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Dynamical and Scale Invariance of Charged Particles Slipping on a Rough Surface with Periodic Excitation

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## Highlights

- The stability of fixed points is analyzed with the help of eigenvalue analysis method, and further invariant manifold is constructed to investigate the dynamical invariance such as energy diffusion for  $A > 0$  or decay process for  $A < 0$ .
- Scale invariance analysis is performed to demonstrate the power law of the statistical behavior.
- Both the FA phenomenon and the velocity decay process characterized by then root mean square velocity  $V_{rms}$  can satisfy scale invariance.
- Transient number  $n_x$  is proposed to evaluate the speed of the velocity decay process, and more importantly is found to posses the attribute of scaling invariance with respect to both the initial velocity  $V_0$  and the parameter  $A$ .

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