NeoPhotonics

Photonic Devices for Coherent Sensing

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Jan 24, 2022

Forward Looking Statements and Other Important Cautions

This presentation includes statements that qualify as forward-looking statements under the Private Securities Litigation Reform Act of 1995. These forward-looking statements include statements about the following topics: future financial results, demand for the Company's high-speed products, and the Company's market position.

Forward-looking statements are subject to certain risks and uncertainties that could cause the actual results to differ materially. Those risks and uncertainties include, but are not limited to, such factors as: the Company's reliance on a small number of customers for a substantial portion of its revenues; market growth in key countries; possible reduction in or volatility of customer orders or delays in shipments of products to customers; timing of customer drawdowns of vendor-managed inventory; potential governmental trade actions; possible disruptions in the supply chain or in demand for the Company's products due to industry developments; the ability of the Company's vendors and subcontractors to supply or manufacture the Company's products in a timely manner; ability of the Company to meet customer demand; volatility in utilization of manufacturing operations and manufacturing costs; reductions in the Company's rate of new design wins, and/or the rate at which design wins go into production, and the rate of customer acceptance of new product introductions; potential pricing pressure that may arise from changing conditions in the industry or negotiating leverage of buyers; the impact of any previous or future acquisitions or divestitures of assets and related product lines; the discontinuance or end of life of products; changes in demand for the Company's products; the impact of competitive products and pricing and alternative technological advances; the accuracy of estimates used to prepare the Company's financial statements and forecasts; the timely and successful development and market acceptance of new products and upgrades to existing products; the difficulty of predicting future cash needs; the nature of other investment opportunities available to the Company from time to time; the Company's operating cash flow; changes in economic and industry projections; a decline in general conditions in the telecommunications equipment industry, the cloud and datacenter industry, or the world economy generally; and the effects of seasonality.

For further discussion of these risks and uncertainties, please refer to the documents the Company files with the SEC from time to time, including the Company's Annual Report on Form 10-K for the year ended December 31, 2020 and the Company's Quarterly Report of Form 10-Q for the three months ended September 30, 2021. All forward-looking statements are made as of the date of this presentation, and the Company disclaims any duty to update such statements.

You may obtain these documents for free by visiting EDGAR on the SEC website at www.sec.gov.

Non-GAAP and Adjusted EBITDA Measures vs. GAAP Financial Measures

The Company's non-GAAP and Adjusted EBITDA measures exclude certain GAAP financial measures. A reconciliation of the Non-GAAP and Adjusted EBITDA financial measures to the most directly comparable GAAP financial measures is provided in the financial schedules portion of its press release issued on August 3, 2021 and available in the Investor Relations section of the NeoPhotonics website. These non-GAAP financial measures differ from GAAP measures with the same captions and may differ from non-GAAP financial measures with the same or similar captions that are used by other companies. As such, these non-GAAP measures should be considered as a supplement to, and not as a substitute for, or superior to, financial measures calculated in accordance with GAAP.

The Company uses these non-GAAP financial measures to analyze its operating performance and future prospects, develop internal budgets and financial goals, and to facilitate period-to-period comparisons. NeoPhotonics believes that these non-GAAP financial measures reflect an additional way of viewing aspects of its operations that, when viewed with its GAAP results, provide a more complete understanding of factors and trends affecting its business.

NeoPhotonics: Coherent Photonics and High-Speed Optoelectronics Specialist

Deep Technology for Highest Speed Cloud Solutions

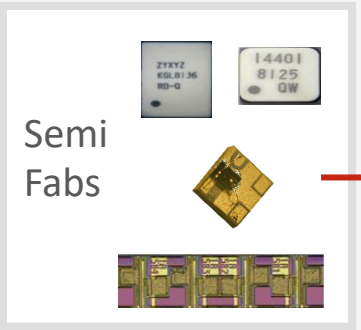
- World's primary supplier of purest light tunable lasers
- 400G / 400ZR / 400ZR+ coherent DCO modules enabled by silicon photonics modulator/receiver integration
- Highest speed coherent suite ramping 64 & 96Gbaud components for 600Gbps and 800Gbps systems
- Coherent PIC technologies for high level of integration

