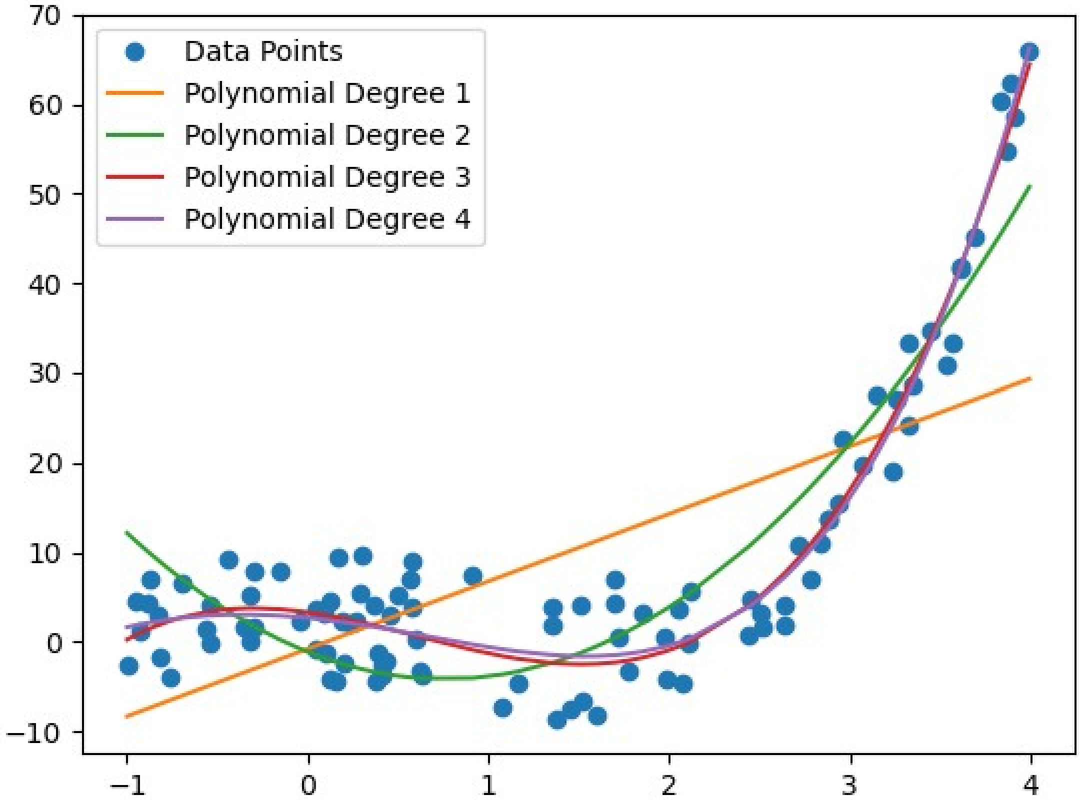
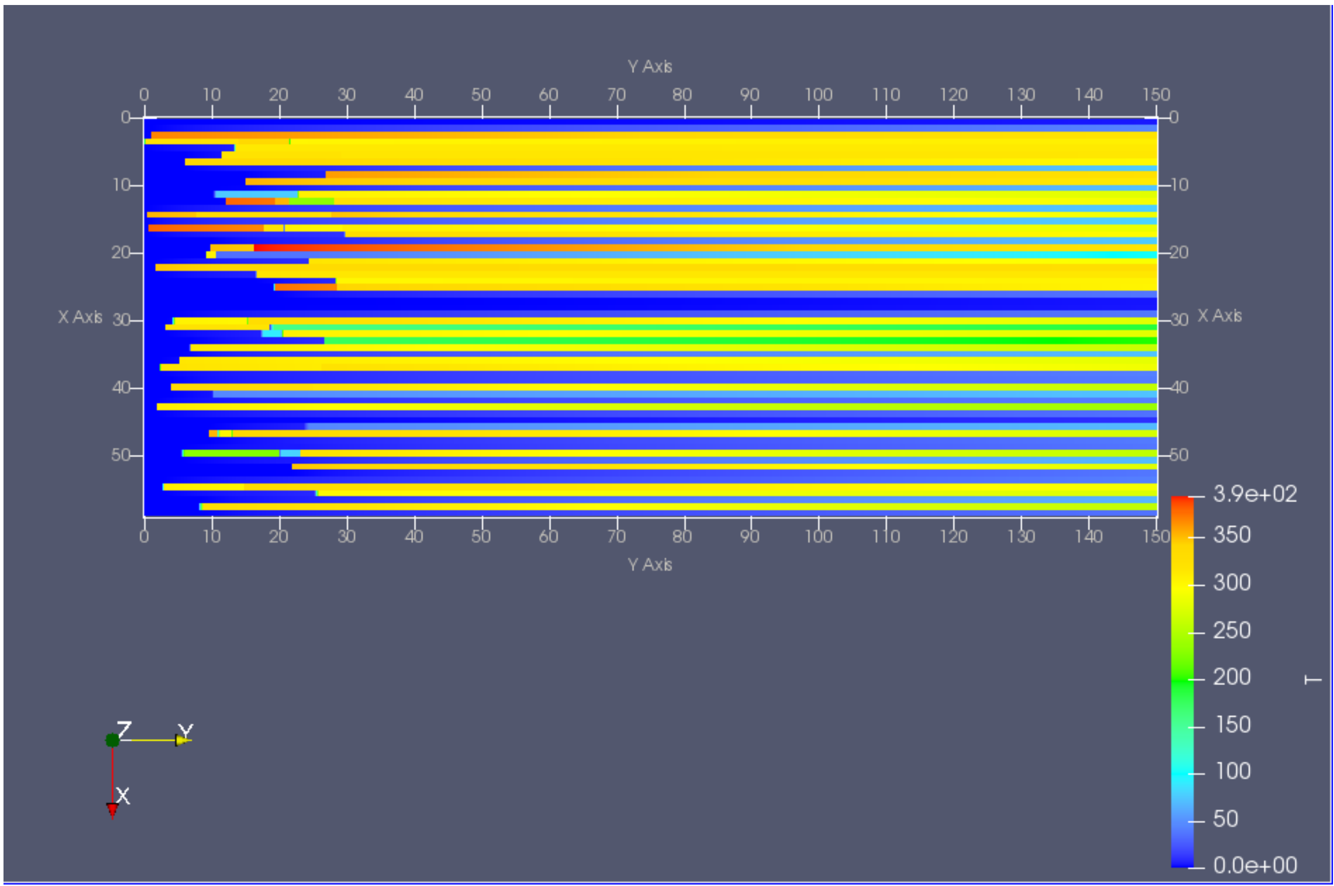
ASTE 404
HW8
Nikita Persikov

