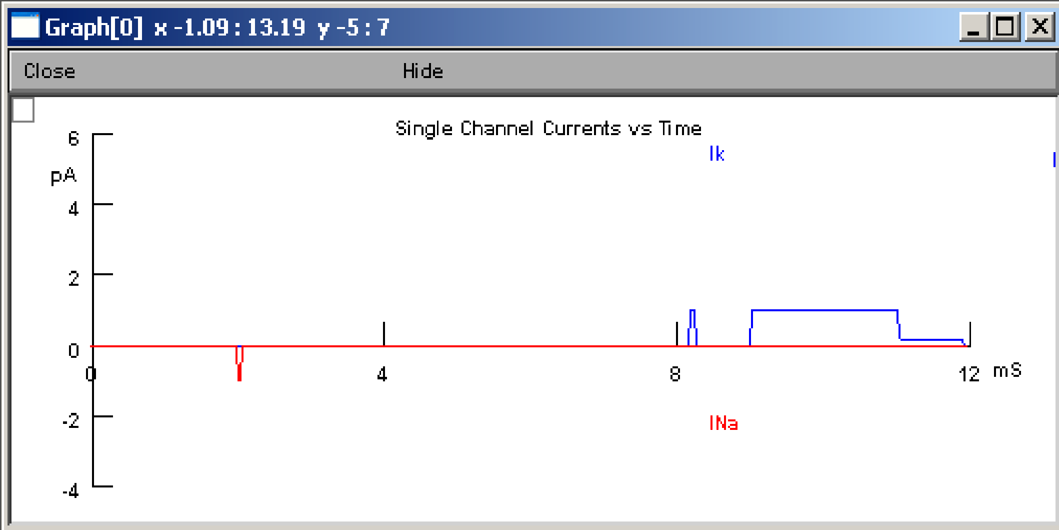
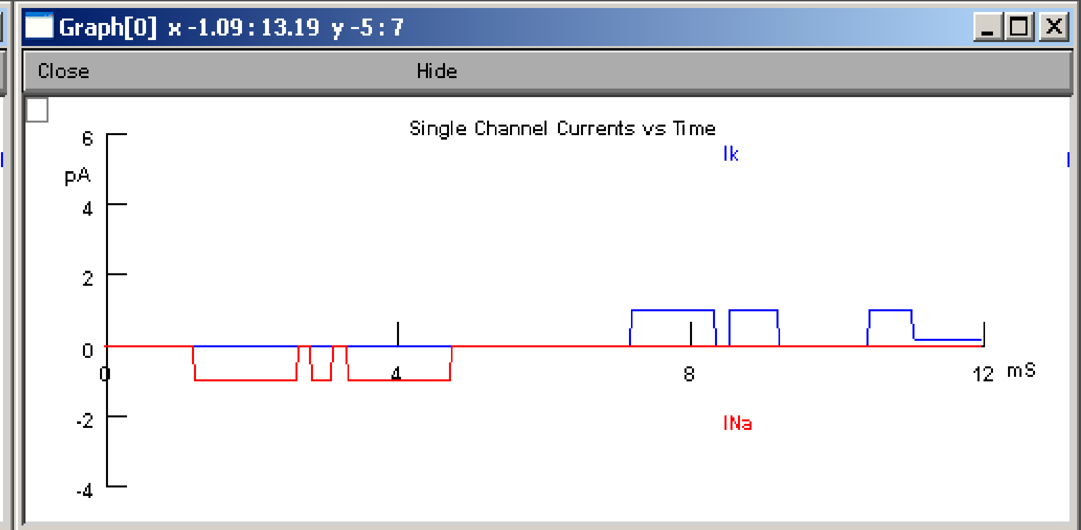
Lab 0

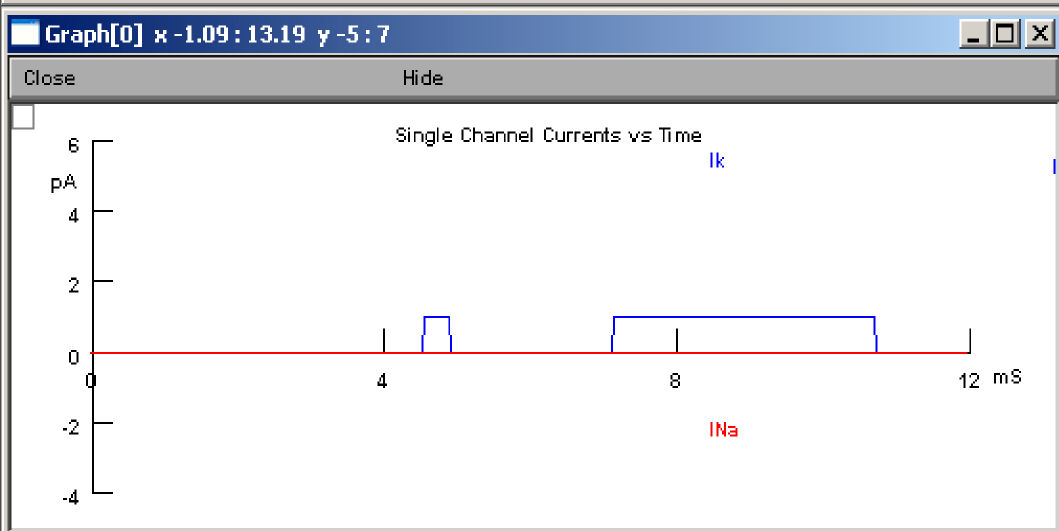
With Bonus?



