Cross Talk in Peta-Byte Interconnect

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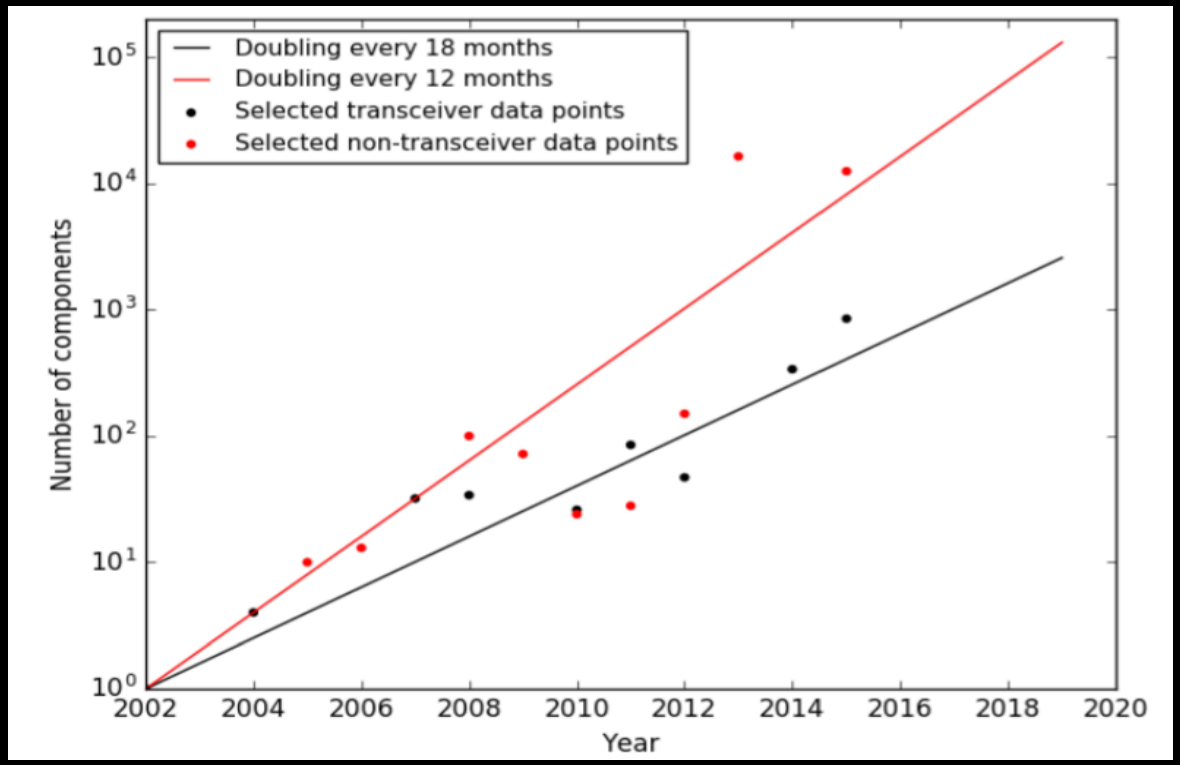
Silicon Photonics Complexity

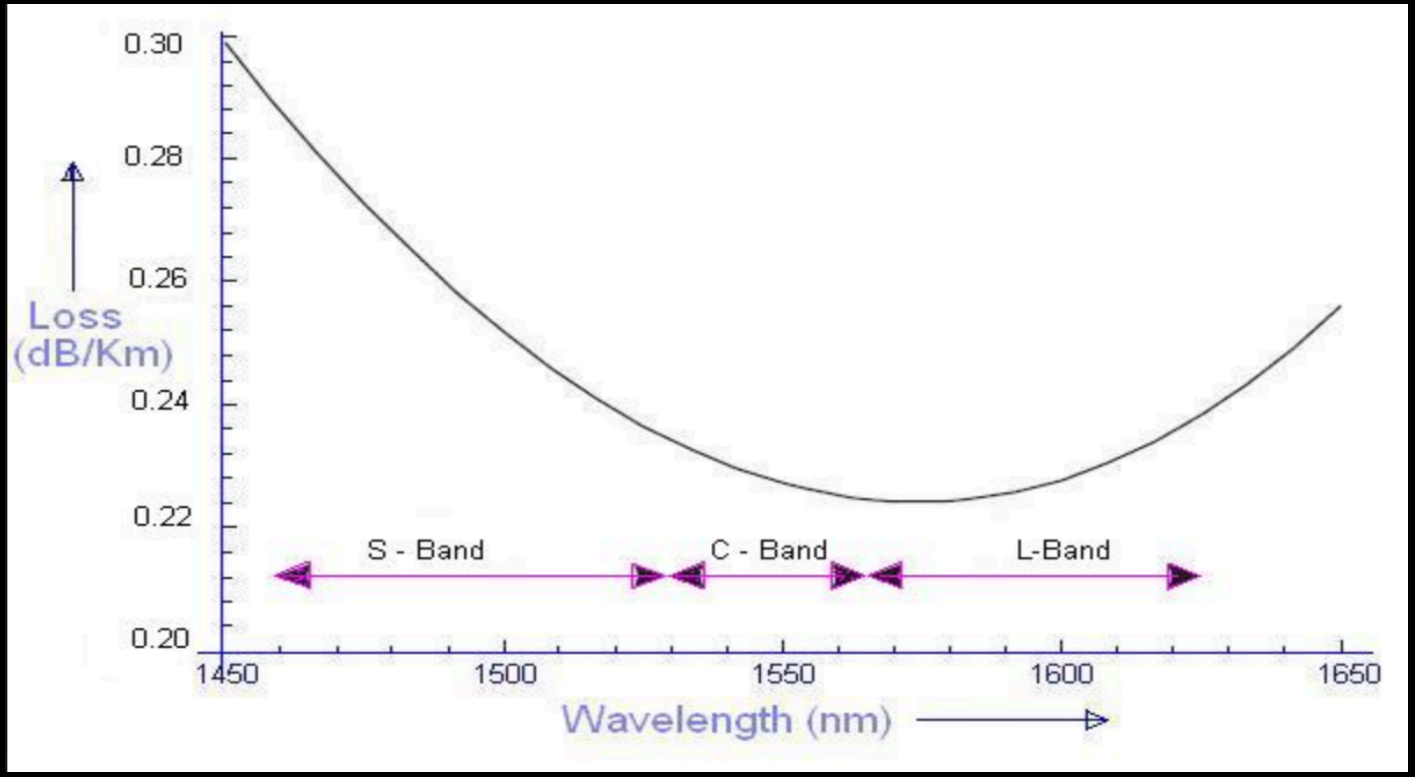


How much complexity does HPC require?

