Fractal self-similarity. From geometric structures to dynamical coherent dynamics

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In recent works the formalism describing fractal self-similar structures has been shown to be isomorph to the one of squeezed generalized SU(1, 1) coherent states [1 – 7]. These last ones, on the other hand, provide a representation of the system of damped/amplified oscillators, which is a prototype of a dissipative system and the environment in which it is embedded. In space-time regions where the magnetic field may be approximated to be constant and the electric field is derivable from a harmonic potential, the isomorphism is shown to exist also between electrodynamics and the system of damped/amplified oscillators, and thus squeezed SU(1, 1) coherent states and fractal self-similar structures. A link is then established between electrodynamics, dissipation, self-similarity and squeezed coherent states. I also note that quantum dissipation implies non-commutative geometry in the plane. A rich scenario emerges, where fractal-like structures appear to be generated by coherent SU(1, 1) quantum condensation processes, and thus they appear as macroscopic quantum systems, as it happens with crystals, ferromagnets and like systems characterized by ordered patterns. The macroscopic appearances (forms) of the fractals seems to emerge out of a process of morphogenesis as the macroscopic manifestation of the underlying dissipative, coherent quantum dynamics. An integrated vision of Nature resting on the paradigm of coherence and dissipation is obtained. Nature appears to be modulated by coherence, rather than being hierarchically layered in isolated compartments, in multi-coded collections of isolated systems and phenomena. The dynamics of coherence appears to be the primordial origin of codes, which are thus promoted from the (syntactic) level of pure information (a la Shannon) to the (semantic) level of meanings, expressions of coherent dynamical processes.

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