Integrated quantum photonics on laser-written waveguide circuits

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Abstract: Integrated photonics is rapidly becoming an essential backbone for developing scalable quantum technologies using photons. The complexity reached in quantum photonics experiment is rapidly saturating the capability of bulk approaches in handling large setups with many optical modes interfering in a stable fashion, and the only way to maintain the technological momentum is to transfer the experiments into miniaturized photonic integrated chips. Among the various fabrication technologies, femtosecond laser waveguide writing (FLW) in glass has emerged as an extremely valuable tool for advancing in this field, thanks to many distinctive features, including low loss, polarization insensitivity, high compatibility with standard optical fibers, and intrinsic 3D capabilities. In addition, this technique can be applied to a large range of transparent dielectric materials, including nonlinear and doped crystals, which allow to add on chip important functionalities such as quantum light generation or coherent photon storage. Finally, the possibility of integrating thermo-optic phase shifters with no losses and high integration density allows for the fabrication of fully reconfigurable chips, and this crucial feature completes the FLW toolbox for advancing in the field of photonic quantum computing and quantum network.