Coherent Photonics for 3D sensing and Lidar

1. Chip-scale coherent sensors can enable high volume and lower cost
2. Coherent technology provides higher sensitivity and dynamic range
3. Leverage coherent technology used in telecom transceivers

Market Ecosystem

Optical ICs



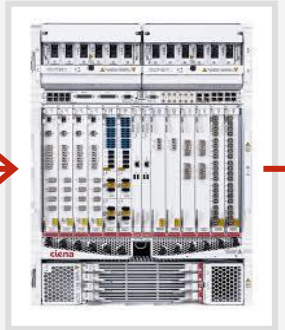
Lasers, Drivers, Amplifiers, Modulators

Components & Modules

Components and Coherent Transceivers

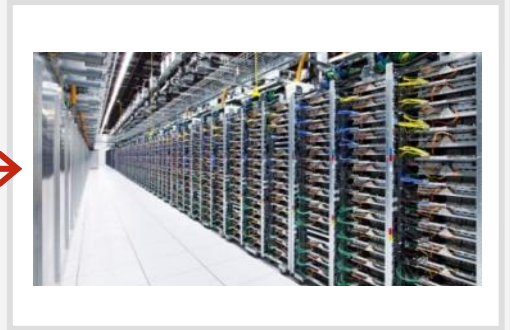
For Data Center and Telco Transport | Metro Network Equipment

Line Card | Daughter Card | Transponder



Systems

Telco Carriers/ Cloud and Hyperscale



Hyperscale Data Center / Telco Central Office

Products ← → **Customers**

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Sensing application and requirements

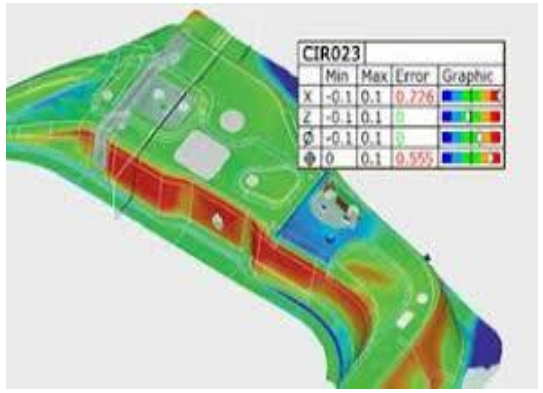
Coherent sensing uniquely enables high precision measurement

