Tiny companion testchip for 56 Gbaud applications based on microring resonators

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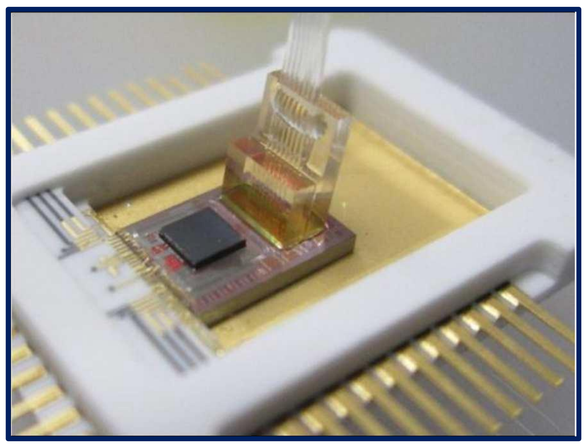
Objective: To address 56G external I/Os issues



- Purpose: IP core for customer at packaging level
- Tiny & configurable companion testchips
- 3D assembly validation
- Passive & active components of PIC25G + BiCMOS/CMOS

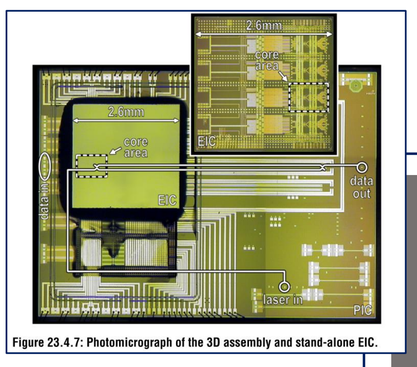
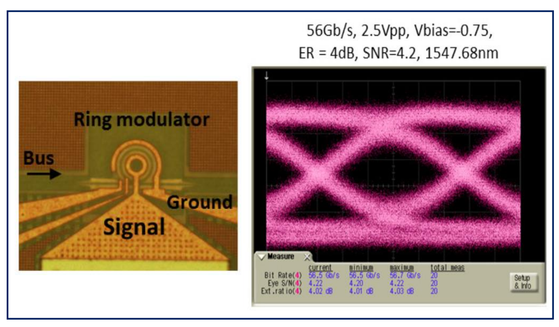
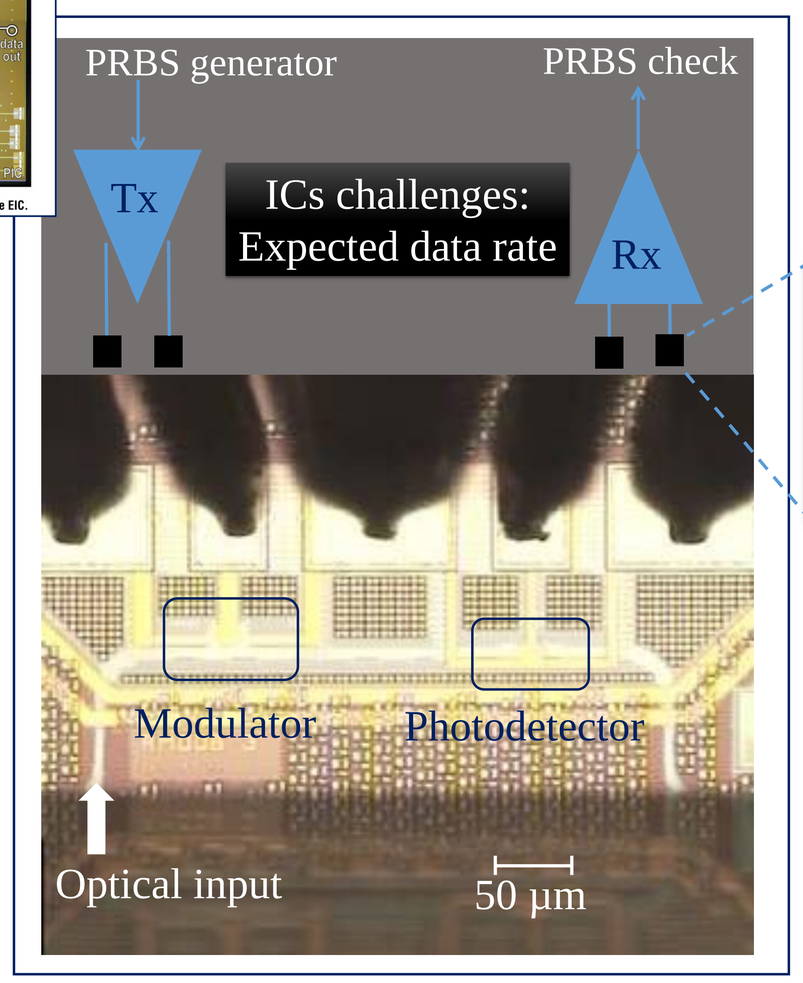


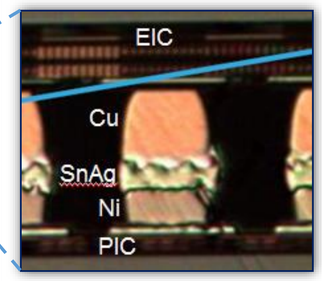
Figure 23.4.7: Photomicrograph of the 3D assembly and stand-alone EIC.

