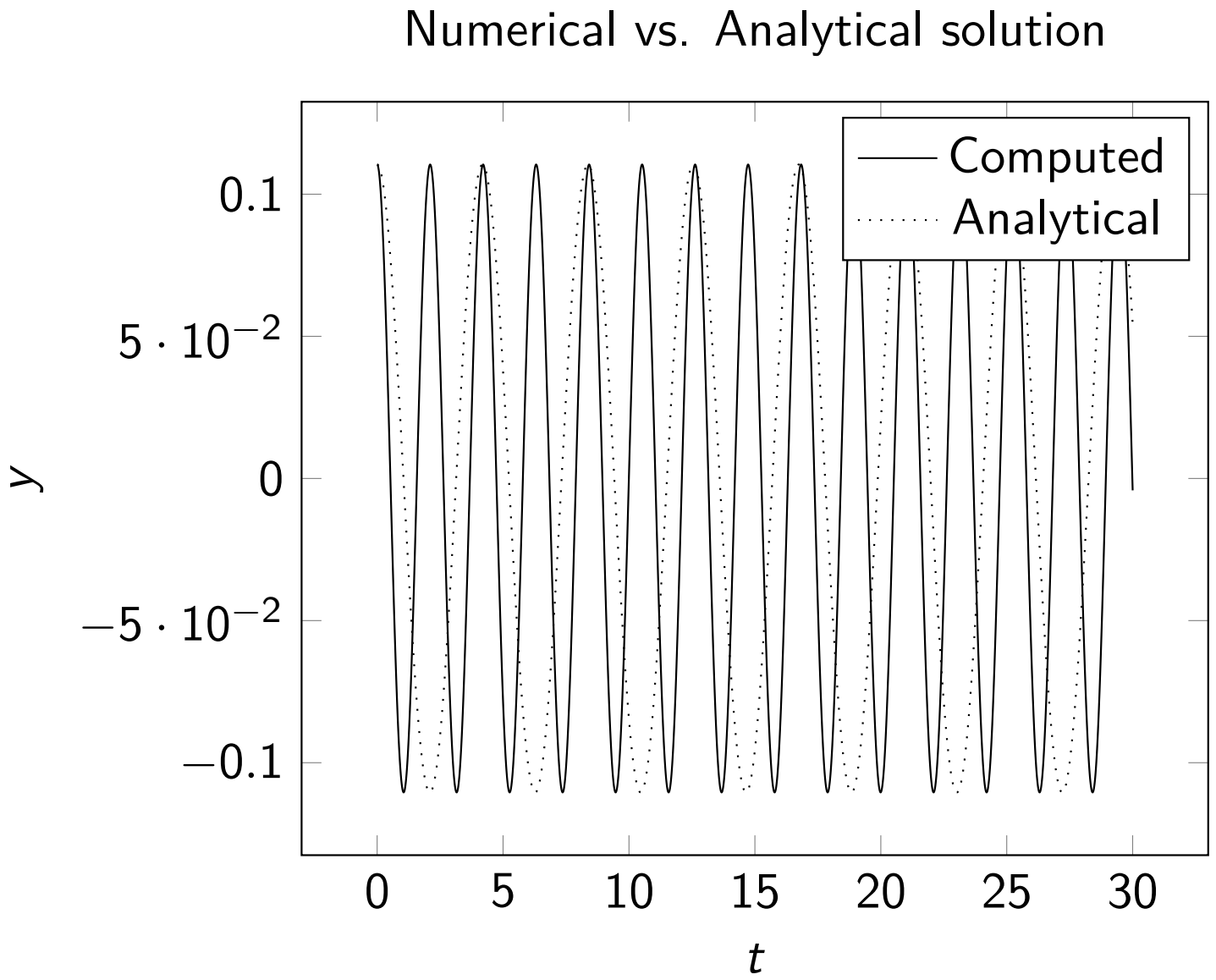
Simulating spin magnons using Runge-Kutta methods

