The role of fluctuations in nonlinear light-matter interactions

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Large intensity fluctuations of optical fields are typically assumed to be detrimental for applications in sensing or spectroscopy. However, this is not necessarily true in nonlinear spectroscopy. For instance, large photon number fluctuations associated with photon bunching can in fact greatly enhance the signal strength of nonlinear wave-mixing processes [1]. This could be of tremendous use in the investigation of photosensitive samples in chemistry or biology, where light intensities should be kept as small as possible. In addition, strong spatiotemporal quantum correlations have a strong impact on nonlinear signals [2], both affecting the signal-to-noise ratio, as well as the spectroscopic information that can be retrieved.

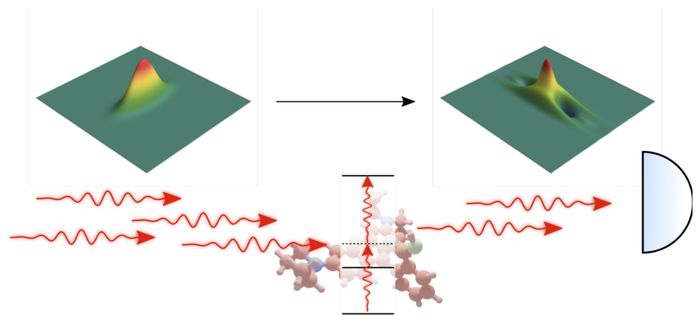

Fig. 1: *Schematic setup of a two-photon absorption measurement as considered in this contribution: The spectroscopic information is encoded in the photonic state's Wigner function, and optimal measurements are devised to optimally detect this change.*

In this talk, we will discuss the intricate interplay between photon number fluctuations, time-energy entanglement, and nonlinear optical measurements. We will discuss optimal quantum states of light to carry out these measurements and propose optimal experimental setups to best exploit the advantages brought about by large fluctuations [3].

References:

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