An Accelerator for AI

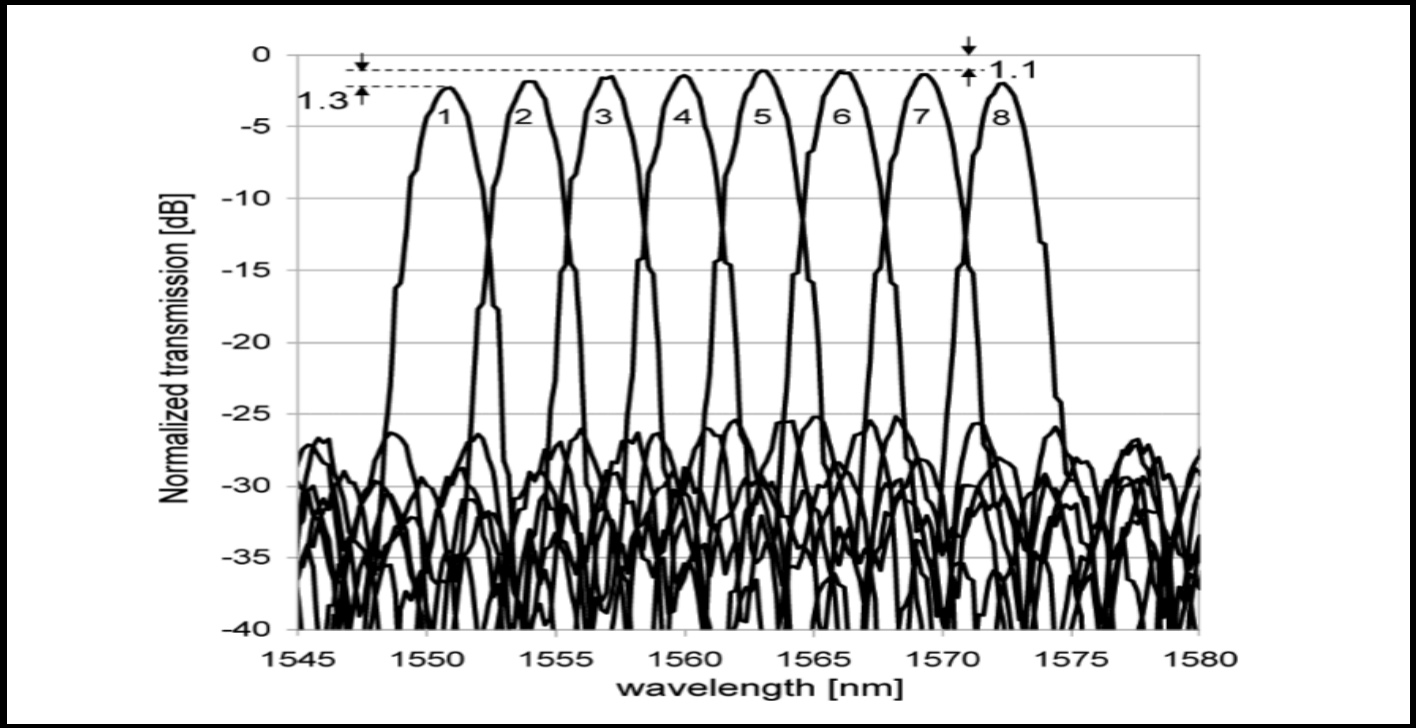
NVIDIA TESLA V100
CT BW 120 Tbps
Bus 2.4 Tbps

Wavelength and Information?



C+L is roughly 12 THz
(1nm = 125 GHz @ 1550nm)

