First Passage Times for non-Markovian Gaussian processes

N Levernier[1], O Bénichou[2], R Voituriez[2,3], and T Guérin[4]

[1] *Aix Marseille Univ., Université de Toulon, CNRS, CPT, Turing Center for Living Systems, 13009 Marseille, France*

[2]*Laboratoire de Physique Théorique de la Matière Condensée, CNRS/UPMC, 4 Place Jussieu, 75005 Paris, France*

[3]*Laboratoire Jean Perrin, CNRS/UPMC, 4 Place Jussieu, 75005 Paris, France*

[4] *Laboratoire Ondes et Matière d'Aquitaine, University of Bordeaux, UMR 5798, CNRS, F-33400 Talence, France*

How much time does it take for a random walker to reach a target ? This question is recurrent in reactivity or search problems, and its answer is provided by the First Passage Time (FPT). First passage properties are now well understood for Markovian (memory-less) processes. However, as soon as a random walker interacts with other variables in its environment, its effective motion becomes non-Markovian and first passage properties are much less understood. I will present a formalism that provides the mean FPT of a Gaussian random walker to a target in a large confining volume [1]. The key aspect of the theory consists in analyzing the statistics of the paths in the future of the FPT, which can be determined self-consistently. The distribution of these paths is very different from stationary paths. The obtained results for the mean FPT can be very different from standard "pseudo-Markovian" approximations, but agree with simulations and are exact for weakly non-Markovian processes. Next, I will show how the same formalism can be adapted to characterize (i) the large time asymptotics of the FPT distribution without confinement [2], and (ii) the kinetics to reach a rarely visited configuration for a non-Markovian reaction coordinate (even non-Gaussian) [3].

[1] T Guérin, N Levernier, O Bénichou, R Voituriez, Nature **534**, 356-359 (2016).
[2] N Levernier, M Dolgushev, O Bénichou, R Voituriez, T Guérin, Nat. Com. **10**, 1-7 (2019).
[3] N Levernier, O Bénichou, R Voituriez, T Guérin, Phys. Rev. Res. **2**, 012057 (2020).