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Experimental Study of the Validity of Entangled Two-Photon Absorption Measurements in Organic Compounds.....	1846
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<i>Eugene Tsao, Alex Lind, Peter Chang, Connor Fredrick, Nazanin Hoghooghi, Franklyn Quinlan, Scott Diddams</i>	
Validation of a Multi-Frequency Differential Absorption LIDAR (DIAL) System from Aerosol and Cloud Retrievals .....	1902
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Frequency-Domain Fluorescence Lifetime Imaging as Method to Analyze Wood Structures .....	1904
<i>Nina Leiter, Maximilian Wohlschläger, Martin Versen</i>	
Crust Deformation Detection System Based on Coherent Optical Fiber Sensing Technology .....	1906
<i>Zhengxuan Shi, Jiang Yang, Hao Li, Baoqiang Yan, Qiong Yuan, Qizhen Sun, Zhijun Yan</i>	

Detection of Starch Content Variations in Grasses using Raman Microscopy.....	1908
<i>A. Fernandez, D. Sen, M. C. Lee, N. Havrilchak, M. Aleman, Z. Han, B. Strycker, Z. Yi, J. B. West, A. Sokolov, M. O. Scully, A. J. Verhoef</i>	
An Intrusion Events Recognition Method by Incremental Learning Assisted with Fiber Optic DAS System.....	1910
<i>Shixiong Zhang, Tao He, Kai Xiao, Cunzheng Fan, Hao Li, Zhijun Yan, Deming Liu, Qizhen Sun</i>	
Fabrication Tolerant Inverse Design Grating Couplers for Scalable Trapped Ion Quantum Computing.....	1912
<i>Daniel Klawson, Mizuki Shirao, Sara Mouradian, Ming C. Wu</i>	
Optimal-Classical and Quantum-Enhanced Sensing of a Small Transverse Beam Displacement .....	1914
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<i>Mohammadreza Saemian, Djamel Gacemi, Baptiste Chomet, Etienne Rudriguez, Yanko Todorov, Angela Vasanelli, Isabelle Sagnes, Konstantinos Pantzas, Gregoire Beaudoin, Olivier Lopez, Benoît Darquié, Carlo Sirtori</i>	
Spot-Size Converter with Low Polarization-Dependent Loss Manufacturable with 0.18 $\mu\text{m}$ CMOS Design Rules.....	1918
<i>Hirota Uemura, Reona Motoji, Naoki Matsui, Dan Maeda, Tomoya Sugita</i>	
Plasmonic Effect of Ag-Nanoparticles on Self-Powered Photodetection Performance of NiO/Si Heterostructure Device.....	1920
<i>Savita Chaoudhary, Avijit Dewasi, Vipul Rastogi, Anirban Mitra</i>	
Modeling the Frequency Response of Vertical and Lateral Ge-On-Si Waveguide Photodetectors: Is 3D Simulation Unavoidable? .....	1923
<i>Matteo Giovanni Carmelo Alasio, Marco Vallone, Alberto Tibaldi, Francesco Bertazzi, Soha Namnabat, Donald Adams, Prakash Gothoskar, Fabrizio Forghieri, Gianlorenzo Masini, Giovanni Ghione, Michele Goano</i>	
Electrically Reconfigurable Photonic PUF Based on a Moiré Quasicrystal Interferometer.....	1925
<i>Farhan Bin Tarik, Derrick Joyce, Yingjie Lao, Judson D. Ryckman</i>	
Infrared Refractive Index Measurement of Niobium Nitride Thin-Film via FTIR.....	1927
<i>Dip Joti Paul, Tony X. Zhou, Karl K. Berggren</i>	
Hybrid Integration of Multilayers GeP on a Silicon Photonics Platform for Optoelectronic Application .....	1929
<i>Ghada Dushaq, Bruna Paredes, Juan Esteban Villegas, Srinivasa Reddy Tamalampudi, Mahmoud Raras</i>	
Cd <sub>1-x</sub> Mn <sub>x</sub> Te as a Magneto-Optical Material for Miniaturized Optical Isolators: A broad-Range Spectroscopic Analysis of Relevant Optical Properties .....	1931
<i>Christoph Tyborski, Muhammad T. Hassan, Max Schiemangk, Andreas Wicht</i>	
Integration of Single GaN Micro-Lenses with High Index Semiconductors by Transfer Printing.....	1933
<i>Nils Kolja Wessling, Saptarsi Ghosh, Benoît Guilhabert, Menno Kappers, Rachel A. Oliver, Martin D. Dawson, Michael J. Strain</i>	
Correction of Apodisation-Induced Phase Error in Small-Spot Direct UV Bragg Grating Writing.....	1935
<i>James W. Field, Rex H. S. Bannerman, Devin H. Smith, Alex I. Flint, Corin B. E. Gawith, Peter G. R. Smith, James C. Gates</i>	

