1D Slow oscillations (A>>C0) (Numerical)

In this case we do not have any model, because $C(t)$ takes negative values along the period. Here we compare the results of simulations with the **kink's dynamics model** developed for **slow** oscillations, even if the hypothesis under which it has been developed are not true.
We **also** show that the model is **wrong** if $A \sim C_0$ (are of the same order) even if $C(t)$ is strictly positive!

(Extended) Kink dynamics model

Consider a system with only two kinks. According to the kink's dynamics model, their distance decays as

$$\dot{d}(t) \simeq -24\sqrt{2}C(t)^{\frac{1}{2}}[e^{-2^{\frac{1}{2}}C(t)^{\frac{1}{2}}d} - e^{-2^{1/2}C(t)^{1/2}(L-d)}]$$

where L is the size of the simulation box.

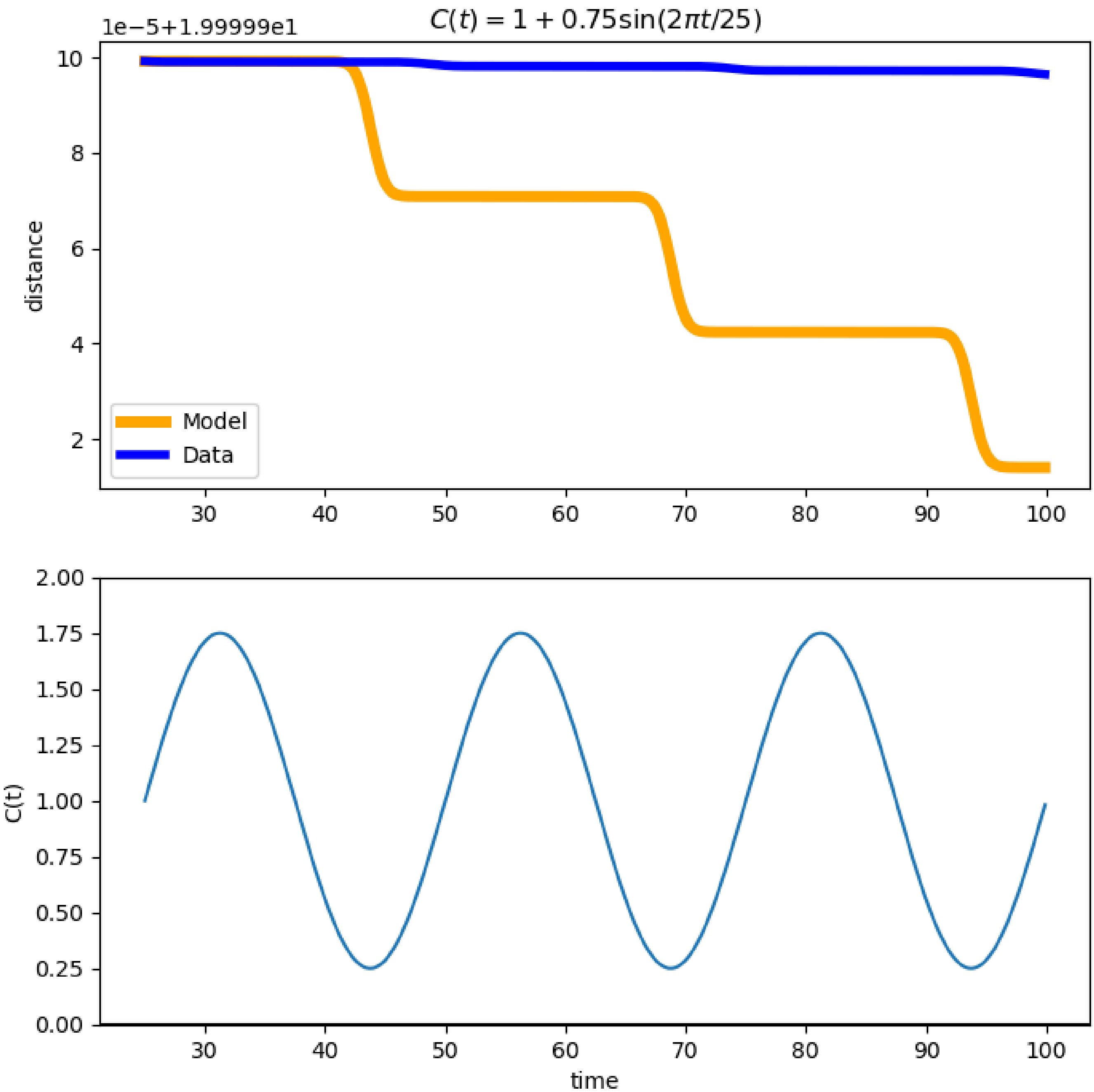
What if $C(t) < 0$?

In order to consider also cases where $C(t)$ takes negative values, we **extend** the model **assuming there is no interaction** between the kinks when $C(t) < 0$.