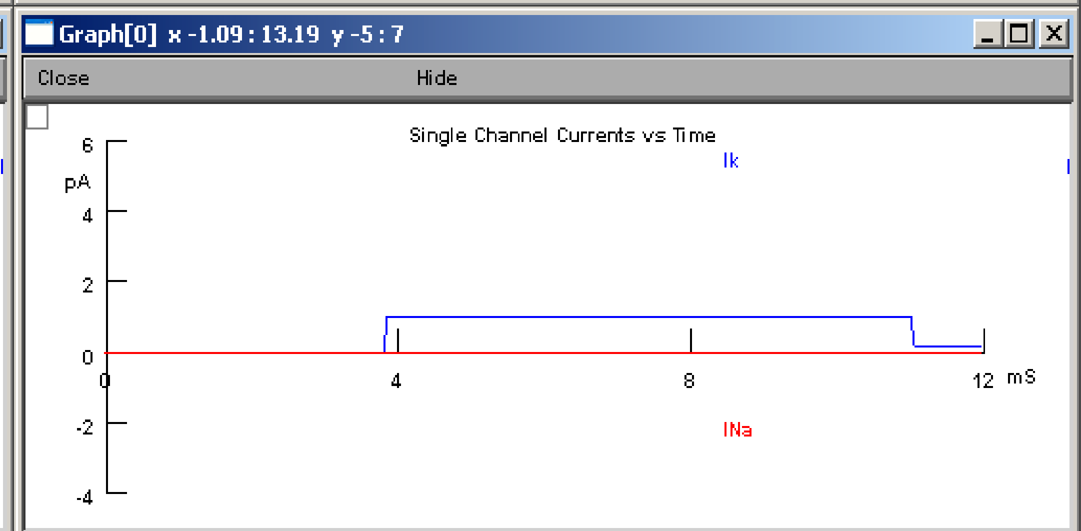
Graph[0] x -1.09 : 13.19 y -5 : 7
Close
Hide
Single Channel Currents vs Time
Ik
pA
6
4
2
0
-2
-4
0
4
8
12
mS
INa



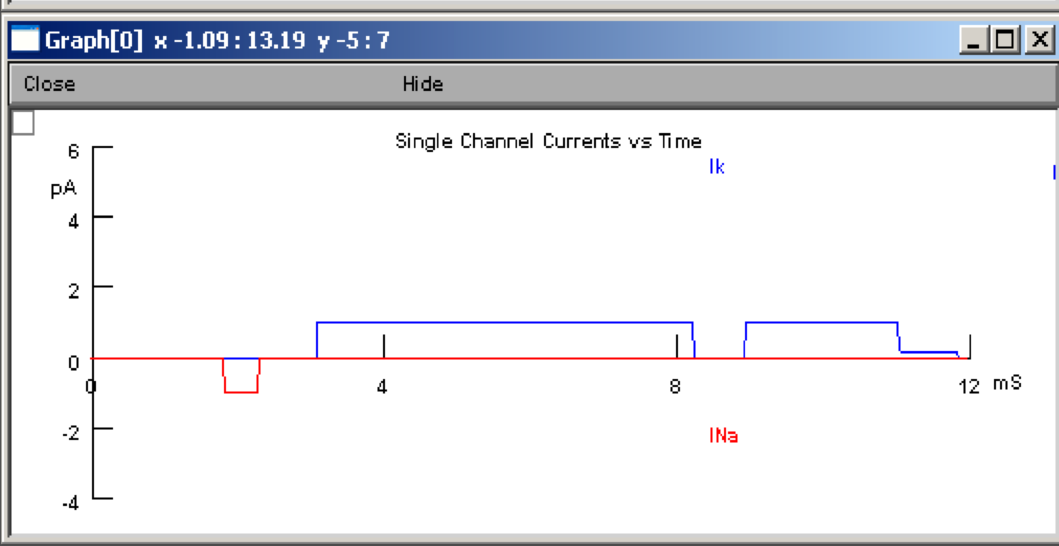
Graph[0] x -1.09 : 13.19 y -5 : 7
Close
Hide
Single Channel Currents vs Time
Ik
pA
6
4
2
0
-2
-4
0
4
8
12
mS
INa



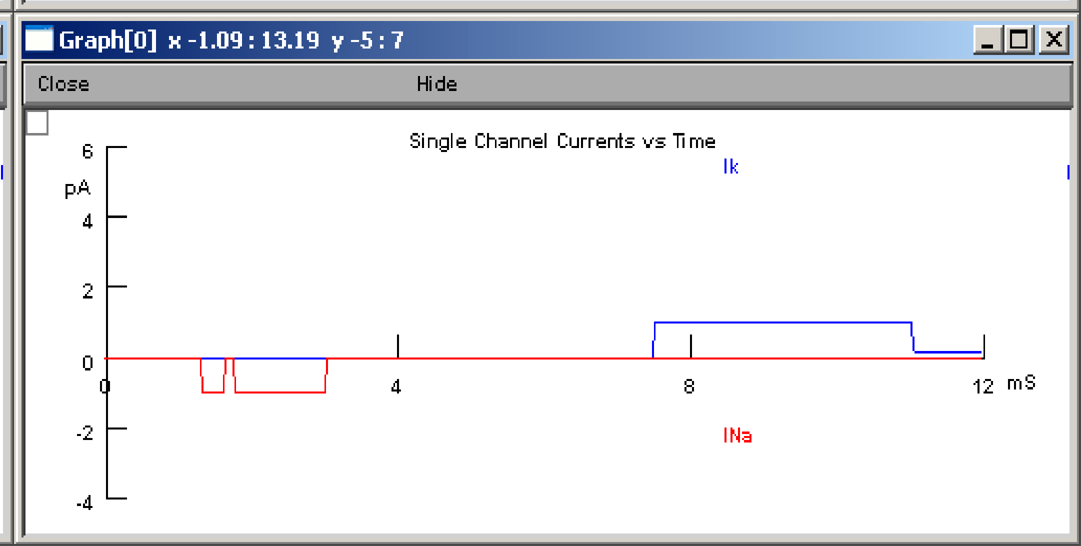
Graph[0] x -1.09 : 13.19 y -5 : 7
Close
Hide
Single Channel Currents vs Time
Ik
pA
6
4
2
0
-2
-4
0
4
8
12
mS
INa



Graph[0] x -1.09 : 13.19 y -5 : 7
Close
Hide
Single Channel Currents vs Time
Ik
pA
6
4
2
0
-2
-4
0
4
8
12
mS
INa