- Laser tuning/chirp bandwidth can be tailored to application requirement

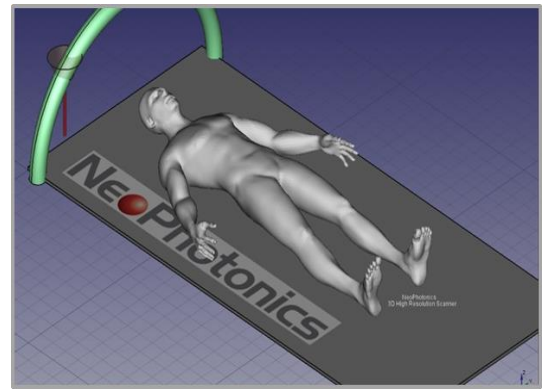
cm ⟶ Precision ⟶ µm

Applications

Coherent LIDAR for Autonomous Vehicles



Coherent Industrial Metrology



Coherent Medical Imaging

Device Requirements

>100mW ⟵ Optical Power ⟵ <10mW

>200m ⟵ Laser Coherence Length ⟵ ~1cm

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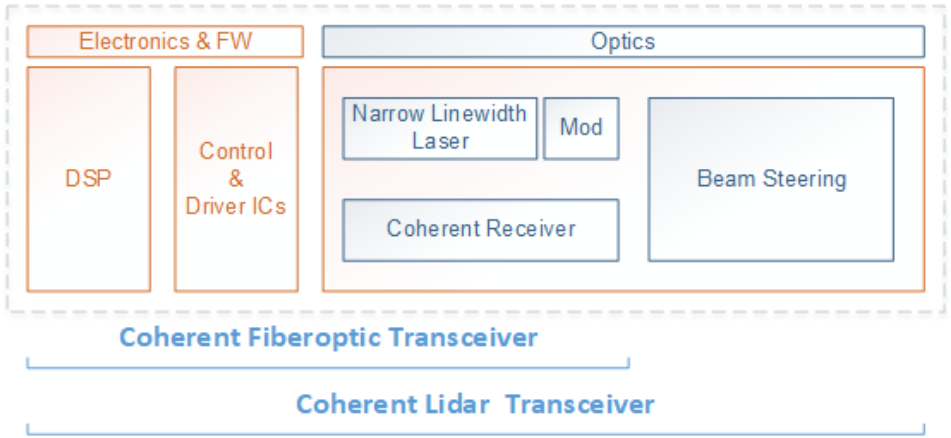
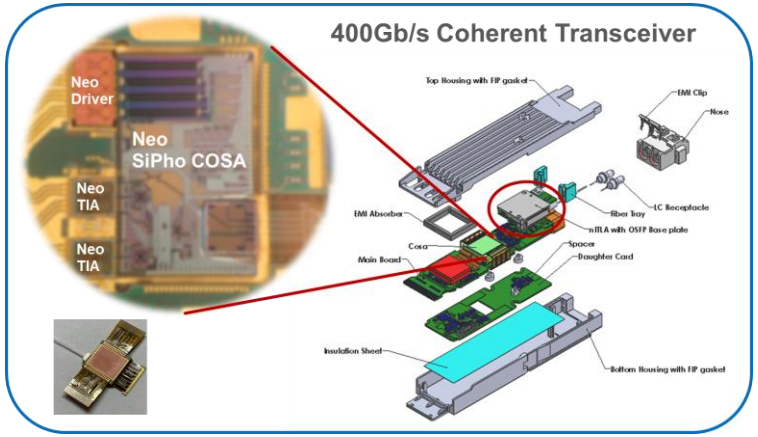
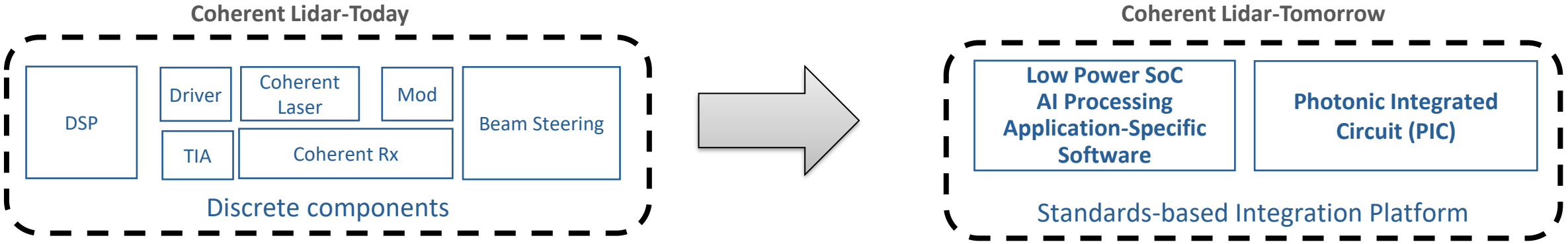
Chip-scale Sensors to leverage coherent technology used in telecom transceivers

Coherent (or FMCW) Lidar Tx and Rx technology is very similar to the coherent transceivers developed for telecom





Photonic Integrated Circuits developed for communication industry can be leveraged for next generation Lidars with optimized SWAP-C



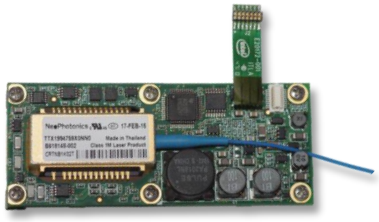
Case Study: 100G – 400G Tunable Long Haul Transceiver Evolution

Ten Years of Rapid Technology Evolution Driving Data Rate, Distance, Form Factor & Power

