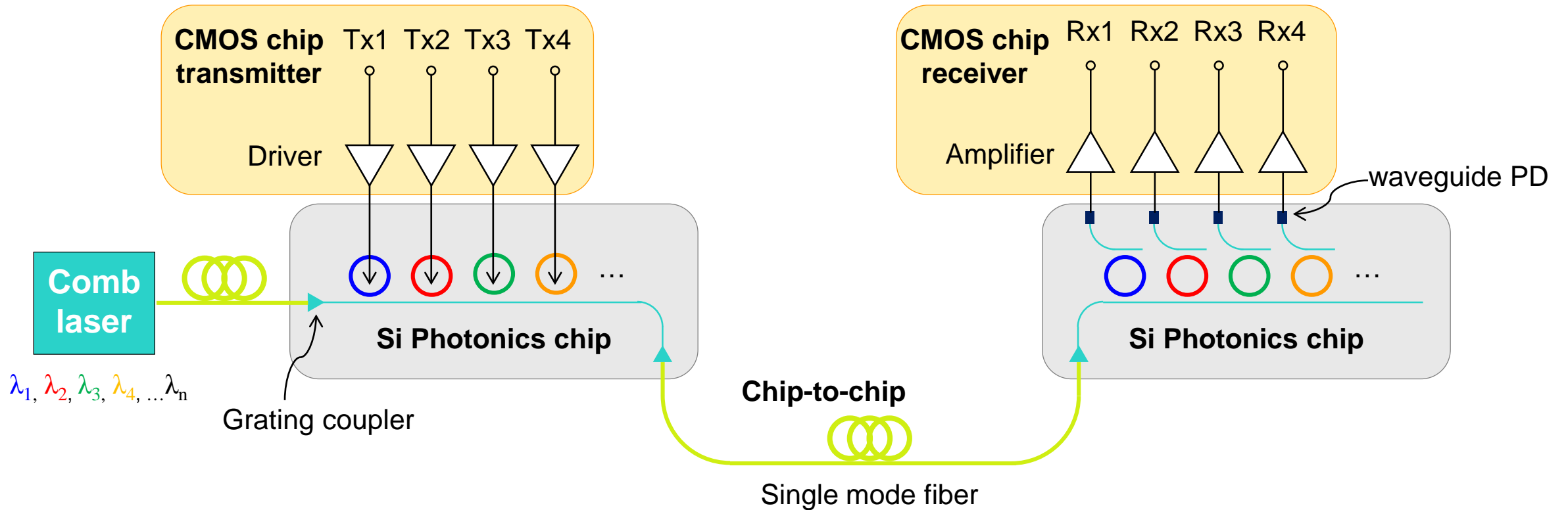
# PhASIC ecosystem

Developing photonic-enabled ASICs



- Leverage ASIC development ecosystem
- Internal (control point)
- External (contract)
- ASIC Design Kit specifies available electronic technologies
- Si Photonics Design Kit specs available SiP technologies
- Co-design and co-packaging
- Innovative PhDK

