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Mode-selective generation and analysis of ultrashort quantum light states in the time-frequency domain

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The accurate determination and analysis of the mode occupied by a quantum state is mandatory for its manipulation, detection, and use. We will present recent results on the full experimental reconstruction of the unknown spectral/temporal shape of ultrashort single photons, of high interest also for novel data encoding architectures in quantum information processing and communication.

We will also show how the ability to accurately control the mode of pulsed quantum states of light, combined with techniques for the addition and subtraction of single photons to/from arbitrary light fields, can give us access to new forms of hybrid entangled states that harness the multimode nature of time-bins.