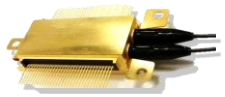
Component Evolution

2011

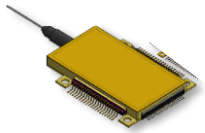
Tunable Laser



Modulator

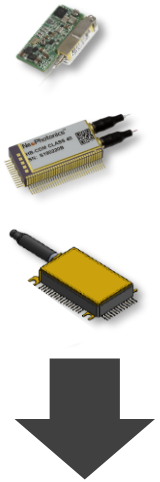


Receiver



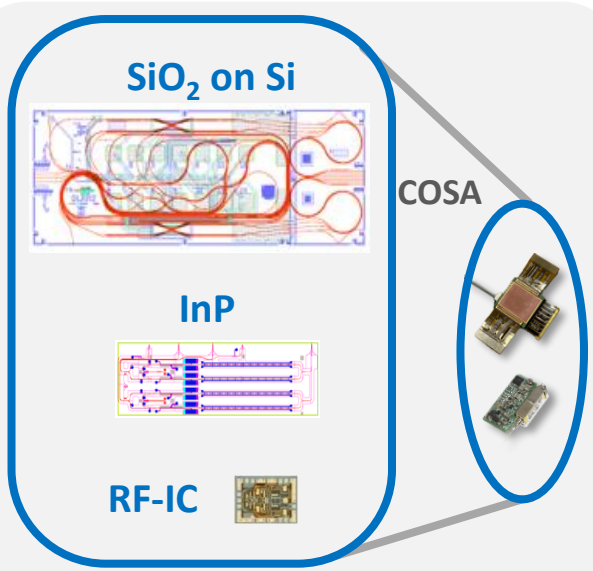
Component Shrink + 100G => 400G

2017



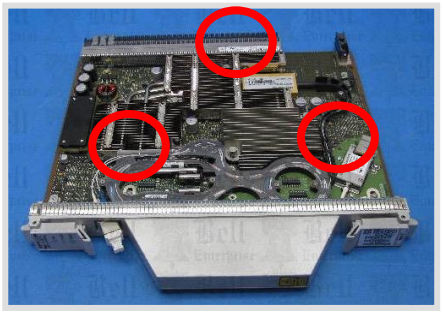
Silicon Photonics Integration

2020



Subsystem Evolution

100G Line Card



OEM DIY Discrete Components

Outsource

NPTN 400G Tunable Transponder

Component-based Optical Sub-system

Standards-based Silicon & Miniaturization

NPTN Pluggable 400G Transceiver

Silicon Photonics-based Pluggable Module

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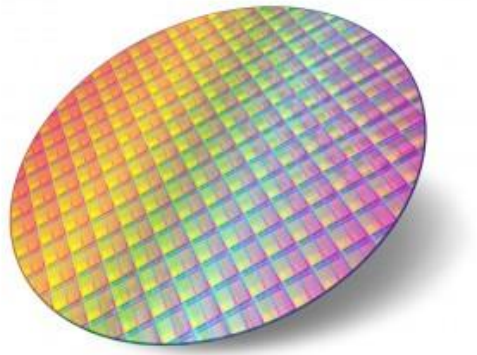
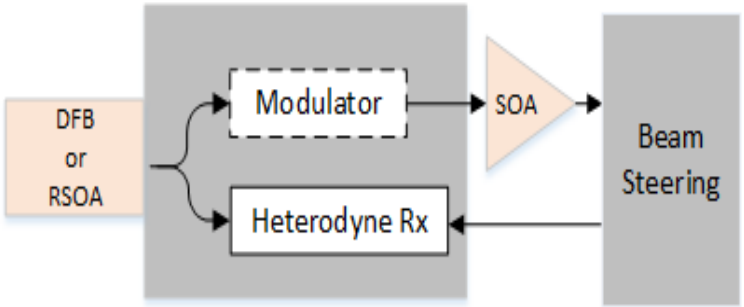
Optical Amplifiers and Lasers for Silicon Photonics Lidar PICs

