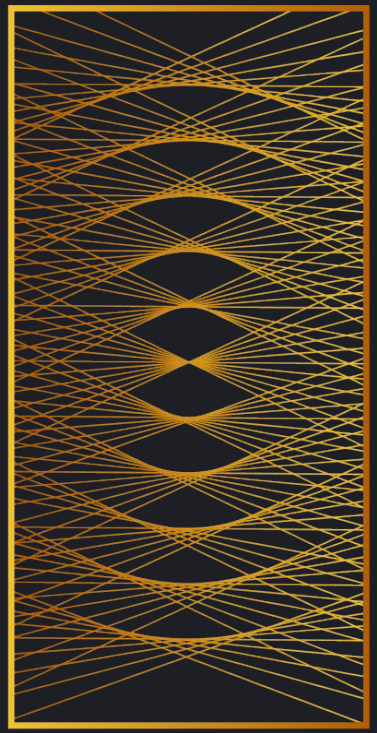


01.

Differential Equation

$$\frac{dy}{dx} - \exp(-y) = 0$$

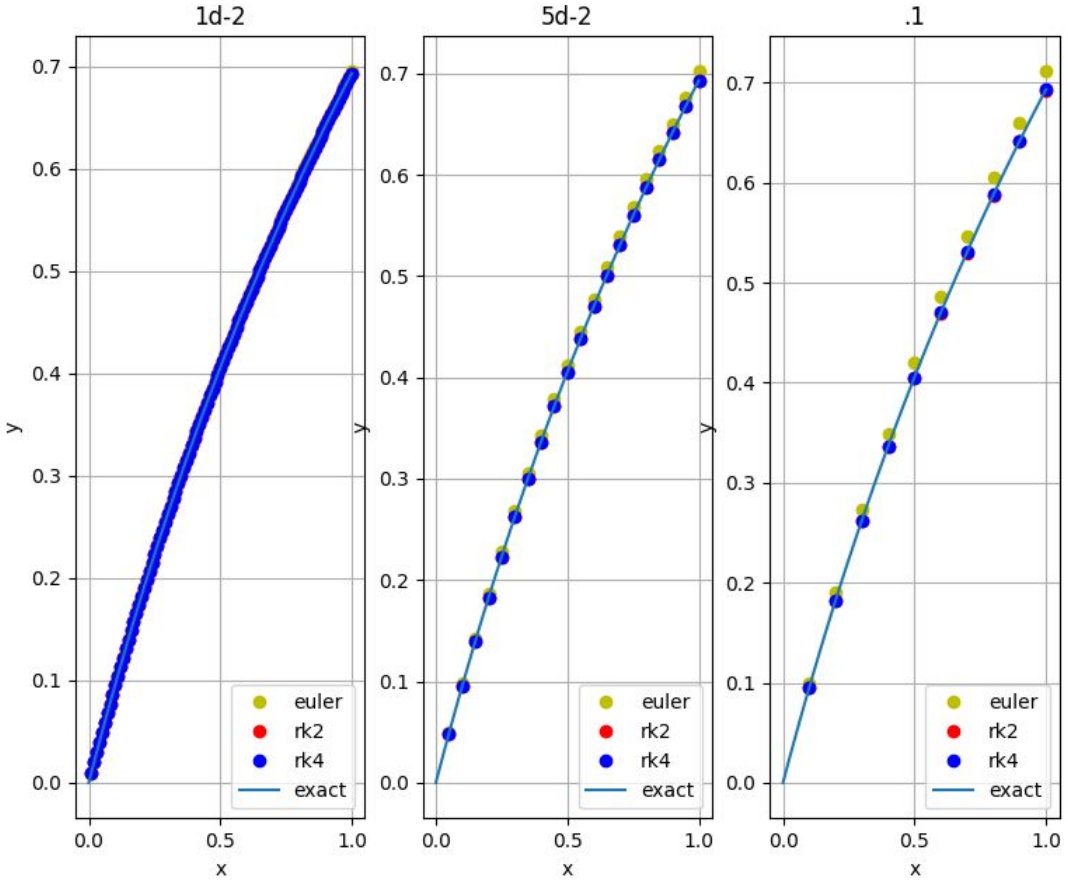
$$\frac{dy}{dx} - e^{-y} = 0 \Rightarrow \frac{dy}{e^{-y}} = dx$$

$$e^{y} = x + C$$

$$y = \ln(x + C)$$

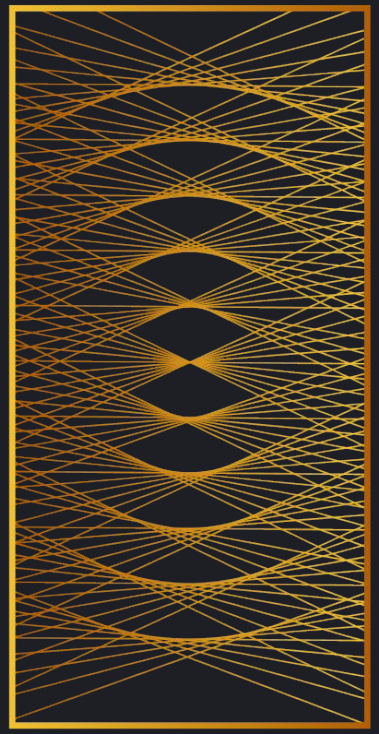
$$y(0) = \ln C \Rightarrow C = 1$$

$$y = \ln(x+1)$$


1d-2
5d-2
.1
y
x
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.0
0.5
1.0
euler
rk2
rk4
exact