Jonas Bueie

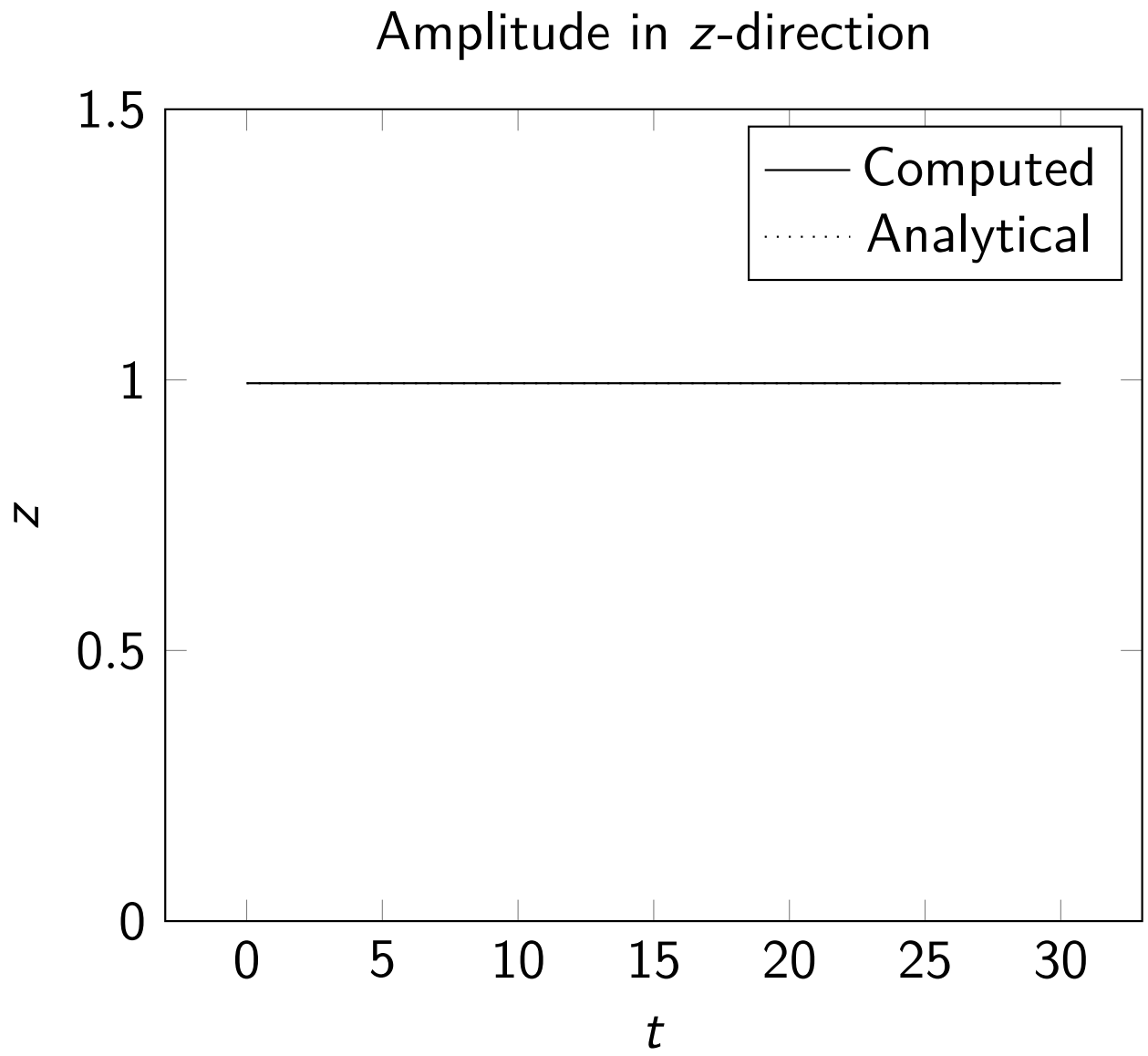
May 7, 2021

Part one: Single spin

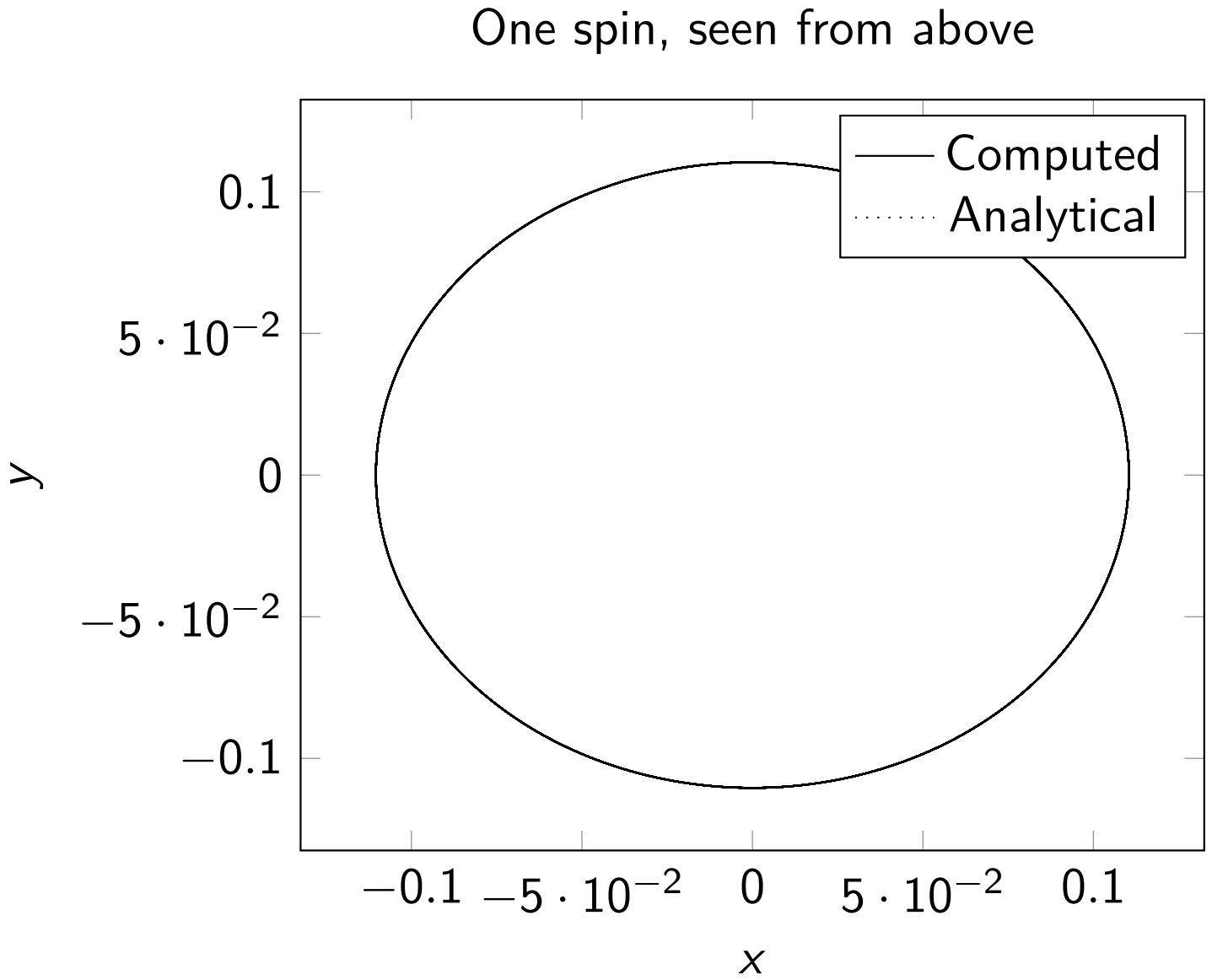
Simplest case



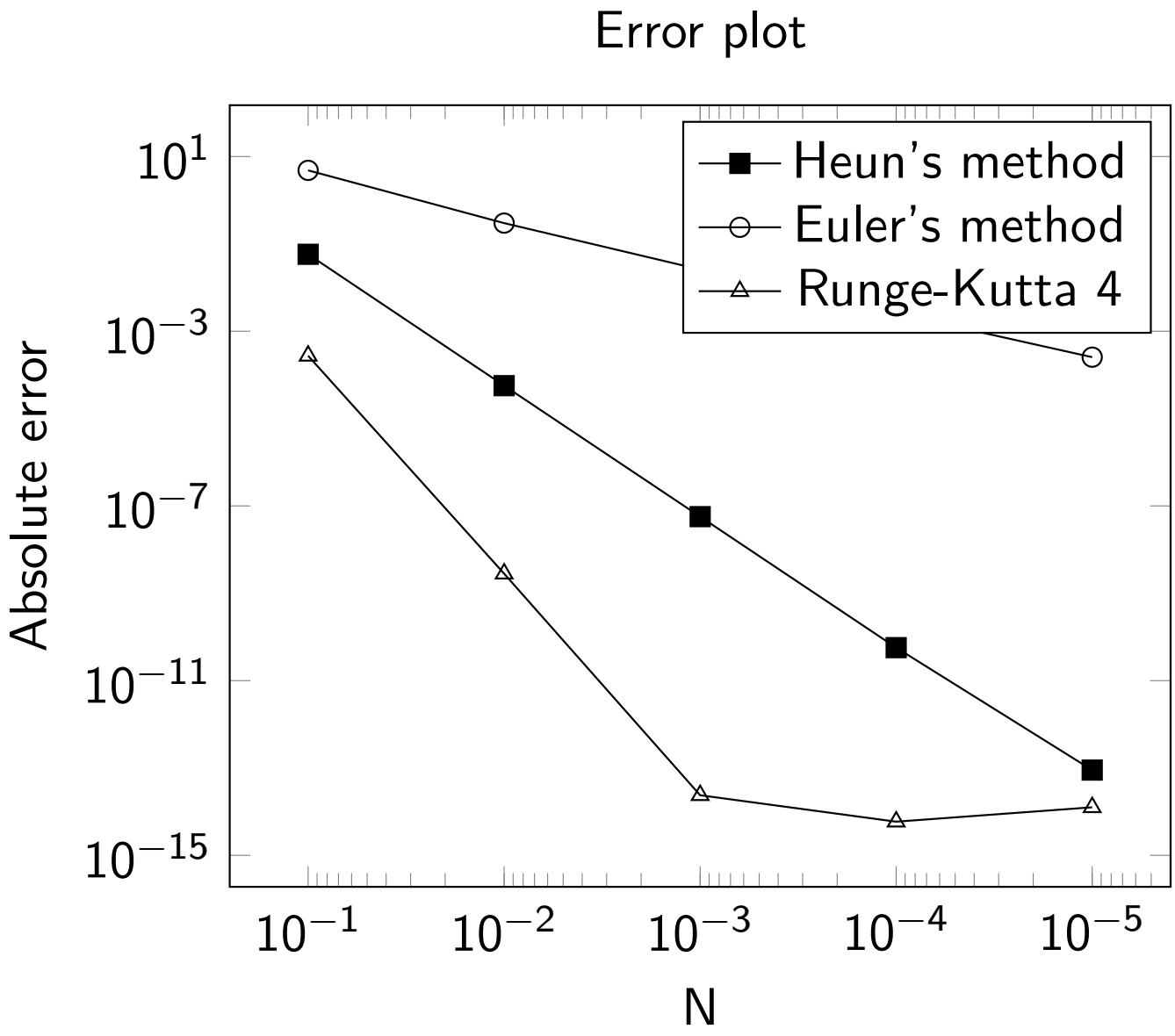
Simplest case