Optical Nonlinearity of Colloidal Quantum Wells Coupled to a Low Mode-Volume Cavity.....	1937
<i>David Sharp, Arnab Manna, Max Friedfeld, Brandi Cossairt, Arka Majumdar</i>	
Flatten Optical Frequency Combs Generated via Parametric Oscillations of a Bottle Microresonator.....	1939
<i>Manuel Crespo-Ballesteros, Andrey B. Matsko, Misha Sumetsky</i>	
Silicon Nitride Waveguide Polarization Components for Rubidium Saturated Absorption Spectroscopy On-Chip.....	1941
<i>Kevin Gallacher, Paul F. Griffin, Erling Riis, Marc Sorel, Douglas J. Paul</i>	
Highly Selective Optical Filtering Technology on 300 mm Glass Wafer for Advanced Spectroscopy Applications .....	1943
<i>S. Villenäve, S. Monfray, Q. Abadie, S. Audran, S. Guillaumet, D. Ristoiu, H. Benisty</i>	
Coil-Based Waveguide Layout Architecture for Micro-Photonic Devices .....	1945
<i>S. Bidnyk, K. Yadav, A. Balakrishnan</i>	
TiO <sub>2</sub> -Based Flexible Integrated Photonics for High-Sensitivity Temperature Sensing.....	1947
<i>Xuan Zhao, Bo Fan, Ashok Veeraraghavan, Jacob Robinson</i>	
AutoML Hyperparameter Tuning of Generative DNN Architecture for Nanophotonic Device Design.....	1949
<i>Toshiaki Koike-Akino, Keisuke Kojima, Ye Wang</i>	
Exploiting Atomic Nature of the Interface for Controlling Mode Coupling in Microresonators .....	1951
<i>Xingchen Ji, Andres Gil-Molina, Michal Lipson</i>	
Ultra-Broadband, Low Loss 3dB Splitter in Silicon Photonics Waveguides .....	1953
<i>Pierre Maidment, Marc Sorel</i>	
Stability and Deterministic Generation of Single Solitons and Soliton Crystals in Microresonators with Avoided Crossings .....	1955
<i>Zhen Qi, Giuseppe D'Aguanno, Thomas F. Carruthers, Omri Gat, Curtis R. Menyuk</i>	
Photonic Crystals with Split Ring Unit Cells for Subwavelength Light Confinement.....	1957
<i>Kellen P. Arnold, Sami I. Halimi, Joshua A. Allen, Shuren Hu, Sharon M. Weiss</i>	
Picometer-Precise Post-Processing of Optical Microresonators via Slow-Cooking.....	1959
<i>Gabriella Gardosi, Brian J. Mangan, Misha Sumetsky</i>	
Generation of Sub-20 fs Pulses at 2 $\mu\text{m}$ via Degenerate Optical Parametric Amplification .....	1961
<i>K. R. Keller, A. Budweg, J. Allerbeck, D. Brida</i>	
Degradation Free Spectral Broadening in a Multimode Fiber with $\sim 0.5 \mu\text{J}$ Pulses.....	1963
<i>Laura Wooldridge, Scott R. Domingue, Matthew S. Kirchner, Peter Fendel</i>	
Ion-Based High-Harmonic Generation from Water Window to keV X-Ray .....	1965
<i>Hsu-Hsin Chu, Yao-Li Liu, Jyhyng Wang</i>	
Proton Beam Enhancement from Ultrafast Laser Interactions with Compound Parabolic Concentrators.....	1967
<i>H. Smith, D. Rusby, G. Zeraoui, P. Campbell, T. Ha, D. Mariscal, T. Ma, S. Wilks, A. Mackinnon, H. Quevedo, E. Medina, M. Spinks, S. Bruce, M. Donovan, T. Ditmire</i>	
Sub-GHz Resolution Dynamic Line-By-Line Pulse Shaper at 1 $\mu\text{m}$ .....	1969
<i>Dahyeon Lee, Takuma Nakamura, Andrew J. Metcalf, Franklyn Quinlan</i>	

