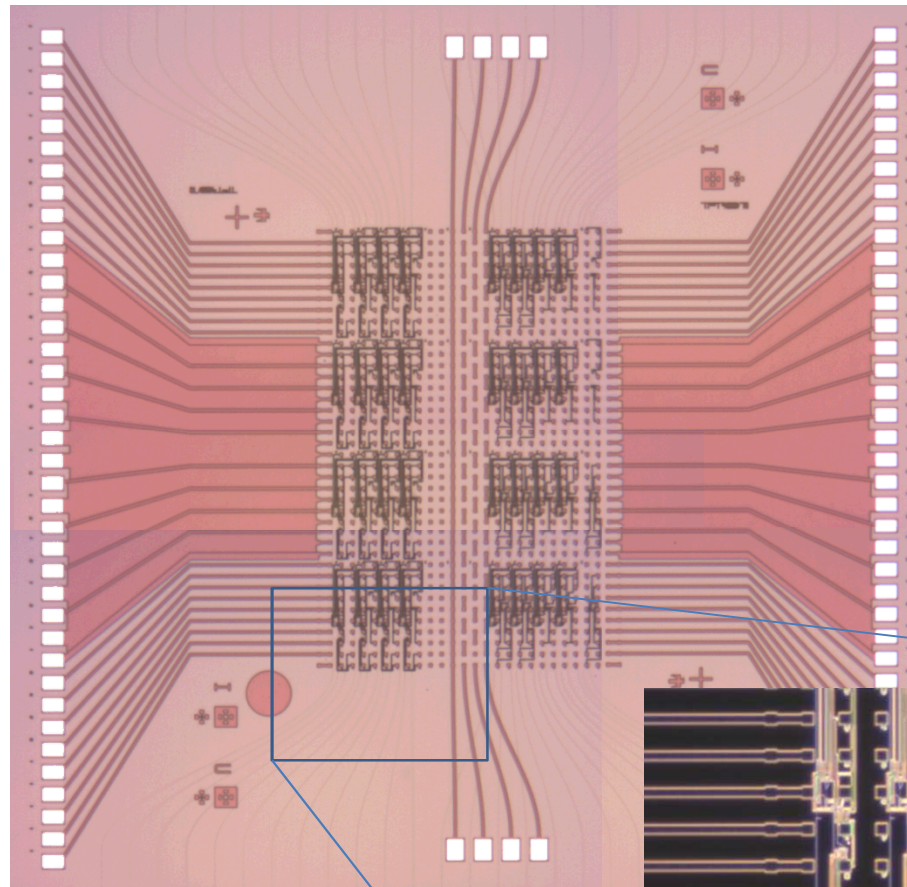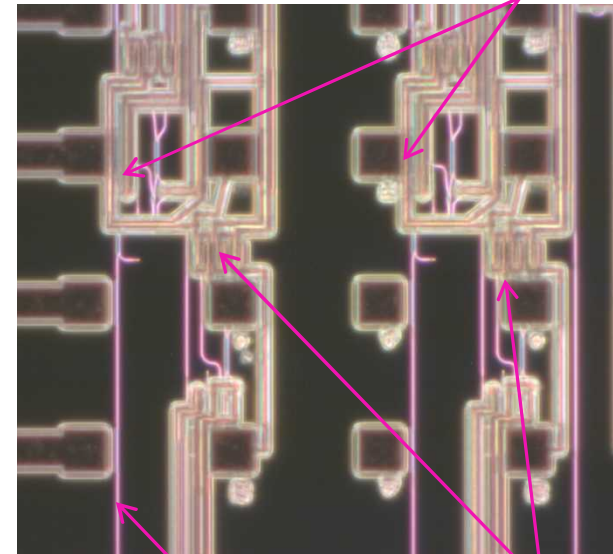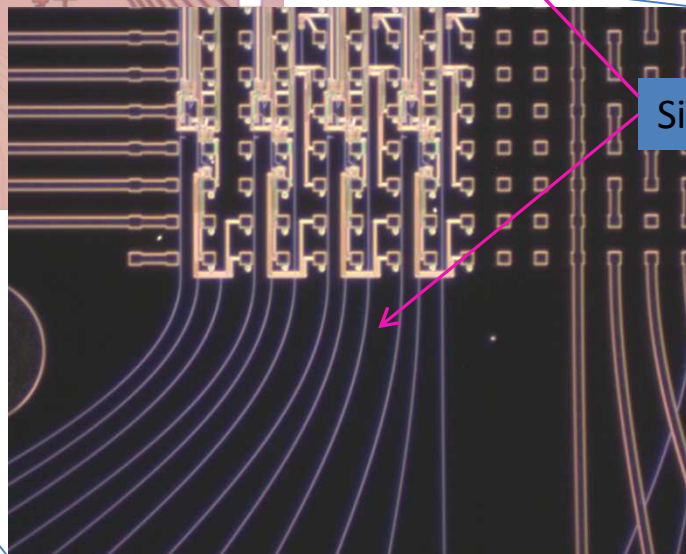# Slides for Keith Williams

5/27/15

Sandia Si-Photonic Interposer Tx/Rx Array chip for ExaScale Computing R&D Project

