Statistical Physics Research Line
Post Doc position in Stochastic Modelling for Complex Systems

The improvement of experimental devices in the last years led to a dramatic increase of experimental achievements in the study of biological systems. Unexpected behaviours were disclosed and new challenges emerged for their understanding calling for new experimental, modelling and theoretical methods.

The research will be focused on the development of stochastic processes for modelling anomalous diffusion in complex systems. In particular, the approach that it is intended to be developed is based on randomly scaled Gaussian processes, namely each simulated trajectory is given by a Gaussian process times a scale that results to be distributed according a proper population. This approach is compatible with the dynamics of a heterogeneous ensemble of Brownian particles where the population of the scale codes the heterogeneity of the ensemble. Hence, beside established approaches as the continuous time random walk or fractional Brownian motion, the classical Langevin equation will be also considered for the formulation of a stochastic dynamics generating anomalous/fractional diffusion. This construction on the basis of the Langevin equation provides a dynamical framework that allows for discussing the model with physical perspectives.

The research will be conducted in view of a multidisciplinary collaboration involving physicists, applied mathematicians and biologists by combining mathematical modelling and experimental measurements. In this respect, the research is expected to contribute to the design of new experiments and participate to data analysis, e.g. by the execution of very recent algorithms for classifying experimental trajectories by between normal and anomalous diffusion and among diffusion models, or for the estimation of the characterizing parameters.

Recent papers by the group:

Sliusarenko O., Vitali S., Sposini V., Paradisi P., Chechkin A., Castellani G., Pagnini G., Finite-energy Lévy-type motion through heterogeneous ensemble of Brownian particles. J. Phys. A: Math. Theor. 52, 095601 (2019)

D'Ovidio M., Vitali S., Sposini V., Sliusarenko O., Paradisi P., Castellani G., Pagnini G., Centre-of-mass like superposition of Ornstein–Uhlenbeck processes: A pathway to non-autonomous stochastic differential equations and to fractional diffusion. Fract. Calc. Appl. Anal. 21, 1420–1435 (2018)

Vitali S., Sposini V., Sliusarenko O., Paradisi P., Castellani G., Pagnini G., Langevin equation in complex media and anomalous diffusion. J. R. Soc. Interface 15, 20180282 (2018)