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Complexity of anomalous diffusion processes

Nerea Alcázar-Cano [1]* and Rafael Delgado-Buscalioni [1,2]

[1]Theoretical Condensed Matter Physics Department, Universidad Autónoma de Madrid, Spain
[2]Condensed Matter Physics Center (IFIMAC), Madrid, Spain
*nerea.alcazar@uam.es

The main motivation for studying anomalous diffusion is the great variety of phenomena that give rise to it. The structure of the environment, the interactions with other particles of the system, or the presence of an external force field are examples that modify the dynamics and lead to anomalous diffusion. Over the last few years we have been working on two very different systems in which anomalous diffusion is the main character: the subdiffusion of passive tracers in disordered media and the collective diffusion of a population of excitons in two-dimensional perovskite layers. Both works are nice examples of the complexity of the anomalous diffusion processes.

In disordered or heterogeneous media, a diffusive particle encounters obstacles which slow down its dynamics. We observe that, although some dynamic properties as the subdiffusion exponent does not depend on the structure of the media, the full dynamics given by displacement probability distribution of the particle strongly depends on the heterogeneity of the structure [1,2].

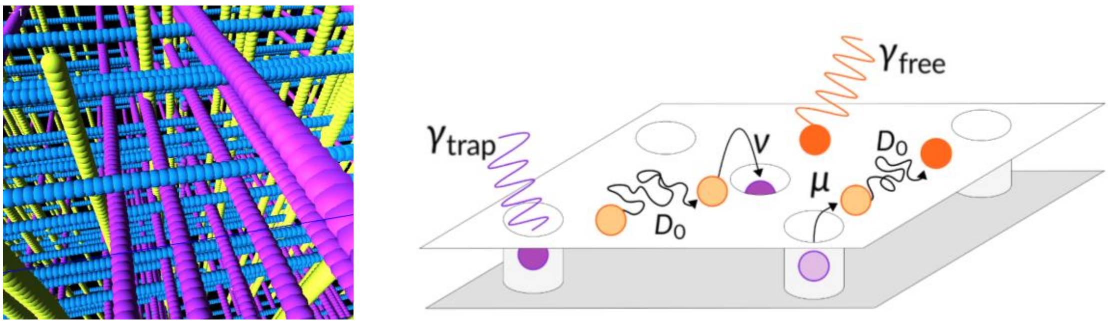

Figure 1: (Right) One of the random networks where passive tracers diffuse anomalously. (Left) Pictorial representation of our model for the exciton diffusion in perovskite layers.

Experimentally it has been measured that an exciton population presents anomalous diffusion when it moves in two-dimensional metal-halide perovskites. This anomalous behaviour is due to the presence of defects in the material, where excitons get trapped. We develop a continuum model for the exciton concentration field which is able to reproduce the spatial dynamics of the exciton population and allow us to estimate important quantities such as the defect density and the diffusion coefficient [3].

References

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