# Si Photonics DWDM link



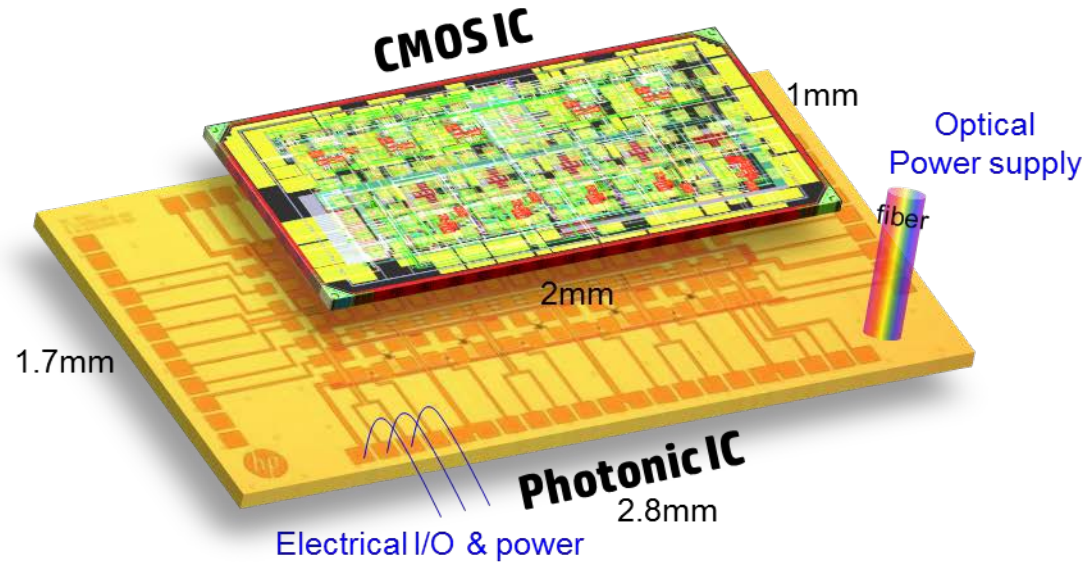
## Comb laser

- InAs/GaAs quantum-dot Fabry-Perot laser module @ 1.3 $\mu$ m
- 16 channels with 80GHz spacing at operating point
- Improved performance at higher temperature: 1mW/channel @48°C

## Hybrid integration

- 1<sup>st</sup> generation: wirebonding
- 2<sup>nd</sup> generation: flip-chip bonding
- 3<sup>rd</sup> generation: TSV

# Si Photonics DWDM link



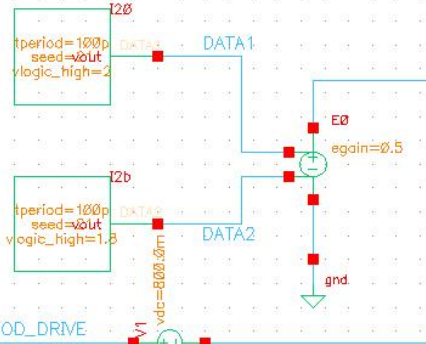
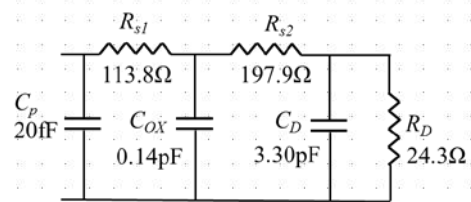
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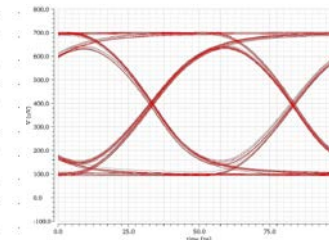
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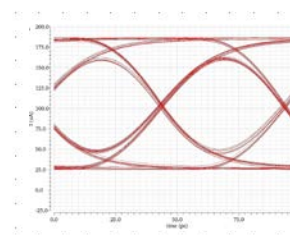
# PhDK: device models