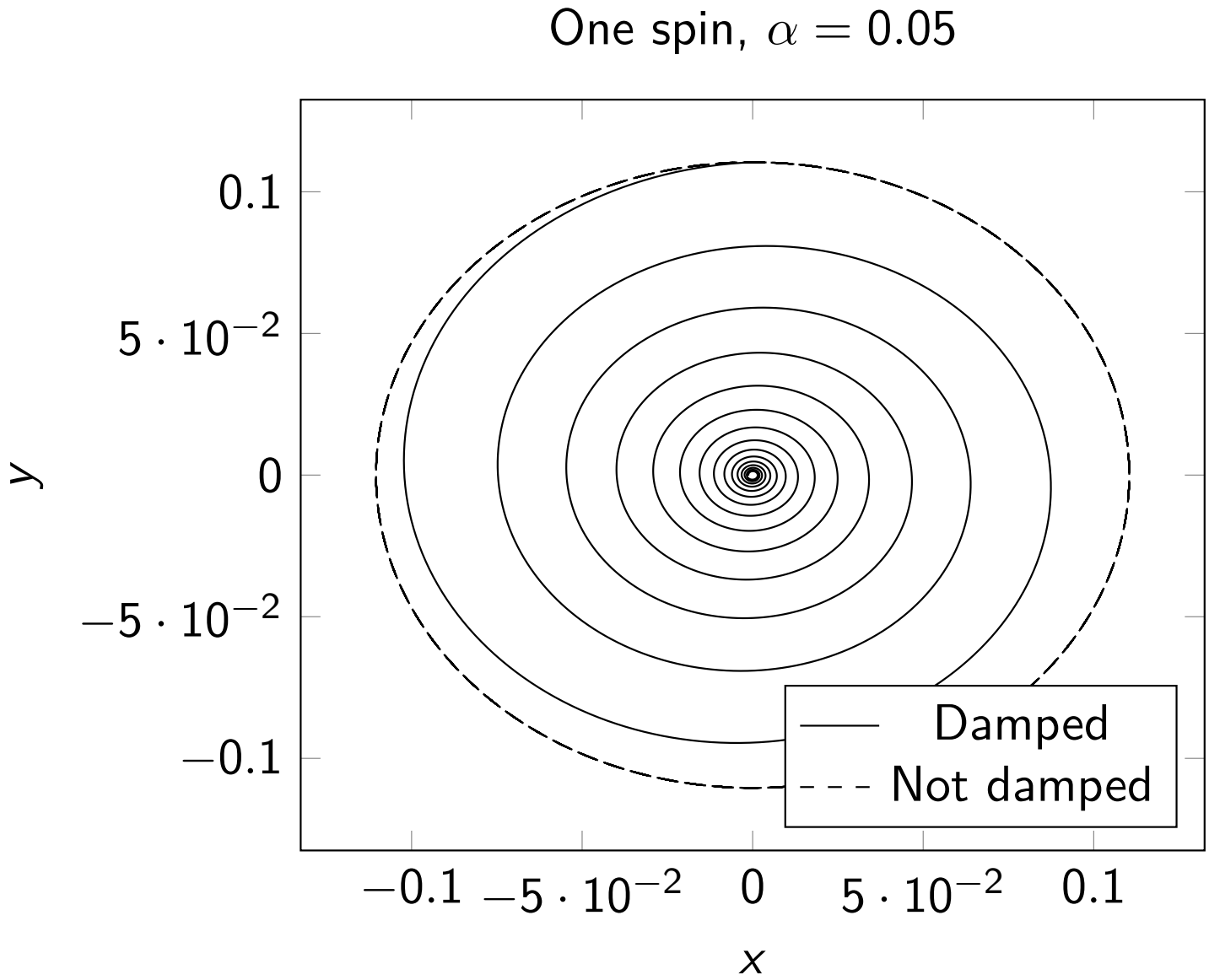
Phase space


One spin, seen from above
Computed
Analytical
0.1
$5 \cdot 10^{-2}$
0
$-5 \cdot 10^{-2}$
-0.1
y
-0.1
$-5 \cdot 10^{-2}$
0
$5 \cdot 10^{-2}$
0.1
x

