

COMPLEXITY, EMERGENCE AND IRREVERSIBILITY

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Since experimentally proven confirmation of existence of a very broad ensemble of systems called “complex”, and the behavior of which escapes from simple binary logics of all mechanistic or all statistical developed over the last three centuries, a huge theoretical and numerical effort has been made mainly during the last ten years with relatively disappointing results to catch up their specific character despite interesting developments on the methods.

Main reason is the absence of clear and understandable definition of the state of these systems, in contradiction with most elementary basis of any Science already fixed some 25 centuries ago by the great greek philosophers of Antiquity. Starting from perfectly identifiable definition in terms of observable elements of such system, it is possible to show that complexity state of a system can be characterized by specific properties, and corresponds to a universally observed behavior in any structure with interacting elements (and in particular not a necessarily very large number as usually imposed).

This allows to establish a “**Universal Emergence Principle**” generalizing usual binary logics which it is a particular case. An extremely important consequence for the dynamics of a system passing to complex state is that invariants of its constitutive elements are not conserved, and that there is irreversibility which appears here as only due to existence of interactions and not, as hammered since more than a century, to some obscure propensity of Universe to have either fluctuating background of still mysterious origin or to be more fundamentally given an “arrow of time” by some even more mysterious divine hand to guide its evolution.

Many applications in Mathematics, Physics, Mechanics, Chemistry, Biology, Sociology, and Economy are found which instantaneously recover known results from more than a century, and are explaining recent observations. From this synthesis, a new vision of the Universe is proposed which shows a remarkable unity in the way its evolution can be approached and systematically analyzed uniquely from the (four) known fundamental interaction laws.