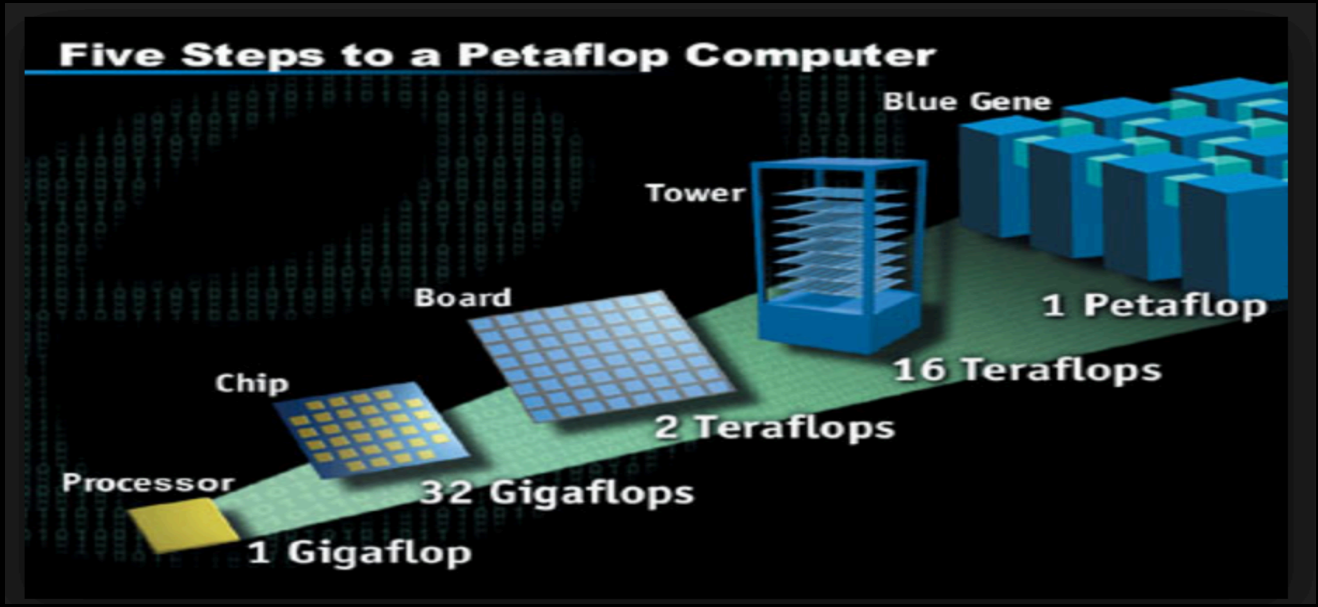
DWDM



20% use of C+L is 2.5 Tbps

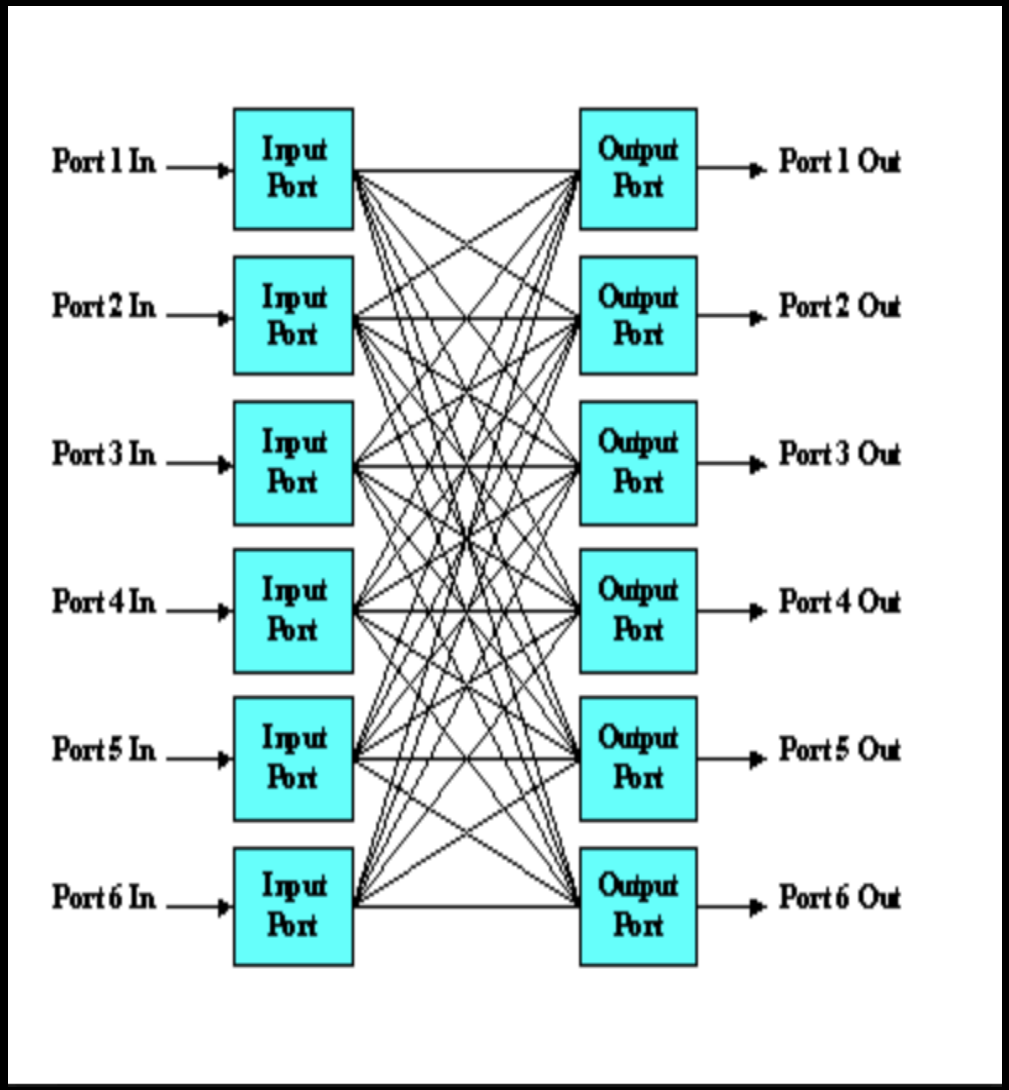
2.5 Tbps = 50 x 50 Gbps

How Big is a Peta Byte per second?