Engineering the Frequency Response of Petahertz-Electronic Nanoantenna Field-Sampling Devices.....	1971
<i>Felix Ritzkowsky, Mina R. Bionta, Marco Turchetti, Karl K. Berggren, Franz X. Kartner, Philip D. Keathley</i>	
High Order (N=4-6) Multiphoton Mid-IR Absorption in GaP, ZnSe, GaSe, and ZGP and the Role of Free Carriers.....	1973
<i>Taiki Kawamori, Peter G. Schunemann, Vitaly Gruzdev, Konstantin L. Vodopyanov</i>	
Spatially Variable Wave Plate for Depolarization Compensation Induced in High-Power Yb:YAG Amplifier .....	1975
<i>Raimundas Burokas, Orestas Ulcinas, Kirilas Michailovas, Rokas Danilevicius, Aivaras Kazakevicius, Andrejus Michailovas</i>	
Measurement-Verified Spatiotemporal Ultrafast Pulse Propagation.....	1977
<i>Keith A. Wernsing, Daniel J. Kane</i>	
All-Optical Dynamic Pulsed Beam Steering .....	1979
<i>Suparna Seshadri, Andrew M. Weiner</i>	
Fast Dynamics of 10 $\mu\text{m}$ Breakdown in Air by Time and Space Resolved Visible Interferometry .....	1981
<i>Eric Welch, Sergei Tochitsky, Daniel Matteo, Chan Joshi</i>	
Quantum Cascade Laser Dual-Comb Spectrometer Intensity Noise Comparison: Symmetric Vs. Asymmetric Configuration.....	1983
<i>Nicholas Kosan, Link Patrick, Jie Liu, Gerard Wysocki</i>	
Mid-Infrared Time-Stretch Optical Coherence Tomography .....	1985
<i>Satoko Yagi, Kazuki Hashimoto, Takuma Nakamura, Shotaro Kawano, Venkata Ramaiah Badarla, Hiroyuki Shimada, Takuro Ideguchi</i>	
Hollow-Core-Fiber-Delivered Mid-Infrared Heterodyne Spectroscopy.....	1987
<i>Pablo Castro-Marin, Kerr Johnson, Carl Farrell, Ian A. Davidson, Gregory T. Jasion, Natalie V. Wheeler, Francesco Poletti, David J. Richardson, Derryck T. Reid</i>	
Ghost Sensing.....	1989
<i>Emroz Khan, Evgenii E. Narimanov</i>	
Fiber Sensing using Higher-Order Spatial Modes and the Orbital Angular Momentum of Light.....	1991
<i>Yifan Wang, Brendan M. Heffernan, Mo Zohrabi, Julia Farrell, Mark E. Siemens, Juliet T. Gopinath</i>	

### **JOINT POSTER SESSION II-B (VIRTUAL)**

Low Noise 560 GHz Generation from a Fiber-Referenced Kerr Microresonator Soliton Comb .....	1993
<i>Naoya Kuse, Kenji Nishimoto, Yu Tokizane, Shota Okada, Kaoru Minoshima, Takeshi Yasui</i>	
Hybrid Metal-Silicon Metasurface for Reconfigurable THz Wave Modulation .....	1995
<i>Ahasan Ulla, Li-Jing Cheng</i>	
Terahertz Microcavity Modulation Mediated by Strongly Coupled to LSPR Mode.....	1997
<i>Xitan Xu, Yao Lu, Qiang Wu, Jingjun Xu</i>	
Ultrafast Photoexcited Molecular Dynamics of Metalated Porphyrin - Naphthalimide Based Donor-Acceptor Systems .....	1999
<i>Md Soif Ahmed, Chinmoy Biswas, Dipanjan Banerjee, Botta Bhavani, S. Prasanthkumar, Lingamallu Giribabu, Venugopal Rao Soma, Sai Santosh Kumar Raavi</i>	

