

“Integrated Lithium Niobate Photonics for Communication, Sensing and Quantum applications”

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Lithium niobate (LN) is an “old” material with many applications in optical and microwave technologies, owing to its unique properties that include large second order nonlinear susceptibility, large piezoelectric response, and wide optical transparency window. Conventional discrete LN components, the workhorse of the optoelectronic industry for many decades, are reaching their limits, however. I will discuss our efforts aimed at the development of integrated LN photonic platform, featuring strong light confinement and dense integration, that has the potential to revolutionize optical communication networks and microwave photonic systems, as well as enable realization of quantum photonic circuits and integrated spectroscopic tools. Examples include high bandwidth, low voltage, and low loss electro-optic (EO) modulators [1], EO frequency combs [2], and programmable “photonic molecules” [3]. Devices that benefit from LN’s strong second and third order nonlinearity, including second harmonic generators [4] and Kerr frequency combs [5] will also be discussed.

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2. M. Zhang, B. Buscaino, C. Wang, A. Shams-Ansari, C. Reimer, R. Zhu, J. Kahn, and M. Loncar. “[Broadband electro-optic frequency comb generation in an integrated microring resonator.](#)” *Nature*, 568, 373(2019)
3. M. Zhang, C. Wang, Y. Hu, A. Shams-Ansari, T. Ren, S. Fan, and M. Loncar. “[Electronically Programmable Photonic Molecule.](#)” *Nature Photonics*, 13, 36 (2019)
4. C. Wang, C. Langrock, A. Marandi, M. Jankowski, M. Zhang, B. Desiatov, M. M. Fejer, and M. Loncar. “[Ultrahigh-efficiency wavelength conversion in nanophotonic periodically poled lithium niobate waveguides.](#)” *Optica*, 5, 1438 (2018)
5. C. Wang, M. Zhang, M. Yu, R. Zhu, H. Hu, and M. Loncar, “[Monolithic lithium niobate photonic circuits for Kerr frequency comb generation and modulation.](#)” *Nature Communications*, 10, 978 (2019)



Marko Loncar is Tientsai Lin Professor of Electrical Engineering at Harvard’s John A Paulson School of Engineering and Applied Sciences (SEAS), as well as Harvard College Professor. Loncar received his Diploma from University of Belgrade (R. Serbia) in 1997, and his PhD from Caltech in 2003 (with Axel Scherer), both in Electrical Engineering. After completing his postdoctoral studies at Harvard (with Federico Capasso), he joined SEAS faculty in 2006. Loncar is expert in nanophotonics and nanofabrication, and his current research interests include quantum and nonlinear nanophotonics, quantum optomechanics, and nanofabrication. He has received NSF CAREER Award in 2009 and Sloan Fellowship in 2010. In recognition of his teaching activities, Loncar has been awarded Levenson Prize for Excellence in Undergraduate Teaching (2012), and has been named Harvard College Professor in 2017. Loncar is fellow of Optical Society of America, and Senior Member of IEEE and SPIE. He is co-founder of HyperLight Corporation, VC backed startup commercializing lithium-niobate technology developed in his lab.

