Boson Sampling and Quantum Computing in Programmable Interferometers with Optical Feedback

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We will discuss a photonic approach to quantum computing focusing on implementations using linear optics. Our experiments use demultiplexed single photon sources based on semiconductor quantum dots in microcavities with in-fiber efficiency above 30%. The second key ingredient are programmable multiport interferometers manufactured using femtosecond laser writing. Using a multi-scan technique, we are able to manufacture waveguides with propagation loss below 0.05 dB/cm and coupling loss below 1 dB at 925 nm. This allows us to implement both gate-based algorithms and a novel approach to boson sampling using optical feedback loops to increase the dimensionality of the system. We will discuss the experimental implementation and benchmarking of such loopback boson samplers and their applications to combinatorial optimization problems.