

PHOTONIC WAVE PHENOMENA INDUCED BY SPACETIME DISCONTINUITIES

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Research Group: Antennas, Radar and Optical Communications

The research group of Antennas, Radar and Optical Communications (COM) is an internationally recognized research team specializing in electromagnetics, antennas, radar, photonics, and advanced communication technologies. With more than two decades of experience, the group combines fundamental research with industrial innovation, contributing to cutting-edge projects funded at the European and national levels. Its expertise spans the entire innovation chain from theoretical modeling and numerical simulation to prototype development, laboratory validation, and technology transfer. The group also operates state-of-the-art research laboratories dedicated to antenna measurements, radar, photonics, optical communications, and quantum technologies.

Keywords: Theoretical Study of Novel light/spacetime-structured-matter Interactions | Quantum-Level Sub-Cycle Modulation | Atomic Polarizability Dynamics | Macroscopic Resonant Lattice Homogenization | Relativistically Moving Scatterers | Time-perturbed Metasurfaces

Research Focus:

Research in theoretical photonics, particularly in the “hot” topic of light/matter interactions in the presence of time modulations and discontinuities (“temporal metamaterials” in the jargon of the community). The approach of the foreseen research activities will be of fundamental Science: unveiling new mechanisms of wave interactions in out-of-the-box toy models that harness space-time symmetries and dualities (or the lack thereof). Ideally, one final goal would be to coalesce a few of these studies with a quantum treatment (e.g. quantizing time-perturbed-induced photonic transitions from an initial vacuum state). Examples of research sub-topics include the study of sub-cycle time modulations in the atomic/nanoscatterer’s polarizability (up to macroscopic homogenizations of resonant lattices: space-time crystals), rotating crystals and anisotropies, relativistically moving scatterers, time-modulated graphene metasurfaces (or other mechanisms for time-induced polaritons), spacetime-modulation-induced Lorentz reciprocity breaking, pure-time (superluminal) boundaries in presence of space and/or time dispersion, synthetic vs true motion of materials with a polarization response, etc.