1.25 PBps is 4000 2.5 Tbps
4000 x 50 50 Gbps Channels

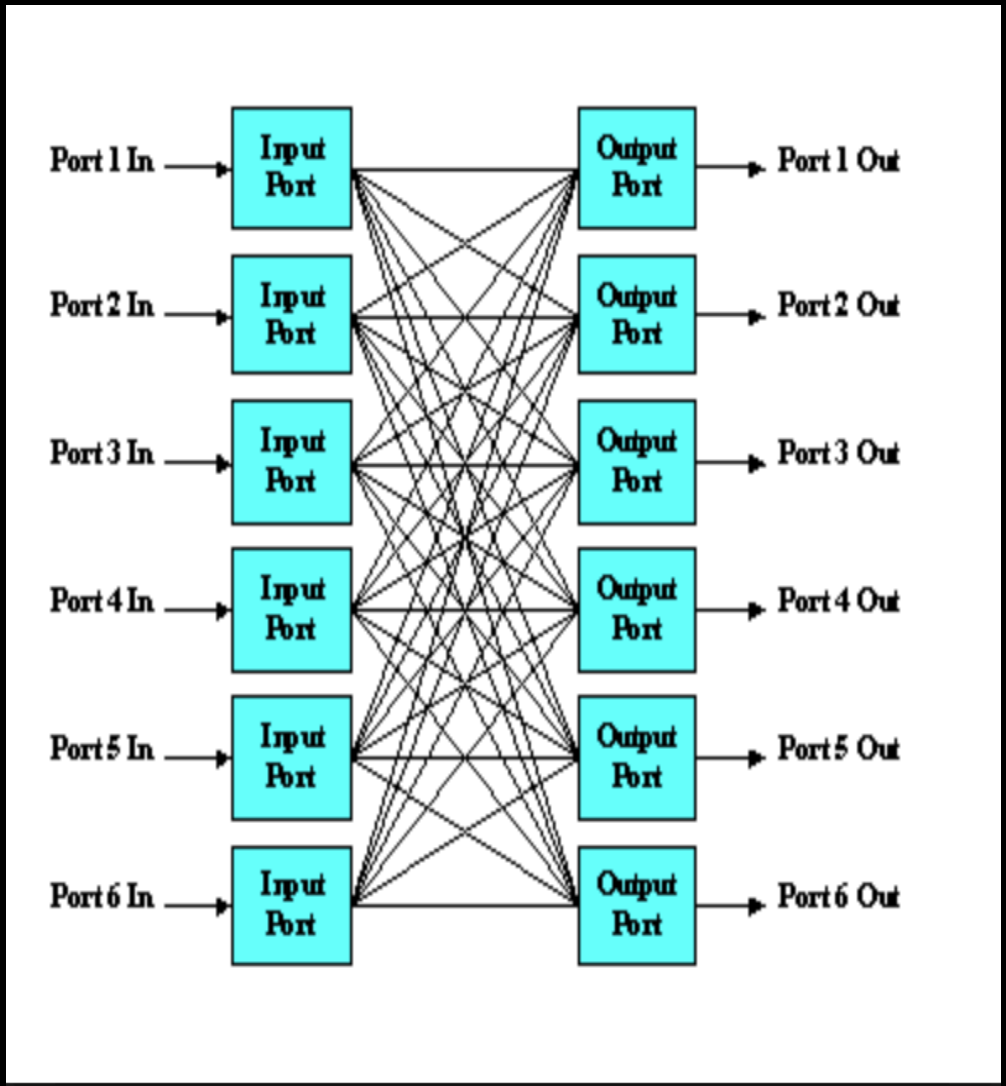
Memory Peta Byte Interconnect



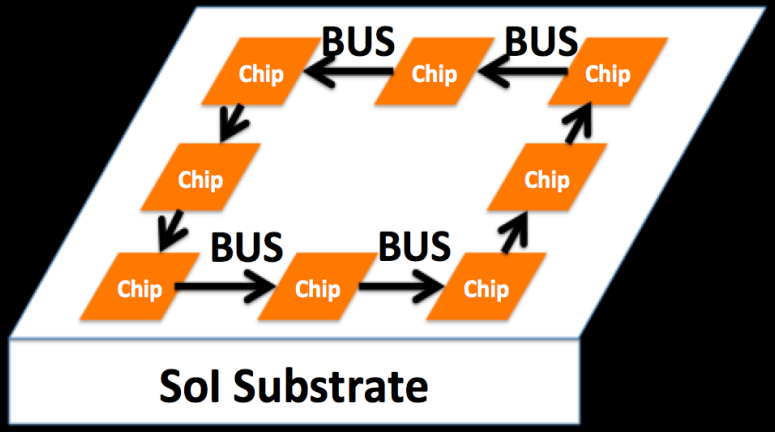
64 x 64 Crossbar requires 4032 2.5 Tbps channels

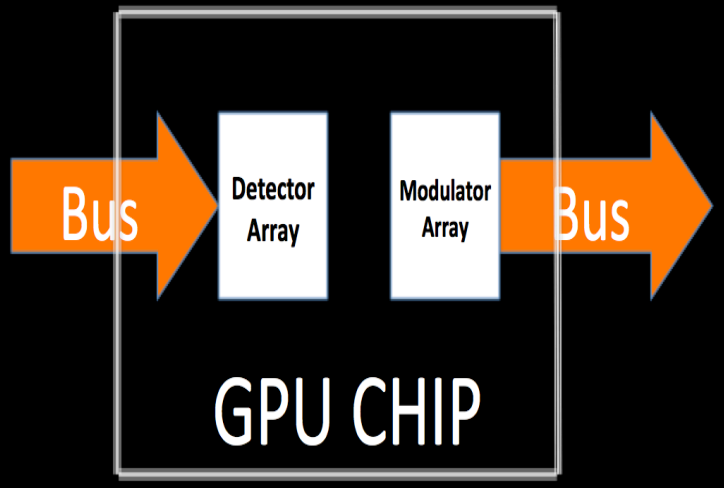
Memory Peta Byte Interconnect II

2.5 Tbps requires 50 modulators and 50 detectors at each chip



How Big is a 50 Modulator Array?





4000 wg's -> 3.6 mm

Array limited by crosstalk

Modulator Crosstalk Studies

Experimental Study of Electro-Optic Crosstalk in Parallel Silicon Photonic Mach-Zehnder Modulators

[1,2]Lingjun Jiang, [1]Xi Chen, [1]Kwangwoong Kim, [1]Guilhem de Valicourt, [2]Zhaoran Rena Huang and [1,*]Po Dong

[1]*Bell Laboratories, Nokia, 791 Holmdel Road, Holmdel, NJ 07733, USA*

[2]*Department of Electrical, Computer and Systems Engineering, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY12180, USA*

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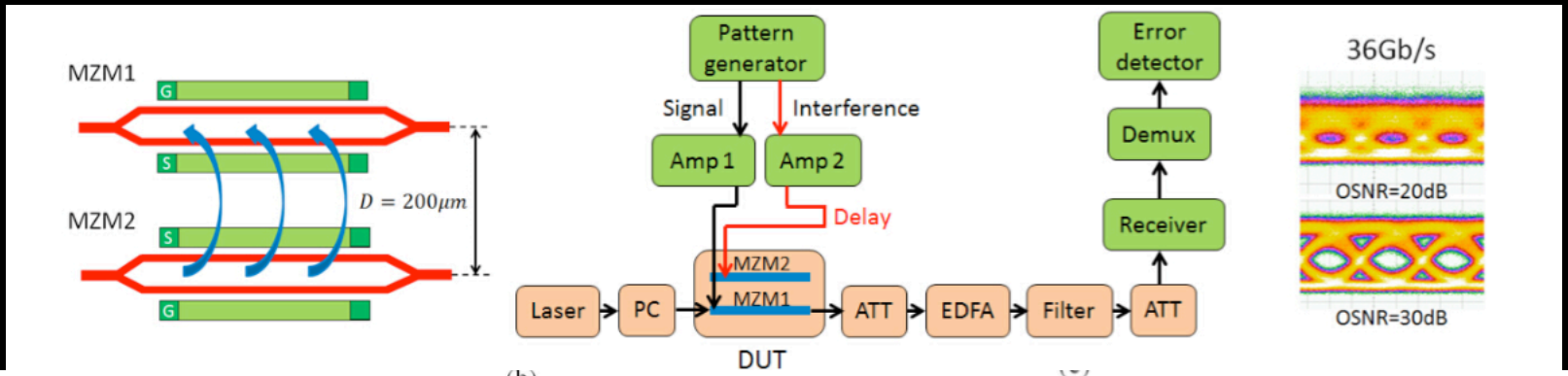
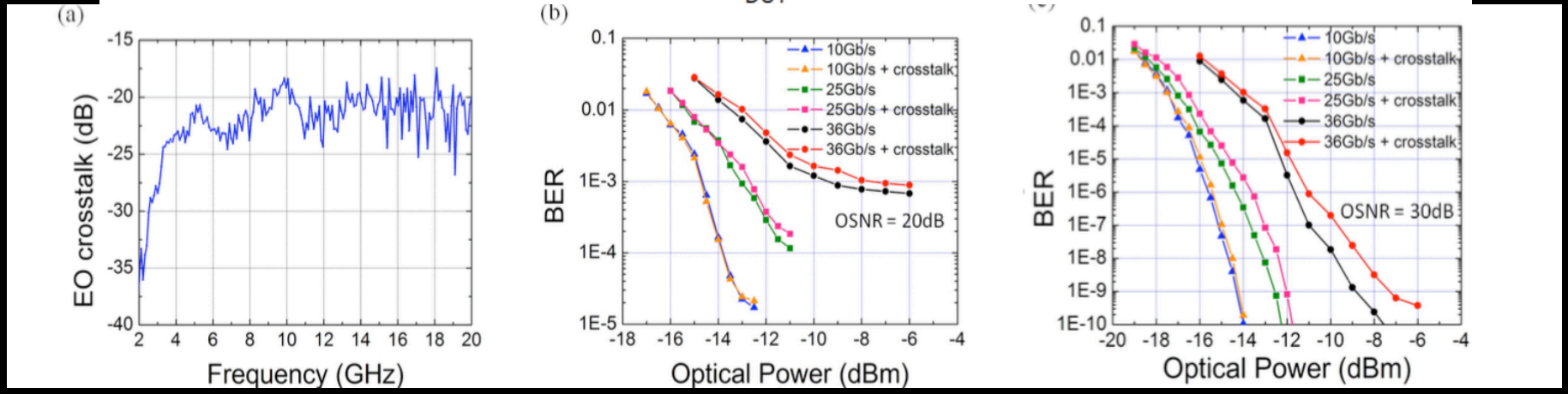
Experimental and Numerical Study of Electrical Crosstalk in Photonic-Integrated Circuits

