Quasiperiodic Kicked Rotor

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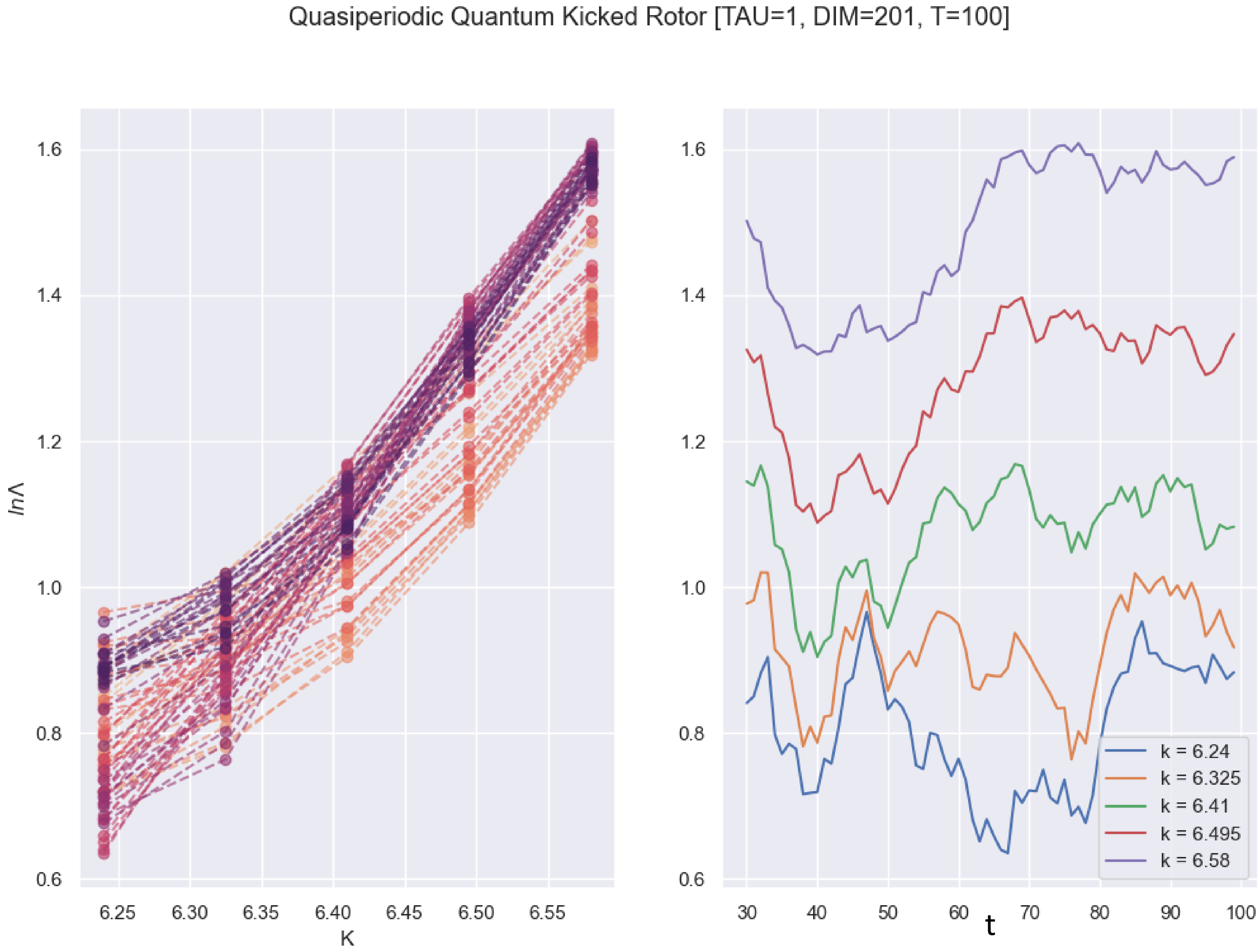
The quasiperiodic kicked rotor. – The quasiperiodic kicked rotor we consider is a three-incommensurate-frequencies generalization of the kicked rotor:

$$H_{qp} = \frac{p^2}{2} + \mathcal{K}(t) \cos\theta \sum_n \delta(t-n), \tag{1}$$