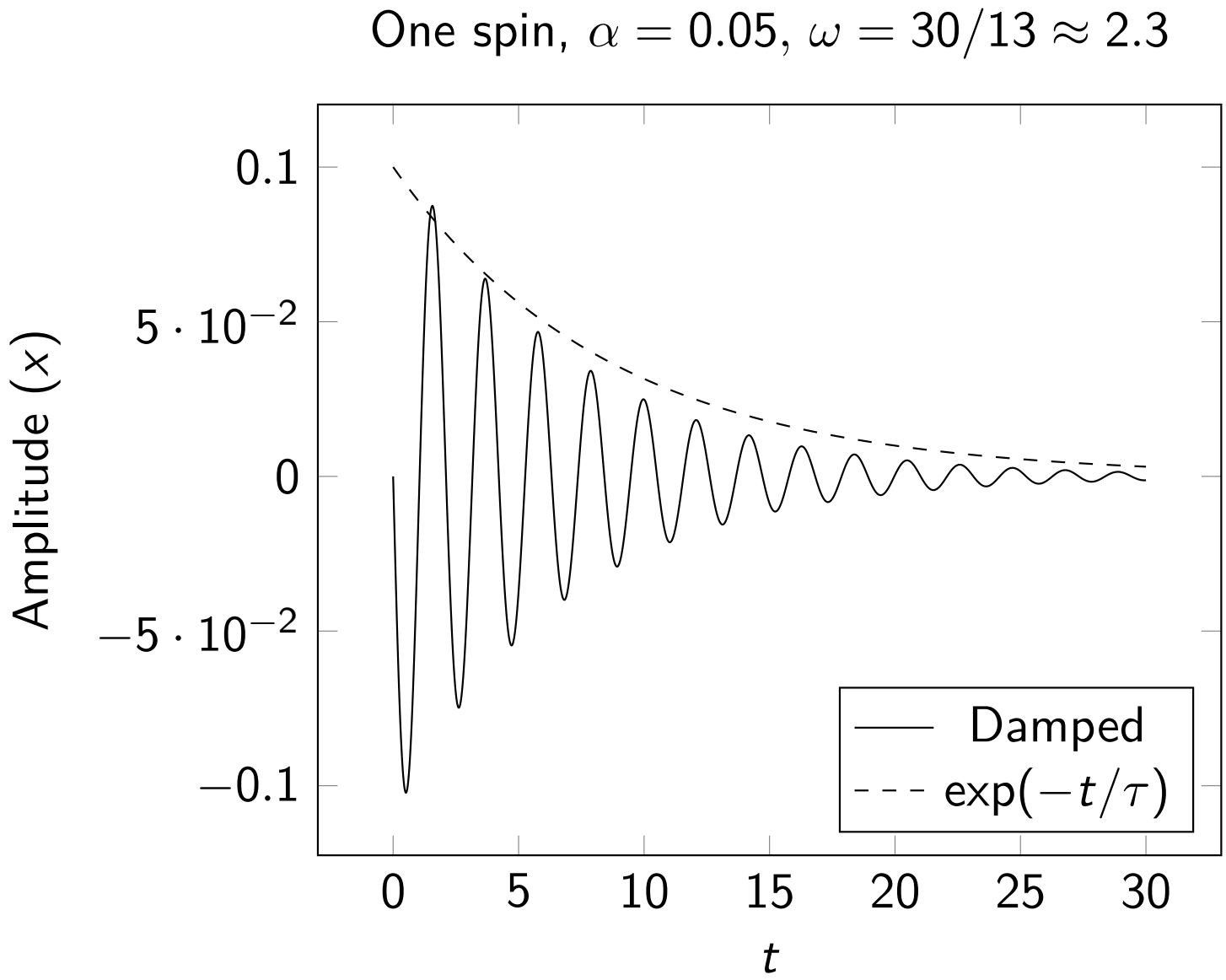
Convergence plot



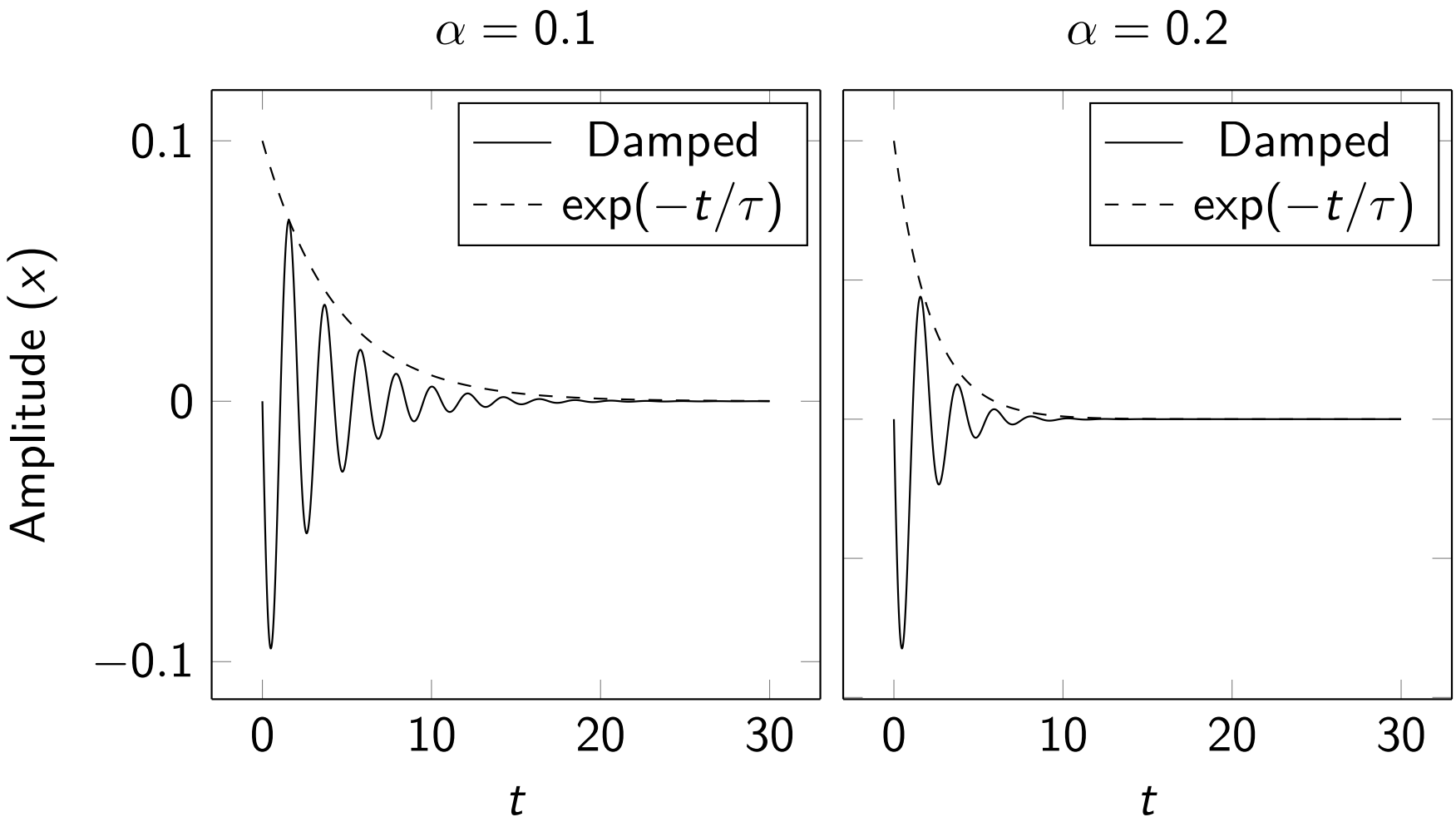
With damping



Analyzing the damping

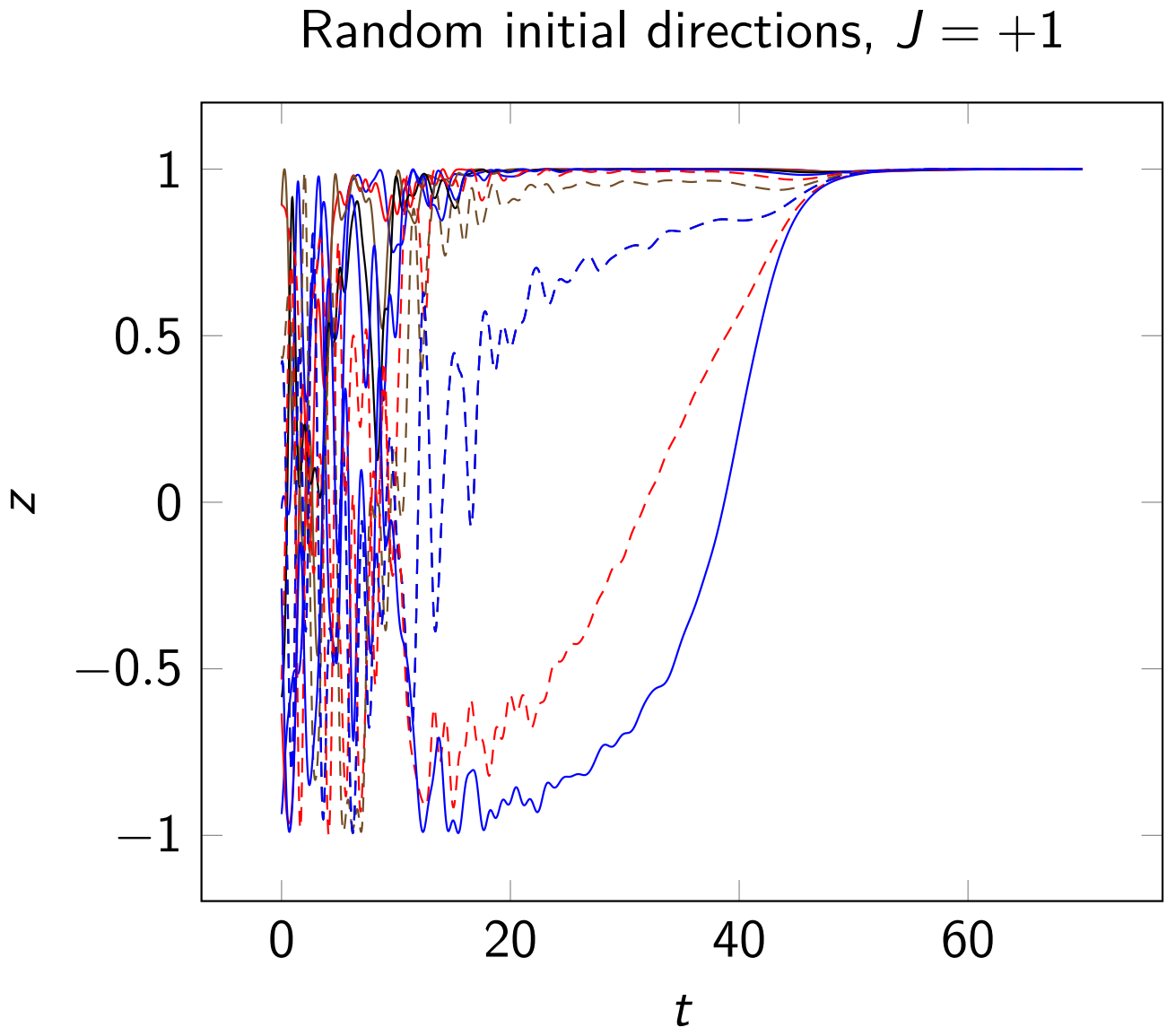