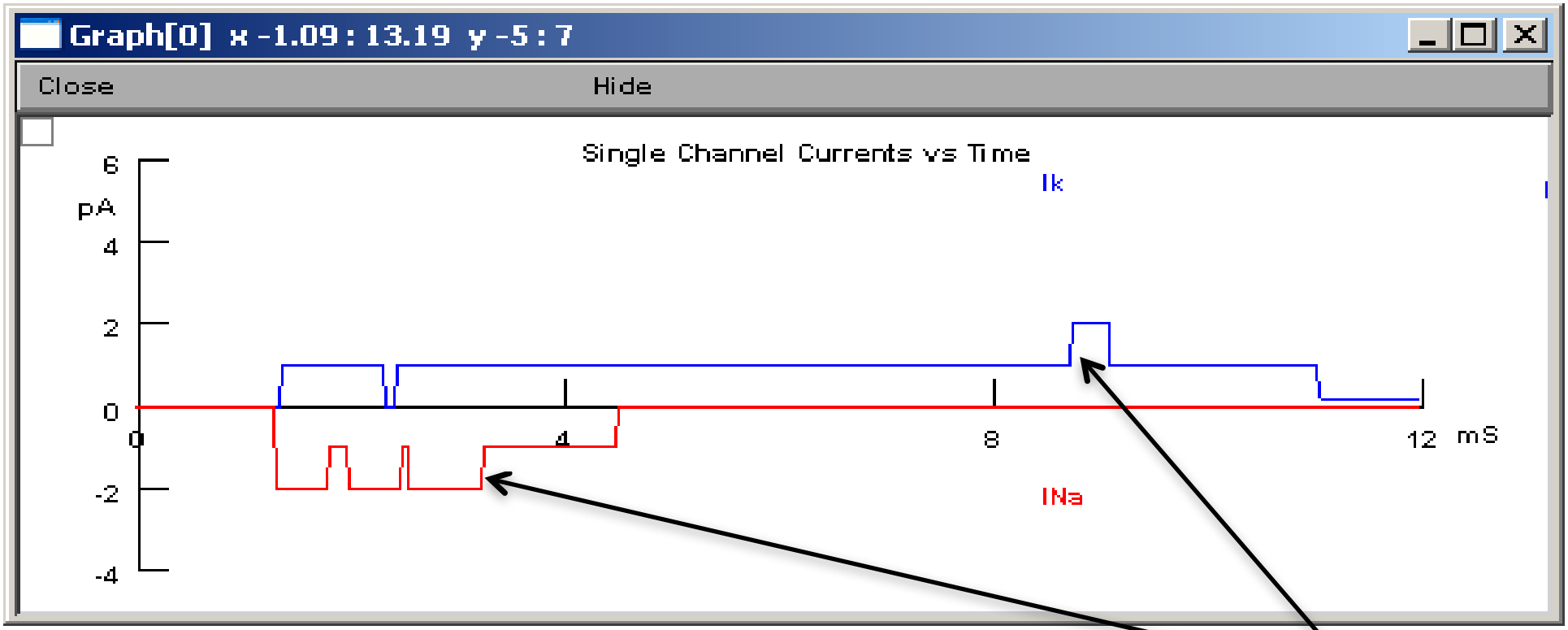


Graph[0] x -1.09 : 13.19 y -5 : 7
Close
Hide
Single Channel Currents vs Time
Ik
pA
6
4
2
0
-2
-4
0
4
8
12
mS
INa



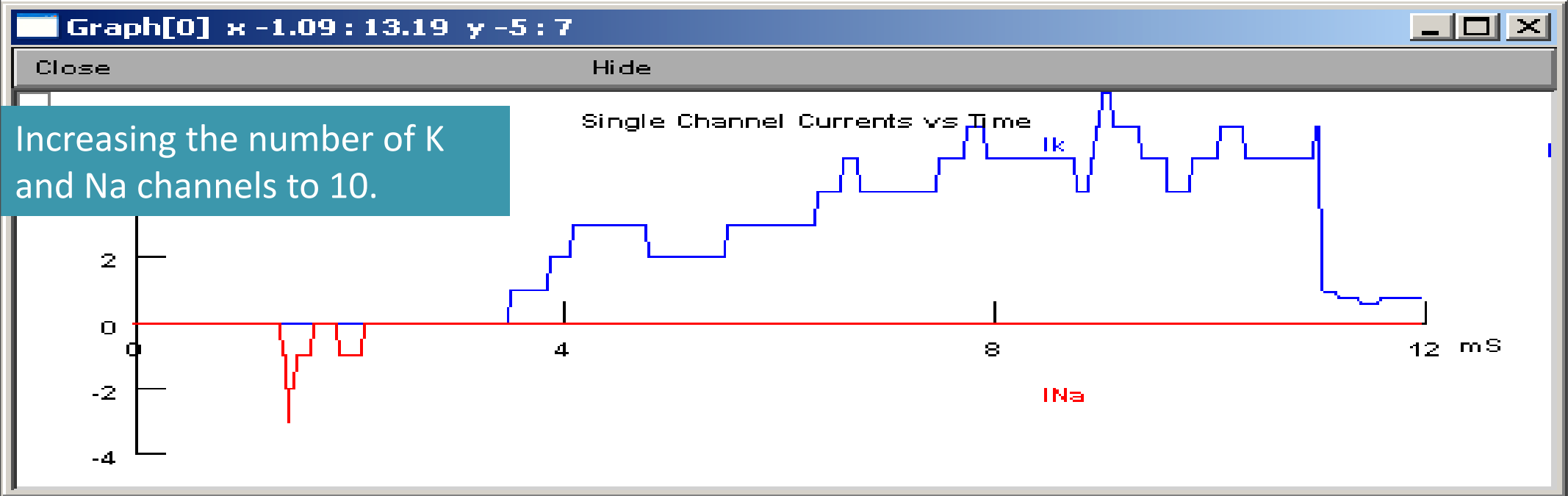
Graph[0] x -1.09 : 13.19 y -5 : 7
Close
Hide
Single Channel Currents vs Time
Ik
pA
6
4
2
0
-2
-4
0
4
8
12
mS
INa