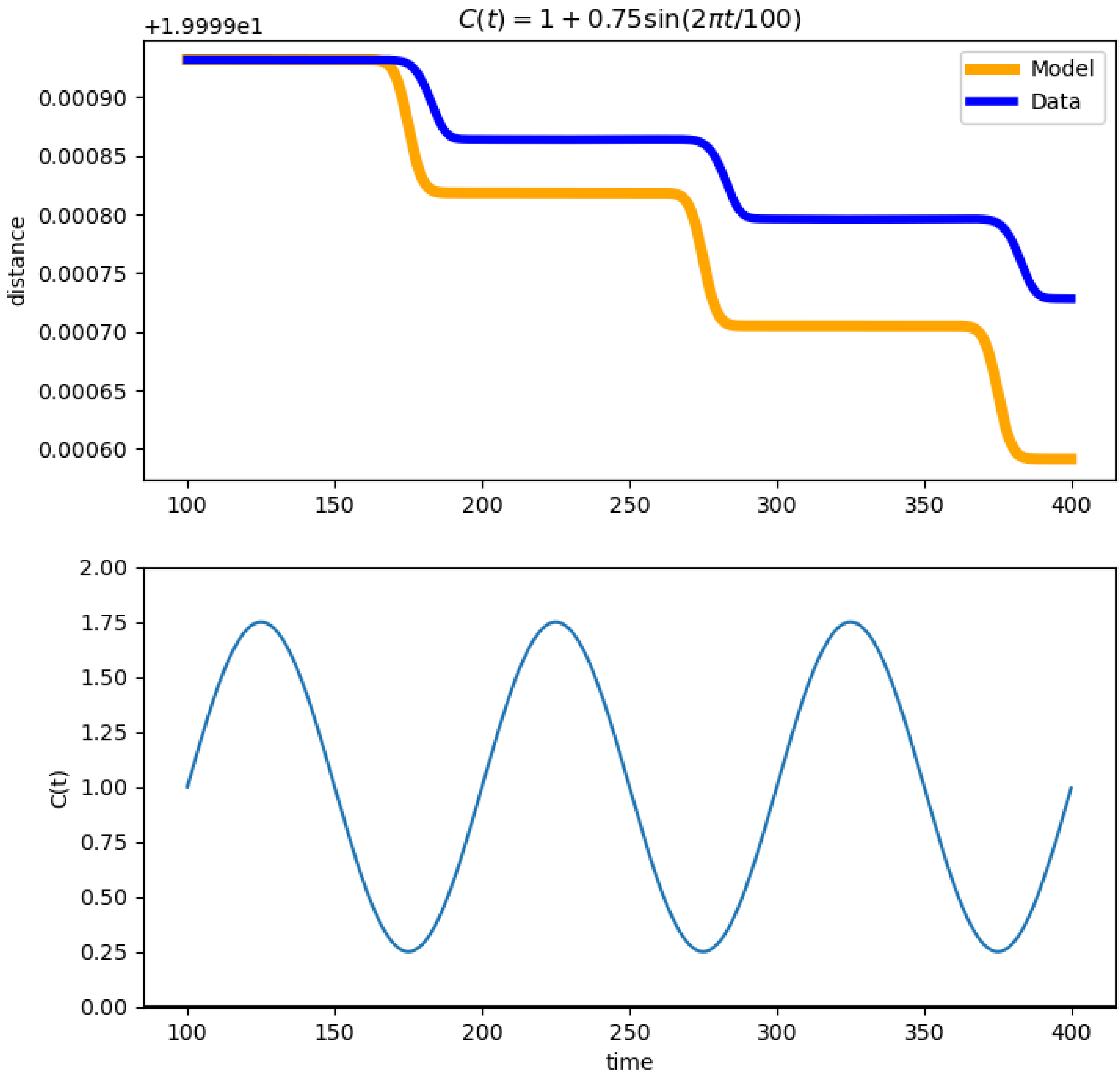
Simulations

Distance as a function of time (steps)