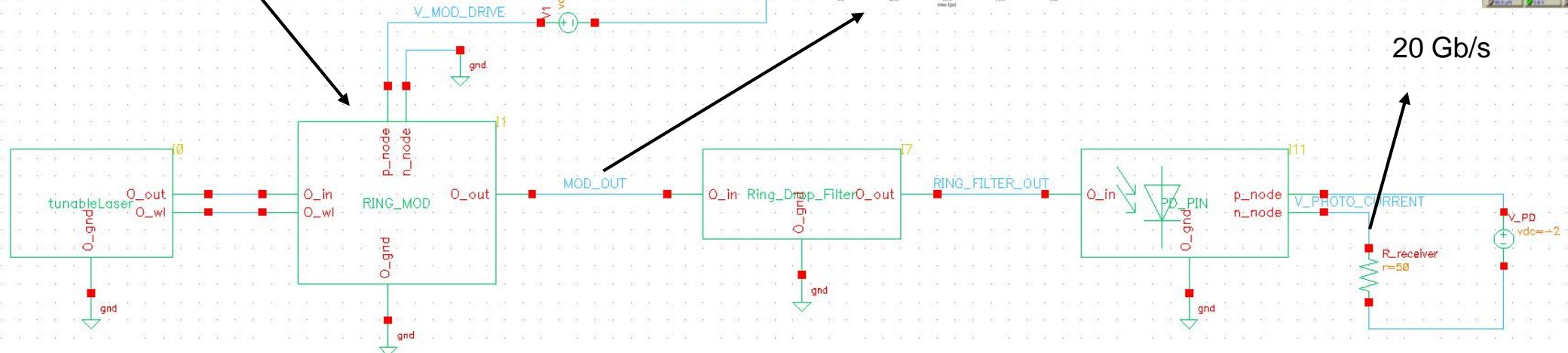
Mod Output  
Optical Eye



PD Photocurrent  
Electrical Eye



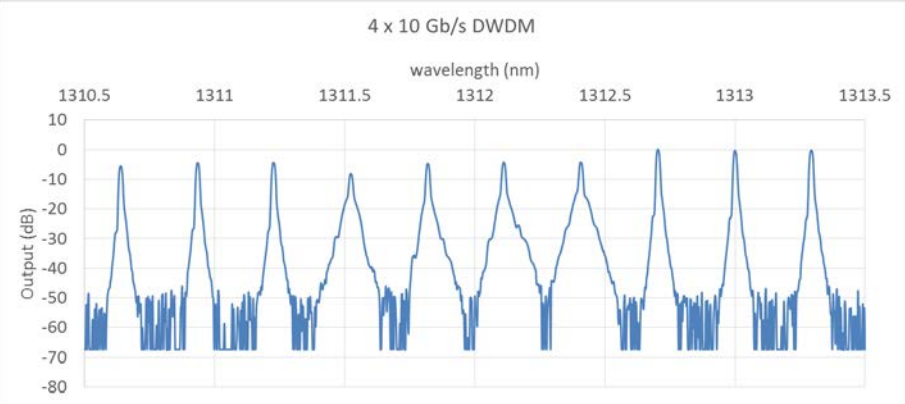