<u>Problem 1:</u>

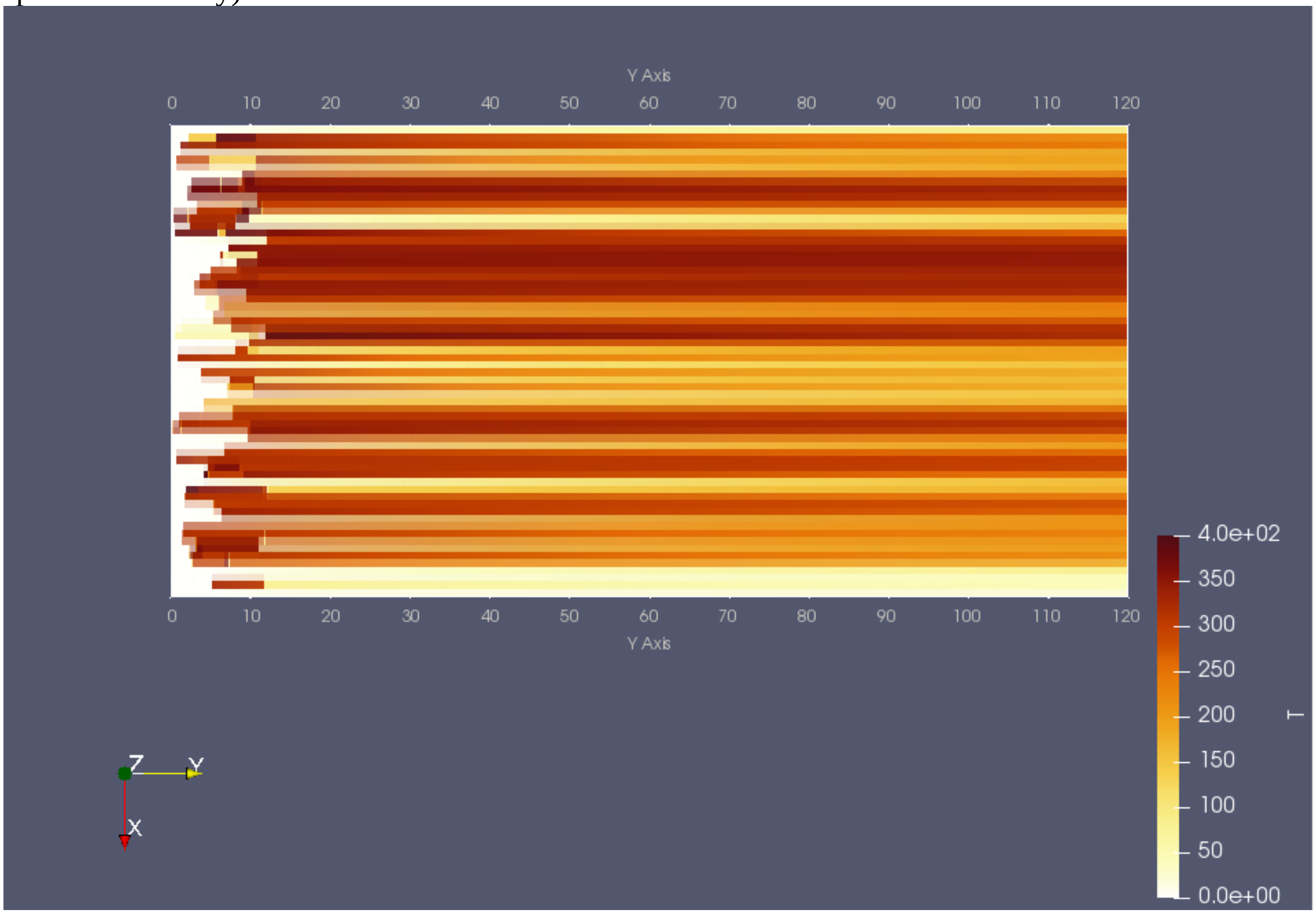


Problem 2:

This is a top view plot from Paraview (since C++ was used). I was not sure how to get a waterfall plot, but I made a few different variations. The longer axis is the time axis (in 100 time steps), and the short axis is the spacial axis.