SNL XGC Si Photonic chip

Si Modulators Tx

Ge Detectors Rx

Si Waveguides

Sandia InP-based Photonic Integrated Circuits

- Sandia's PIC toolkit is based on quantum well intermixing to achieve multiple bandgaps on the same chip

  - Components: Lasers (DBR, DFB,…), modulators (EAMs and Mach-Zehnders), passive waveguides, high-gain SOAs, high-saturation power SOAs, evanescently-coupled photodetectors, quantum well photodetectors, ring resonators, TIR mirrors, resistors, capacitors

  - Demonstrated Circuits: optical logic gates, optical RF channelizers, transmitters, receivers, coupled-cavity lasers
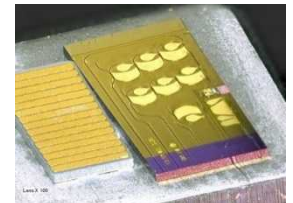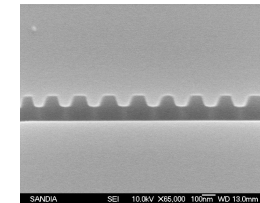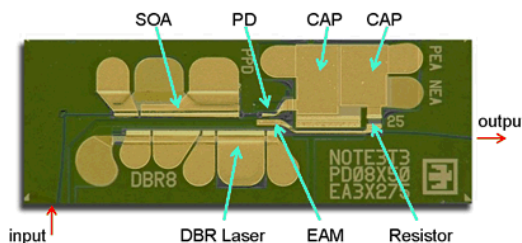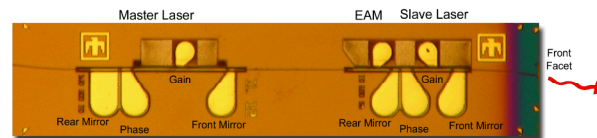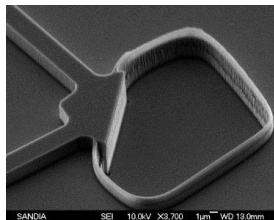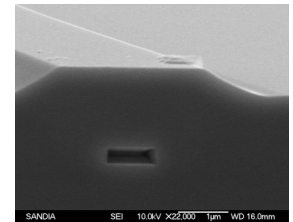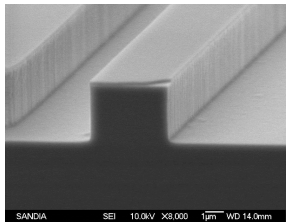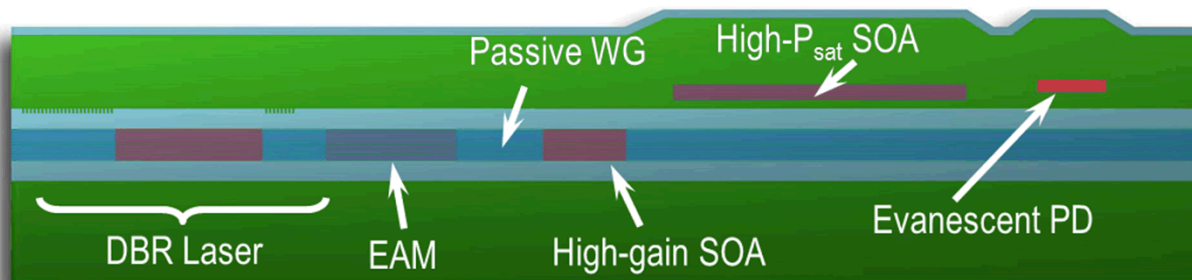
Sandia Si-Photonic Integrated Circuits

- Sandia's Si Photonic process (with MPW capability) enables complex circuit functionalities for a variety of DoD and Industrial applications
  - Active Components: Linear and digital Mach-Zehnder modulators, ring and disk ultra-low energy modulators with/without integral micro-heaters for resonant wavelength stabilization, high-freq. and high power integrated germanium detectors, integration with rad-hard CMOS, 2 x 2 wavelength selective switches and broad-band switches, and tunable filters
  - Passive Components: wavelength division multiplexers using resonant filters and arrayed grating routers, surface normal and in-plane polarization beam splitters, polarization rotators, polarization mode filters, directional couplers and splitters, integral SiN second photonics routing layer, Sagnac interferometers, AWG RF channelizers, nano-antennas
  - Demonstrated Circuits: transmitters, receivers, on-chip links, resonant wavelength stabilization circuits for both modulators and filters, optical active beam steering, optical logic (matrix multiply), low noise oscillators, optical network add-drop node (CIAN), optical channel monitor (spectrum analyzer) (CIAN)

Suspended μresonator

Ultra low crosstalk AWG

45 GHz High-speed Ge Detector on Si

Top Cladding   Metal   Pad Opening

Metal   Metal   Metal

Nitride Optical Interconnect and off-chip facets

Vertical Junction   Ridge Cut

Silicon Handle Wafer

Ring Filter with Heater   10 μm

Through Port

Drop Port Tap

Input Tap-DC

Thermal Phase Shifter   MZI-DC   Ge Detectors

Filter with wavelength stabilization

Tx/Rx Si Photonics chip

Tx/Rx Elect chip

Flip-chip assembly

Si Photonics Multi-user project chip for