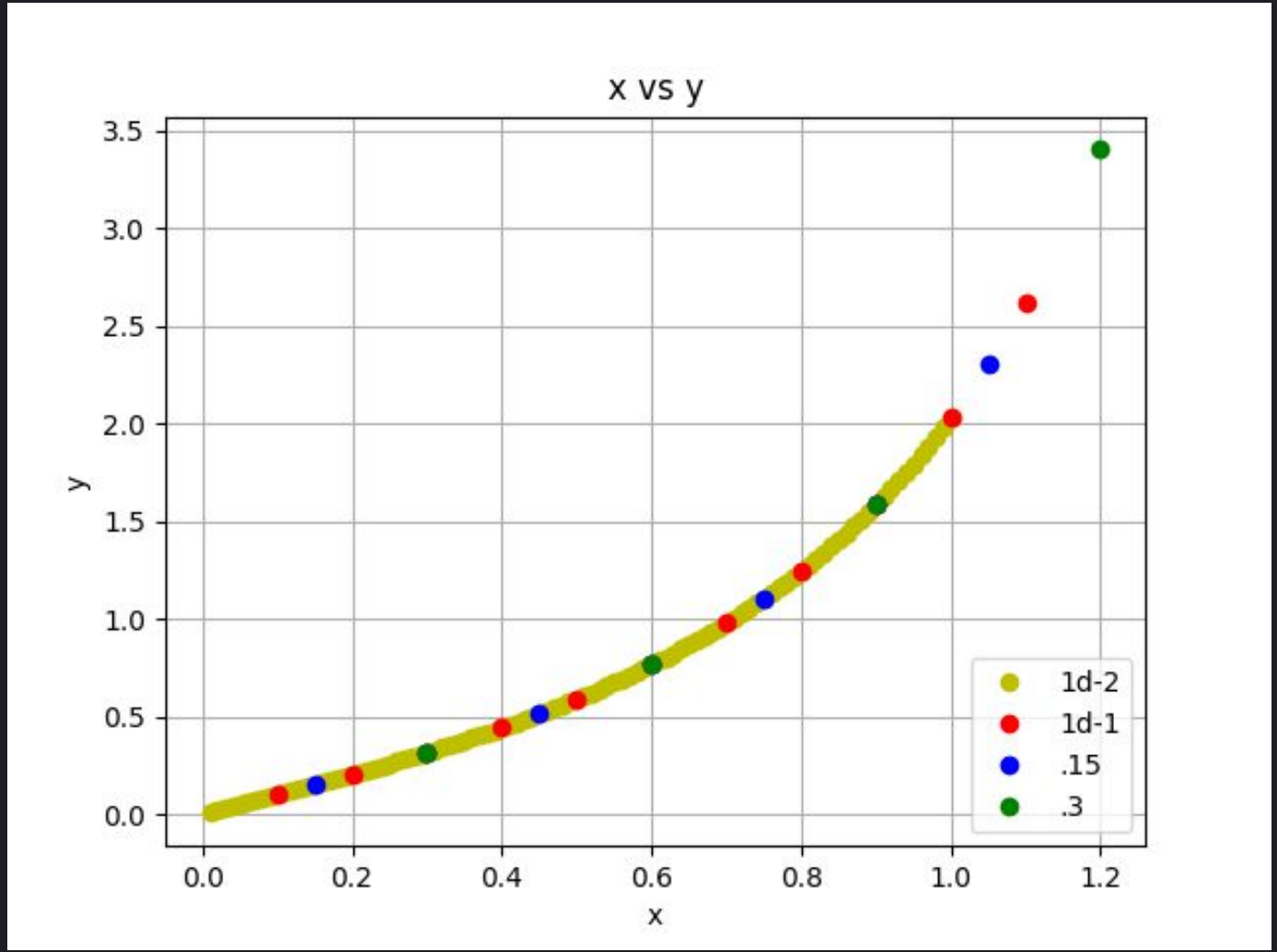
Conclusion

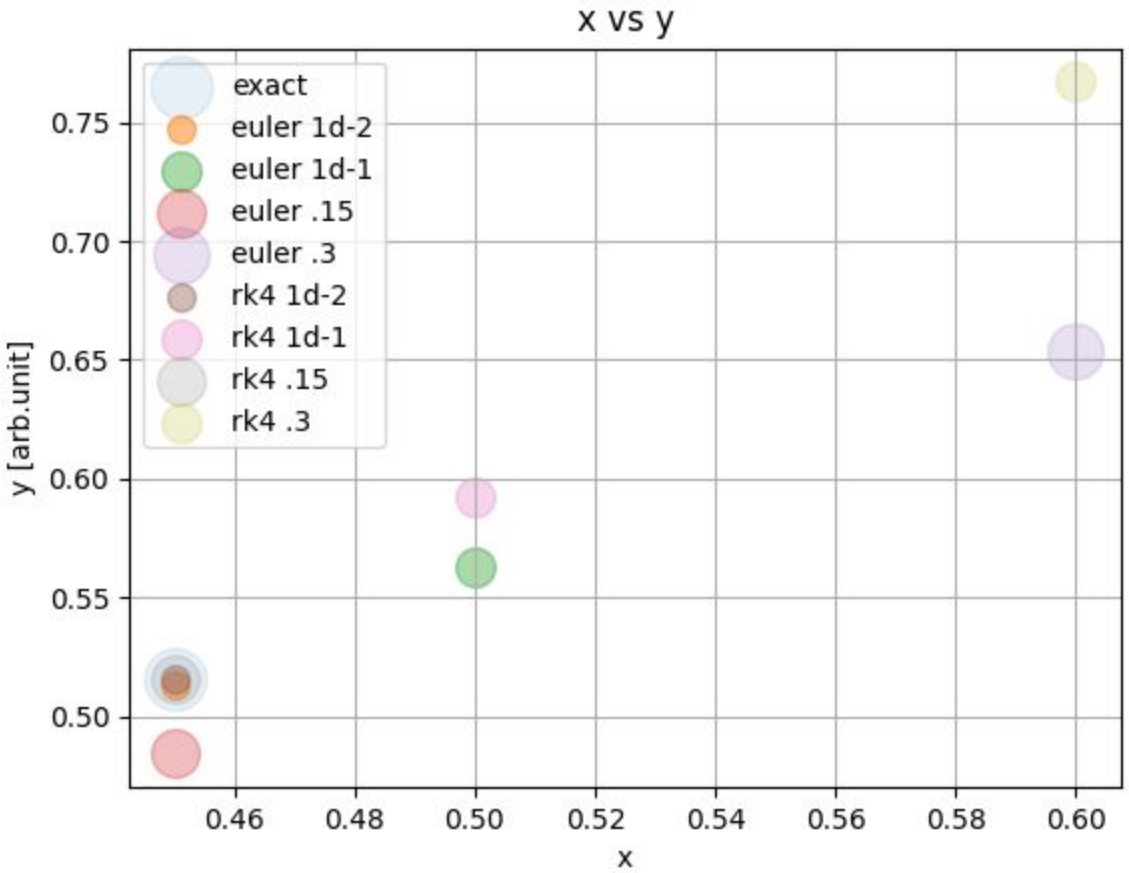
It converges very well even at .1

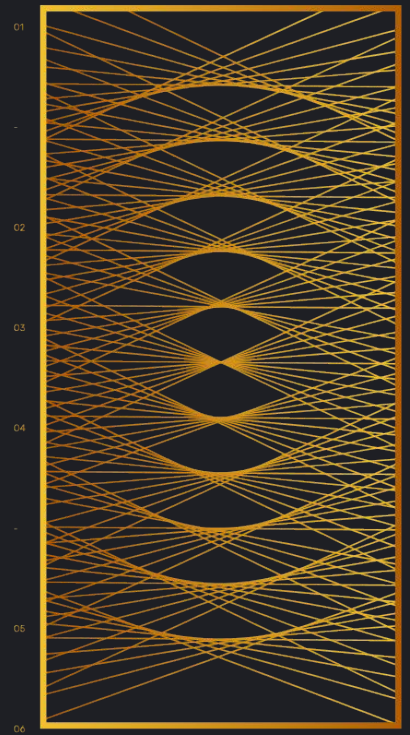


02.

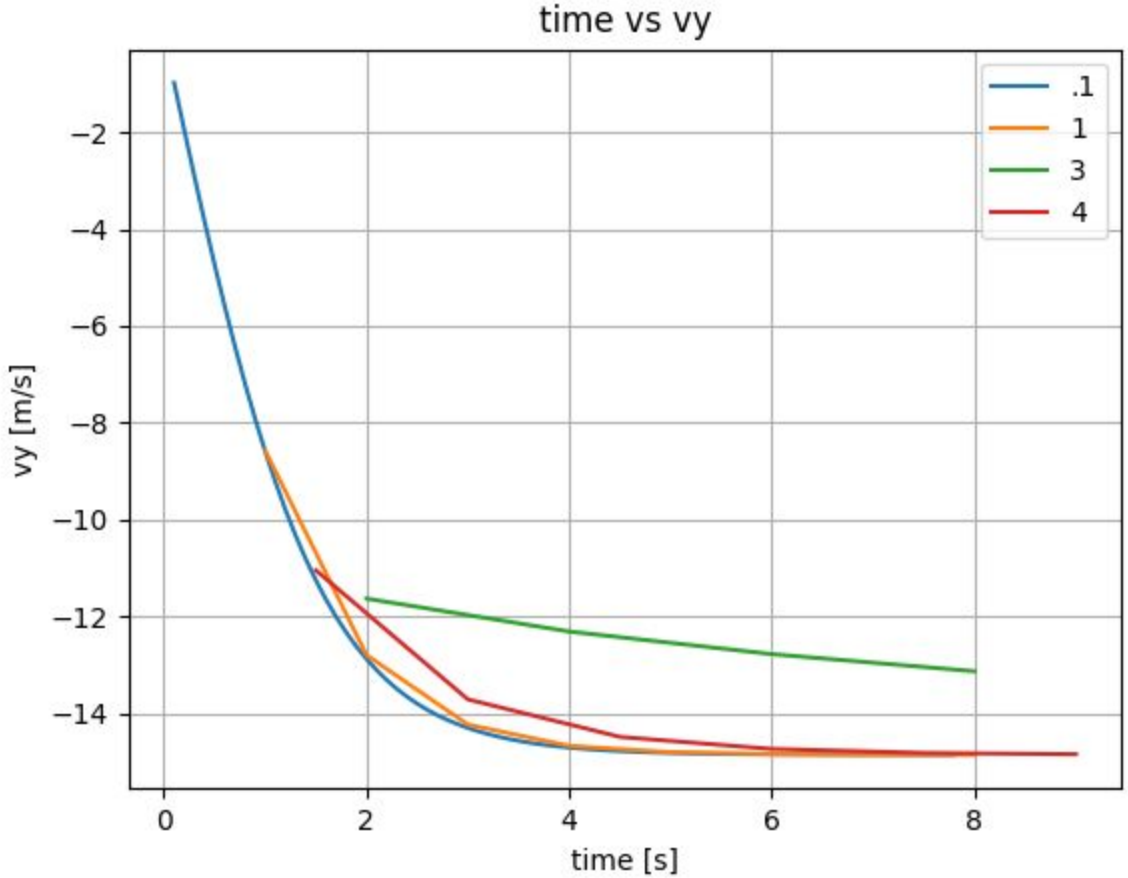
$$\frac{dy}{dx} - 1 - 2 \cdot x \cdot y = 0$$