Exciton Complexes and Quantum Electrodynamics of Highly-Symmetric Single-Site-Controlled InGaAS Quantum Dot Nanocavities .....	2001
<i>Jiahui Huang, Wei Liu, Alessio Miranda, Benjamin Dwir, Alok Rudra, Eli Kapon, Chee Wei Wong</i>	
Spiral Phase Modulation Based Deep Learning for Autofocusing .....	2003
<i>Zezheng Zhang, Ryan K. Y. Chan, Kenneth K. Y. Wong</i>	
High Accuracy Robot Indoor Navigation using Visible Light Positioning and LiDAR Fusion.....	2005
<i>Wanlin Liang, Shangsheng Wen, Linyi Huang, Weipeng Guan</i>	
Novel Data-Processing Method for High-Resolution Spectrally Steered LiDAR using Dispersion-Tuned Swept Laser .....	2007
<i>Zheyuan Zhang, Chao Zhang, Takuma Shirahata, Shinji Yamashita, Sze Y. Set</i>	
High Resolution Fiber Grating Dynamic Strain Sensor with Broadband Light .....	2009
<i>Shuting Liu, Qingwen Liu, Shuangxiang Zhao, Zuyuan He</i>	
Self-Powered GaN Nanowire-Based Photoelectrochemical Type Photodetector for Wireless UV Photodetection in Seawater .....	2011
<i>Yuanmin Luo, Danhao Wang, Yang Kang, Xin Liu, Shi Fang, Haiding Sun</i>	
Ship Detection Based on LiDAR and Visual Information Fusion.....	2013
<i>Ruixin Ma, Yong Yin, Kexin Bao</i>	
Two-Dimensional Visible and Near-Infrared Beam Steering of Silicon Nitride Optical Phased Arrays .....	2015
<i>Caiming Sun, Binghui Li, Wu Shi, Jing Lin, Ning Ding, Aidong Zhang</i>	
Polarization Independent Waveguide Bragg Gratings using Tilted Subwavelength Grating Waveguides .....	2017
<i>Hao Sun, Lawrence R. Chen</i>	
Global Net-Gain Characterization of Monolithically Integrated Waveguide Amplifiers.....	2019
<i>Jinfeng Mu, Meindert Dijkstra, Sonia Garcia-Blanco</i>	
GaP-OI Resonator Design for Octave-Spanning Kerr Soliton Frequency Comb Generation .....	2021
<i>Qiancheng Zhao, Zhaoting Geng, Houling Ji, Yi Li</i>	
Waveguide Integrated Nonreciprocal Optical Routers for Silicon Photonics .....	2023
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Flat Band Quantum Dot High Order Mode Locked Laser for Tbit/s Transmission .....	2025
<i>Jing-Zhi Huang, Zi-Tao Ji, Jia-Jian Chen, Wen-Qi Wei, Jia-Le Qin, Zi-Hao Wang, Ting Wang, Zhi-Yuan Li, Xi Xiao, Jian-Jun Zhang</i>	
Programmable On-Chip Photonic Machine Learning System Based on Joint Transform Correlator .....	2027
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Predicting Molecular Properties using Photonic Chip-Based Machine Learning Approach.....	2029
<i>J. Lau, H. Zhang, L. Wan, L. Shi, C.-K. Lee, L. C. Kwek, A. Q. Liu</i>	
Heterogeneously Integrating Photonic Crystal Lasers on SiN <sub>x</sub> Waveguide by Transfer Printing .....	2031
<i>Tsan-Wen Lu, Jing-Ting Wang, Po-Tsung Lee</i>	

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