Varying α

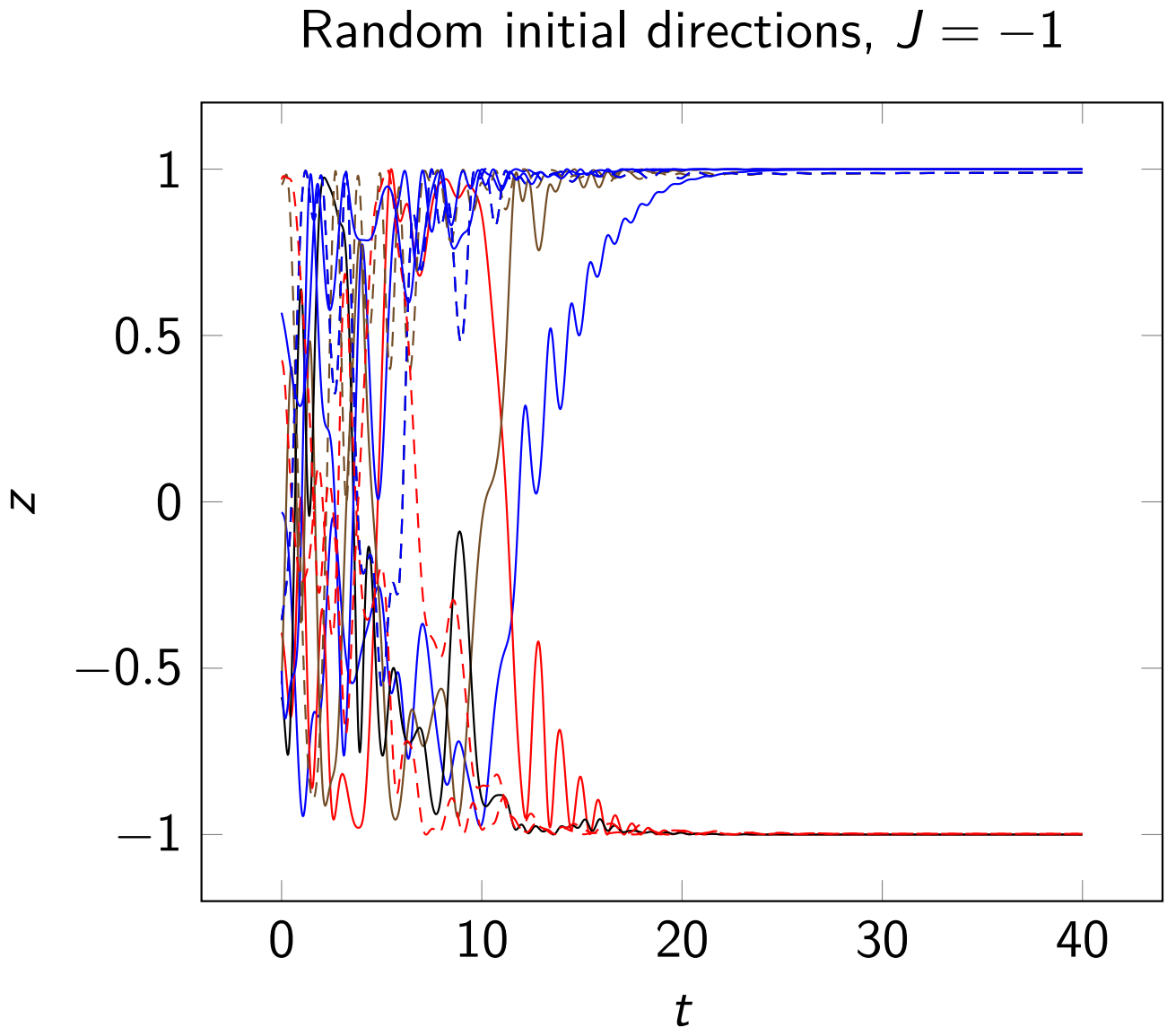


Part two: Spin chain

Ferromagnetic coupling

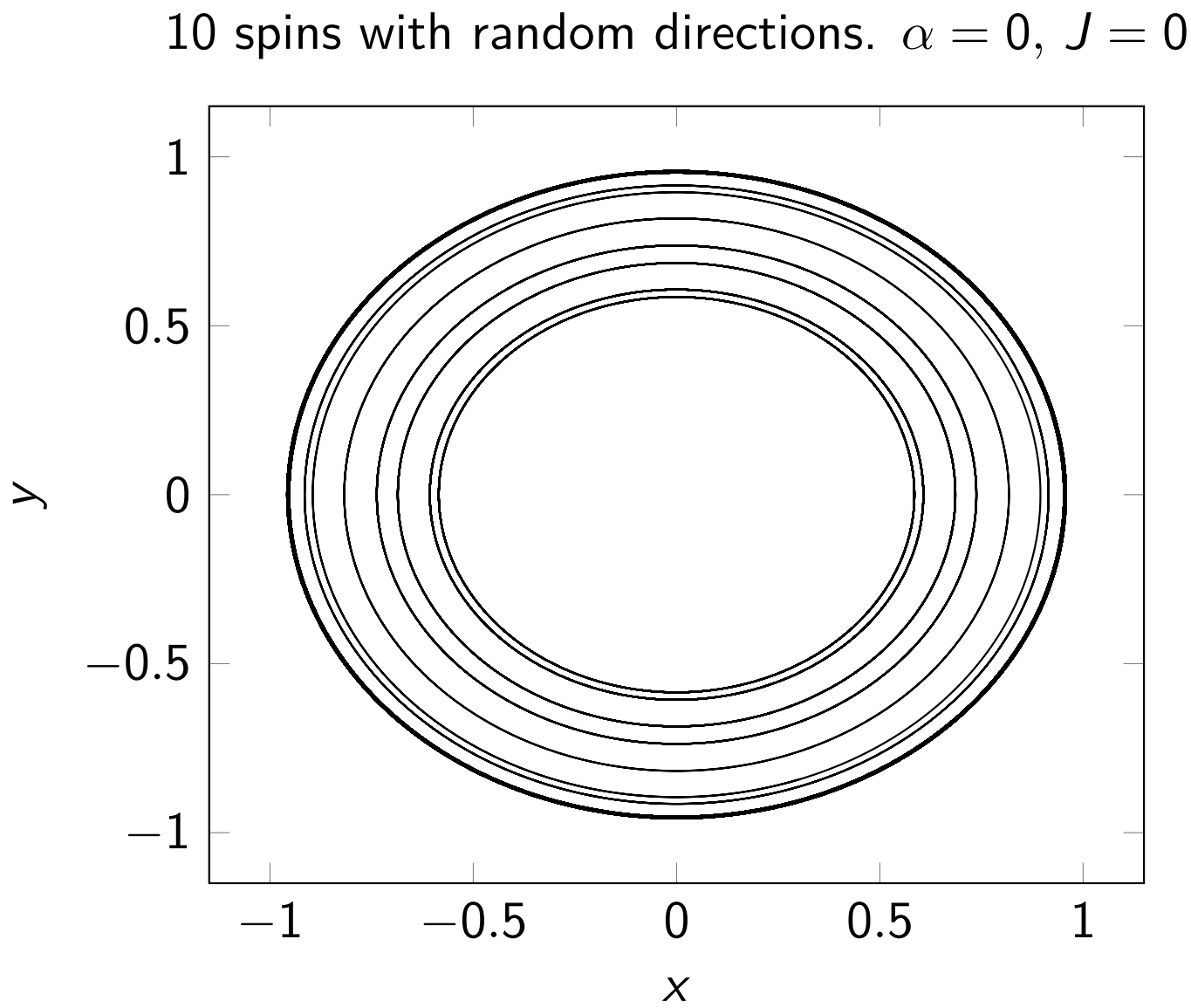


Antiferromagnetic coupling

