

Extreme Quantum Optics: Generation of optical Schrödinger "cat" states using intense laser-matter interactions and applications in non-linear optics

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Recent theoretical and experimental investigations have shown that implementing fully quantized approaches in intense light-matter interactions opens new exciting ways for both fundamental research and applications in quantum technology and ultrafast science. These advances arise from the synergy between quantum optics, strong-field physics, and ultrafast science. Together, they have led to the development of the field of quantum optics and quantum electrodynamics in strong-field processes [1–4 and references therein], namely sometimes as *Extreme Quantum Optics*. At the core of this research field is the generation of non-classical and entangled light states from the far-infrared (IR) to the extreme-ultraviolet (XUV). This includes, coherent state superpositions (namely optical Schrödinger "cat" states) [5–7] and bright squeezed light sources [8, 9] with mean photon numbers capable to induce non-linear process in matter [10,11].

Here, after a brief introduction, I will focus my talk on our most recent studies concerning the generation of optical "cat" states and their role in nonlinear optics [12]. I will also highlight the potential of fully quantum approaches in laser-driven semiconductor crystals for developing non-classical and entangled light states [13] in the VUV spectral region with attosecond pulse durations [14]. Finally, I will briefly discuss a few additional key approaches developed more recently by other groups in this field, including our theoretical work on the propagation of bright squeezed-vacuum light states in nonlinear media [15].

References

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