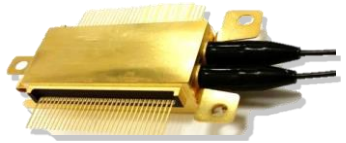
- Lidar PICs designed on silicon photonic wafers are powered by
  - Narrow linewidth lasers
    - Medium range applications <200KHz Linewidth
    - Long range (>200m) applications <100kHz linewidth
  - High power optical amplifiers(>100mW) for long range applications
- First generation Lidar PICs typically use co-packaged laser & SOA chips in gold-boxes
- Next generation Lidar PICs will use flipped-chip Laser/SOA chips on silicon wafer



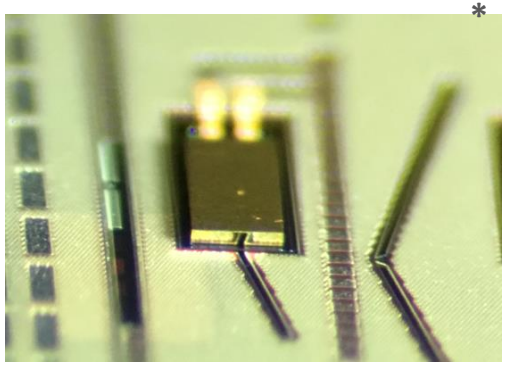
Coherent Lidar
Simplified Block Diagram

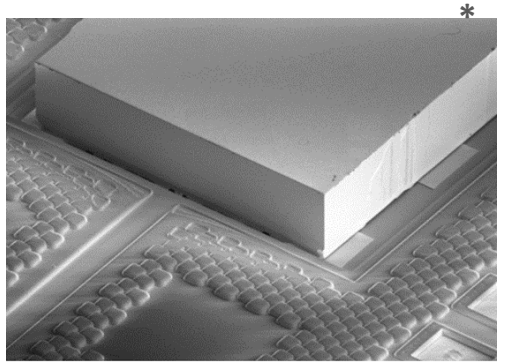


1st gen Lidar PIC package



Flipped-chip DFB laser on Silicon





** Dan Berger, Semicon-west, 2020*

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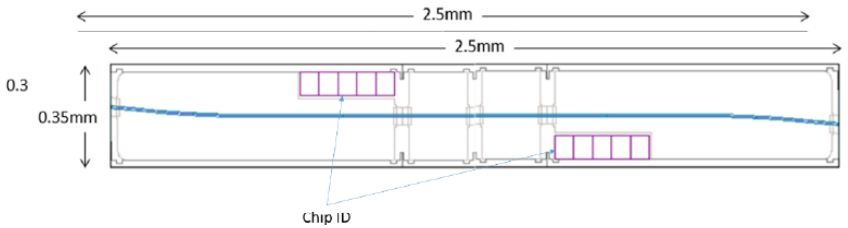
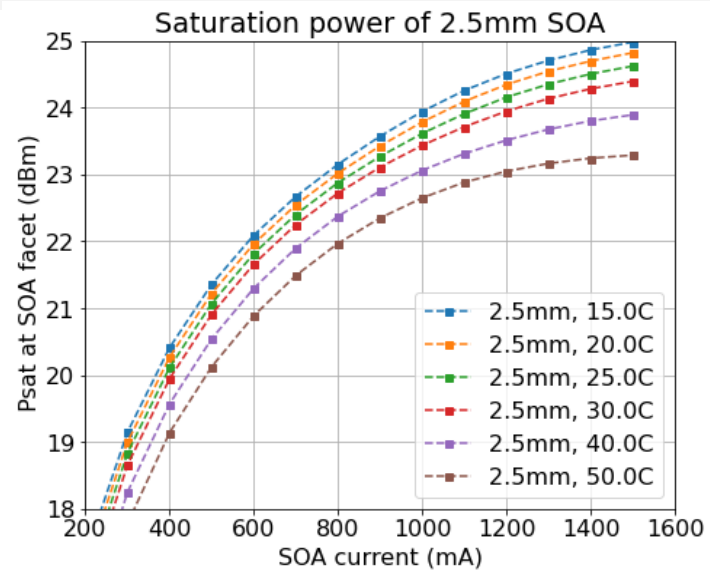
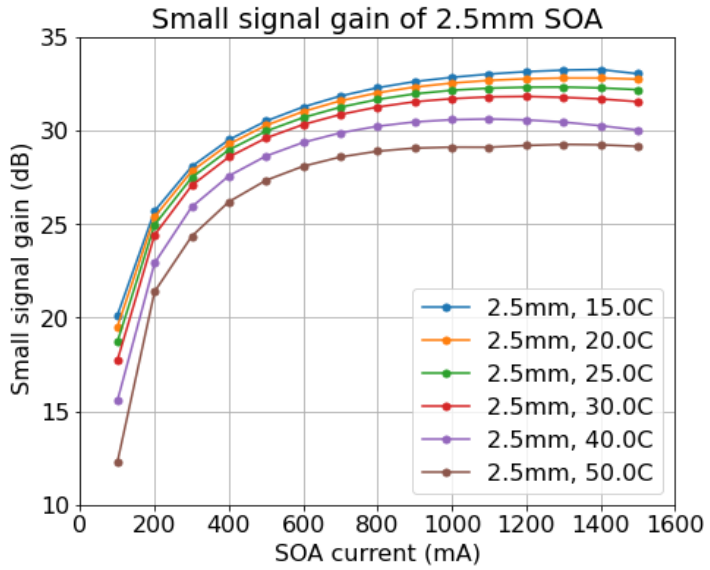
High Power SOAs for Lidar PICs