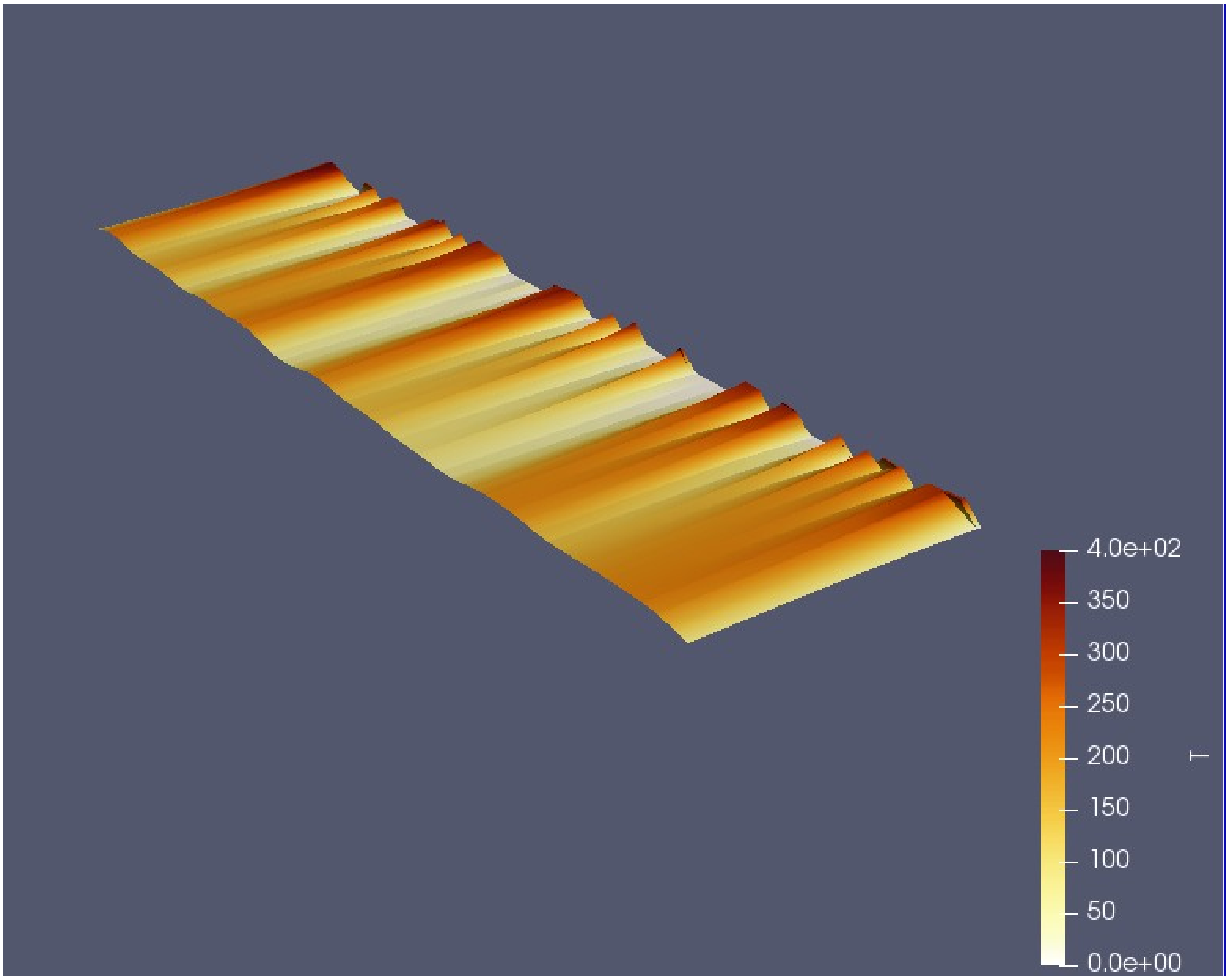


This is another graph of the same situation. It is run for twice as long but displayed with larger timesteps (thus the change in the numbers on the grid). The different color scheme makes it easier to see how each spot on the rod changed its temperature (such as when the color was constant/heating during a pulse, and how it started to move towards the cooler colors after the pulse was over (if no hot spots were nearby):

