Controlling spectral correlations in integrated sources: from energy-entangled to uncorrelated photon pairs

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Integrated micro- and nano-structures allow for the efficient generation of photon pairs via parametric fluorescence, thanks to the enhancement of the light-matter interaction due to light spatial confinement in small volumes. It has been shown that the efficiency of spontaneous four wave mixing (SFWM) in a silicon micro ring resonator can range up to 10 orders of magnitude larger than in bulk silicon [1] . Yet the advantages of using integrated devices go well beyond the sole efficiency improvement, for micro structures grant an unprecedented control over the properties of generated non-classical light. For instance, one can engineer the spectral correlations of the generated photons at a level that is hardly accessible using bulk sources, with the generation of either energy-entangled to nearly-uncorrelated photon pairs [1,2] . It is also possible to design integrated microring resonators to independently tune the spectral properties of the resonances involved in the SFWM process by utilizing an interferometric coupling scheme and achieve a Schmidt number arbitrarily close to unity (see Fig.1) [3-5]. Thanks to such a flexibility offered by integrated structures, energy is also emerging as a *usable* degree of freedom for qbit and qudit encoding in the context of photon pairs and multipartite states [6,7].

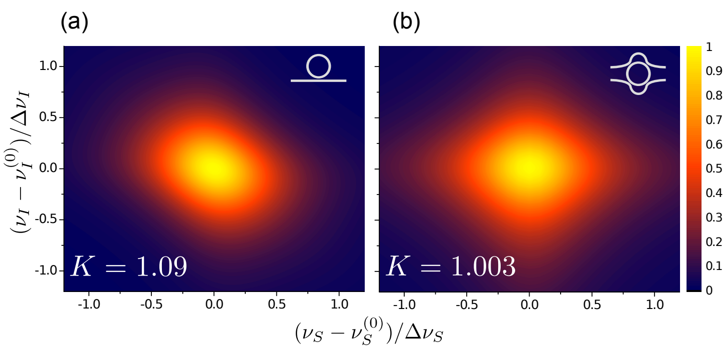

Figure 1: Joint spectral intensity (arb. units) for (a) conventional single-channel system with equal quality factors and (b) a structure with a interferometric couplers and optimized resonance widths

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