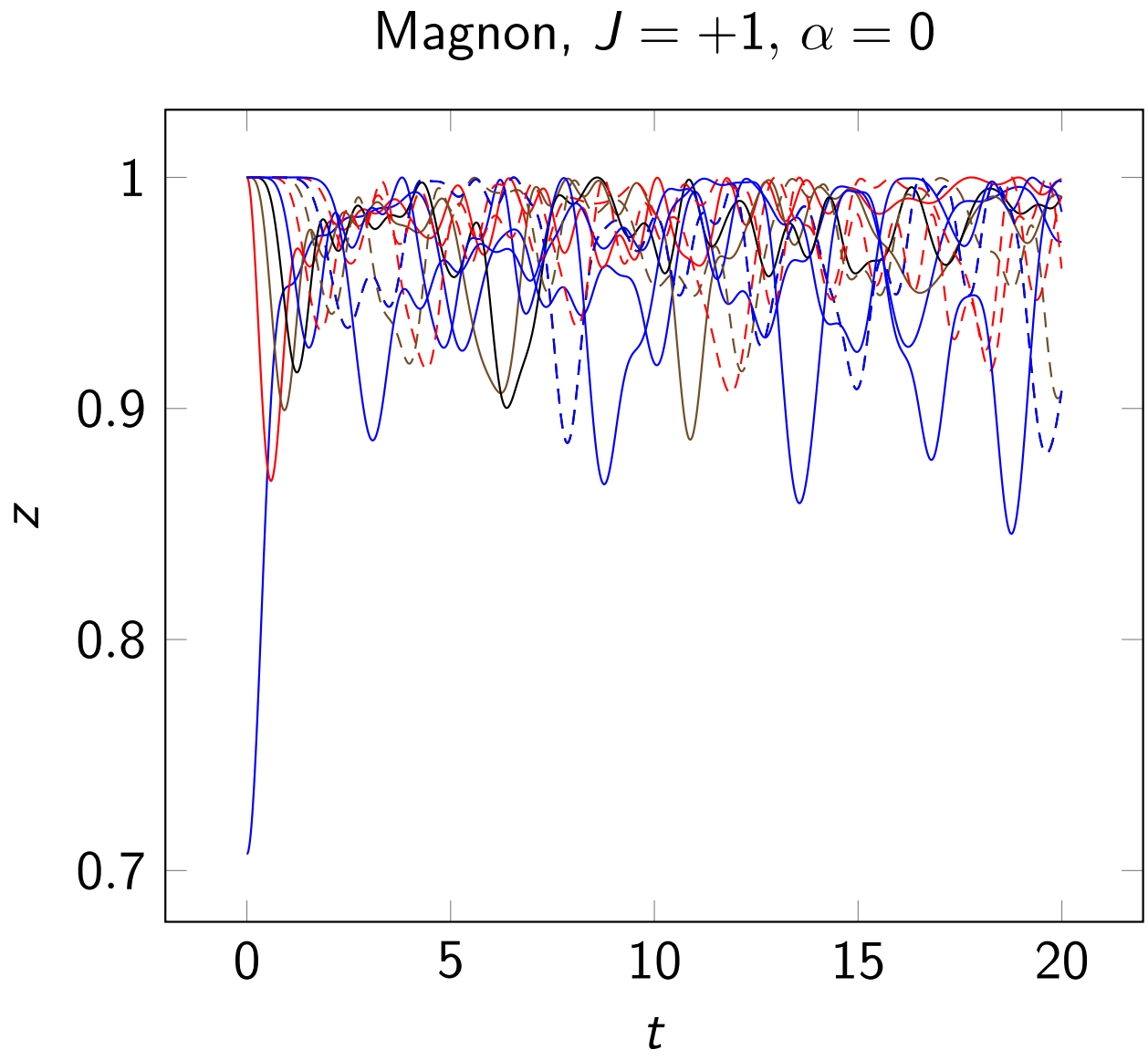


Magnons

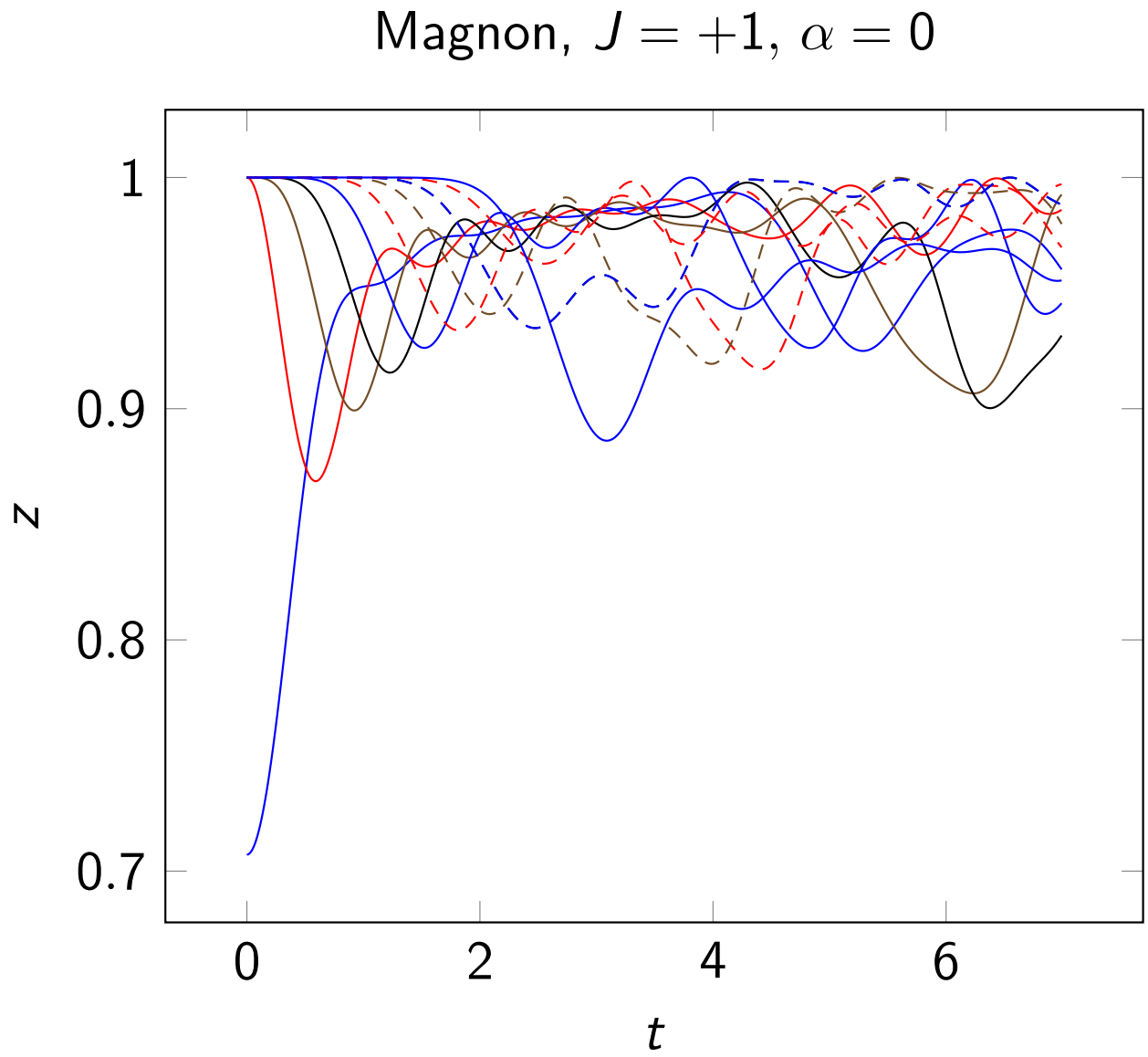
No coupling


10 spins with random directions. $\alpha = 0$, $J = 0$
1
0.5
0
−0.5
−1
y
−1
−0.5
0
0.5
1
x

