

**TECHNICAL
PROGRAM**

SPIE. PHOTONICS WEST

27 JANUARY-1 FEBRUARY 2024
THE MOSCONE CENTER | SAN FRANCISCO, CALIFORNIA USA



OPTO DAILY CONFERENCE SCHEDULE

Check the conference schedule frequently for updates
Presentation times are subject to change

SATURDAY 27 January	SUNDAY 28 January	MONDAY 29 January	TUESDAY 30 January	WEDNESDAY 31 January	THURSDAY 1 February
Optoelectronic Materials and Devices (James G. Grote, Shubin Jiang)					
			12880 Physics and Simulation of Optoelectronic Devices XXXII (Bernd Witzigmann; Marek Osinski; Yasuhiko Arakawa) Location: Moscone Center, Room 2008 (Level 2 West)		
		12881 Physics, Simulation, and Photonic Engineering of Photovoltaic Devices XIII (Alexandre Freundlich; Stéphane Collin; Karin Hinzer; Ian R. Sellers) Location: Moscone Center, Room 2014 (Level 2 West)			
		12882 Optical Components and Materials XXI (Shubin Jiang; Michel J. F. Dignonnet) Location: Moscone Center, Room 2012 (Level 2 West)			
				12883 Organic Photonic Materials and Devices XXVI (William M. Shensky III; Ileana Rau; Okihiko Sugihara) Location: Moscone Center, Room 2018 (Level 2 West)	
		12884 Ultrafast Phenomena and Nanophotonics XXVIII (Markus Betz; Abdulhakem Y. Elezzabi) Location: Moscone Center, Room 2020 (Level 2 West)			
		12885 Terahertz, RF, Millimeter, and Submillimeter-Wave Technology and Applications XVII (Laurence P. Sadwick; Tianxin Yang) Location: Moscone Center, Room 2016 (Level 2 West)			
		12886 Gallium Nitride Materials and Devices XIX (Hiroshi Fujioka; Hadis Morkoç; Ulrich T. Schwarz) Location: Moscone Center, Room 2024 (Level 2 West)			
		12887 Oxide-based Materials and Devices XV (David J. Rogers; Ferechteh H. Teherani) Location: Moscone Center, Room 2022 (Level 2 West)			
			12888 2D Photonic Materials and Devices VII (Arka Majumdar; Carlos M. Torres Jr.; Hui Deng) Location: Moscone Center, Room 2010 (Level 2 West)		
Photonic Integration (Yakov Sidorin, Jean-Emmanuel Broquin)					
		12885 Terahertz, RF, Millimeter, and Submillimeter-Wave Technology and Applications XVII (Laurence P. Sadwick; Tianxin Yang) Location: Moscone Center, Room 2016 (Level 2 West)			
		12889 Integrated Optics: Devices, Materials, and Technologies XXVIII (Sonia M. García-Blanco; Pavel Cheben) Location: Moscone Center, Room 304 (Level 3 South)			
		12890 Smart Photonic and Optoelectronic Integrated Circuits 2024 (Sailing He; Laurent Vivien) Location: Moscone Center, Room 302 (Level 3 South)			
		12891 Silicon Photonics XIX (Graham T. Reed; Andrew P. Knights) Location: Moscone Center, Room 301 (Level 3 South)			
		12892 Optical Interconnects XXIV (Ray T. Chen; Henning Schröder) Location: Moscone Center, Room 204 (Level 2 South)			
		12893 Photonic Instrumentation Engineering XI (Lynda E. Busse; Yakov Soskind) Location: Moscone Center, Room 312 (Level 3 South)			
		12894 Next-Generation Optical Communication: Components, Sub-Systems, and Systems XIII (Guifang Li; Kazuhide Nakajima; Atul K. Srivastava) 12894 Location: Moscone Center, Room 314 (Level 3 South)			

CONFERENCE 12885

Terahertz, RF, Millimeter, and Submillimeter-Wave Technology and Applications XVII

29 January 2024 - 01 February 2024 | Moscone Center, Room 2016 (Level 2 West)

Conference Chair(s): Laurence P. Sadwick, InnoSys, Inc. (United States); Tianxin Yang, Tianjin Univ. (China)