$A \sim C_0$

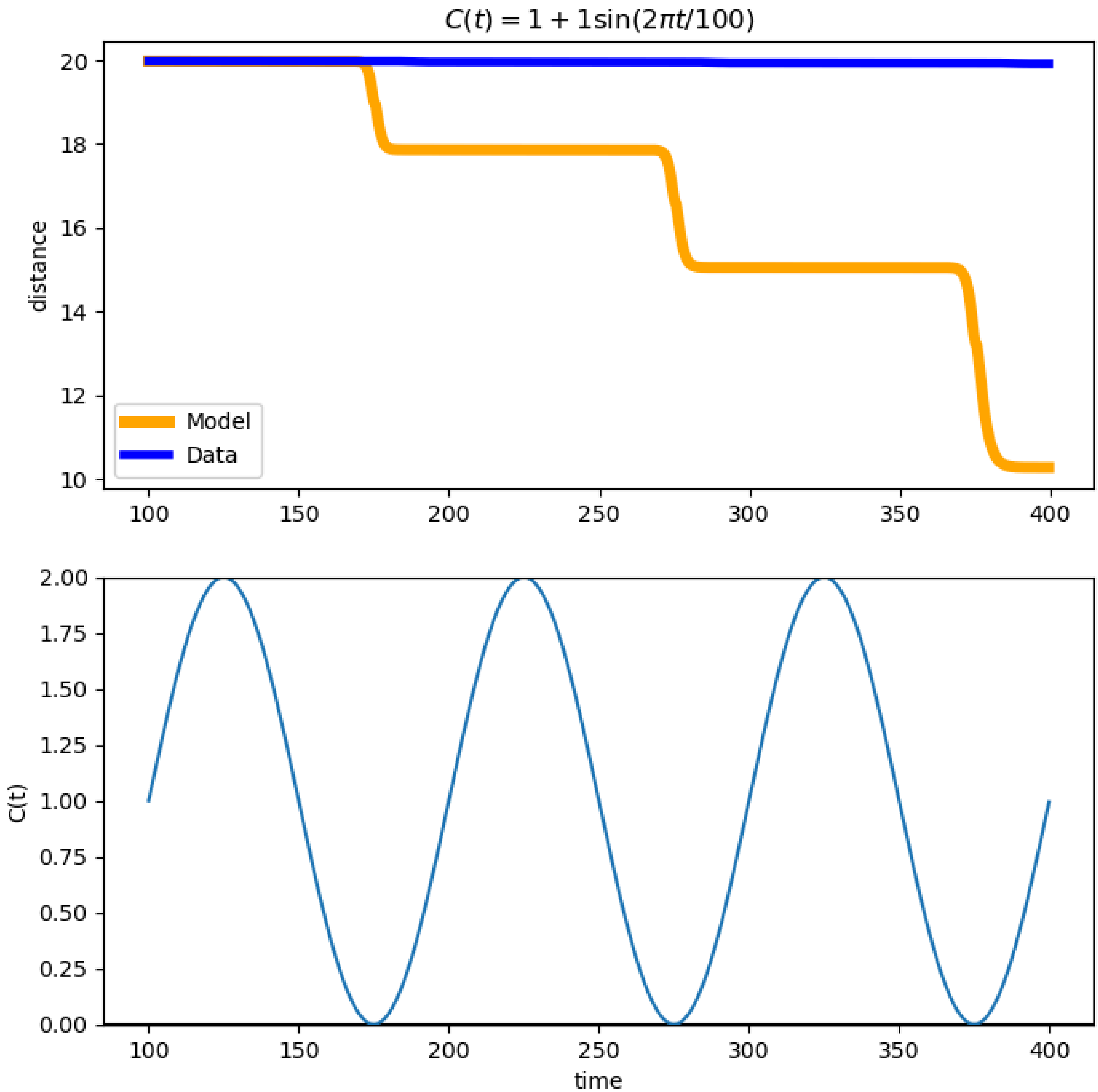


$C(t) = 1 + 0.75\sin(2\pi t/25)$
1e−5+1.99999e1
distance
Model
Data
C(t)
time



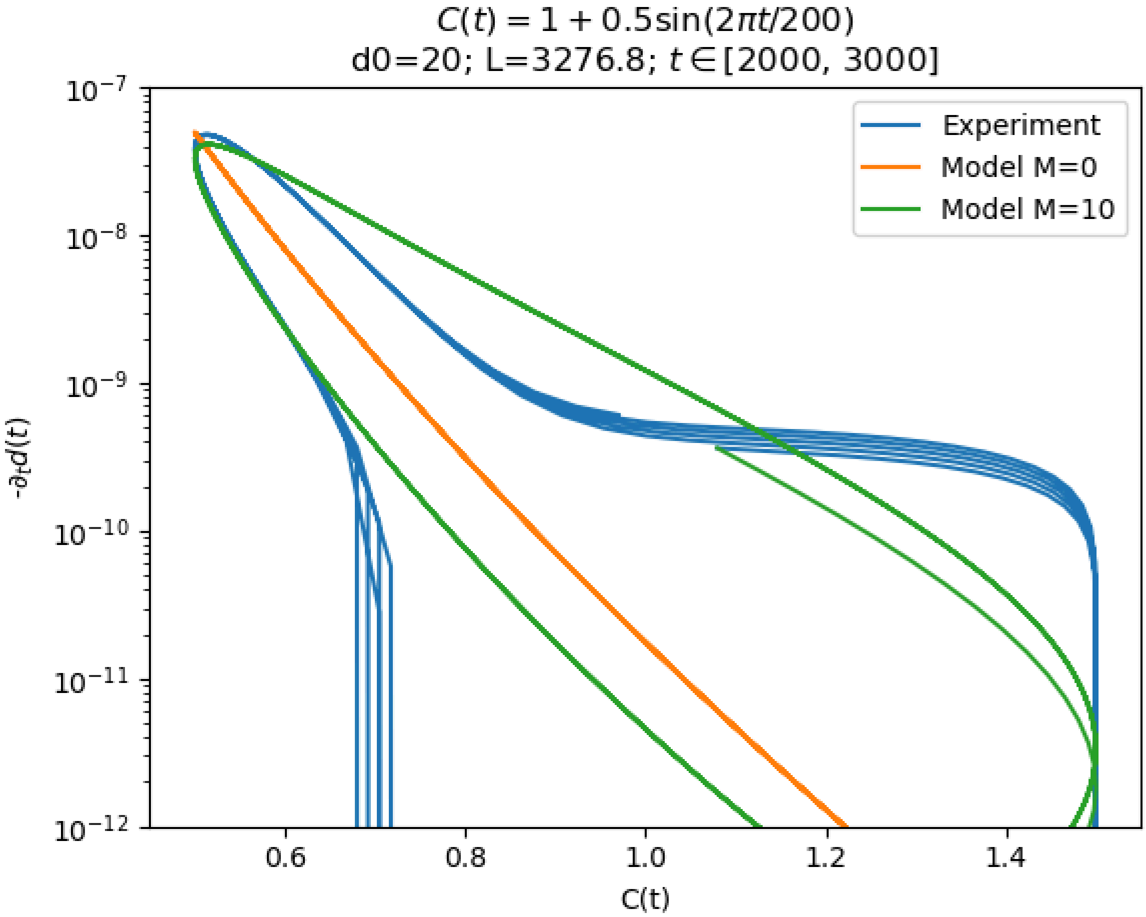
$C(t) = 1 + 0.75\sin(2\pi t/100)$
+1.9999e1
Model
Data
distance
0.00090
0.00085
0.00080
0.00075
0.00070
0.00065
0.00060
100
150
200
250
300
350
400
C(t)
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
time

