

Reply Report 1
SciPost_202401_00039v1

Title: Enhancement of stability of metastable states in the presence of Lévy noise

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Dear Anonymous Referee,

thank you very much for your report. We are very grateful to you for the relevant comments and suggestions. In particular, it is a pleasure to acknowledge the positive feedback emerging you're your detailed report.

Indeed,

Anonymous Referee 1 states that:

"... important results are derived...(citing all the exact results of the manuscript highlighted in the abstract)... To my knowledge, these are the first exact analytical results for any more complex than Markovian case, which have numerous applications in physics, but especially in biology...

Besides that...the authors investigate the noise enhanced stabilization effect and show its significant amplification in comparison with white noise case...'

Finally, the Referee 1 states that: "The paper is interesting and clearly written, so it can be recommended for publication after addressing minor comments listed below."

Minor comments

The Referee writes:

1 – Objection

"1. In Fig. 3b the only empty frame without any curves is visible, please correct."

Our response:

1 - Reply to objection

1. Fig. 3b has been corrected, now all curves are visible in the revised version.

The Referee writes:

2 - Objection

2. When describing the basic definition for NLRT (3),(4), the authors should cite the first paper [https://doi.org/10.1016/0378-4371\(95\)00395-9](https://doi.org/10.1016/0378-4371(95)00395-9), where this definition was used for exact derivation of NLRT of a Brownian particle in a smooth potential. Later, this definition was generalized to arbitrary moments of transition times [https://doi.org/10.1016/S0375-9601\(97\)00599-9](https://doi.org/10.1016/S0375-9601(97)00599-9). Also, it has been demonstrated there for smooth symmetric potentials, that the moments of the First Passage times to the point of symmetry completely coincide with the corresponding moments of transition times. As suggestion for future studies, the authors may try to extend the obtained results to the case of the standard deviation of transition time, which has important applications for description of switching errors of various electronic devices. Another important paper, where the NLRT for the first time has been expressed by quadratures for Markovian processes in smooth potentials, is [https://doi.org/10.1016/0921-4534\(96\)00426-1](https://doi.org/10.1016/0921-4534(96)00426-1). There, the NES effect, studied by the authors, was described analytically both using the exact expression and asymptotic series in the low noise limit, see the plots in Fig. 4, so this reference should be added to the list of papers, devoted to NES effect.

Our response:

2 - Reply to objection

We thank the Referee for suggesting relevant references that we will add in the revised version of the manuscript with related comments. In particular in the introduction of the revised version we will

include the following references: i) K. Binder, “*Time-Dependent Ginzburg-Landau Theory of Nonequilibrium Relaxation*”, Phys. Rev. B **8**, 3423 (1973), <https://doi.org/10.1103/PhysRevB.8.3423>; ii) N. V. Agudov and A. N. Malakhov, “*Nonstationary diffusion through arbitrary piecewise-linear potential profile. Exact solution and time characteristics*”, Radiophys. Quantum Electron. **36**, 97 (1993), <https://doi.org/10.1007/BF01059491>; iii) A.N. Malakhov, A.L. Pankratov, “*Exact solution of Kramers' problem for piecewise parabolic potential profiles*”, Physica A: Statistical Mechanics and its Applications **229**, 109-126 (1996), [https://doi.org/10.1016/0378-4371\(95\)00395-9](https://doi.org/10.1016/0378-4371(95)00395-9); iv) A.L. Pankratov, “*On certain time characteristics of dynamical systems driven by noise*”, Physics Letters A **234**, 329-335 (1997), [https://doi.org/10.1016/S0375-9601\(97\)00599-9](https://doi.org/10.1016/S0375-9601(97)00599-9); v) A.N. Malakhov, A.L. Pankratov, “*Influence of thermal fluctuations on time characteristics of a single Josephson element with high damping exact solution*”, Physica C: Superconductivity **269**, 46-54 (1996), [https://doi.org/10.1016/0921-4534\(96\)00426-1](https://doi.org/10.1016/0921-4534(96)00426-1).

Finally, the changes requested by the Referee coincide with the Comments, to which we have already responded, see above. Specifically, the list of changes is as follows:

- 1 – New Fig. 3b
- 2 – Five new references reported in the above response to objection 2.
- 3 – Related comments on these new references in the introduction of the revised manuscript.