ADVANCES ON FRACTIONAL DYNAMICS
OF COMPLEX SYSTEMS

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There are strong motivations today (the unsolved nature of the dark matter and dark energy, the difficult reconciliation of Einstein's General Relativity (GR) and Quantum Theory) to consider alternative theories that modify, extend or replace GR. Some of these theories presume a higher dimensional space-time, and parts of them predict violations of the (Relativistic) Physics (both Special and General) fundamental principles: the Equivalence Principle and Lorentz symmetry could be broken, the fundamental constants could vary, the space could be anisotropic and the physics could become non-local.

During the last few decades, fractional differentiation has drawn increasing attention in the study of so-called anomalous social and physical behaviors, where scaling power law of fractional order appears universal as an empirical description of some complex phenomena. Recently, new numerical algorithms were design to extract hidden information from the dynamics of the complex systems.

In this talk some new trends of the fractional quantum mechanics and the fractional quantum field theory will be presented. Also, a fractional mathematical model for simulation of water table profile between two parallel subsurface drains will be reported.

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