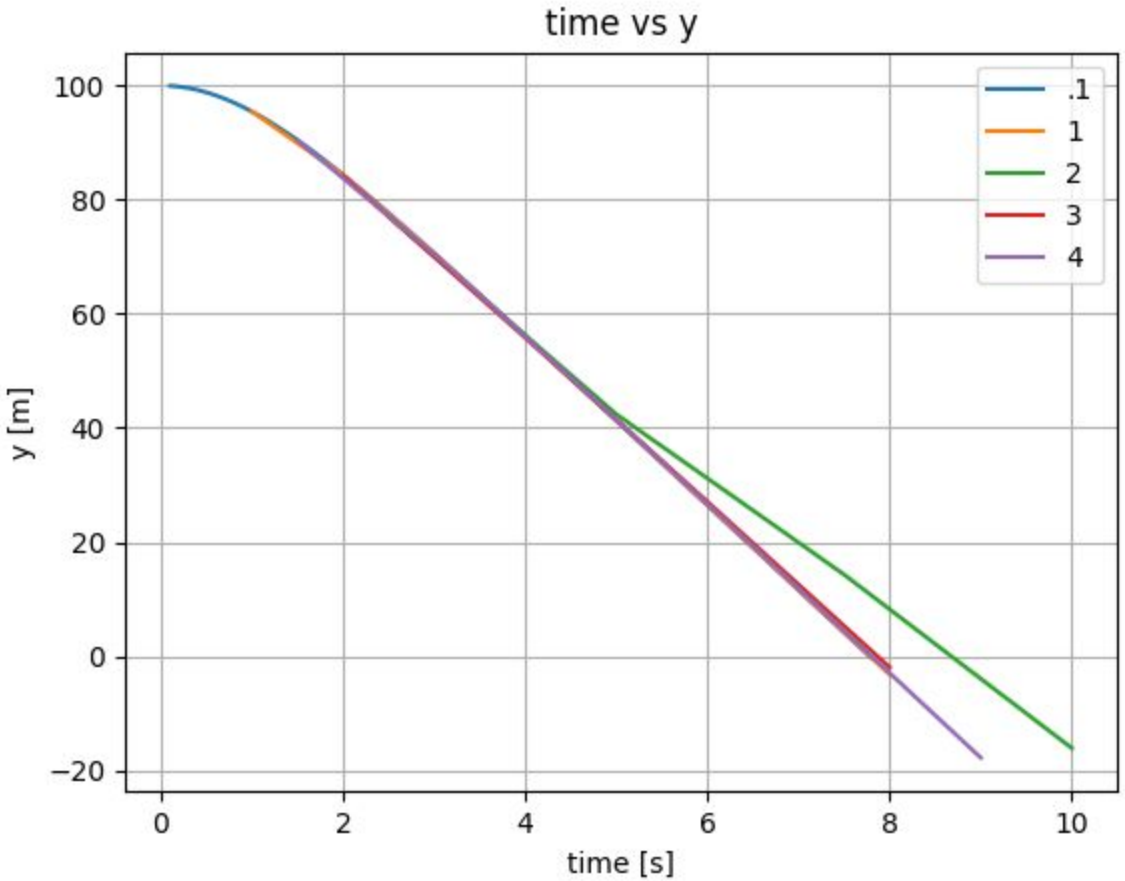

x vs y
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
y
0.0
0.2
0.4
0.6
0.8
1.0
1.2
x
1d-2
1d-1
.15
.3

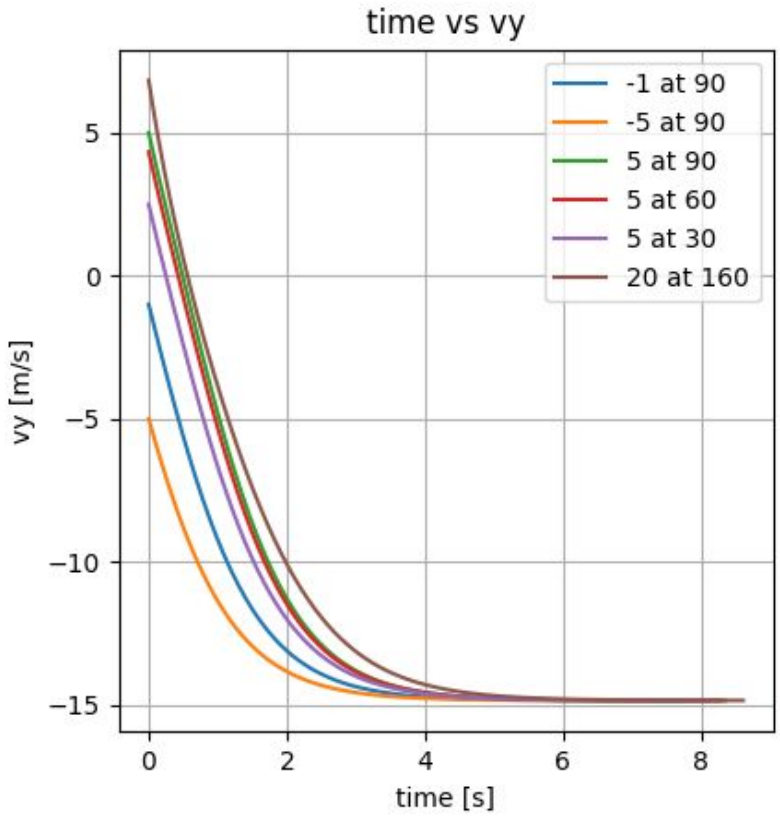

x vs y
exact
euler 1d-2
euler 1d-1
euler .15
euler .3
rk4 1d-2
rk4 1d-1
rk4 .15
rk4 .3
y [arb.unit]
0.75
0.70
0.65
0.60
0.55
0.50
0.46
0.48
0.50
0.52
0.54
0.56
0.58
0.60
x