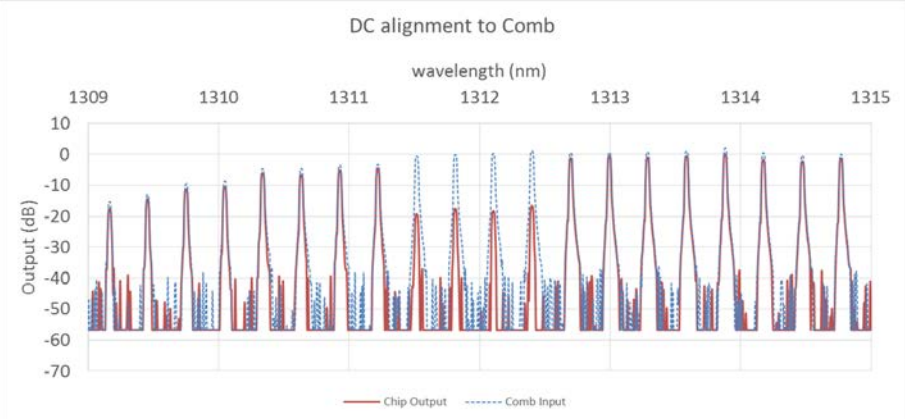
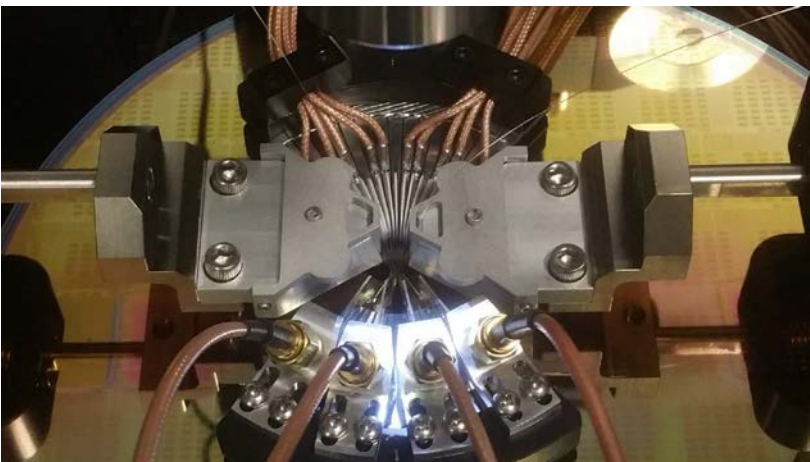
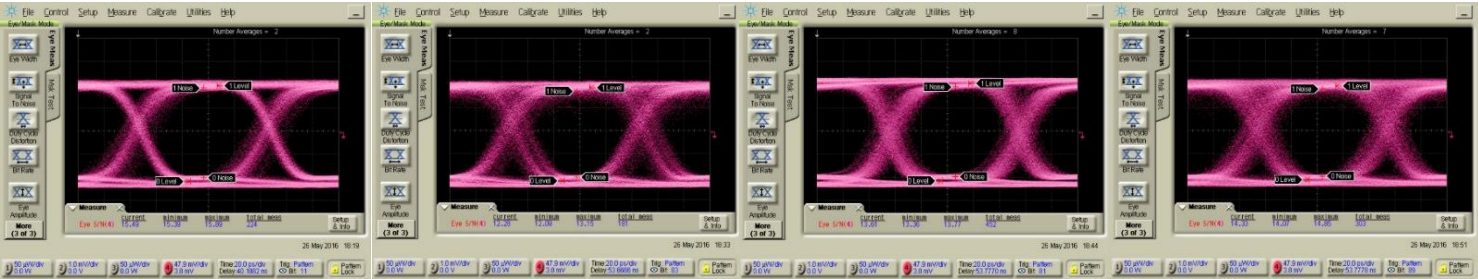
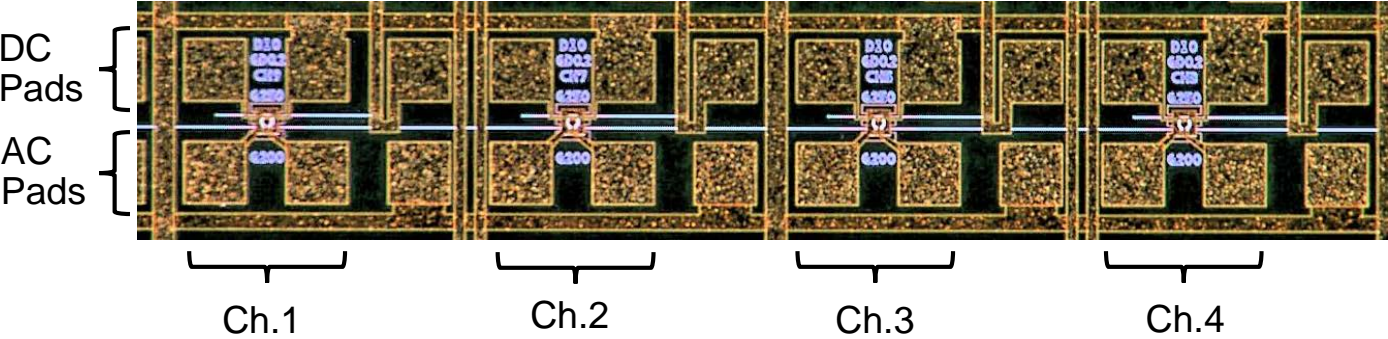
20 Gb/s