Program Committee: René Beigang, Rheinland-Pfälzische Technische Univ. Kaiserslautern-Landau (Germany); Jianji Dong, Huazhong Univ. of Science and Technology (China); Frank Ellrich, Technische Hochschule Bingen (Germany); Fabian Friederich, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany); Robert H. Giles, Univ. of Massachusetts Lowell (United States); R. Jennifer Hwu, InnoSys, Inc. (United States); Mona Jarrahi, UCLA Samueli School of Engineering (United States); Karen K. Lin, A*STAR Institute of Materials Research and Engineering (Singapore); Daniel Molter, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany); Kyung Hyun Park, Electronics and Telecommunications Research Institute (Korea, Republic of); Marco Rahm, Rheinland-Pfälzische Technische Univ. Kaiserslautern-Landau (Germany); Jinghua Teng, A*STAR Institute of Materials Research and Engineering (Singapore); Michael Weibel, Joint Research and Development, Inc. (United States); Maddy Woodson, Freedom Photonics, LLC (United States); Jiangfeng Zhou, Univ. of South Florida (United States)

Monday 29 January 2024

OPTO PLENARY SESSION

29 January 2024 • 08:00 AM - 10:15 AM | Moscone Center, Room 207/215 (Level 2 South)

Session Chairs: Karin Hinzer, Univ. of Ottawa (Canada) and Ulrich T. Schwarz, Technische Univ. Chemnitz (Germany)

8:00 AM - 8:15 AM: **Welcome and Opening Remarks**

Announcement of the Aden and Marjorie Meinel Technology Achievement Award

12891-501 • 08:15 AM - 08:55 AM

Silicon photonics: the quest for sustainable growth (Plenary Presentation)

Author(s): Roel G. Baets, Ghent Univ. (Belgium), imec (Belgium)

12890-501 • 08:55 AM - 09:35 AM

Neuromorphic photonics (Plenary Presentation)

Author(s): Paul R. Prucnal, Princeton Univ. (United States)

12904-501 • 09:35 AM - 10:15 AM

Semiconductor lasers pushed deeper into unseen wavelengths and frontiers (Plenary Presentation)

Author(s): Åsa Haglund, Chalmers Univ. of Technology (Sweden)

Coffee Break 10:15 AM - 11:00 AM

SESSION 1: THZ SOURCES

29 January 2024 • 11:00 AM - 11:40 AM | Moscone Center, Room 2016 (Level 2 West)

Session Chair(s): Tianxin Yang, Tianjin Univ. (China); Laurence P. Sadwick, InnoSys, Inc. (United States)

12885-2 • 11:00 AM - 11:20 AM

Highly efficient optical beats using laser chaos for THz waves

Author(s): Fumiyoshi Kuwashima, Fukui Univ. of Technology (Japan); Mona Jarrahi, Semih Cakmakyapan, Univ. of California, Los Angeles (United States); Osamu Morikawa, Japan Coast Guard Academy (Japan); Kazuyoshi Kurihara, Univ. of Fukui (Japan); Kenji Wada, Osaka Metropolitan Univ. (Japan); Hideaki Kitahara, Takashi Furuya, Univ. of Fukui (Japan); Masanobu Haraguchi, Tokushima Univ. (Japan); Takeshi Moriyasu, Univ. of Fukui (Japan); Yuki Kawakami, National Institute of Technology, Fukui College (Japan); Makoto Nakajima, Osaka

12885-33 • 04:50 PM - 05:10 PM

Modelling a MEMS hotplate mid infrared emitter*Author(s):* **Andreas T. Winzer, Toni Schildhauer**, CIS Forschungsinstitut für Mikrosensorik GmbH (Germany)

12885-34 • 05:10 PM - 05:30 PM

Phase-change metamaterial for tunable polarization conversions in terahertz region*Author(s):* **Surawut Wicharn**, Srinakharinwirot Univ. (Thailand); **Prathan Buranasiri**, King Mongkut's Institute of Technology Ladkrabang (Thailand)**Wednesday 31 January 2024****SESSION 8: THZ, RF, MILLIMETER-WAVE, AND SUB-MILLIMETER WAVE II**

31 January 2024 • 08:00 AM - 10:10 AM | Moscone Center, Room 2016 (Level 2 West)

Session Chair(s): **Laurence P. Sadwick**, InnoSys, Inc. (United States); **Tianxin Yang**, Tianjin Univ. (China)

12885-35 • 08:00 AM - 08:20 AM

Generation of Nyquist pulse sequences using dual parallel Mach-Zehnder modulator and phase modulator*Author(s):* **Jiakang Li, Yusheng Yao, Dongfang Jia, Chunfeng Ge, Zhaoying Wang, Tianxin Yang**, Tianjin Univ. (China)

12885-37 • 08:20 AM - 08:40 AM

Real-time rapid scanning time-domain high-frequency terahertz radiation registration system*Author(s):* **Mingyuan Zhang, Jacob Byers**, Univ. of Alberta (Canada); **Brett Carnio**, Polytechnique Montréal (Canada); **Abdulhakem Y. Elezzabi, Basem Y. Shariar**, Univ. of Alberta (Canada)