Weiming Yao, Giovanni Gilardi, Nicola Calabretta, *Member, IEEE*, Meint K. Smit, and Michael J. Wale, *Member, IEEE, Member, OSA*

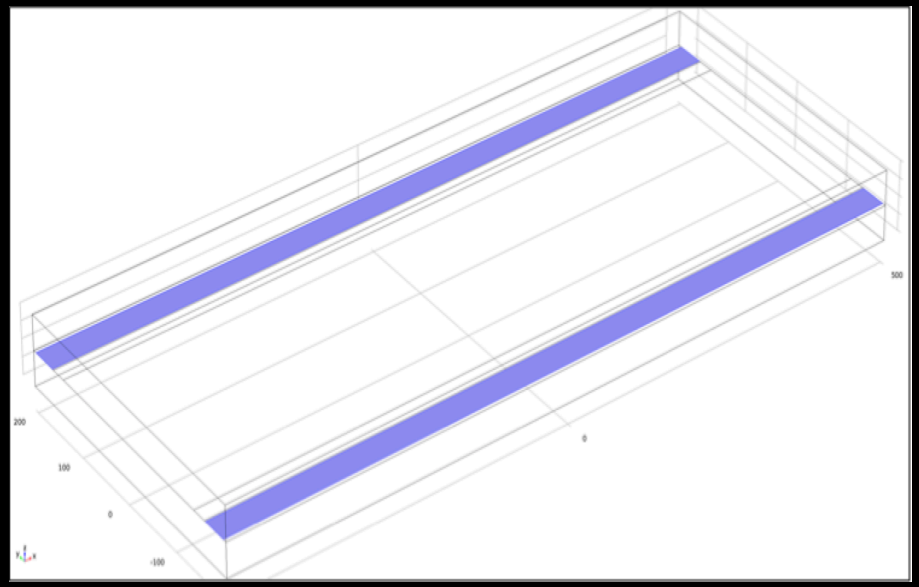
Results from Jiang et al. 2017

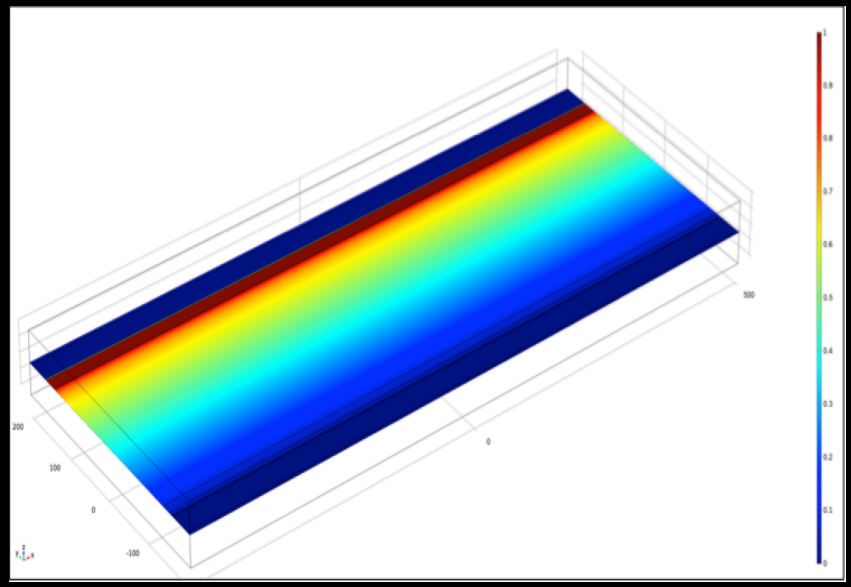




S to S crosstalk is disastrous