Gthru = 200 nm  
Gdrop = 225 nm  
Critical-coupling

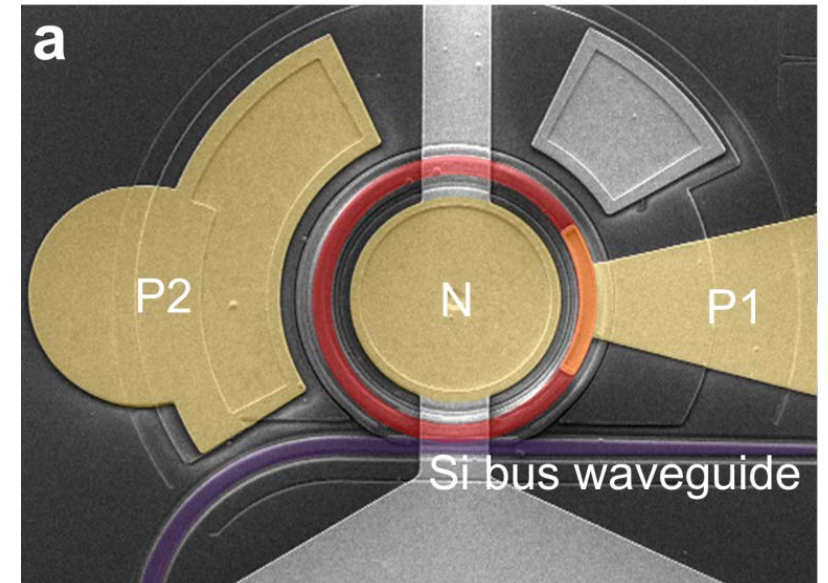
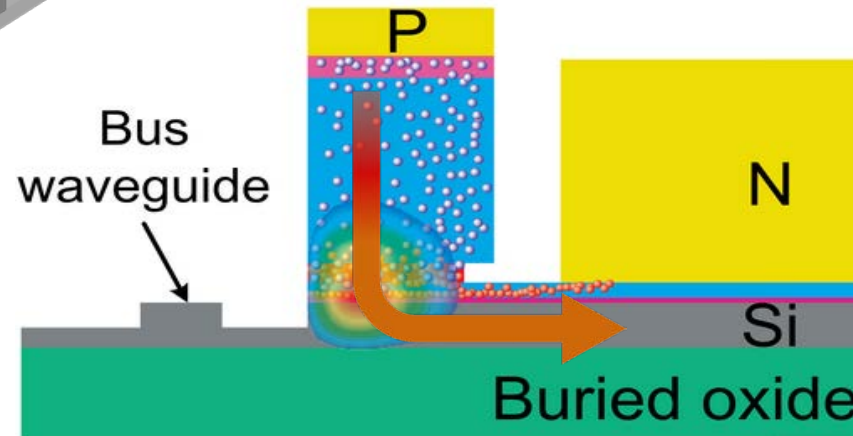
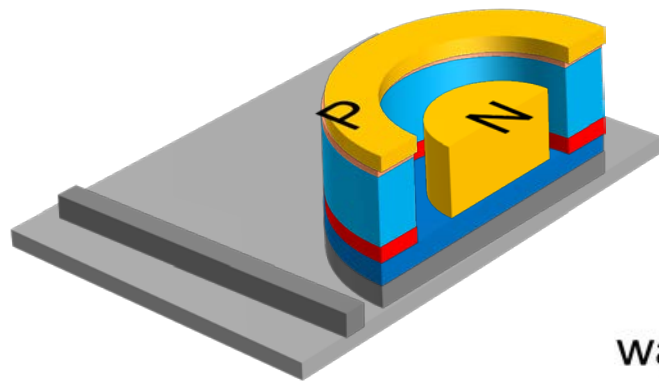
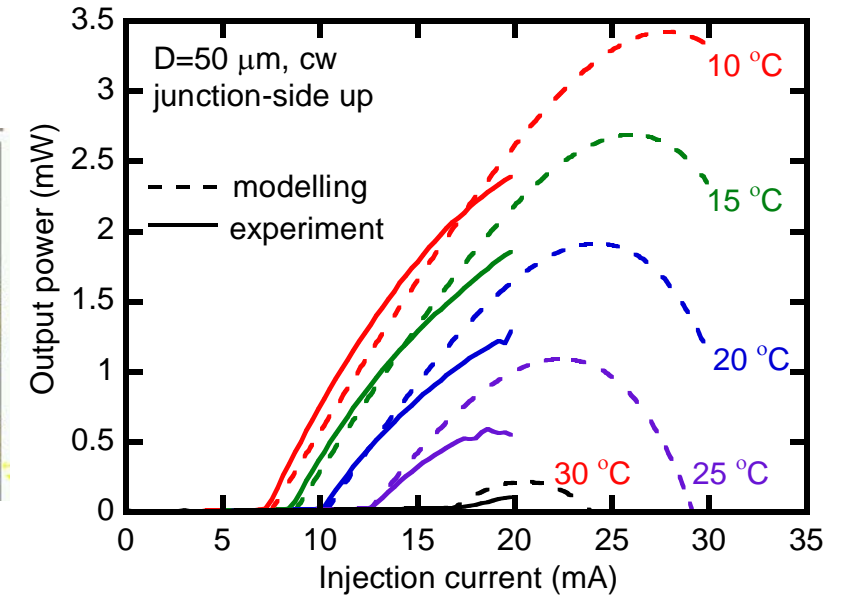
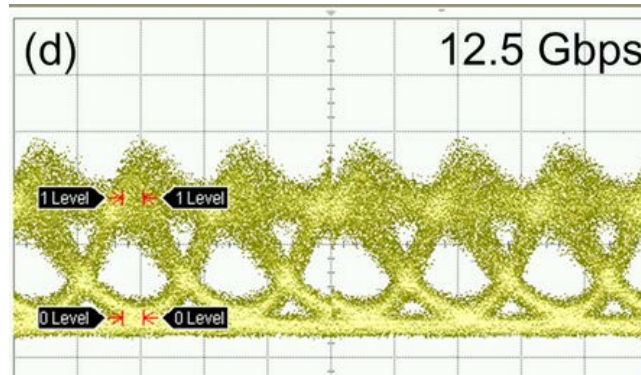