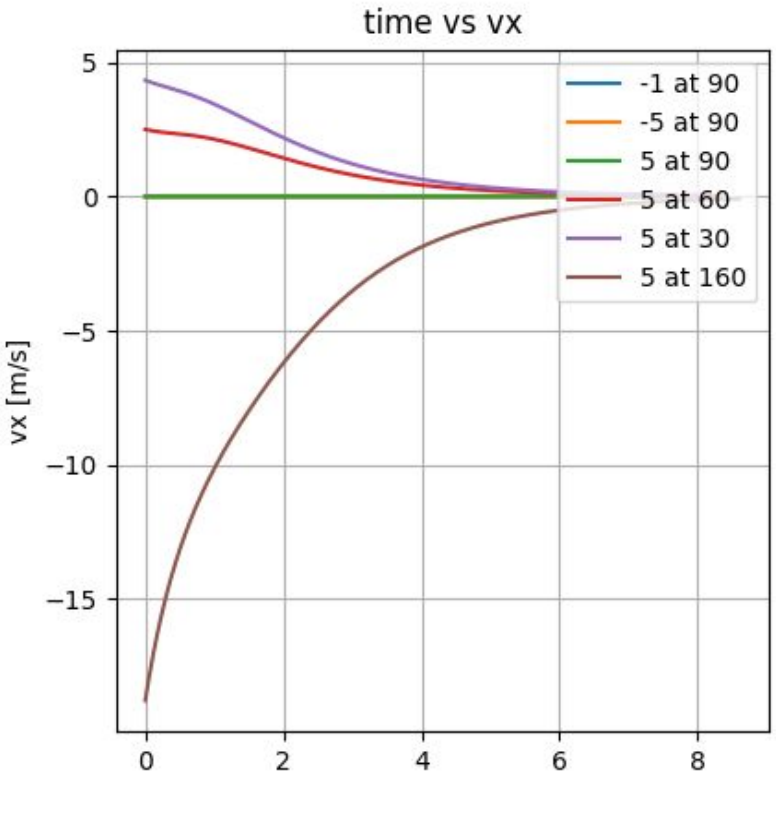


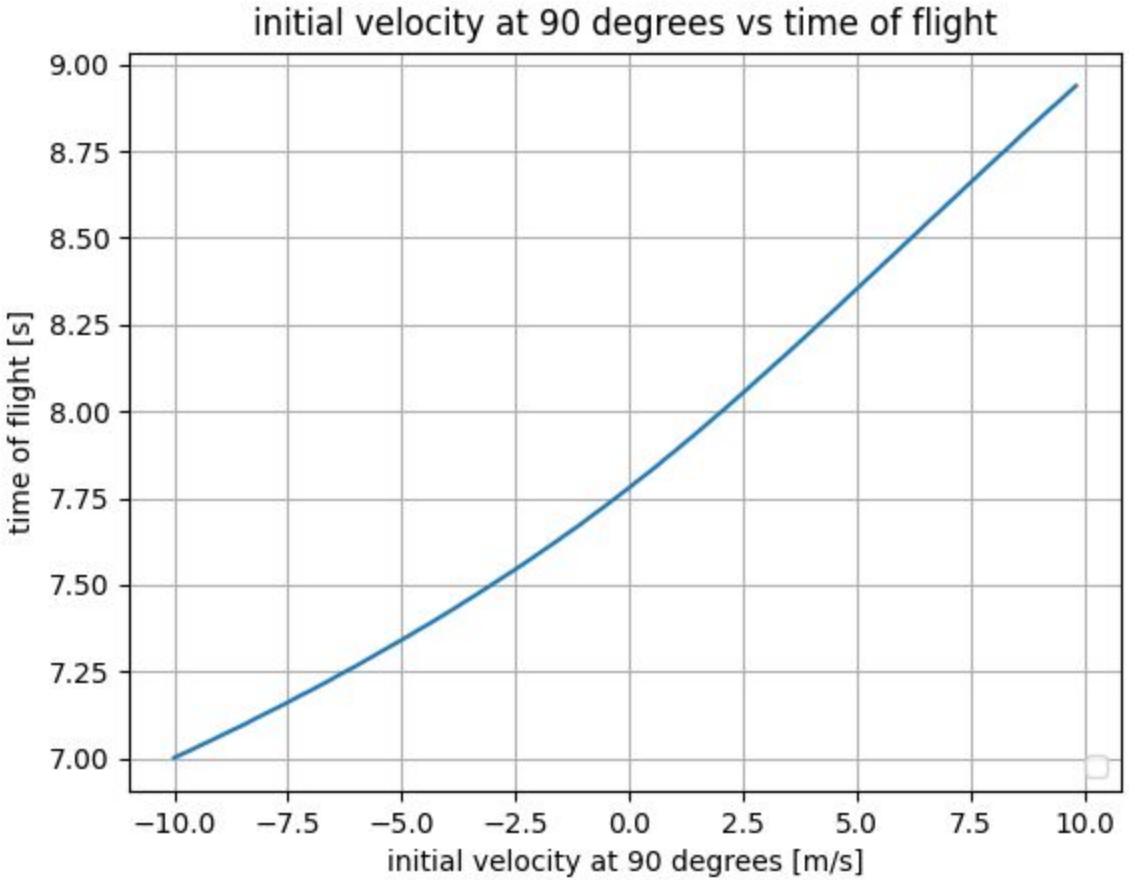
03

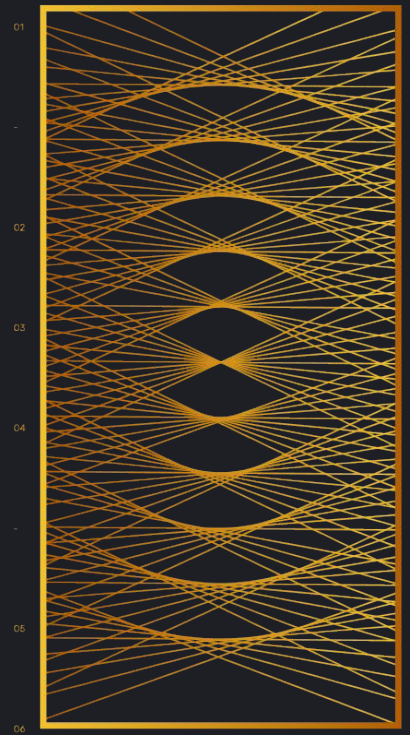

time vs vy
vy [m/s]
time [s]
.1
1
3
4
−2
−4
−6
−8
−10
−12
−14
0
2
4
6
8


time vs y
y [m]
time [s]
100
80
60
40
20
0
−20
0
2
4
6
8
10
.1
1
2
3
4


time vs vy
-1 at 90
-5 at 90
5 at 90
5 at 60
5 at 30
20 at 160
vy [m/s]
time [s]
5
0
−5
−10
−15
0
2
4
6
8