- Provides >200mW (23dBm) output power @50C
- Small signal gain >25dB
- Operating range :C-Band
- Chip length:2.5mm
- Typically used at the output stage of lidar designs

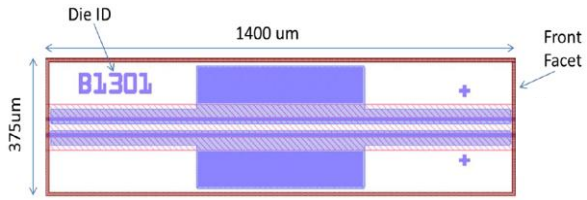


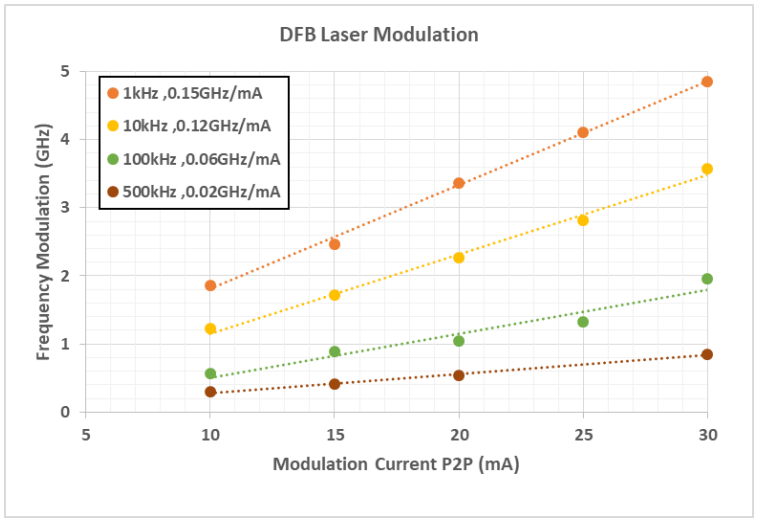


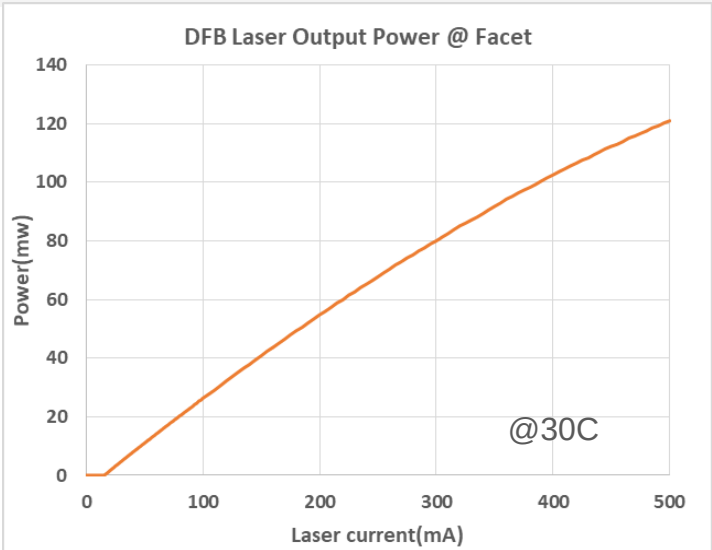


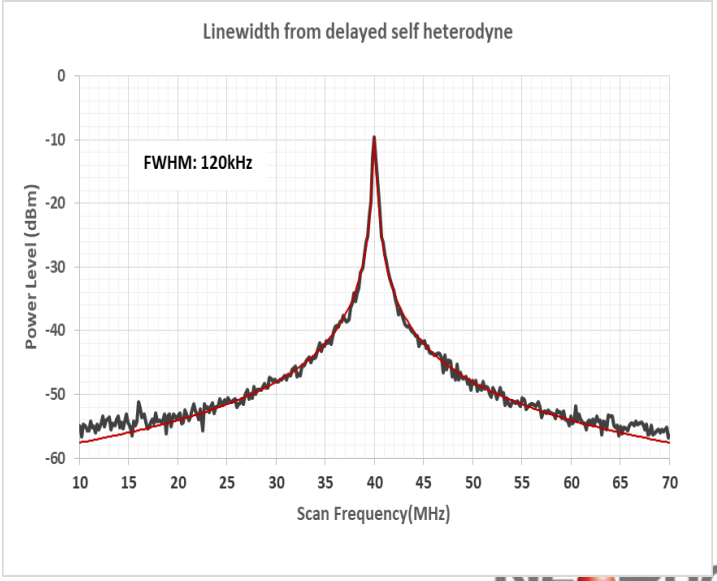
Narrow linewidth DFB laser for Lidar PICs

- Provides >75mW output power @70C
- Linewidth <200KHz
- Fixed wavelength in C-Band
- FMCW modulation through laser current modulation