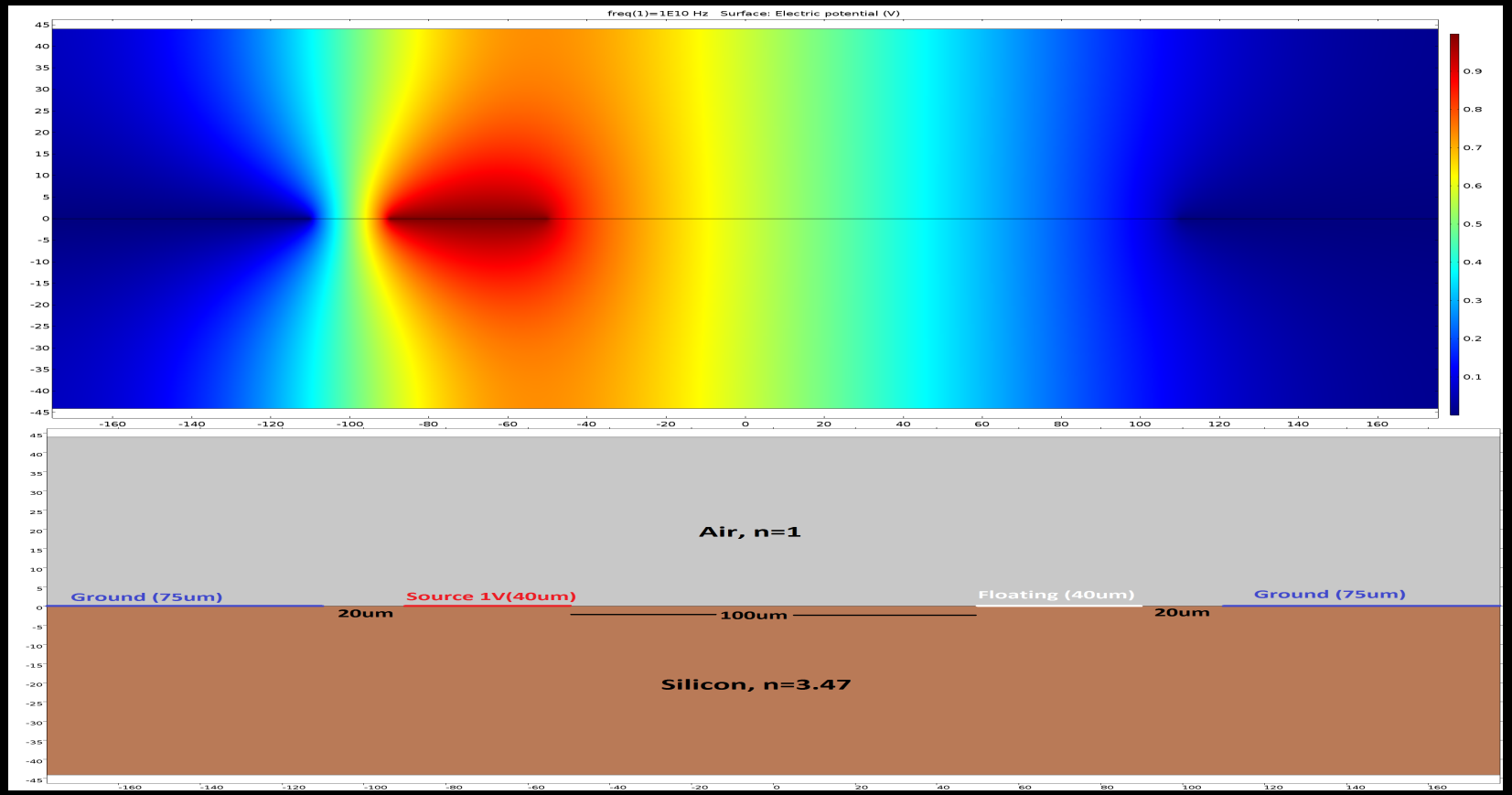
Our Model





S to S crosstalk is disastrous

Our Calculations (Linear Scale)



Shows circa 0.1

CPW from Yao et al. 2015

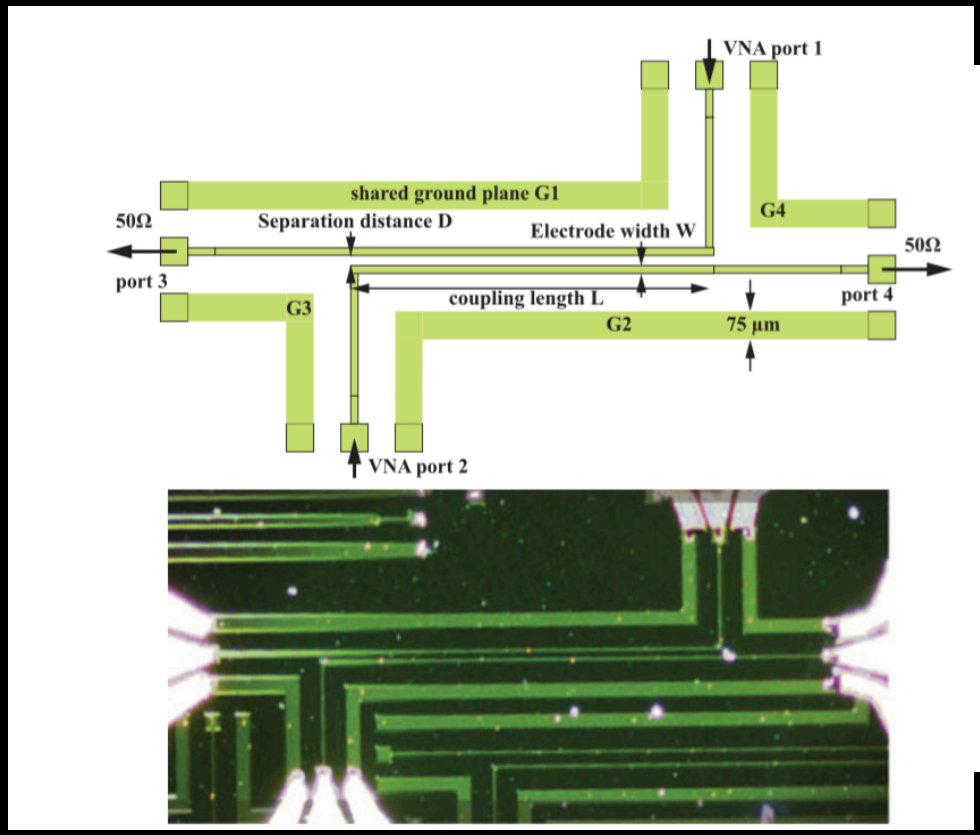
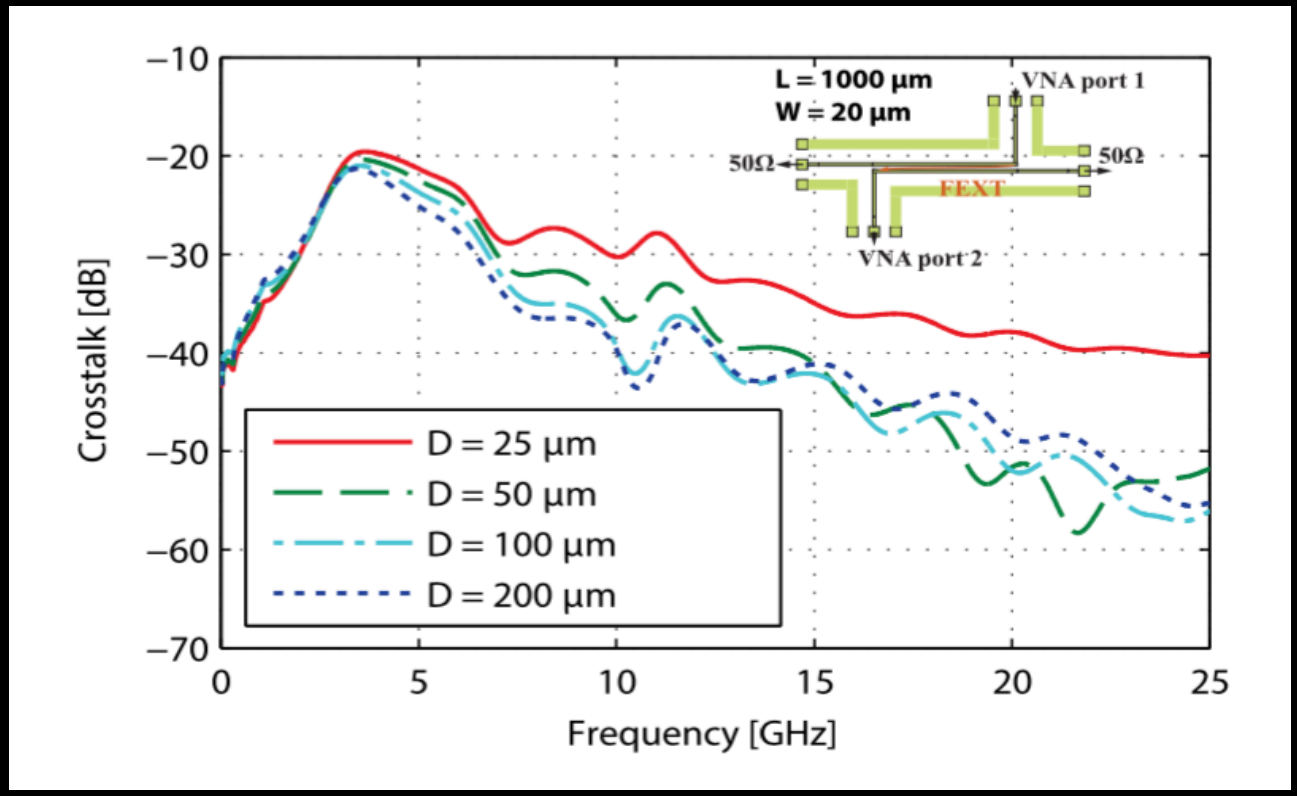