$$A = C_0$$

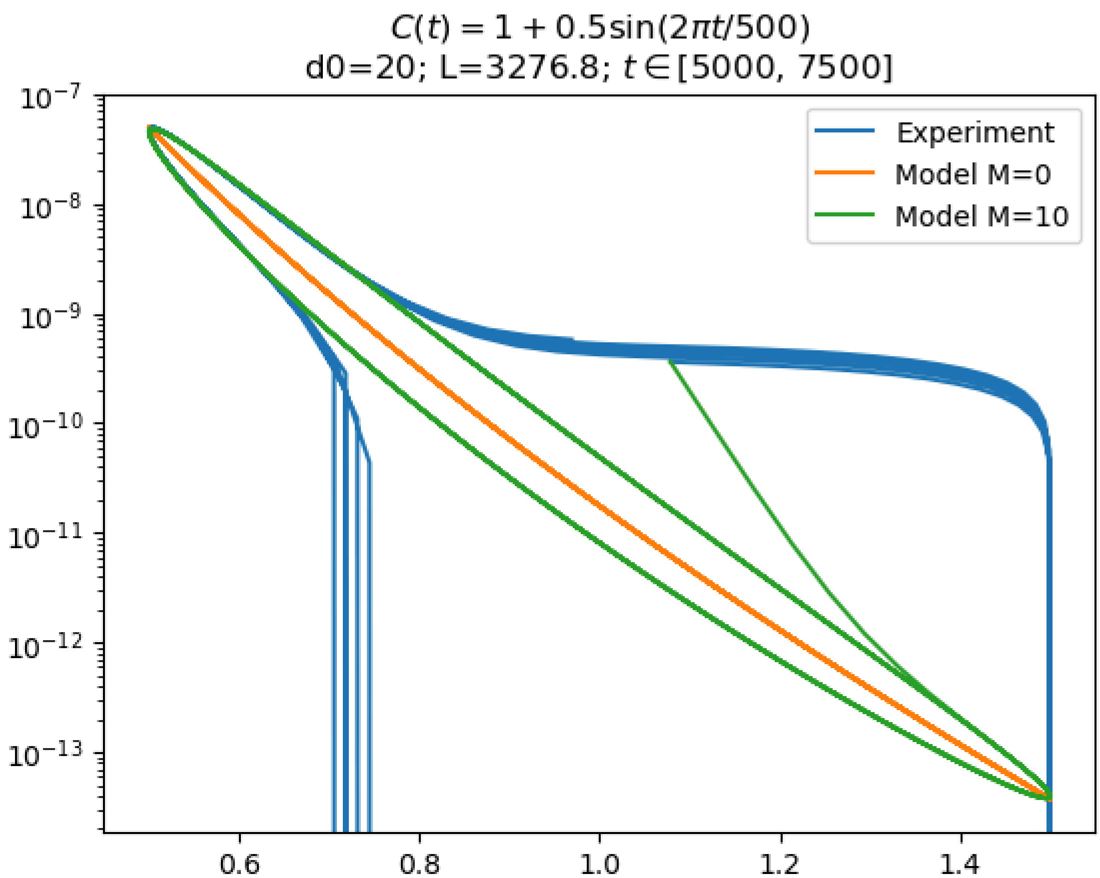


Velocity $-\partial_t d$ as a function of $C(t)$

$A \sim C_0$

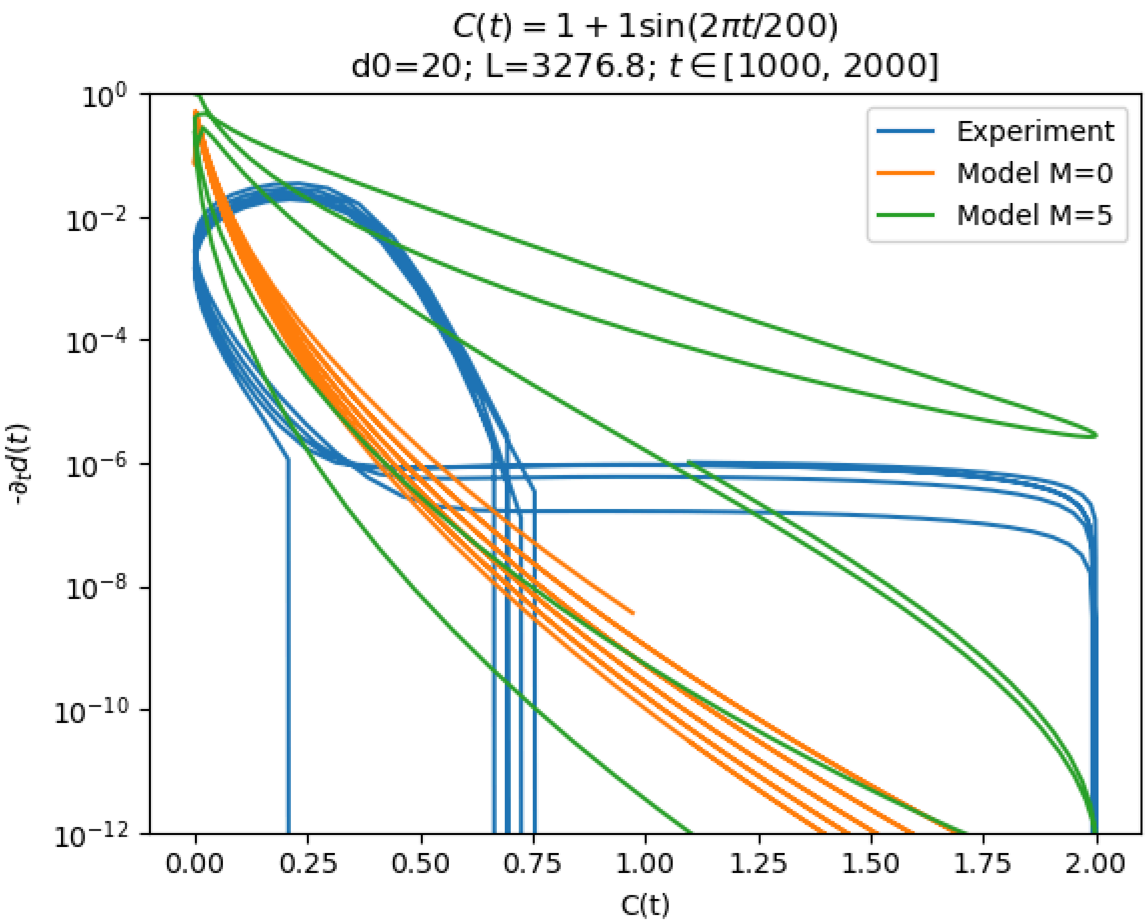


$C(t) = 1 + 0.5\sin(2\pi t/200)$
d0=20; L=3276.8; $t \in$[2000, 3000]
Experiment
Model M=0
Model M=10
$-\partial_t d(t)$
C(t)



$C(t) = 1 + 0.5\sin(2\pi t/500)$
d0=20; L=3276.8; $t \in$[5000, 7500]
Experiment
Model M=0
Model M=10