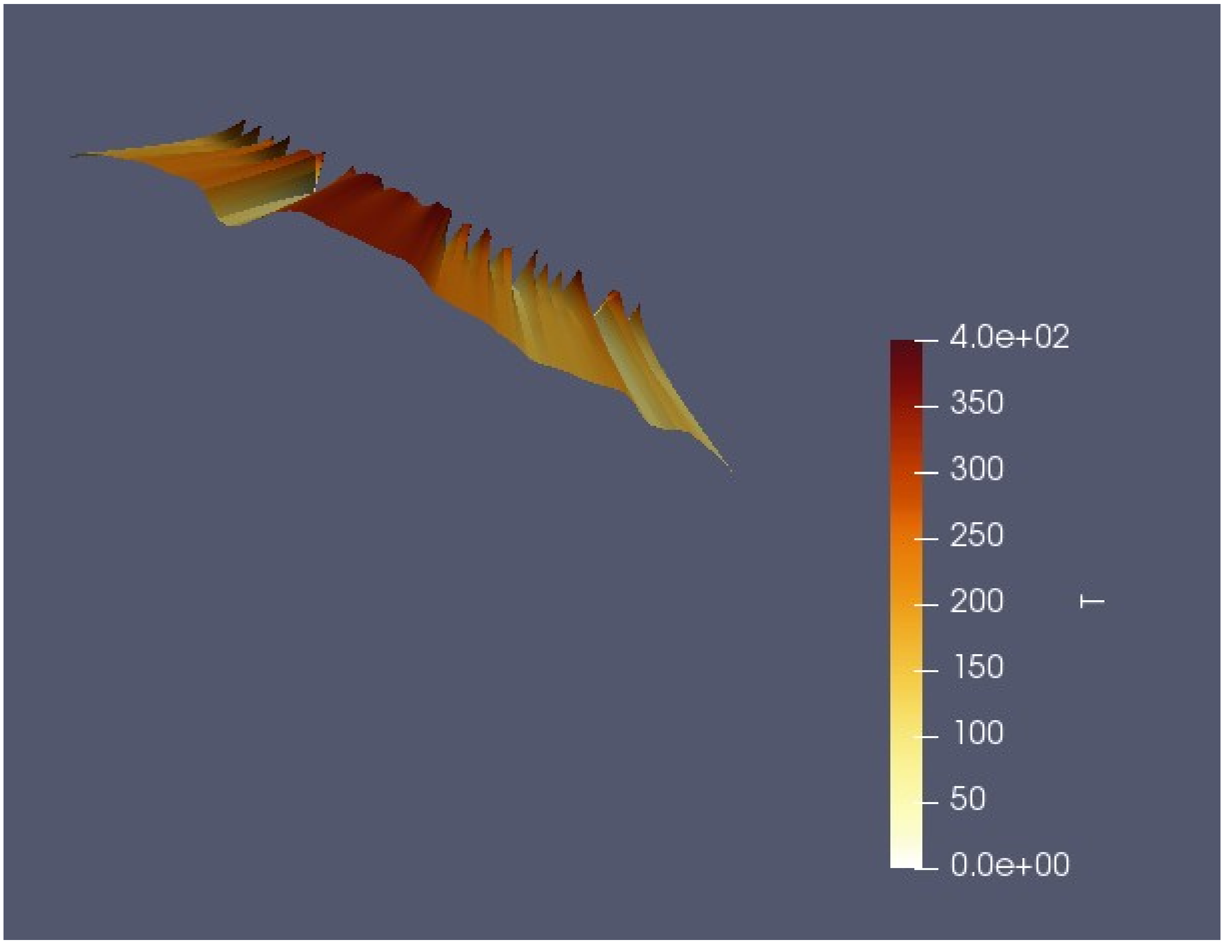


Some more graphs were generated with different plotting time intervals, Paraview filters, simulation times, and color schemes to show the effects of heat diffusion in various ways.

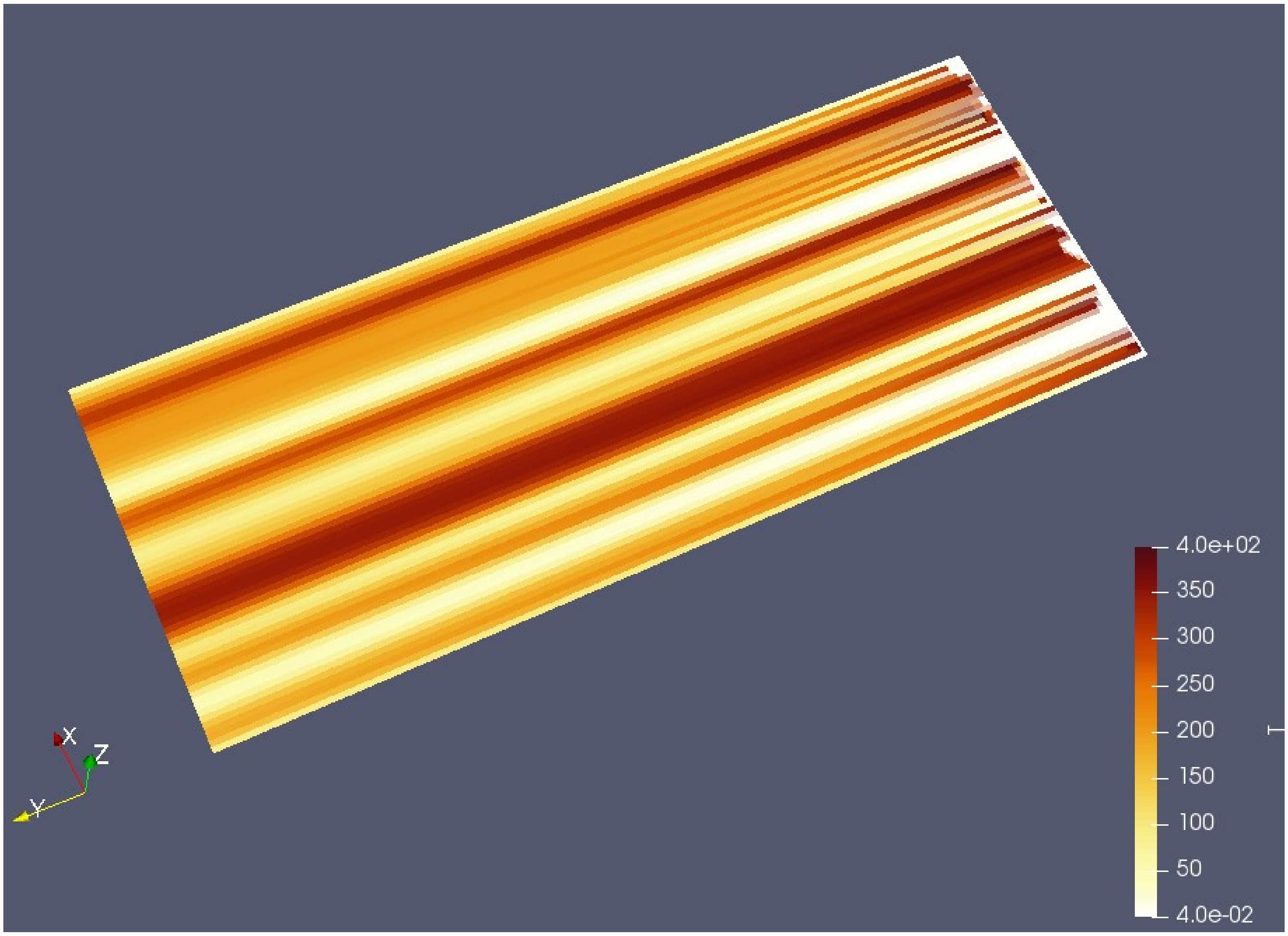
This graph shows how the pulses (dark orange colored areas in the early section before 3000 time steps) diffuse over time. The time axis was condensed so that the diffusion would be visible while keeping the plot small. The short side is the time axis. The long side on the right is time = 0.