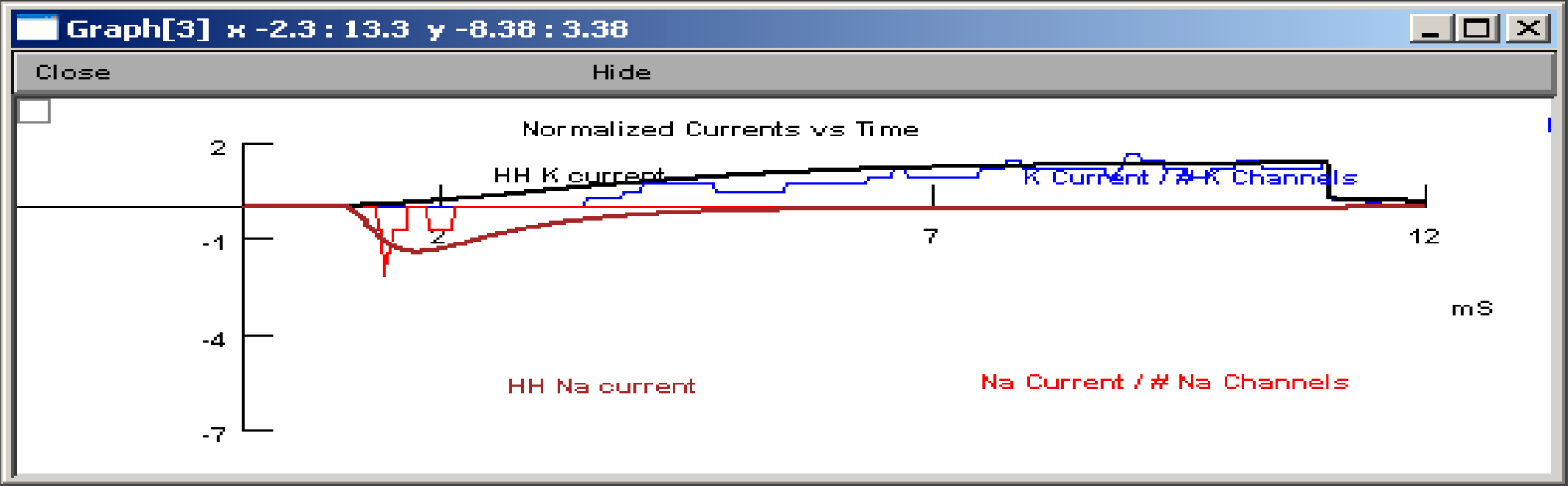
Observation 3

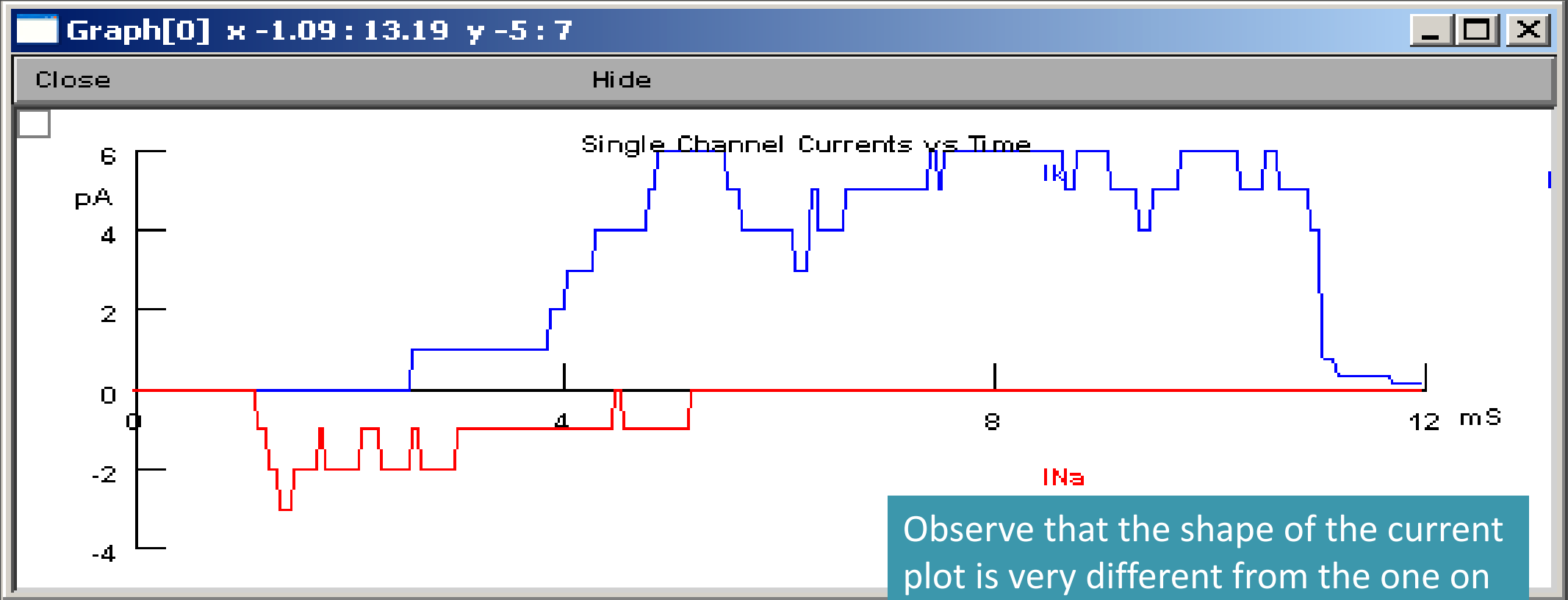


Increasing the number of K and Na channels to 2. We can see that the current doubles in magnitude at some points. These points indicate that both of the channels are open at the same time. The two channels opened but opened at different time so the effects of the current did not sum up. When they have currents in the magnitude equal to the original value, then it would indicate that only one channel is open.