TABLE I
GEOMETRICAL PARAMETERS OF TEST STRUCTURES

	RF interconnects	Phase-shifters
Separation distance D (μm)	25, 50, 100, 200	30, 80, 180, 280
Coupling length L (μm)	1000, 2000	1250
Electrode width W (μm)	10, 20	20
Ground width G2-G4 (μm)	75	25
Ground width G1 (μm)	75	25 (D=30,D=80 μm)
Ground width G1' (μm)		35 (D=180,D=280 μm)
Ground length G1,G2 (μm)	1800	1500
Ground length G3,G4 (μm)	800, 825, 875, 975 (in order of incr. D)	260, 310, 410, 510 (in order of incr. D)

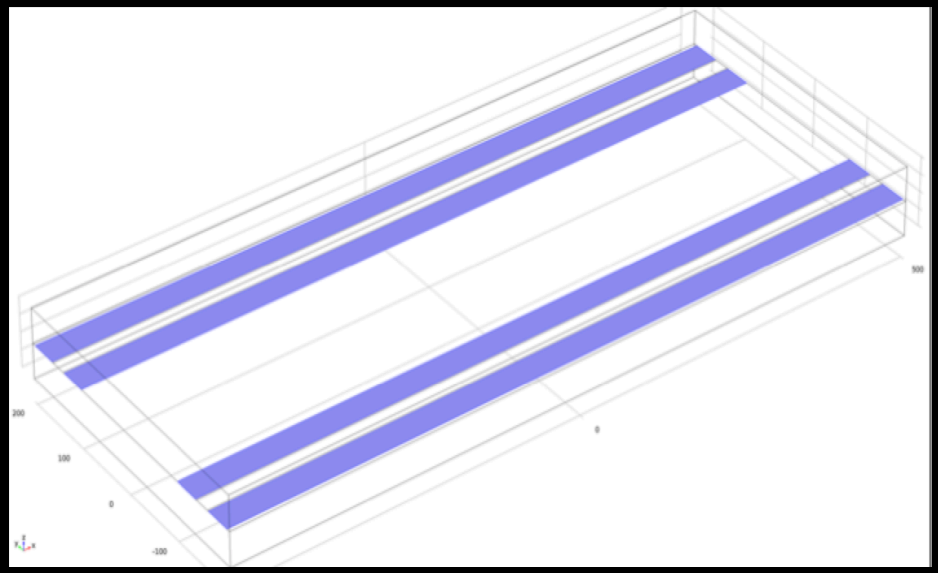
Is CPW Advantageous?