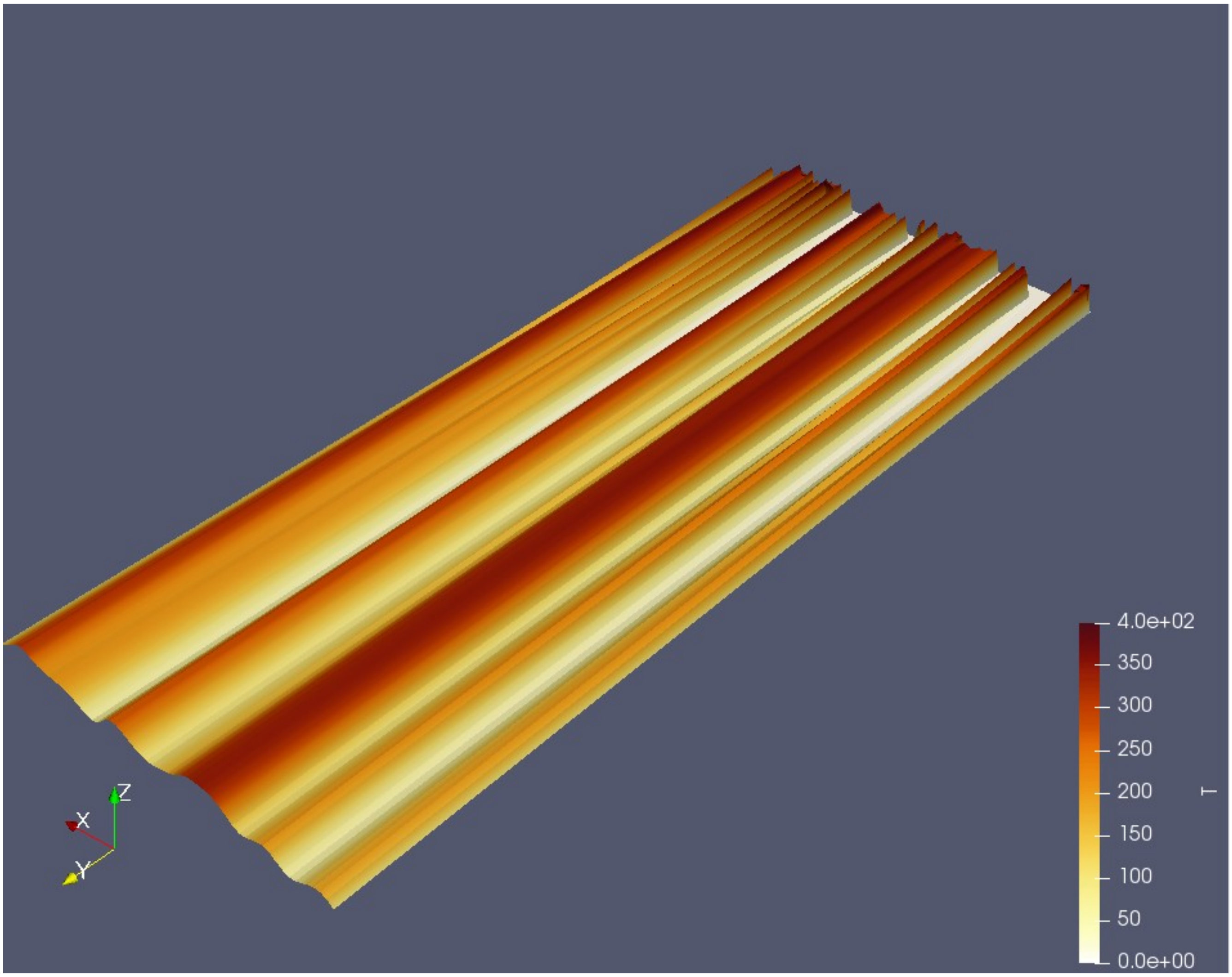
This lengthened plot shows how the sharp pulses slowly smooth out. It is rotated to a near-front view to show the smoothing over time.