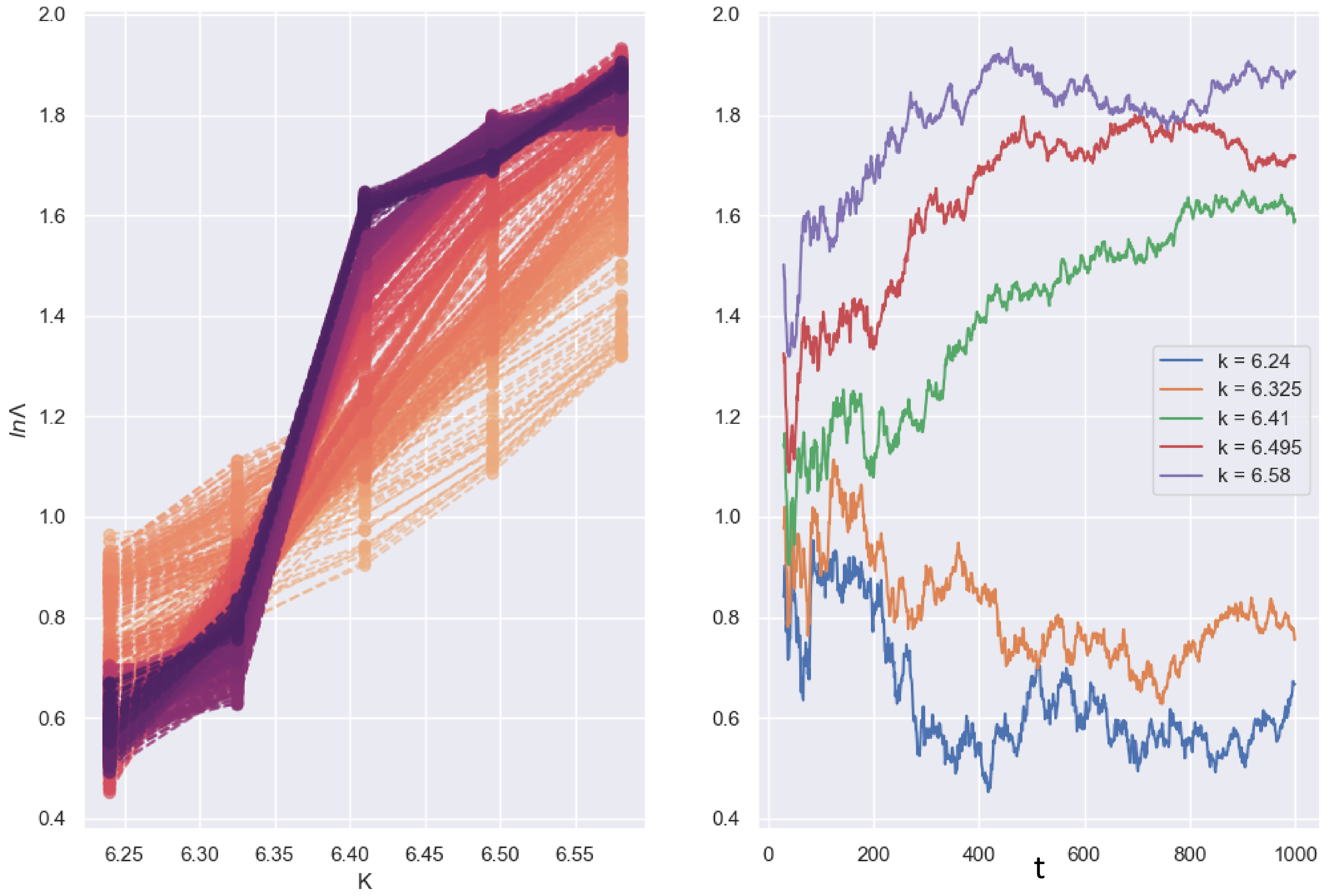
obtained simply by modulating the amplitude of the standing-wave pulses with a set of two new incommensurate frequencies ω_2 and ω_3 of modulation:

$$\mathcal{K}(t) = K\left[1 + \varepsilon \cos\left(\omega_2 t + \varphi_2\right) \cos\left(\omega_3 t + \varphi_3\right)\right]. \tag{2}$$