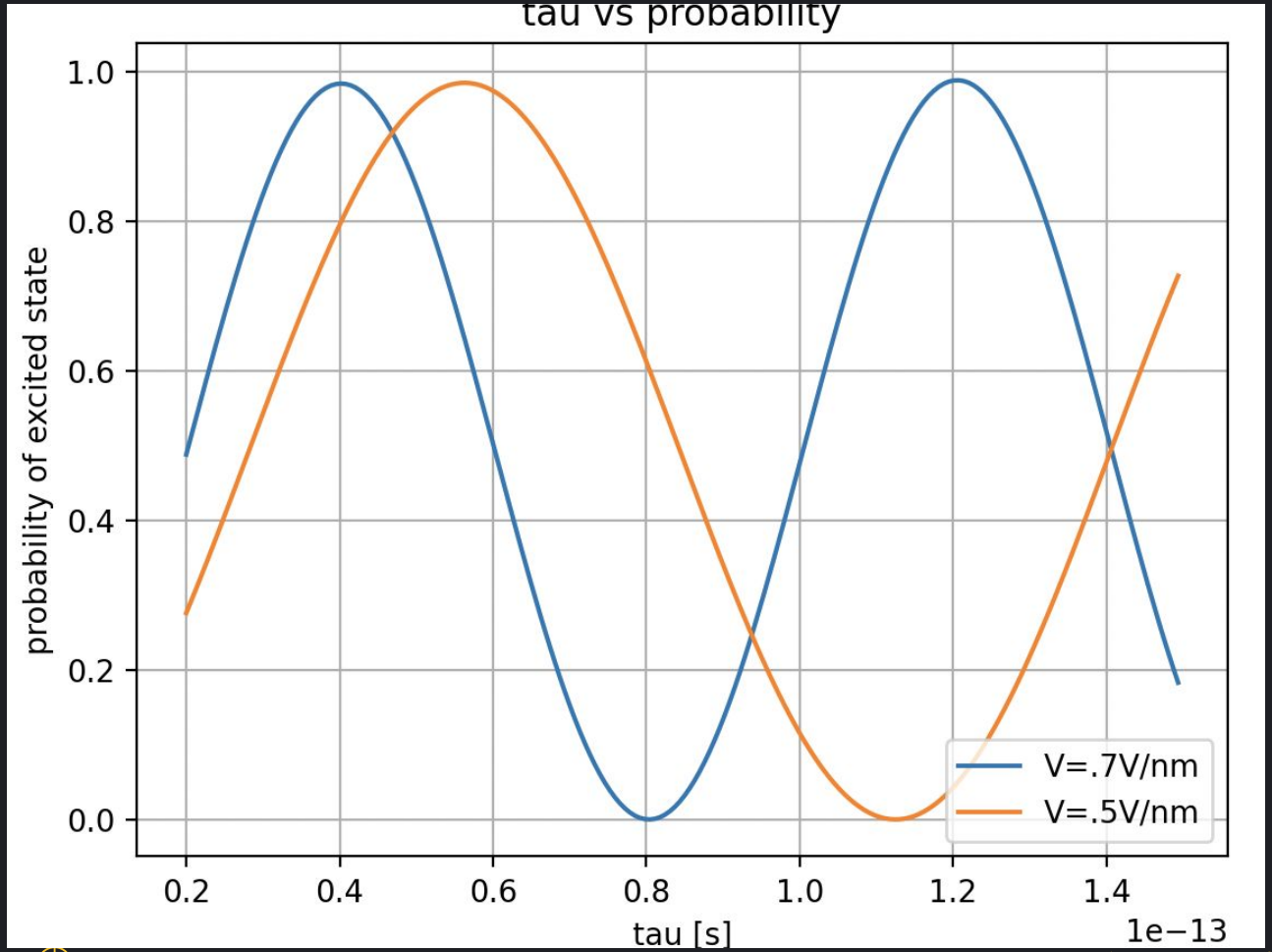

time vs vx
-1 at 90
-5 at 90
5 at 90
5 at 60
5 at 30
5 at 160
vx [m/s]
5
0
−5
−10
−15
0
2
4
6
8

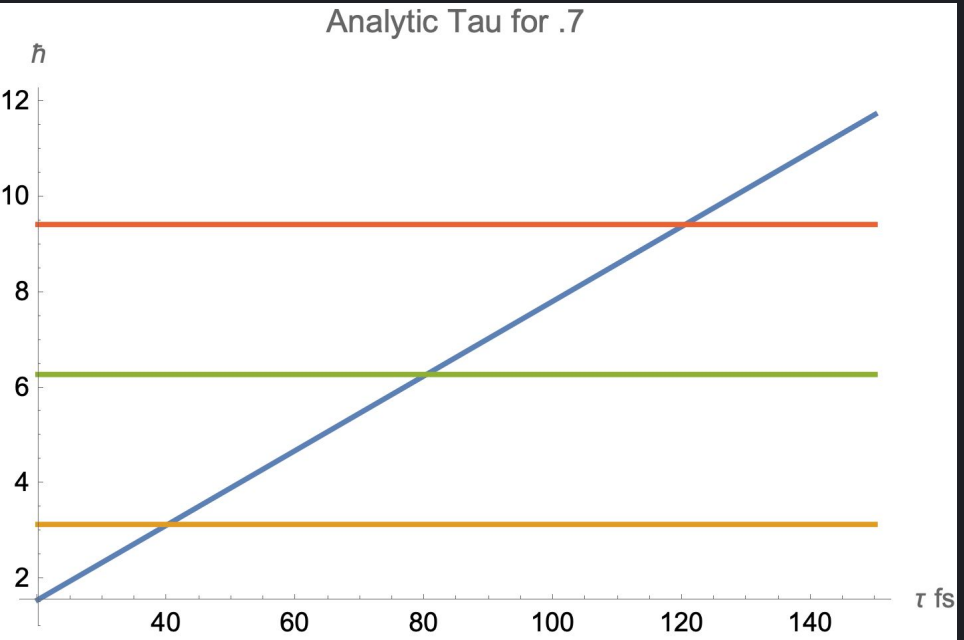

initial velocity at 90 degrees vs time of flight
time of flight [s]
9.00
8.75
8.50
8.25
8.00
7.75
7.50
7.25
7.00
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
initial velocity at 90 degrees [m/s]

