

MSS

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Lecture I: Dynamic Singular Optics and Topological Chain Reactions.

The first realization of true dynamic singular optics in random scalar and elliptically polarized light fields is presented and discussed. It is based on self-action of He-Ne laser beam in the refractive LiNbO₃. The experimental technique is described. The 3D topological scenario of optical vortices “life-story” from pre-nucleation up to after-annihilation states was measured and established as fully reversible local topological transition. The same was done for singular C points. Scenario of the first sine-nucleation up to after-annihilation states was measured and established as fully reversible local topological transition. Scenario of the first singularities creation in random light field was established by parametric dynamic singular optics. Existence and development of topological network of singularities was shown. Finally, topological space-time domain chain reactions in generic developing speckle fields were discovered. Their specific features in comparison with known nuclear and chemical chain reactions are discussed. Applications of dynamic singular optics are considered.

Lecture II: Singular Optics and Topology of LC nanocomposites.

Optics is used effectively many years for investigations of pure LC and LC dispersions with impurities. Quite new structure and properties possess LC composites with high wt % of nano dopants. Singular optics of LC + carbon nanotubes (CNTs) composites was established. It was found CNTs form isolated microscale C-aggregates at low concentration and undergoes percolation transition at higher concentration when aggregates touch and form random network. This moment electroconductivity grows on 3-4 orders. Theoretical model of C-aggregates with fractal micro scale nanotubes skeleton and multitude of captured LC molecules was built. Measured firstly fractal interfacial LC layers around each C-aggregate define in decisive way quite new optical properties of LC nanocomposites. Complex light generated by laser beam propagating through a nanocomposite scatters strongly and creates “see” of optical singularities. Transverse electric field generates topological domain walls in LC host between neighbor C-aggregates at the Freedericksz transition. In general, developed singular optics of LC nanocomposites establishes bridge between properties of LC host with nano scale dopants and micro/macro properties of LC composites on their base. New applied possibilities opened by LC nanocomposites are discussed.