Quasiperiodic Quantum Kicked Rotor [TAU=1, DIM=201, T=100]
lnΛ
K
t
k = 6.24
k = 6.325
k = 6.41
k = 6.495
k = 6.58

Quasiperiodic Quantum Kicked Rotor [TAU=1, DIM=201, T=1000]



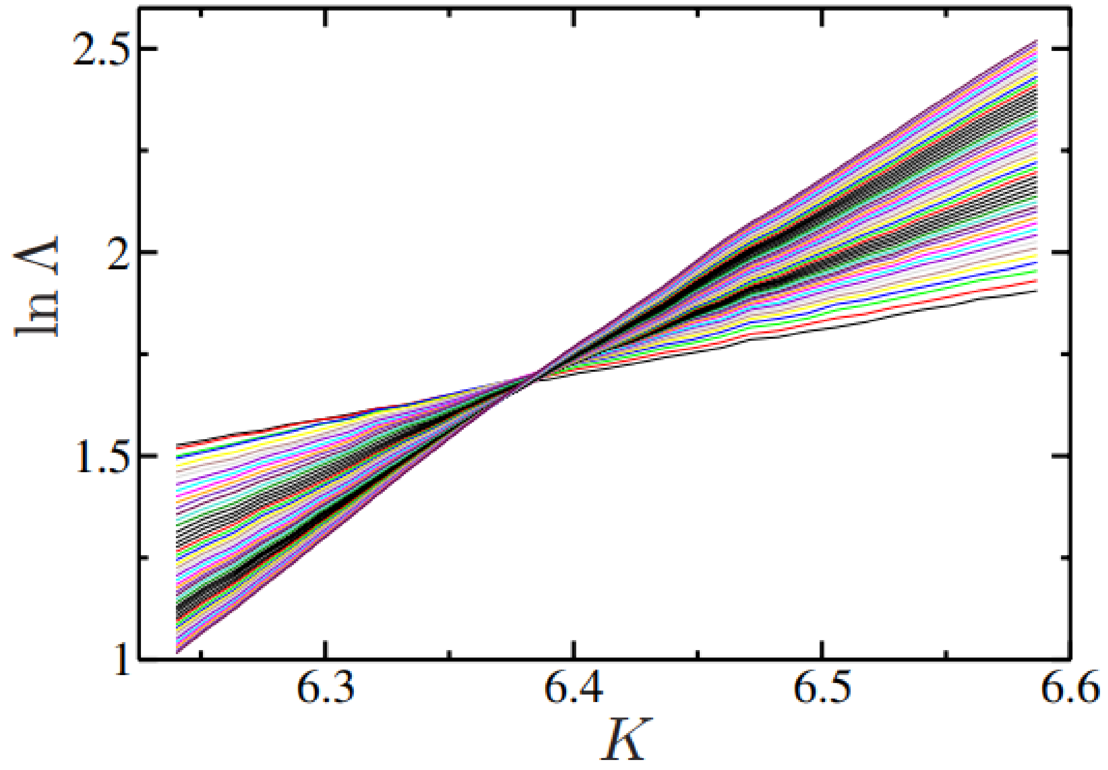
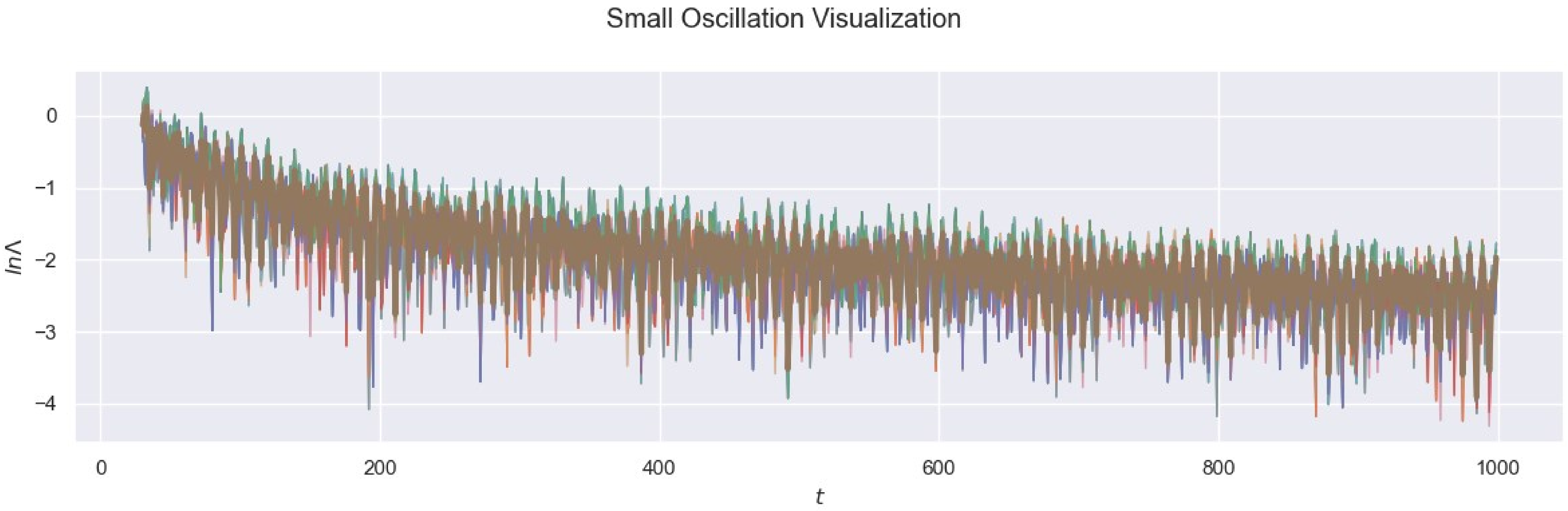
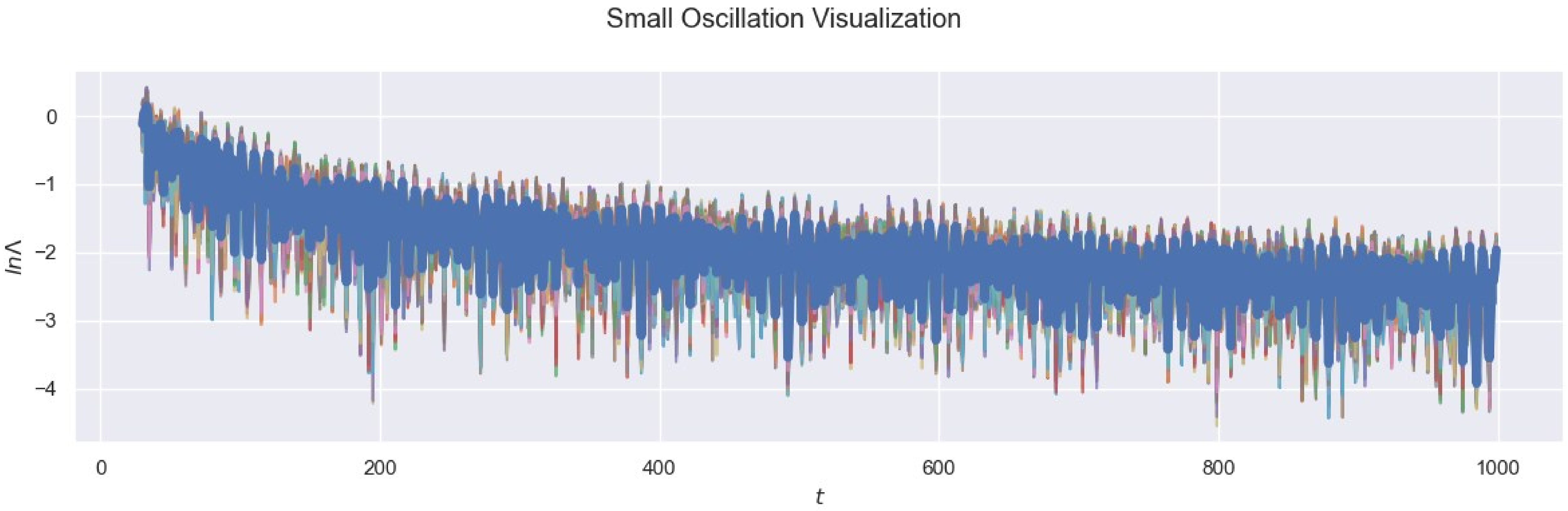