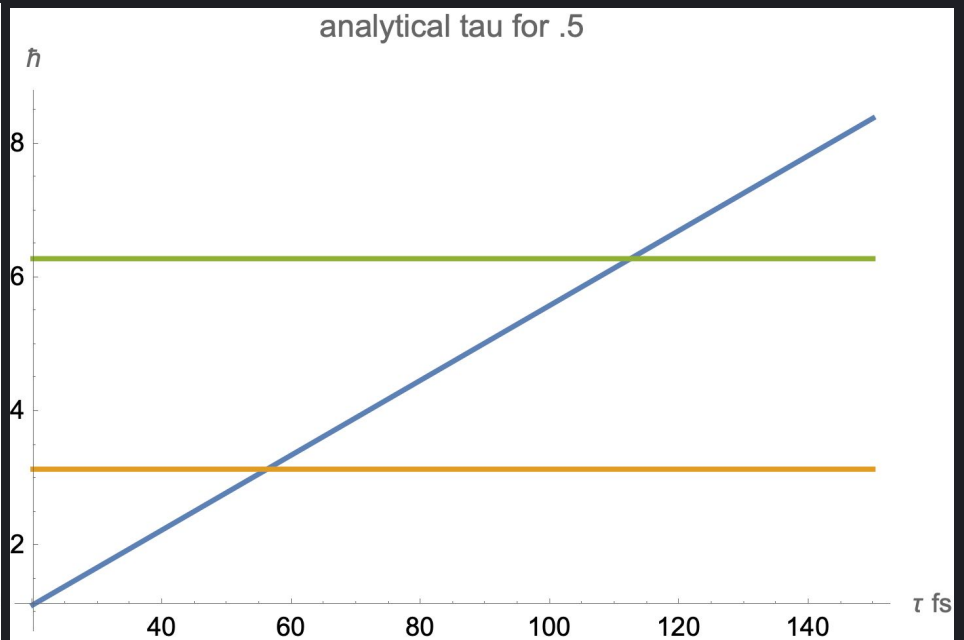


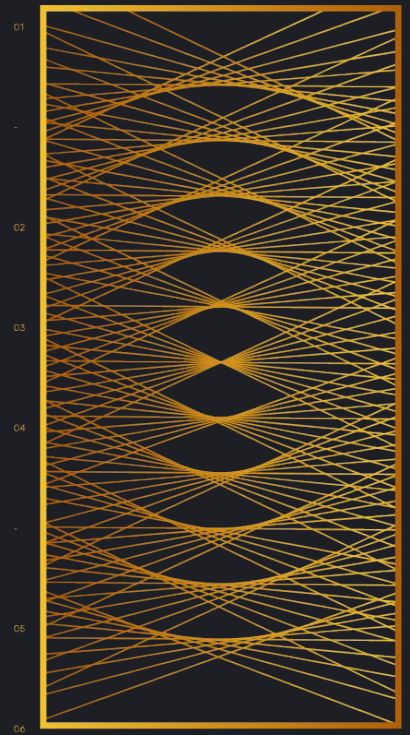
04

Varying Tau


tau vs probability
probability of excited state
1.0
0.8
0.6
0.4
0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
tau [s]
1e−13
V=.7V/nm
V=.5V/nm