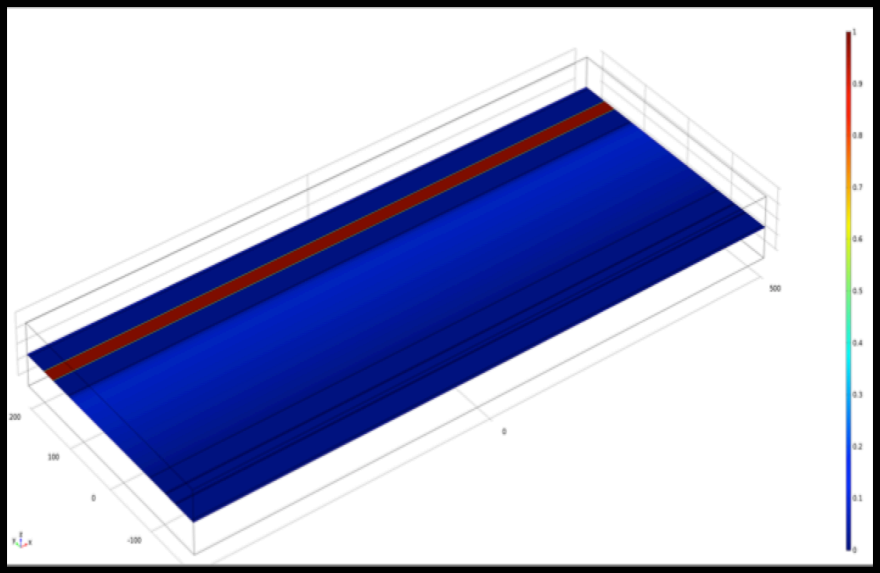
Results from Yao et al. 2015



5 GHz is still problematic

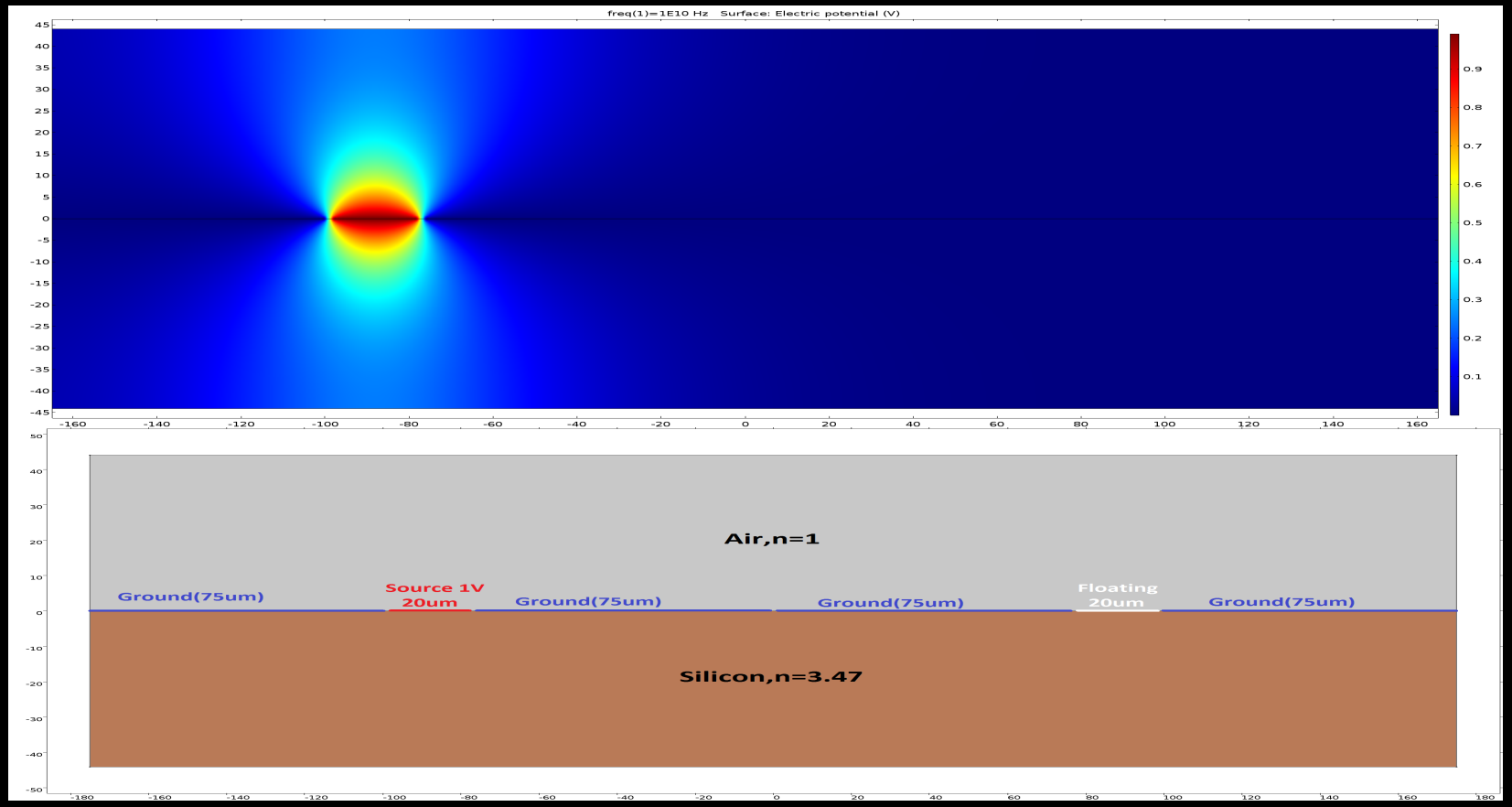
Our CPW Jiang-Like Model





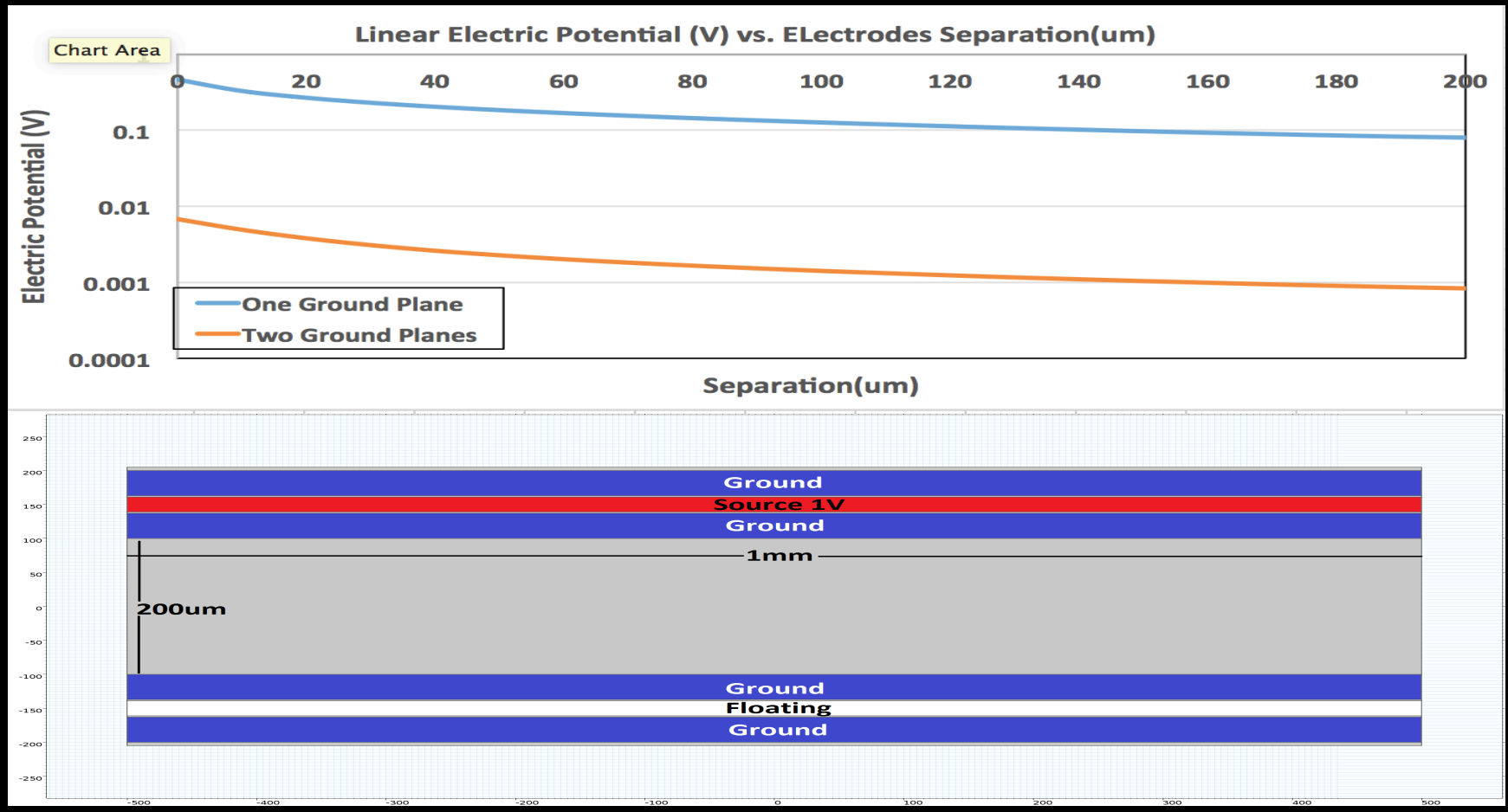
50 Ohm CPW

Our Calculations (Linear Scale)



Shows circa 0.001

Varying Separation



Grounds assumed 75 micron

Summary

- Crosstalk can be severe
- CPW is a compact solution
  - 50 Ohm CPW with 75 individual ground planes may be overkill

Questions?