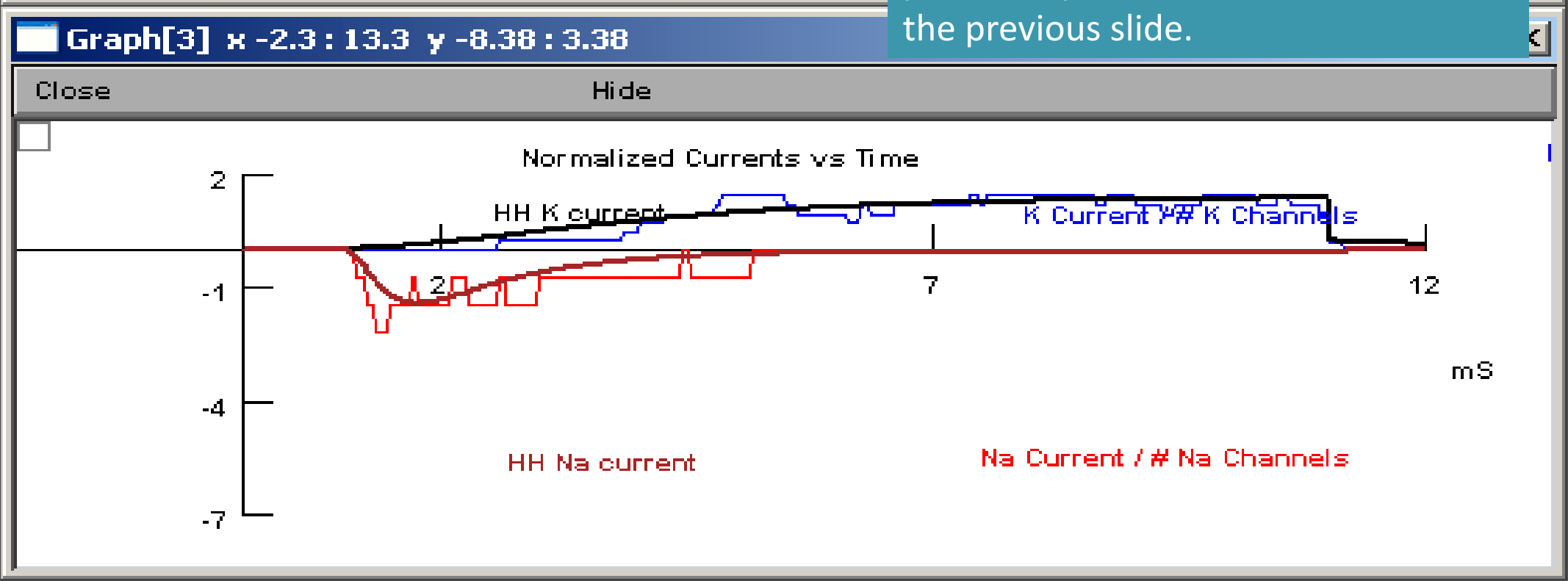
Observation 4

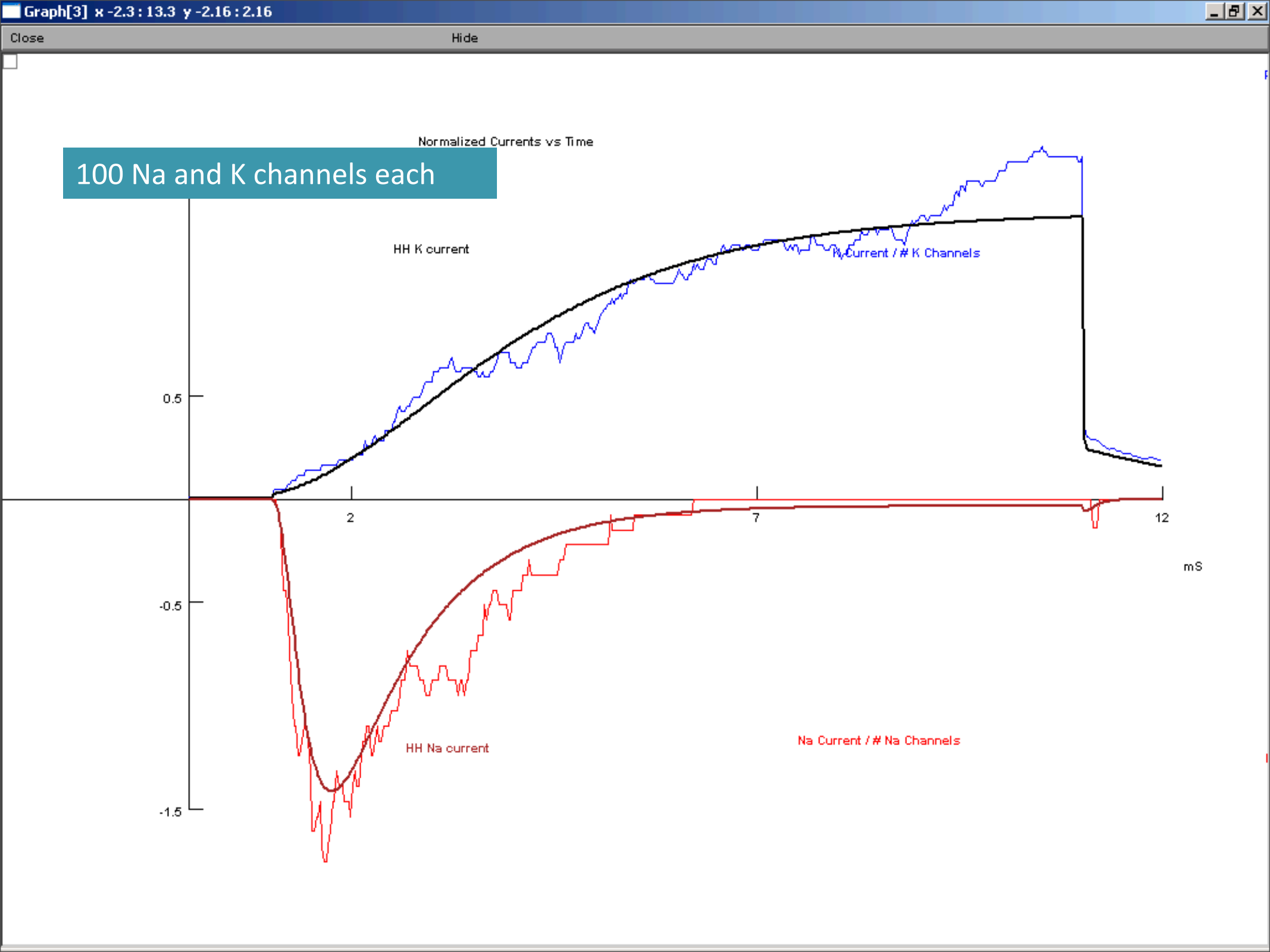


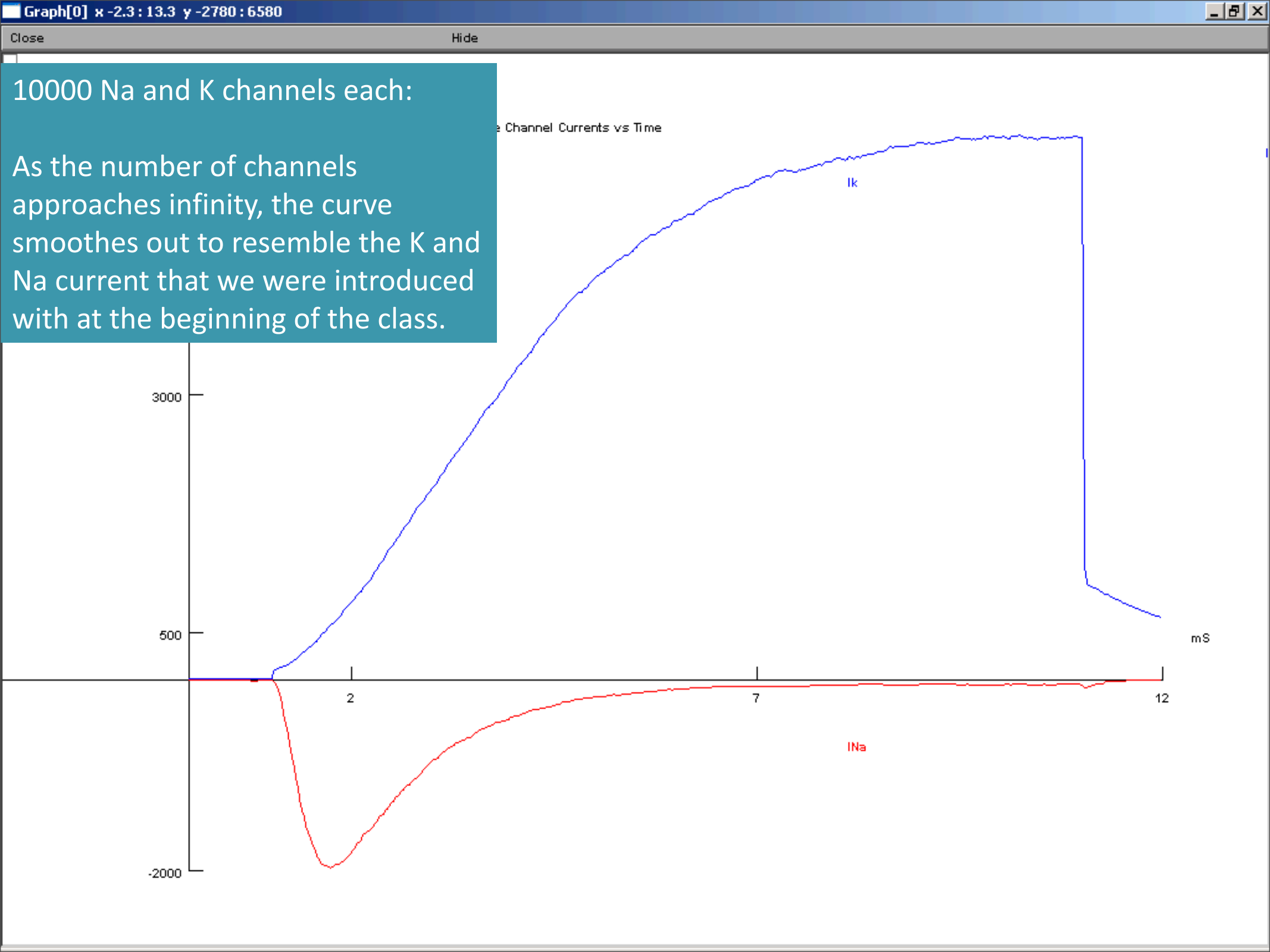