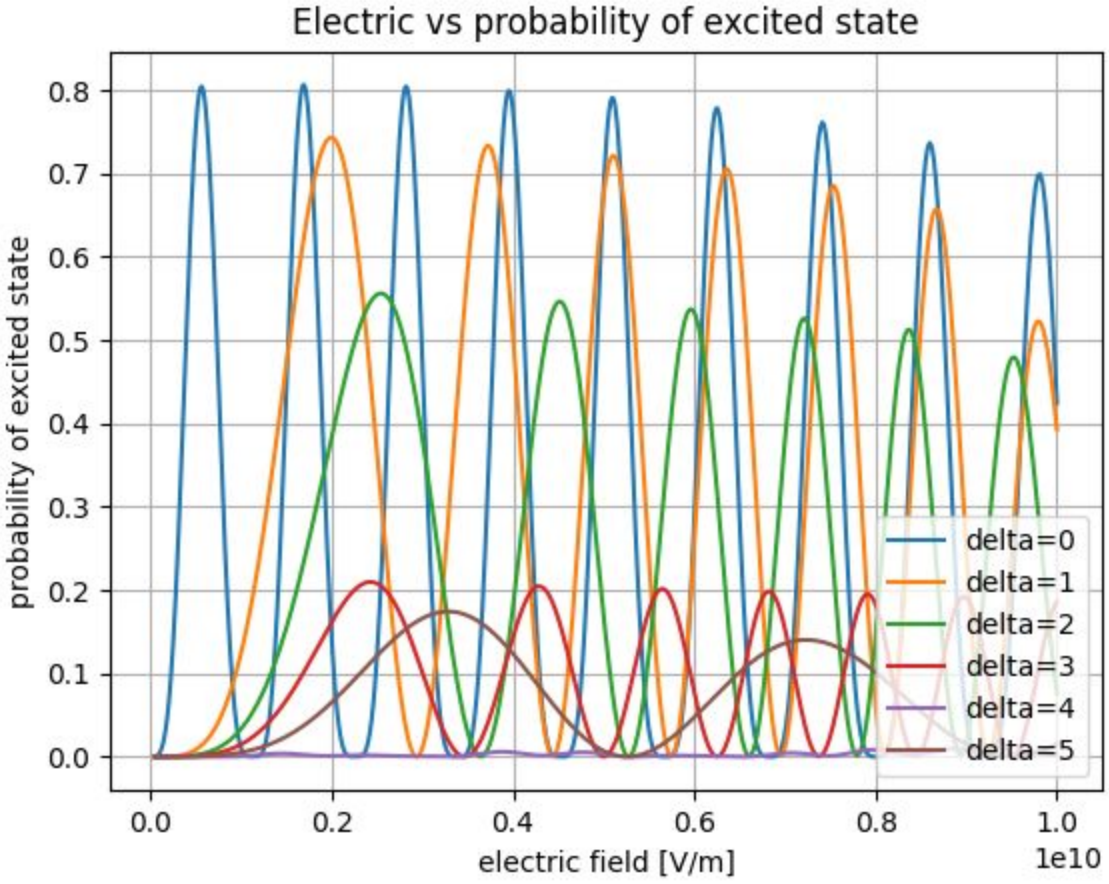

Analytic Tau for .7
ħ
12
10
8
6
4
2
40
60
80
100
120
140
τ fs

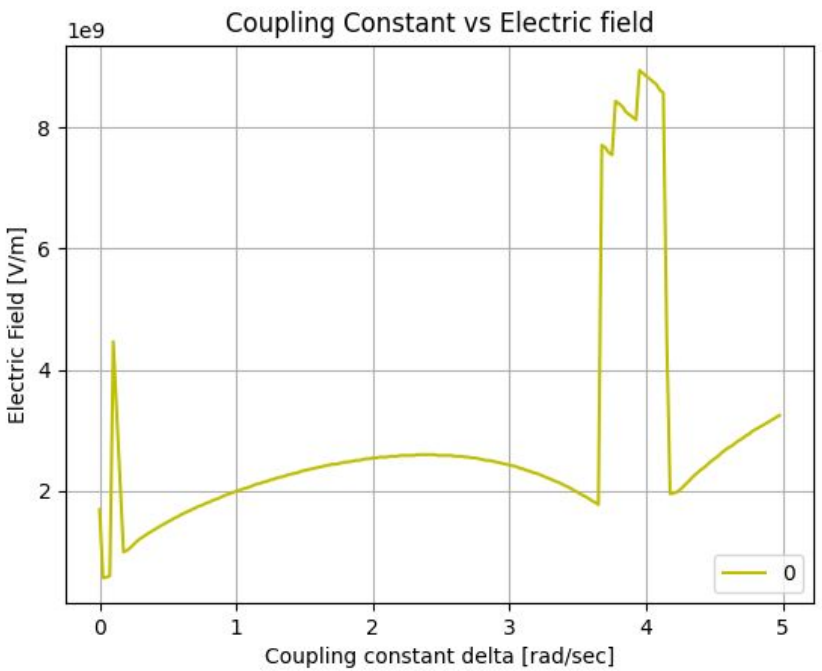

analytical tau for .5
ħ
8
6
4
2
40
60
80
100
120
140
τ fs

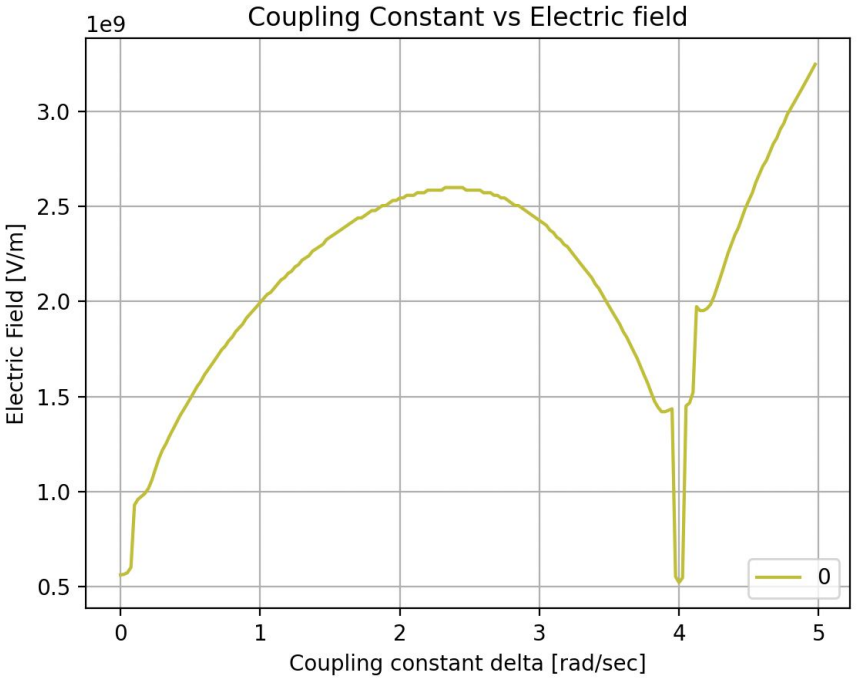


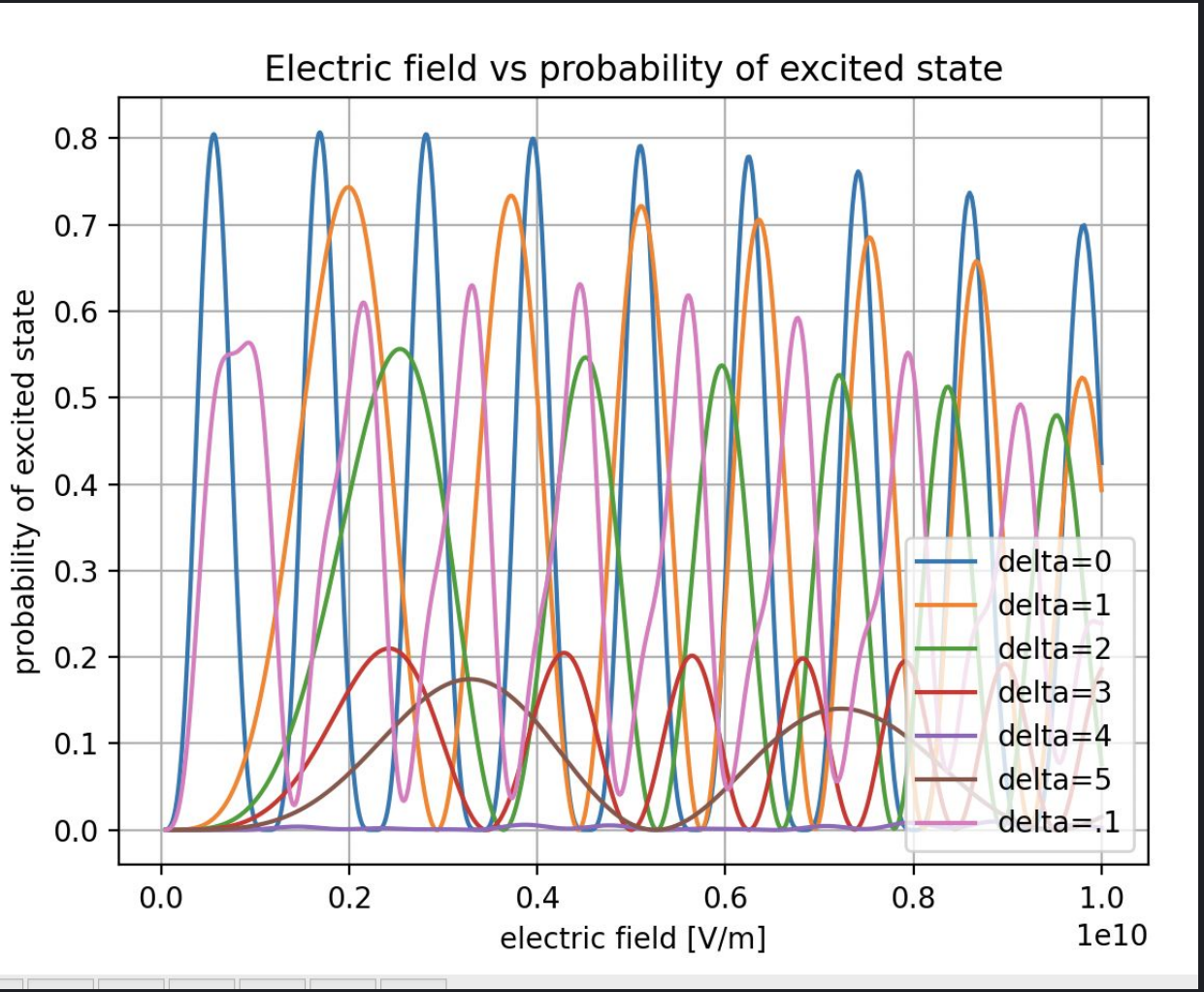
05

Unknown


Electric vs probability of excited state
probability of excited state
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.0
0.2
0.4
0.6
0.8
1.0
1e10
electric field [V/m]
delta=0
delta=1
delta=2
delta=3
delta=4
delta=5


Coupling Constant vs Electric field
1e9
Electric Field [V/m]
Coupling constant delta [rad/sec]
0


Coupling Constant vs Electric field
1e9
Electric Field [V/m]
Coupling constant delta [rad/sec]
0


Electric field vs probability of excited state
probability of excited state
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.0
0.2
0.4
0.6
0.8
1.0
1e10
electric field [V/m]
delta=0
delta=1
delta=2
delta=3
delta=4
delta=5
delta=.1