



Announcement of a lecture series in the Carl Zeiss Visiting Professor program

Analogies in Photonics and Quantum Physics

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Lectures for master and doctorate students:

Wave mechanics and wave optics I: general

Tuesday, May 12, 16:15-17:45 at Fraunhofer Institute, Campus Beutenberg (Carl Zeiss room)

Schrodinger-like formulation of wave propagation in weakly guiding dielectric media. Ray-optics and classical mechanics limit. Lagrangian formulation, eikonal analysis and Fermat's principle. An example: the optical coupler in the quantum-mechanical language. Geometrical forces for light and quantum mechanical analogue (Kramers-Henneberger transformation).

Wave mechanics and wave optics II: tunneling phenomena and coherent processes of three-level systems.

Thursday, May 14, 16:00-17:30 at Fraunhofer Institute, Campus Beutenberg (Carl Zeiss room)

Control of quantum-mechanical tunneling by external driving fields, optical analogue. Atomic STIRAP in three-level systems and application to adiabatic light transfer in coupled waveguides.

Wave mechanics and wave optics III: quantum mechanical decay, quantum Zeno effect, and optical analogues.

Monday, May 25, 15:30-17:30 at Fraunhofer Institute, Campus Beutenberg (Carl Zeiss room)

Theory of quantum mechanical decay. Memory function, markovian (Weisskopf-Wigner) theory. Structured reservoirs: from exponential decay to Rabi oscillations. Quantum Zeno effect. Applications to photonic tunneling in coupled waveguides.

Extraordinary faculty seminar:

Analogies in Photonics and Quantum Physics

Wednesday, May 20, 14:00-15:15 at Lecture Hall 3 (physics, house 3)

Analogies between optics and quantum mechanics, i.e. between light and matter waves, date back to the early developments of quantum physics.

Since then, these two apparently unrelated fields have greatly benefited each other. Many ideas and methods developed in one field have found their counterpart in the other one. In particular, in the past decade engineered photonic waveguides have provided an extremely rich laboratory tool to visualize with optical waves the classic analogues of a wide variety of coherent quantum phenomena encountered in atomic, molecular or condensed-matter physics, which are of difficult (or to date even impossible) access in quantum systems. On the other hand, ideas and techniques developed in quantum physics can be applied to photonics to control the flow of light in nontrivial ways.

In this talk I will briefly review recent theoretical and experimental advances in the field of quantum-optical analogies. Special attention is devoted to some relevant optical analogies based on the use of curved photonic structures, including: coherent destruction of tunneling in driven bistable potentials; coherent population transfer and adiabatic passage in laser-driven multilevel atomic systems; quantum decay control and Zeno dynamics; electronic Bloch oscillations, Anderson localization and dynamic localization in crystalline potentials.