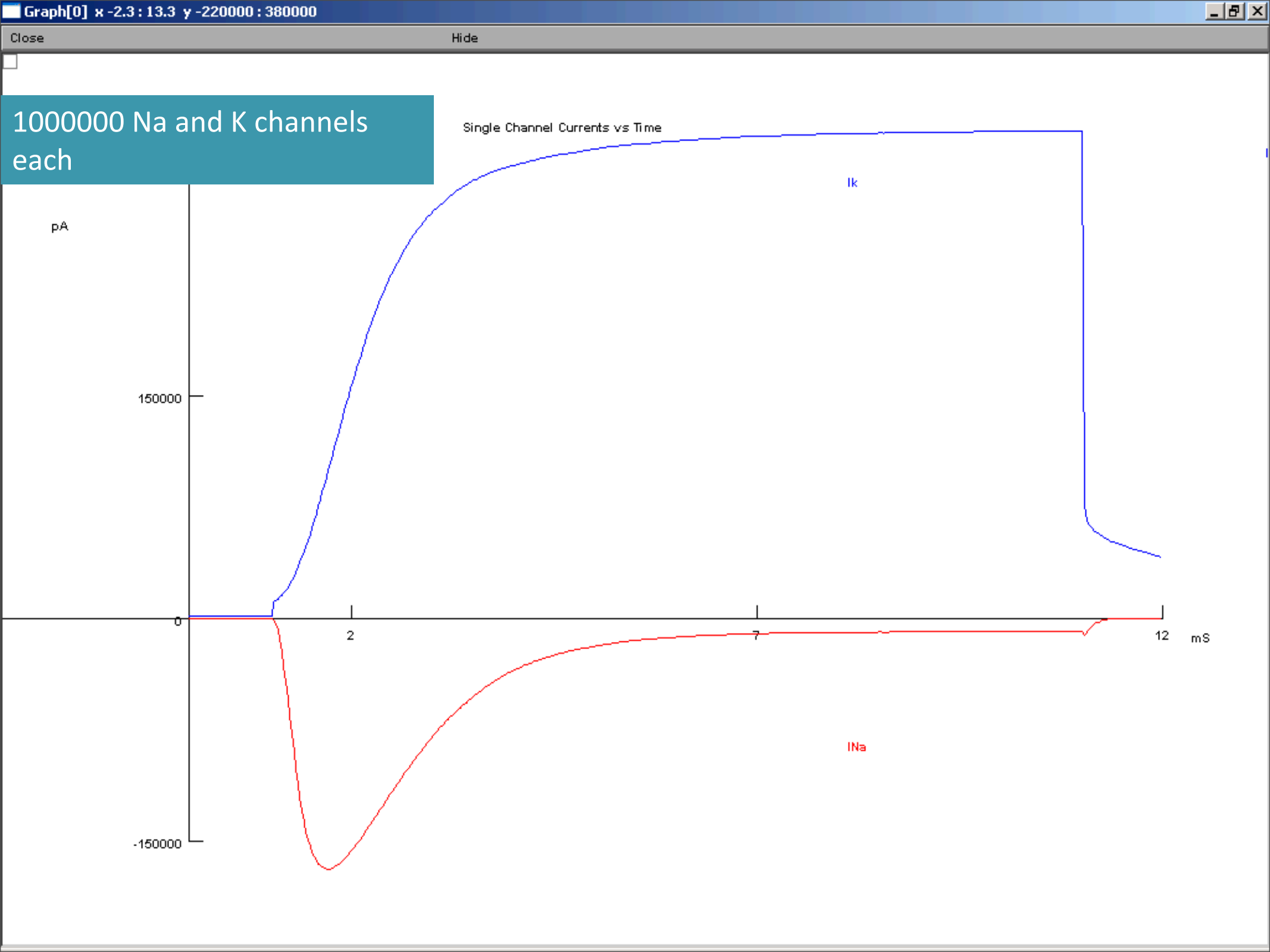


Observe that the shape of the current plot is very different from the one on the previous slide.