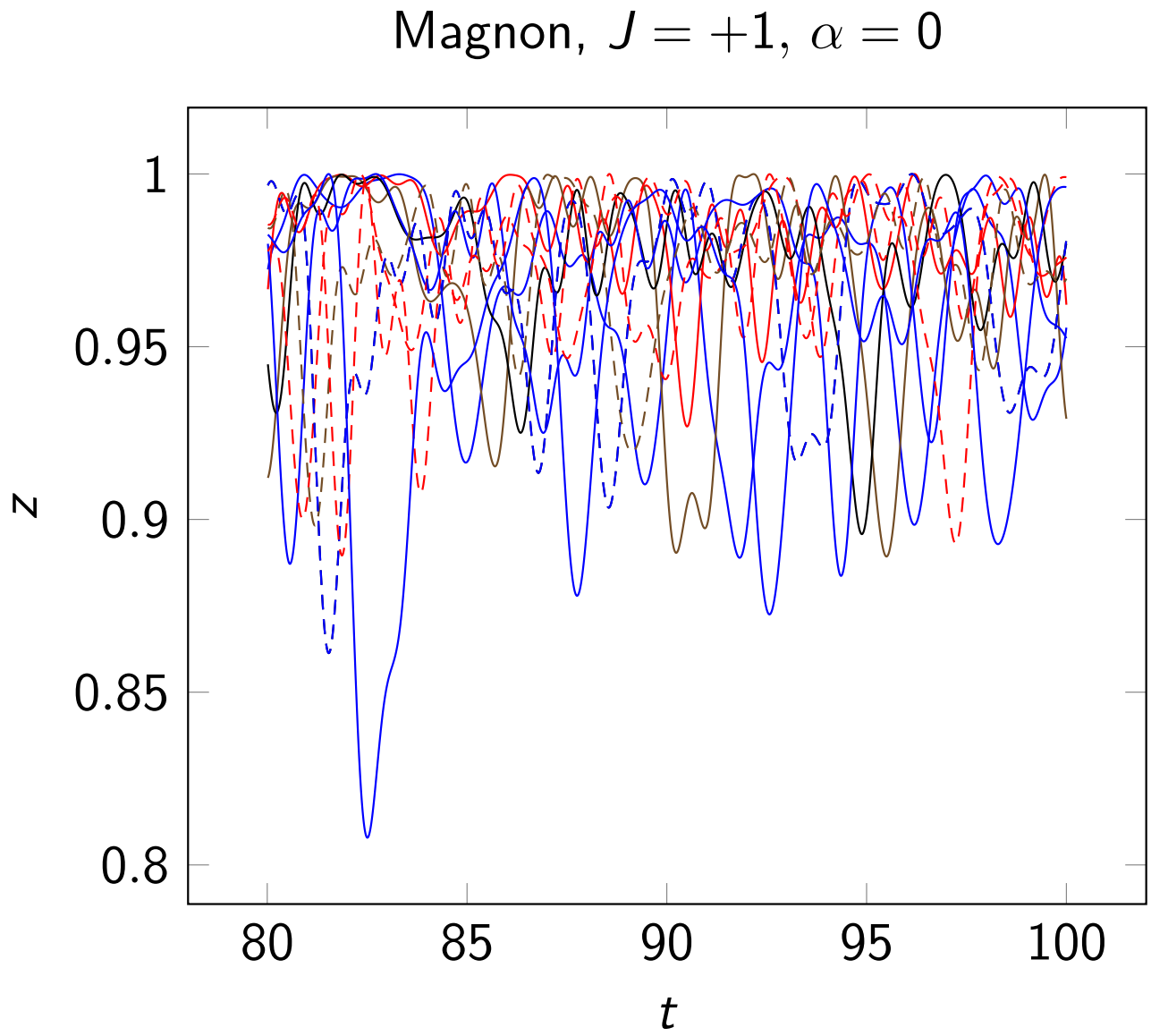
No damping



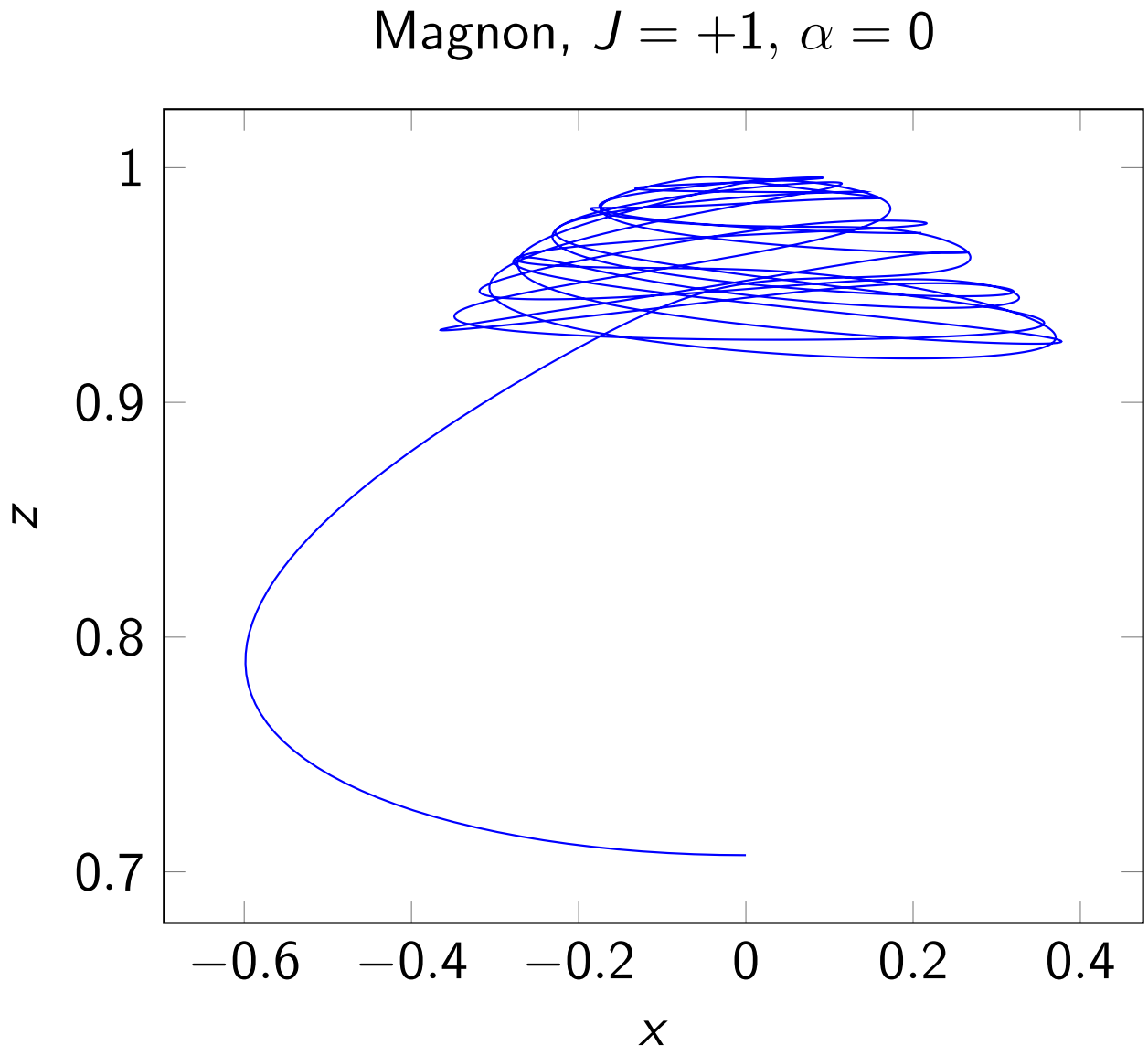
For small t



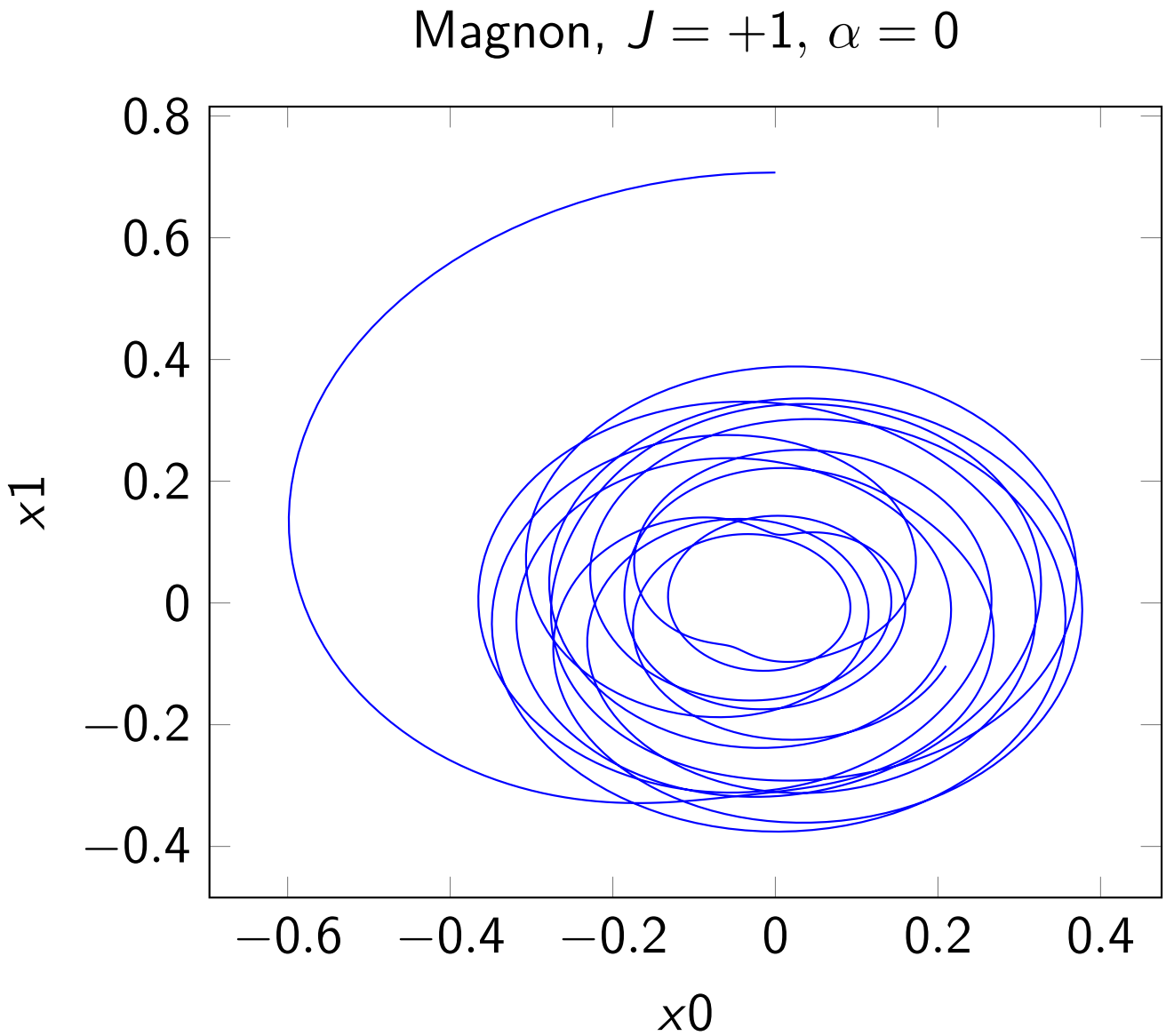
For large t



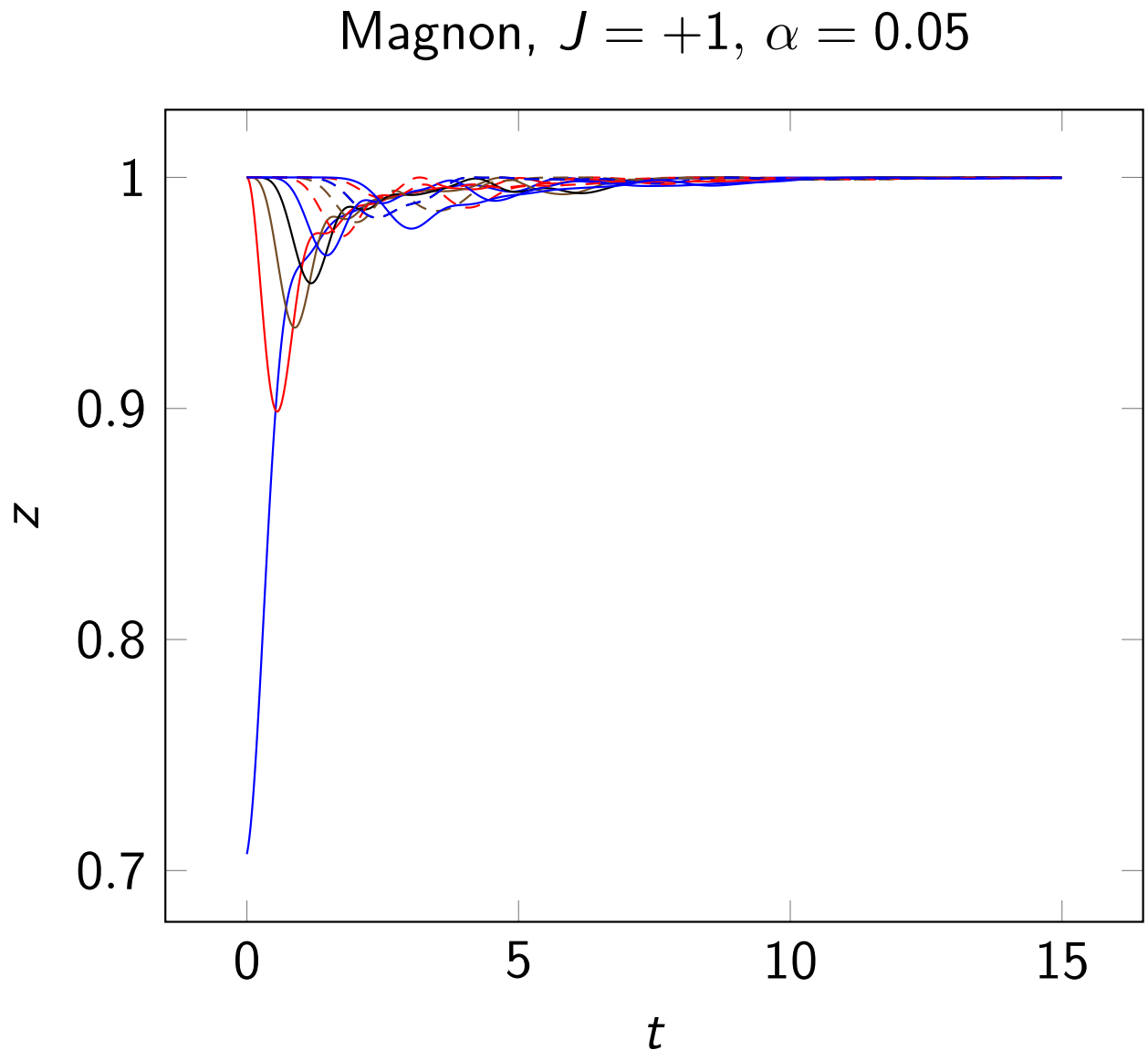