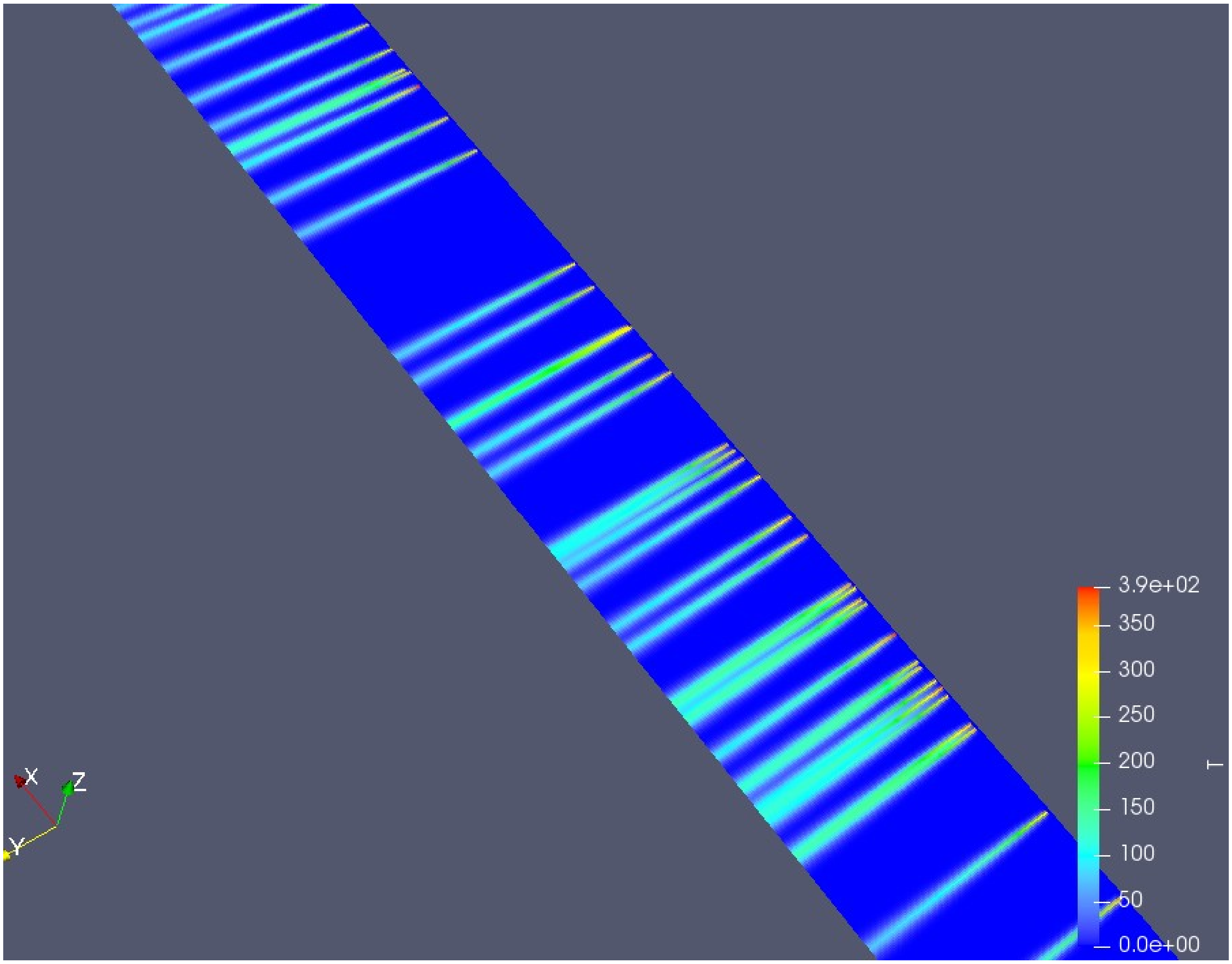
This is a 2D view of the diffusion of heat. The plot was lengthened by increasing the time dimension cell size. The side with the white (0 Kelvin) temperatures is when time = 0.