Graph[3] x -2.3 : 13.3 y -2.16 : 2.16
Close
Hide
100 Na and K channels each
Normalized Currents vs Time
HH K current
K Current / # K Channels
0.5
2
7
12
mS
-0.5
-1.5
HH Na current
Na Current / # Na Channels


Graph[0] x -2.3 : 13.3 y -2780 : 6580
Close
Hide
10000 Na and K channels each:
As the number of channels approaches infinity, the curve smoothes out to resemble the K and Na current that we were introduced with at the beginning of the class.
Channel Currents vs Time
Ik
3000
500
-2000
2
7
12
mS
INa


Graph[0] x -2.3 : 13.3 y -220000 : 380000
Close
Hide
1000000 Na and K channels each
Single Channel Currents vs Time
Ik
pA
150000
0
-150000
2
7
12
mS
INa

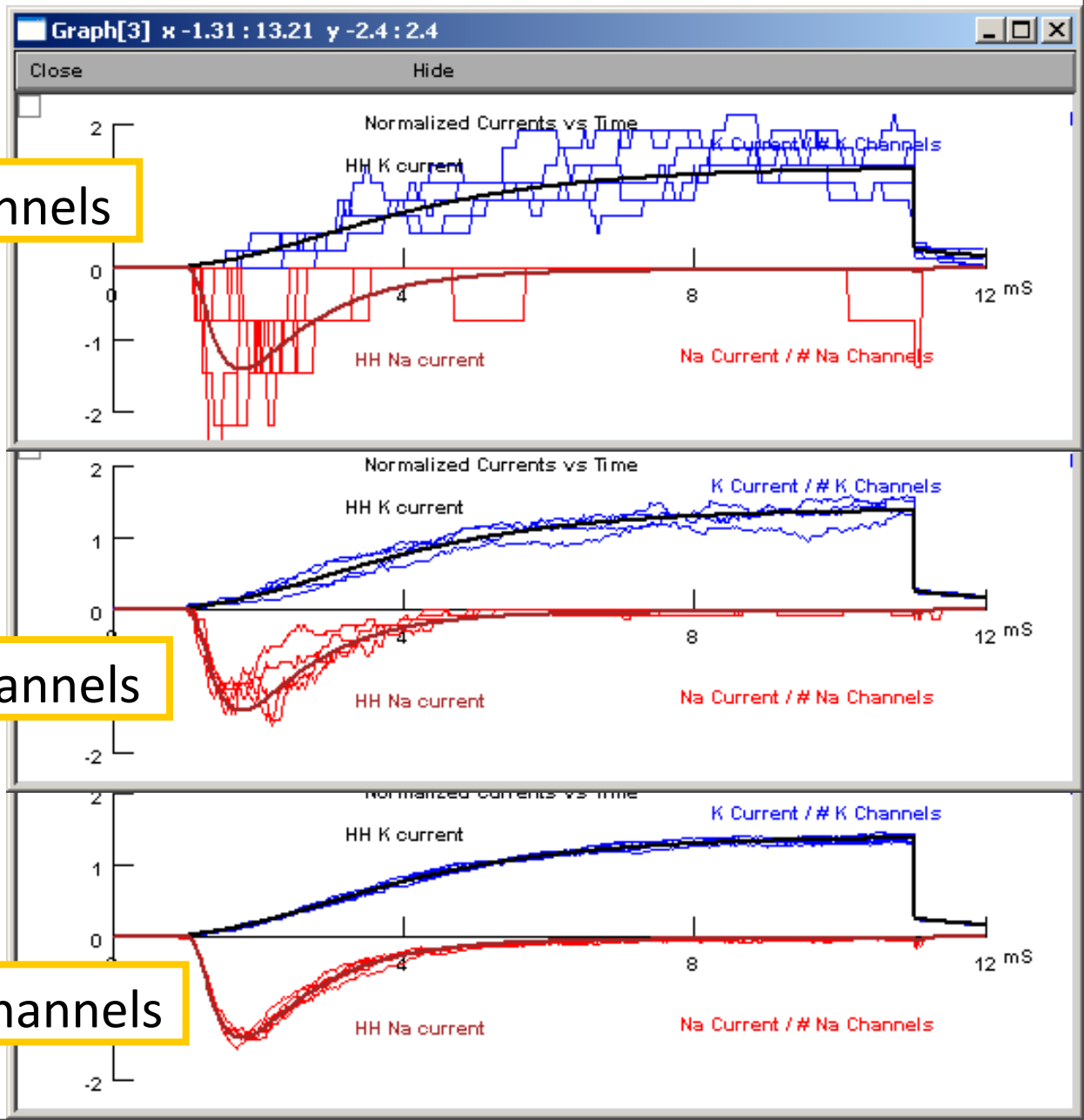
Normalized Current Plot

As the number of channels in the patch increases, the normalized currents begin to converge on the standard HH model currents for the given ion.