$A = C_0$



Variation of the distance over a period

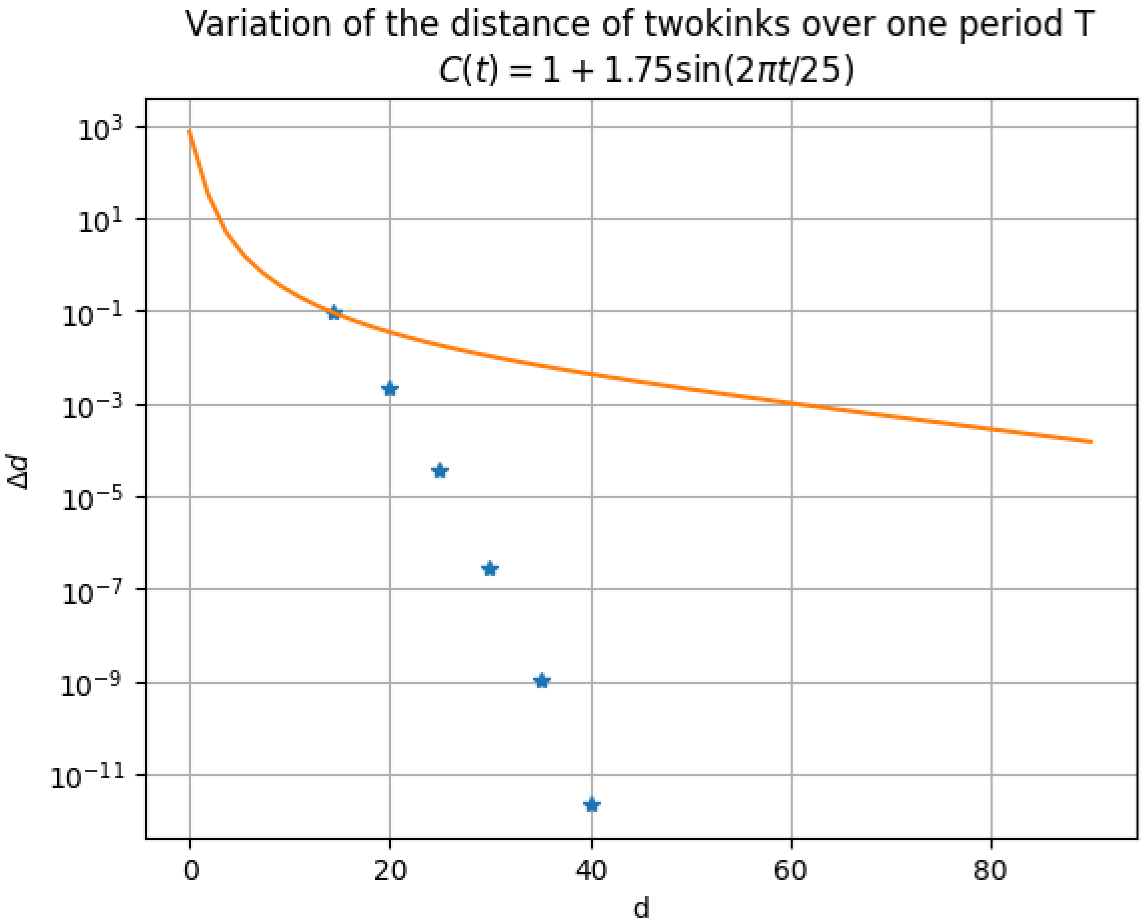
The variation of the distance over a period (assuming the distant to be constant inside the integrand)