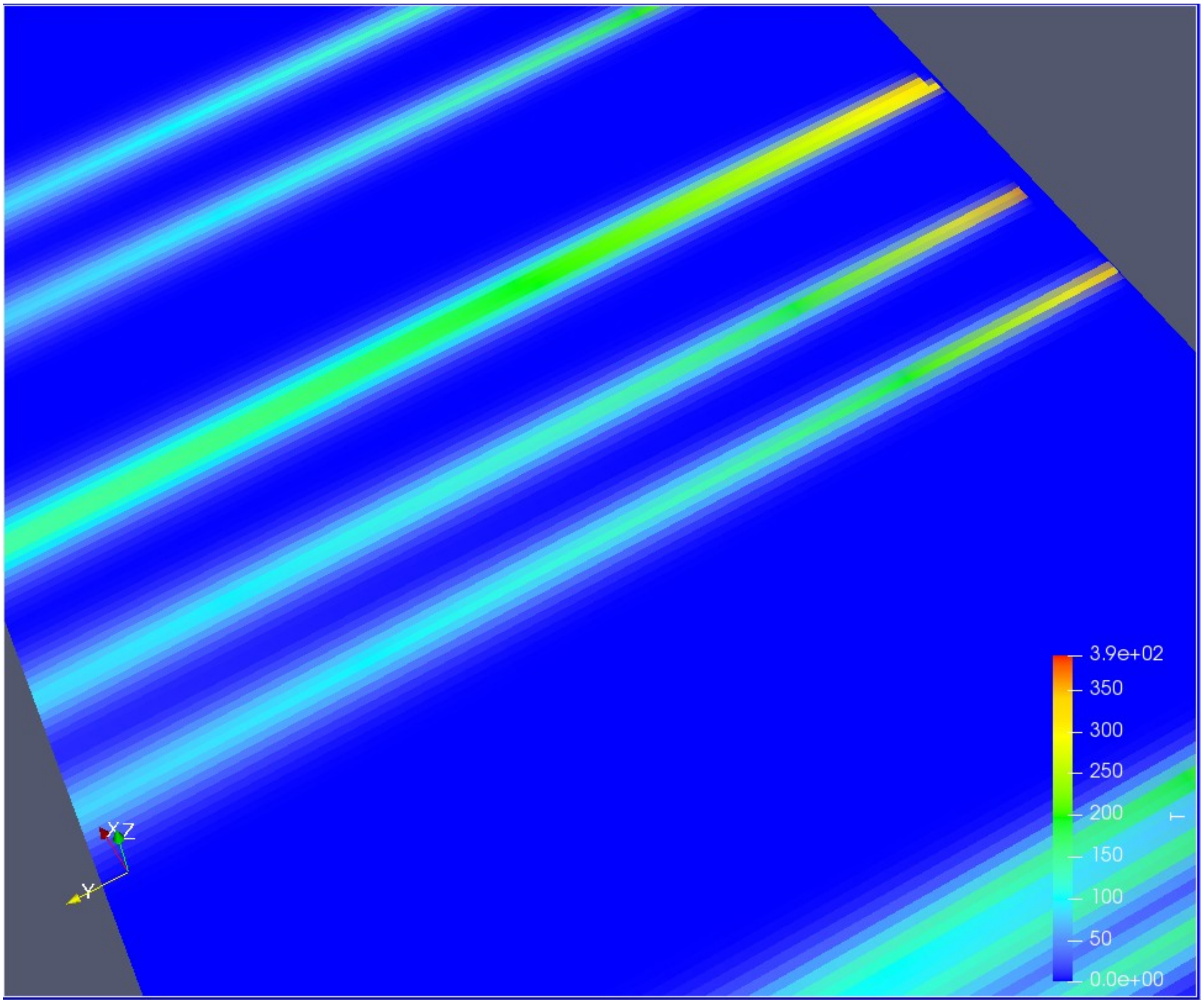
Isometric view. The longer side is the time axis. The short side in the top right is where t=0.



How the plot looks when spacing it out by 600 instead of 60. The color scheme was changed to compare to the example in the HW. Time = 0 at the long side on the right.



This is a zoomed-in view to show the discretized diffusion.



Clearly, these plots are not exactly the same as the waterfall plots in the example in the homework assignment. I think this is because the simulation in the example was run for a longer time (heat seems to be diffusing quickly), and because there were fewer pulses (while seemingly more spacial cells). However, the plots that my code generated still show diffusive behavior. For a long enough sim time, the rod tends to reach the same temperature throughout, so the heat behavior looks reasonable.

Problem 3:

Below are the plots of the LU and GS algorithm total solver time and iteration time, respectively. When running the two codes for ni = nj = 3, LU actually runs faster than GS. In all other cases, GS is faster.