Spatial movement of the spin



Spatial movment of the spin

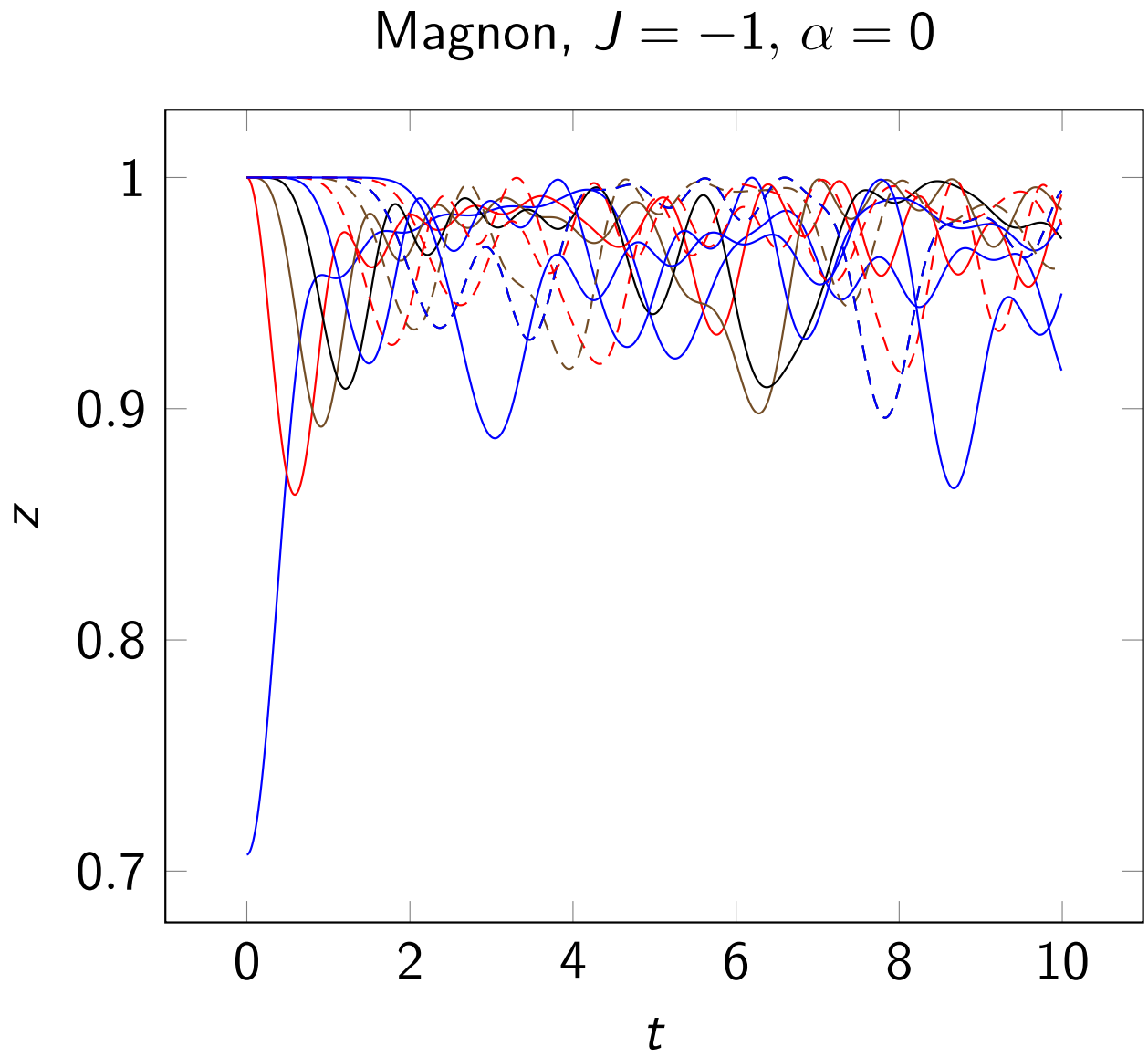


With damping

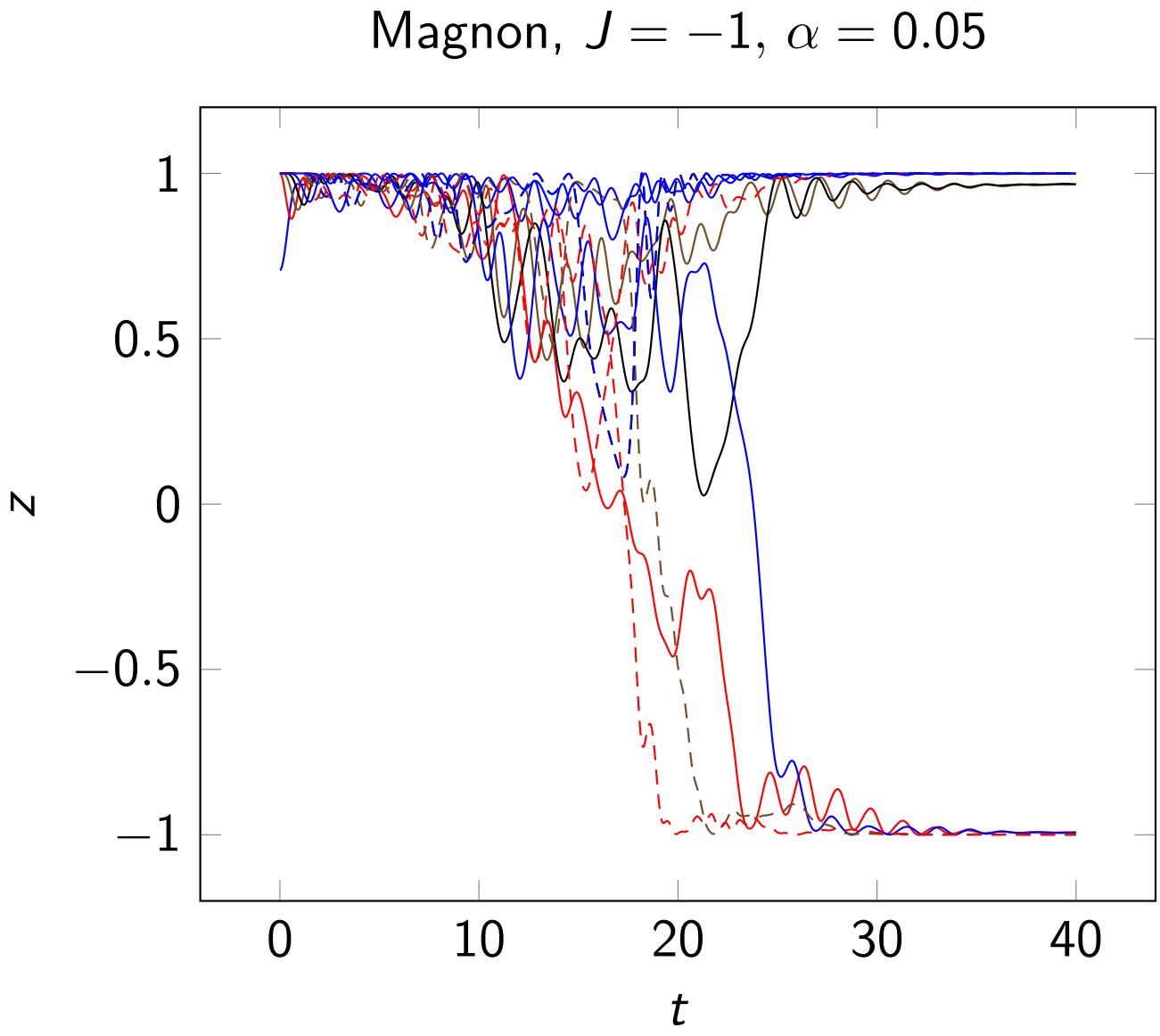


Magnons in antiferromagnetic chain

No damping



With damping



Magnetization