Fig. 1: (Color online) Dynamics of the quasiperiodic kicked rotor in the vicinity of the critical regime. The rescaled quantity $\ln \Lambda(K,t)$ is plotted as a function of K for various values of time t ranging from $t = 30$ to $t = 40000$. The crossing of the different curves at a common point $(K_c \simeq 6.4, \ln \Lambda_c \simeq 1.6)$ indicates the occurrence of the metal-insulator transition. The parameters are that of the set $\mathcal{A}$ (see table 1).



Small Oscillation Visualization
0
−1
−2
−3
−4
lnΛ
0
200
400
600
800
1000
t


Small Oscillation Visualization
0
−1
−2
−3
−4
$ln\Lambda$
0
200
400
600
800
1000
t

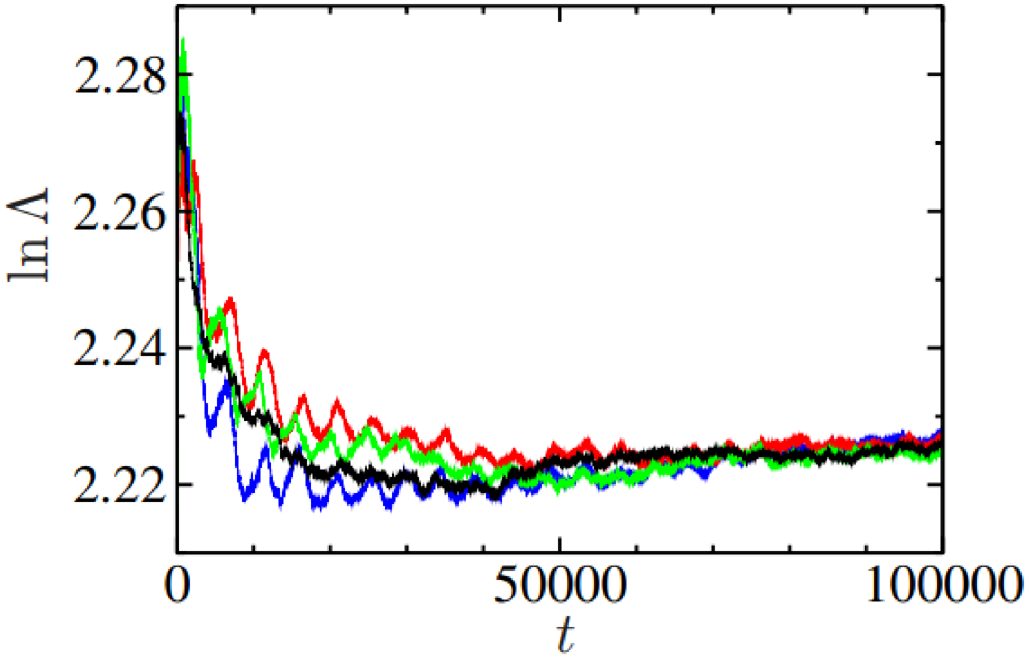


Fig. 2: (Color online) Small oscillating corrections to the scaling behavior in the critical regime. The parameters are the following: $\hbar = 2.89$, $\omega_2 = 2\pi\sqrt{5}$, $\omega_3 = 2\pi\sqrt{13}$, $K = 7.8$ and $\varepsilon = 0.3$. Color curves correspond to various choices of the phases φ_2 and φ_3 (see eq. (1)) whereas the black curve results from a statistical average over different phases. The amplitudes of the quasi-resonant oscillations decrease as time goes on. Averaging over the phases kills the rapidly oscillating structures, while keeping all of the other dynamical properties unchanged.

"We computed ln Λ for times up to $t = 10^6$ kicks with an accuracy of 0.15%. To achieve this accuracy more than 1000 initial conditions are required. To analyze data over the full range of times $t \in [10^3, 10^6]$, we fit the model eq. (12) to the data."

For context, my run with 1000 timesteps, 201 dimensional space and 100 initial conditions of ($\varphi 2$, $\varphi 3$) took around 2 hrs.