$$\Delta d(d) = \int_0^T (\partial_t d) dt$$

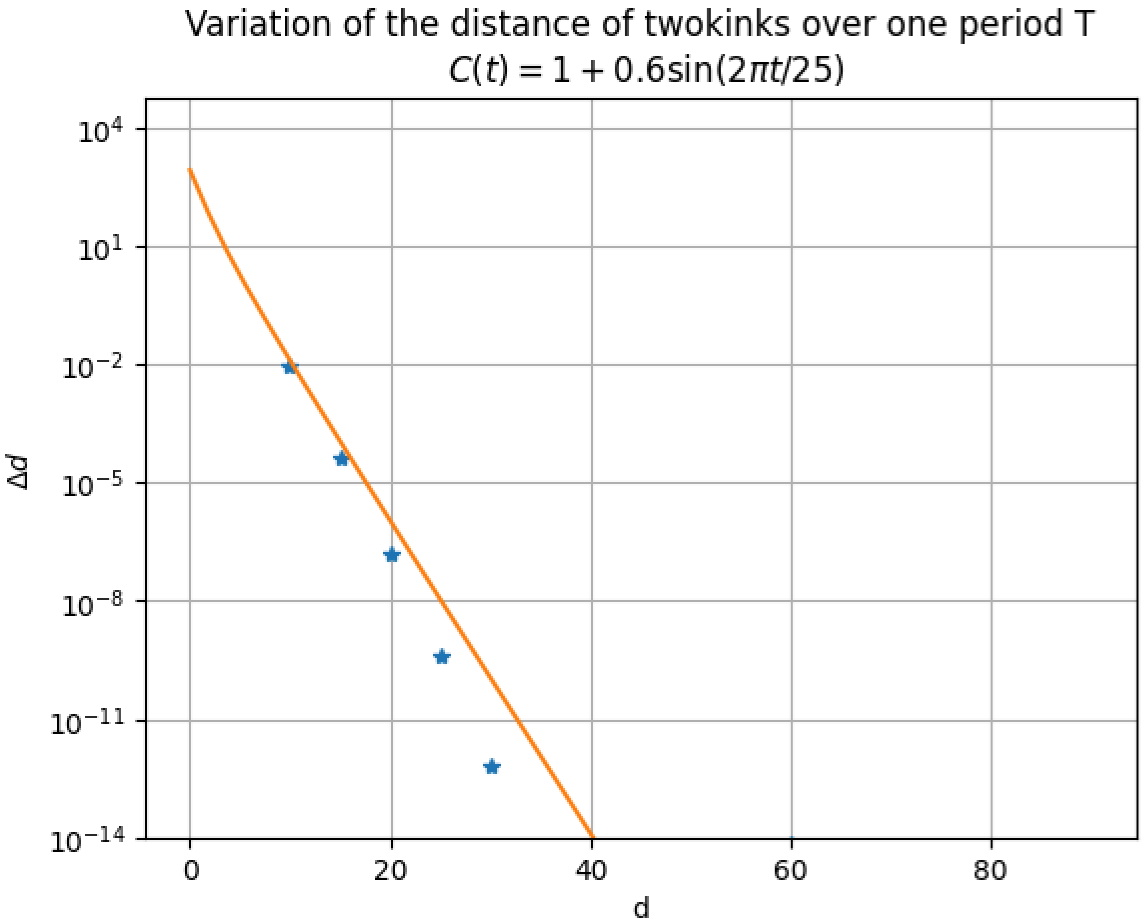
In the following

- The **orange** line: is the kinks dynamics model's prediction.
- The **blue** dots: are the experimental values (simulations)
  To **collect the data**
- Simulation of $\sim 10^2 T$ seconds were launched for many values of the initial distance d_0
- The quantity Δd has been calculated considering data with $t > 10T$, to cancel the influence of the initial state's preparation.
- The value displayed on the x-axis is the distance at the beginning of the period.

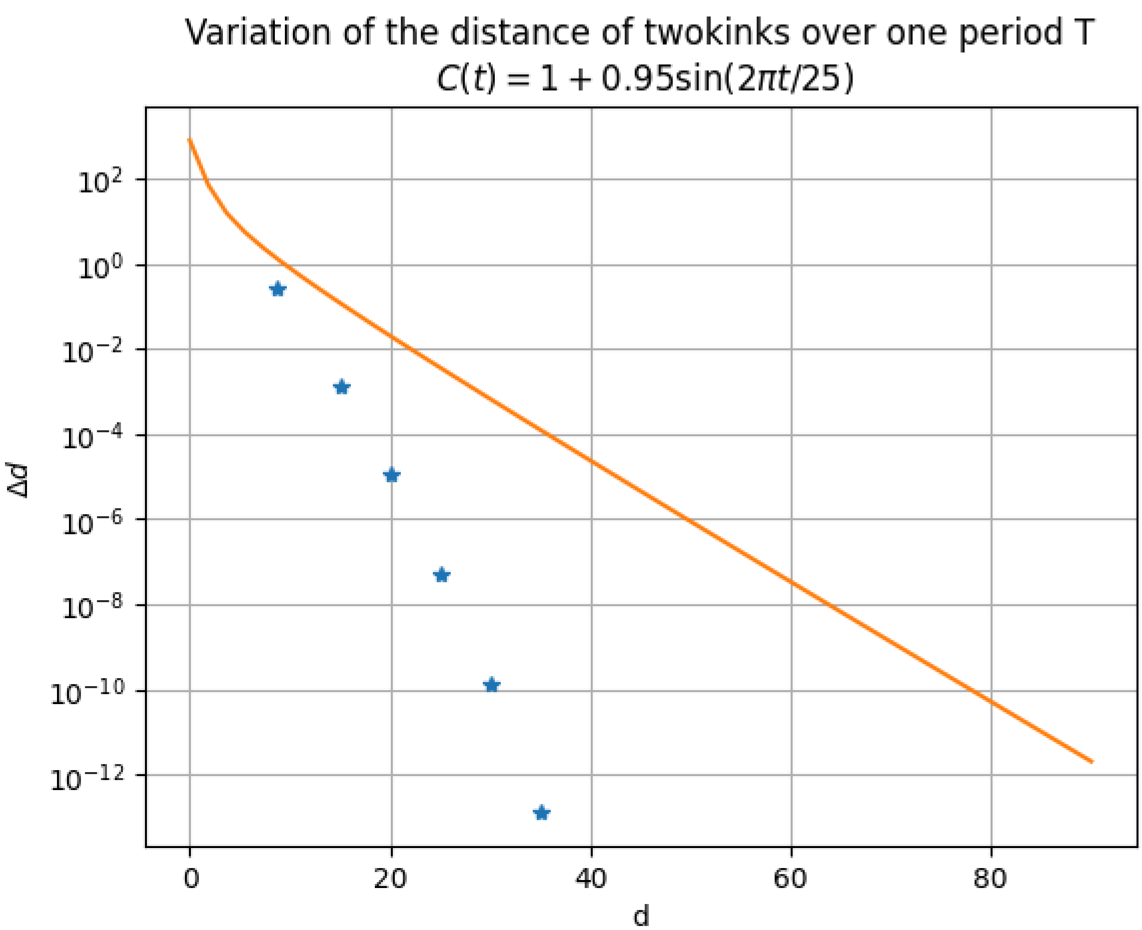
$A \gg C_0$


Variation of the distance of twokinks over one period T
$C(t) = 1 + 1.75\sin(2\pi t/25)$
10^{3}
10^{1}
10^{-1}
10^{-3}
10^{-5}
10^{-7}
10^{-9}
10^{-11}
Δd
0
20
40
60
80
d