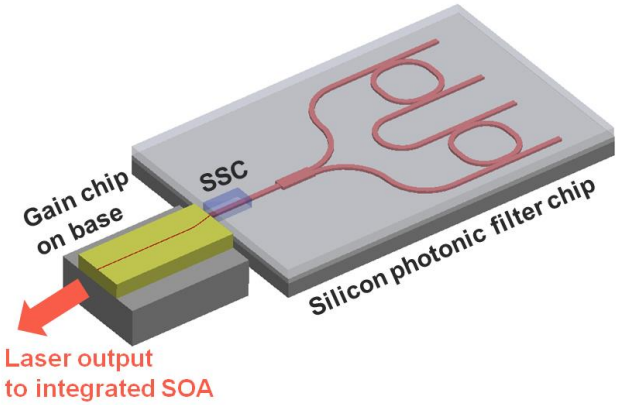


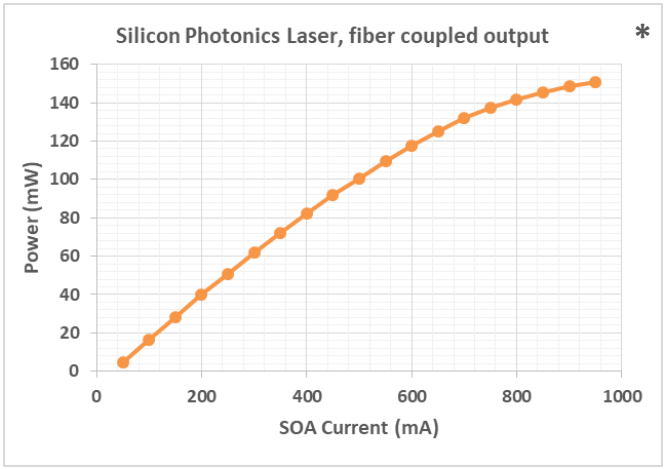


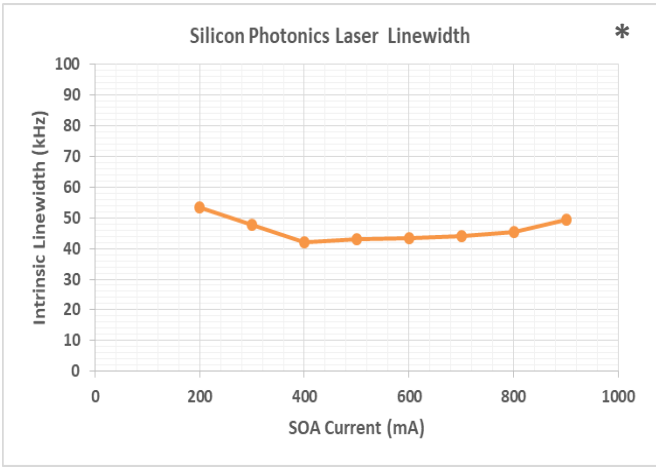


Tunable Silicon Photonics External Cavity Laser With FMCW modulation

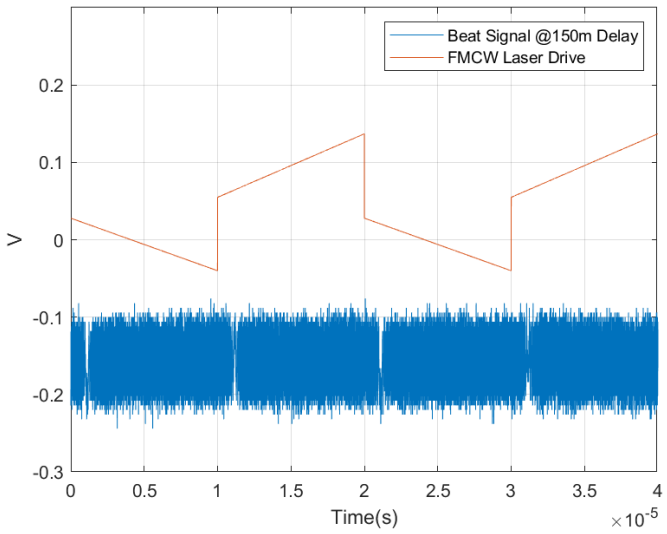
- Output Power >126mW (21dBm)
- Intrinsic linewidth <60KHz
- C-Band Tunable
- FMCW modulation capable

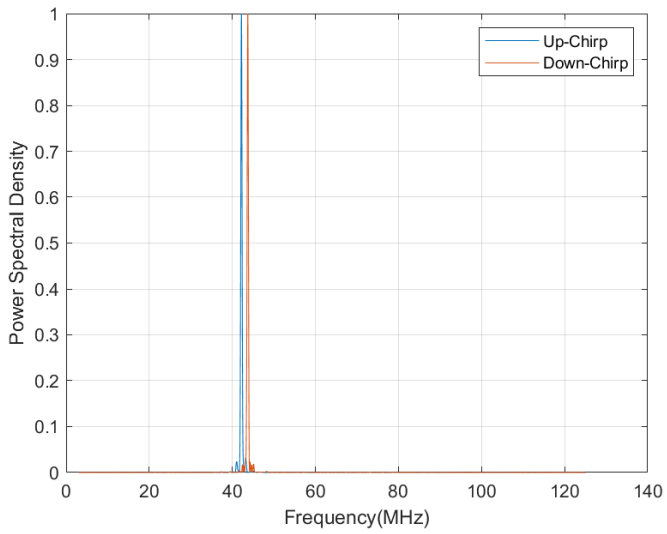






** Yongkang Gao et al, OFC2019*





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Conclusions

- Coherent component technologies developed for telecom devices can address the challenges of 3D Sensing applications through coherent PICs
  - Photonic Integrated Circuit (PIC) based LiDAR solutions are being developed to enable chip-scale sensors to be manufactured in high volumes and address size and cost requirements of automotive lidar applications.
  - With the availability of silicon photonics based PICs from CMOS foundries, designers now can implement complex optical circuits within small area and can fit thousands of these chips onto a single silicon wafer.

- Narrow linewidth lasers and high power semiconductor optical amplifiers are the key enabling components for chip-scale lidar devices
  - SOAs with >23dBm output power and lasers with <100KHz linewidth are available for long range coherent lidar devices.