Driver + MZM demonstrated at 56 Gb/s
STMicroelectronics, "A 56 Gb/s 300mW Silicon-photonics transmitter in 3D-integrated PIC25G and 55nm BiCMOS technologies", *ISSCC* 2016



Ring modulator demonstrated at 56 Gb/s
IMEC, "56 Gb/s Ring modulator on 300mm silicon photonics platform", *ECOC* 2015

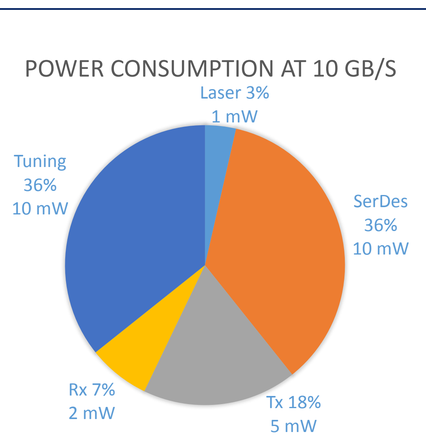


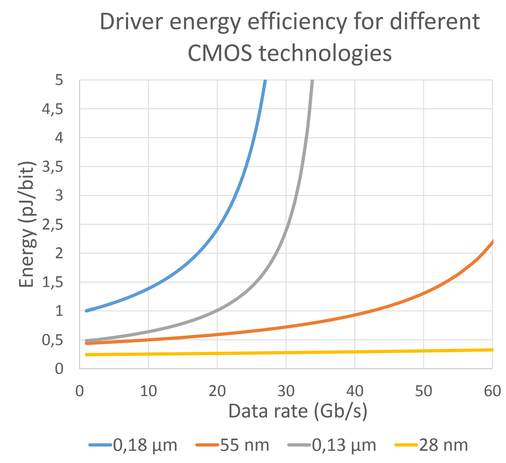


Fine pitch copper pillar flip-chip for connection between photonic interposer and electronic chip

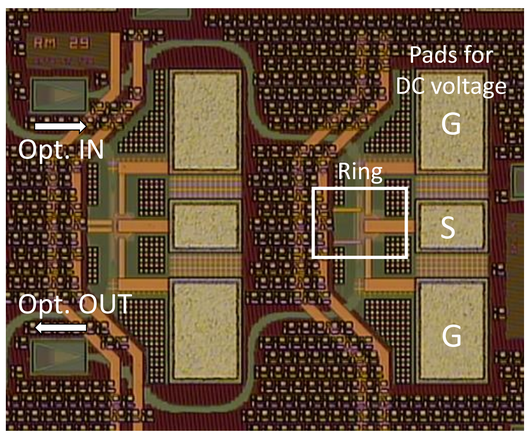
Thesis schedule: Dynamic testchip at wafer-level with 3D assembly

- CMOS driver in B55 at 10 - 25 Gbps
  - Optimal data rate for on-chip links (most energy efficient solution)
  - Learning phase for future 56G driver
- Ring resonator modeling
  - Model required for electro-optical co-simulations
  - Impact of 3D assembly on static characteristics
- Qualification testchips based on microring resonators for 56 Gbps applications
  - Demonstration of 3D integration at 25 Gbps
  - Circuit study : Driver @ 56G
  - Device study : Ring @ 56G

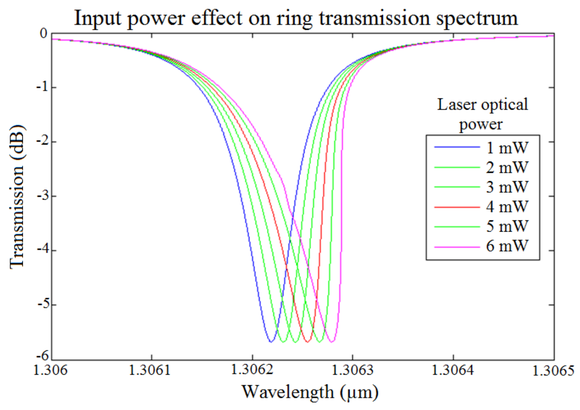


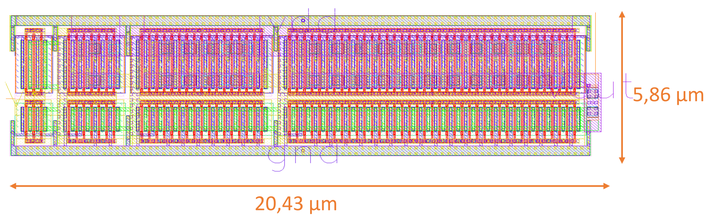


Energy-speed trade-off of complete photonic link
WDM optical link with aggregate throughput higher than 100 GB/s
→ Choice of technological node
→ Evaluation of energy consumption : a few pJ/bit



PN ring resonator, 8µm radius
Measurement of static and dynamic characteristics
→ Transmission spectrum: modeling of plasma dispersion effect and self-heating due to TPA & FCA
→ Small-signal model: RC values extraction from S-parameters





Driver design
→ Architecture based on inverter chain
→ Sizing methodology taking into account logical effort and speed constraints