$$A \sim C_0$$



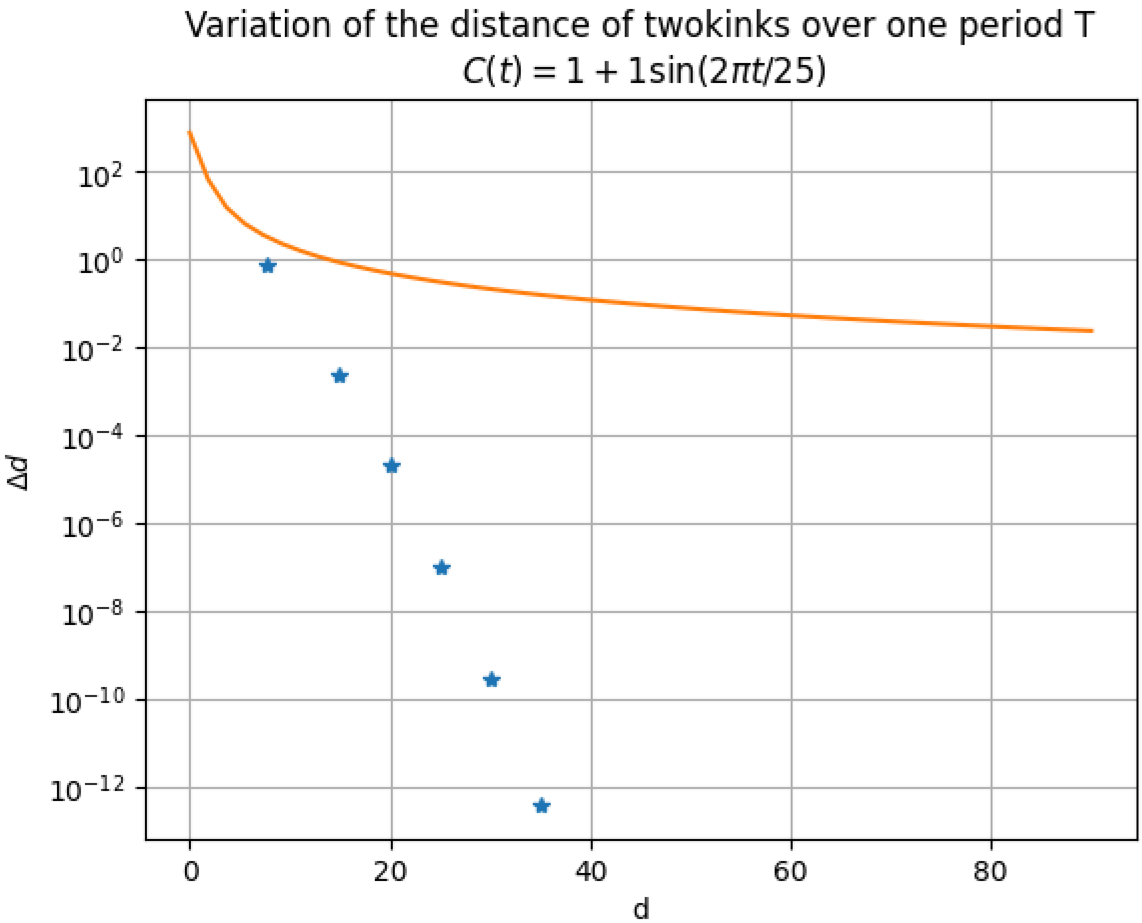
Variation of the distance of twokinks over one period T
$C(t) = 1 + 0.6\sin(2\pi t/25)$
10^4
10^1
10^{-2}
10^{-5}
10^{-8}
10^{-11}
10^{-14}
Δd
0
20
40
60
80
d



Variation of the distance of twokinks over one period T
$C(t) = 1 + 0.95\sin(2\pi t/25)$
10^2
10^0
10^{-2}
10^{-4}
10^{-6}
10^{-8}
10^{-10}
10^{-12}
Δd
0
20
40
60
80
d

$A = C_0$

Here the model predicts a power-law decay. **Instead** an exponential decay is measured!



Linear dynamics

$$\ell = \frac{2\pi}{< q^2 >^{1/2}} \sim t^{1/2}$$

$\tau_{linear} \sim C(t)^{-1}$