fraction of modes other than the selected input mode are converted.

In contrast, Fig. 4 (right) has no mode matching, the gating pulse FWHM is twice that of the input pulse. Multiple strong overlaps between SFG Schmidt modes φ_j and input modes $\tilde{u}_l$ appear: A wide range of modes is converted for any given input spectrum. The checkerboard pattern reflects the fact that only modes of the same parity exhibit an overlap, an odd and an even mode are orthogonal regardless of mode-matching.

5. Conclusion and outlook

In conclusion, we have introduced the concept of the QPG, a flexible device to separate well-defined broadband modes from a light pulse based on spectrally engineered SFG. The selected mode can be switched by shaping the gating pulse spectrum and converted with high fidelity. Further, we have given a realistic set of experimental parameters for a QPG realized in a PPLN waveguide and demonstrated the high flexibility of the QPG achieved through shaping the gating pulse form. We proposed as an initial application the preparation of pure heralded single photons from an arbitrary type II PDC source. For pulsed QKD schemes [1], it can act as a de-multiplexer of multiple quantum channels within one physical pulse, and in metrology it may be used to further enhance measurement accuracy beyond the classical limit by replacing multiple squeezed pulses [2] with one multi-mode squeezed pulse of light.

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