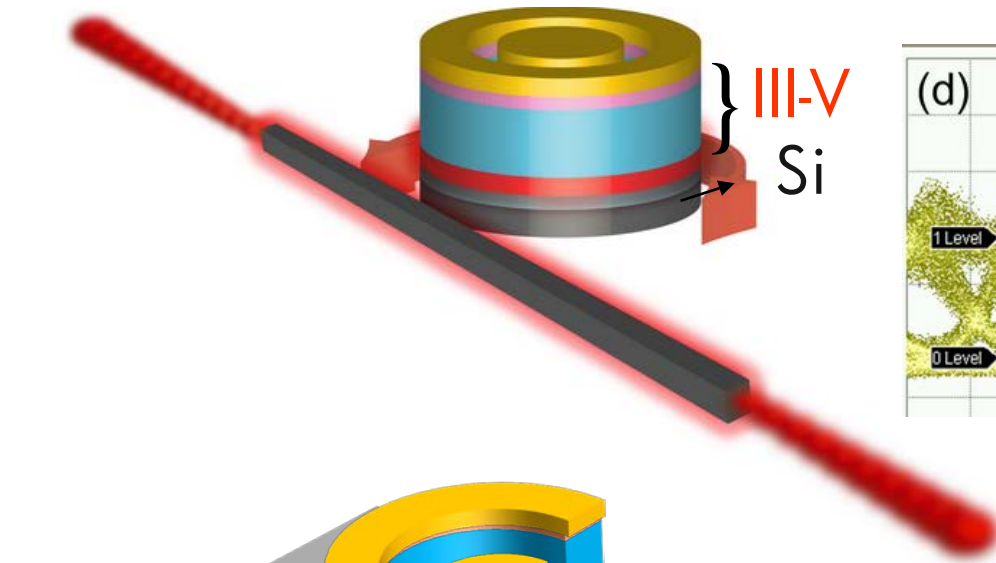


# 4-channel demo





# Integrated light source



# Future work

- Packaging
  - 3D integration
  - Fiber attach
  - Hybrid integration
- Volume production
  - Transfer
  - Qualification