12885-38 • 08:40 AM - 09:00 AM

Mitigating the effects of water vapour absorption within terahertz wireless communication systems*Author(s):* **Ahmed Adel Nasreldin Mohamed, Alexis N. Guidi**, The Univ. of British Columbia (Canada); **Matthew E. Reid**, The Univ. of Northern British Columbia (Canada); **Jonathan F. Holzman**, The Univ. of British Columbia (Canada)

12885-39 • 09:00 AM - 09:20 AM

Frequency multiplexing in millimeter-wave over fiber fronthaul transmission links with an InAs/InP quantum dash mode-locked laser*Author(s):* **Xiaoran Xie**, National Research Council Canada (Canada), Concordia Univ. (Canada); **Guocheng Liu, Zhenguo Lu, Jiaren Liu**, National Research Council Canada (Canada); **Xiupu Zhang**, Concordia Univ. (Canada); **Khan Zeb**, National Research Council Canada (Canada), Concordia Univ. (Canada); **Philip J. Poole, Youxin Mao, Martin Vachon, Chun-ying Song, Pedro Barrios, John Weber, Nicolas Sabourin**, National Research Council Canada (Canada)

12885-40 • 09:20 AM - 09:40 AM

Emergent potential of the terahertz CMOS microprocessor*Author(s):* **Fabian M. Mihelic**, The Univ. of Tennessee Graduate School of Medicine (United States), Averose Inc. (United States)

12885-36 • 09:40 AM - 10:10 AM

High-sensitivity detection of incoherent terahertz radiation through photomixing (Invited Paper)*Author(s):* **Mona Jarrahi**, UCLA Samueli School of Engineering (United States)**Coffee Break 10:10 AM - 10:40 AM****SESSION 9: THZ, RF, MILLIMETER-WAVE, AND SUB-MILLIMETER WAVE III**

31 January 2024 • 10:40 AM - 12:00 PM | Moscone Center, Room 2016 (Level 2 West)

Session Chair(s): **Marco Rahm**, Rheinland-Pfälzische Technische Univ. Kaiserslautern-Landau (Germany); **Laurence P. Sadwick**, InnoSys, Inc. (United States)

12885-41 • 10:40 AM - 11:00 AM

A simple but accurate linearity model for Si Mach-Zehnder modulators*Author(s):* **Min-Hyeok Seong, Yongjin Ji**, Yonsei Univ. (Korea, Republic of); **Chul-Soon Im**, Hanwha Systems Co., Ltd. (Korea, Republic of); **Youngeok Bae**, Agency for Defense Development (Korea, Republic of); **Woo-Young Choi**, Yonsei Univ. (Korea, Republic of)

12885-42 • 11:00 AM - 11:20 AM

Directly modulated quantum-dash mode-locked lasers for millimeter-wave over fiber applications*Author(s):* **Guocheng Liu, Zhenguo Lu, Jiaren Liu, Philip J. Poole, Youxin Mao, Xiaoran Xie, Martin Vachon, Chun-ying Song, Pedro Barrios**, National Research Council Canada (Canada)



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Conference 12885 > Paper 12885-41

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Paper 12885-41

A simple but accurate linearity model for Si Mach-Zehnder modulators

31 January 2024 • 10:40 AM - 11:00 AM PST | Moscone Center, Room 2016 (Level 2 West)

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Abstract

Authors

Si optical modulator, one of the key components in Si photonic integrated circuits (PIC), should have good linearity performance so that the microwave photonic systems based on Si PIC can satisfy requirements in many applications. The linearity performance of Si optical modulators, including Si Mach-Zehnder modulators (MZM), is typically evaluated by third-order intermodulation distortion (IMD₃) and spurious-free dynamic range (SFDR). In this presentation, we propose a new methodology to determine the IMD₃ and SFDR values of Si MZMs accurately. Our model includes several characteristics of Si MZMs and, therefore, the model parameters should be extracted by various methods. Using the parameters, we simulate the values of the IMD₃ and SFDR for a sample Si MZM. Examples of design optimization will be also presented based on this model to maximize the linearity performance of Si MZMs.

Presenter

Min-Hyeok Seong
Yonsei Univ. (Korea, Republic of)

Min-Hyeok Seong received the B.S. degree in electrical and electronic engineering from Yonsei University, Seoul, South Korea, in 2019. He is pursuing the combined Ph.D degree with High-Speed Circuits and Systems Laboratory in Yonsei university. He currently interests in several research topics including optical modulators based on Si photonics for digital and analog applications.

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Conference 12885 > Paper 12885-41

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A simple but accurate linearity model for Si Mach-Zehnder modulators

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Abstract

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