10 channels

100 channels

1000 channels



Bonus

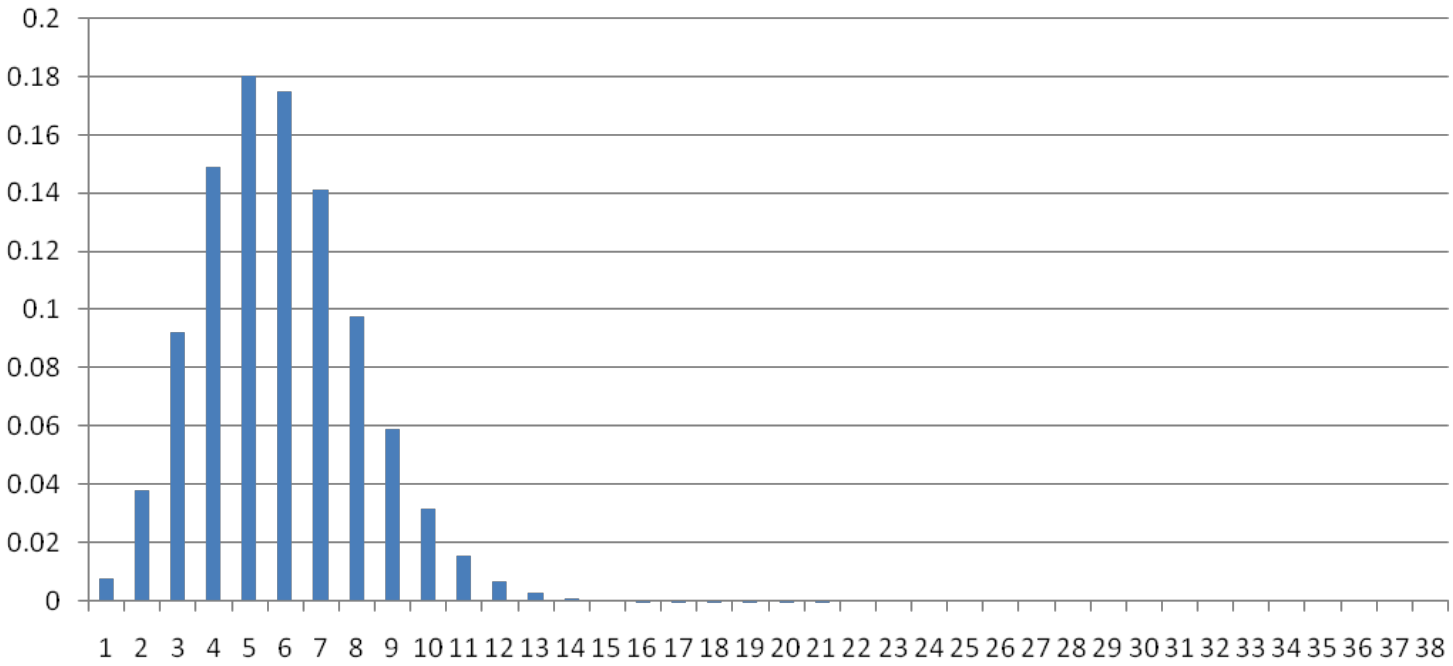
Here I will try to count the frequency of inward and outward rectifying channel opening with no voltage clamp applied and model each phenomena as a Poisson process by estimating parameter lambda from the observed data. Also, I will see if we can model the waiting time in between channel openings with an exponential distribution.

Data for the K^+ channel

Event #	Click #
1	9
2	32
3	48
4	66
5	78
6	109
7	116
8	124
9	146

$$P[(N(t+\tau)-N(t))=k]=\frac{e^{-\lambda\tau}(\lambda\tau)^k}{k!} \qquad k=0,1,\ldots,$$

Here we use the method of moments estimate of lambda tao which is simply the sample mean. We take the bin size to be 1 click. So then the sample average is 10/(172*12e-3) =4.845 seconds. This is pmf for the distribution of channel opening events in a one second interval based on the above data.



I have been working on the bifurcation diagram from the ghostburster paper. I am in the process of running the trajectories in reverse to get the unstable equilibrium points and complete the bifurcation diagram.

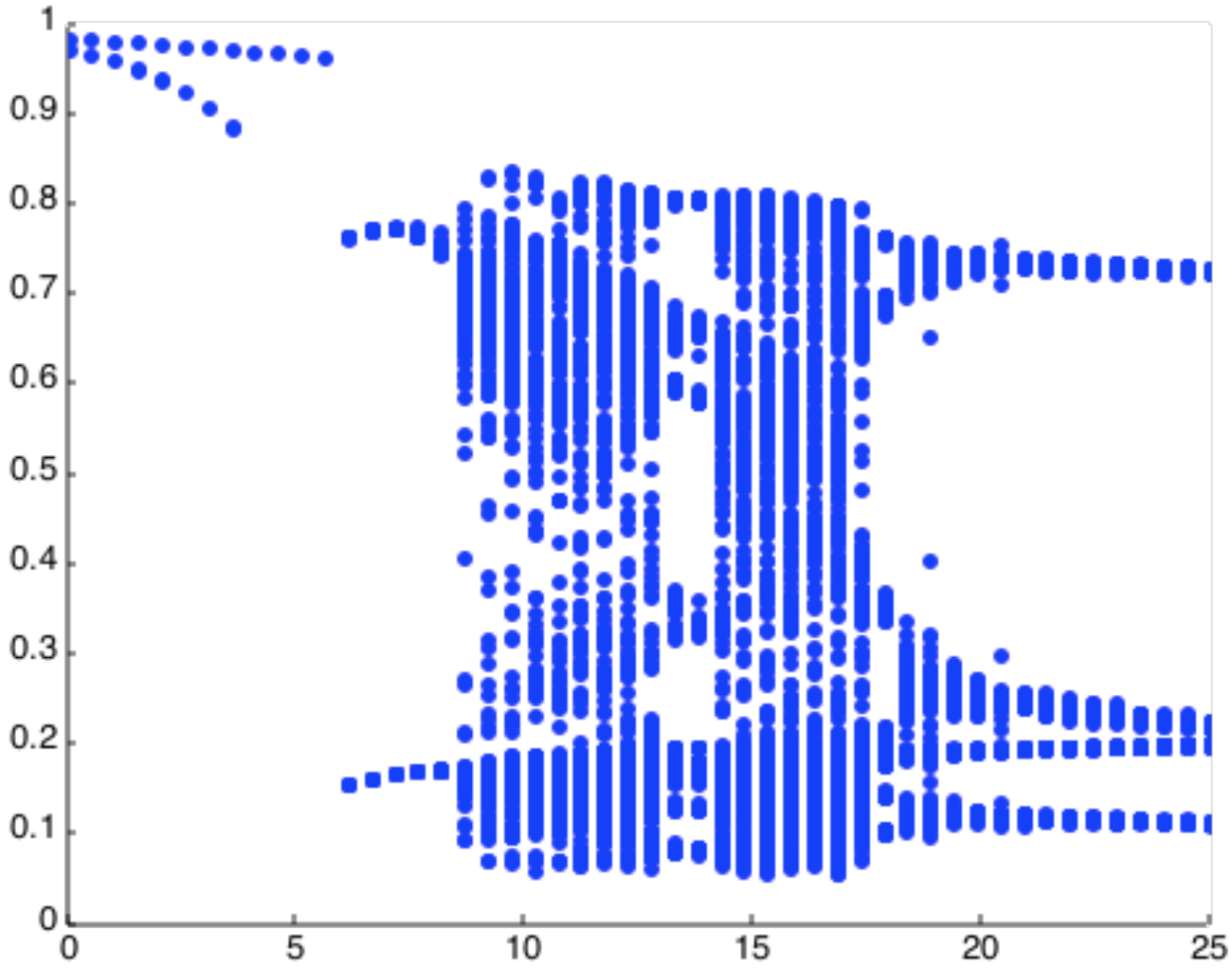


Figure from Paper