FRACTIONAL FOKKER-PLANCK EQUATIONS, ANOMALOUS DIFFUSIONS AND TRANSPORT, SPACE-TIME MULTIFRACTAL PROCESSES

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A broad generalization of the Fokker-Planck equation have been considered in the last five years. In the simplest case, it corresponds to the linear generating equations of Levy's anomalous diffusions. The anomalous scaling of the latter introduces fractional power of the Laplace operator in this generalized Fokker- Planck equation, which is therefore called Fractional Fokker-Planck Equation (FFPE). Not only the FFPE solutions have heavy/fat tails and therefore yield an extreme variability, but they can be strongly asymmetric, due to the appearance of a non trivial term which have at the same time convective and diffusive properties. These properties of FFPE solutions seem rather indispensable for inhomogeneous and directed transports. We discuss the relevance of the (linear) FFPE to given types of anomalous transport in turbulent experiments and geophysical flows, in porous media and radiative transfer. The limitations of the linear case help us to introduce the nonlinear case, which has been investigated only very recently. It is not only far more interesting, but rather indispensable in order to take into account the strong inhomogeneity of the medium We also emphasize its importance for space-time multifractal processes, from a better theoretical understanding of cascade processes up to modeling applications to geophysics.