University of Crete
Department of Physics

Physics Colloquium

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Strong Field Quantum Optics

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ABSTRACT

Recent theoretical and experimental investigations have shown that implementing fully quantized approaches in intense light–matter interactions opens new 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 research field of quantum optics and ultrafast quantum electrodynamics in strong-field processes, namely sometimes as Strong Field 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) and squeezed light sources with mean photon numbers capable to induce non-linear process in matter.

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. I will also highlight the potential of fully quantum approaches in laser-driven semiconductor crystals for developing non-classical and entangled light states in the VUV spectral region with attosecond pulse durations. 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.