David Hemlin

# Six Weeks Report

## Week One

### Monday, June 16

On Monday I arrived at the orientation given by Dr. Dubois, which lasted from 9:00 A.M to 5:00 P.M. Over the course of the orientation we discussed logistical details such as where to fill out our hours, where we were expected to report to in the mornings, and transportation arrangement. After the orientation I went to introduce myself to Dr. Chu, after which I was given a tour of the facility.

### Tuesday, June 17

On Tuesday I arrived at 8:30 A.M. to sign in and when I arrived at Lab I was introduced to Dr. Dharshana who discussed with me my prior knowledge regarding the subject of physics. Dr. Dharshana then introduced me to the project that I would begin working on which was to simulate how gold and silicon atoms interact and cluster at varying temperatures. The rest of the day I spent working on the model by laying down the framework for the program such as how the program defines atoms and the array on which the simulation would take place. After completing the framework I began to define the method that would allow for potential energy calculations.

### Wednesday, June 20

On Wednesday I finished the potential energy calculator, and after some debugging it was able to successfully identify the element of a target atom's neighbors and calculate a potential energy of the target atom based off these neighbors. Later I began work on a kinetics method which would take a target atom identify a random neighbor and run an algorithm to calculate the difference in potential energy if the target atom were switched in position with the neighbor. After calculating the difference in potential energies, the program would find if the kinetic energy of the atoms is large enough to make the switch. If they are, the program will switch them and redistribute the kinetic energy other wise it will do nothing.

### Thursday, June 21

On Thursday after arriving I was introduced to Dr. Buddhi, who explained to me what he was working on and showed me the gas cluster ion beam he has been using and explained how it worked. After Dr. Buddhi finished explaining his work to me, he gave me an assignment, which was to read about gas cluster ion beams. In the

following week Dr. Buddhi and I will discuss what I read and create a power point over the topic, after which we will run a small experiment. After reading about Gas Cluster Ion Beams, I went to work on the simulator and spent time fine tuning the kinetic energy transfer method and fixing bugs as well as implementing a color based graphic display representation of the atoms showing there position as the simulation ran.

Friday, June 22

On Friday I finished the kinetic energy method as well as fixing any remaining bugs in the simulation. I added some adjustments to the simulator to make changing variables quicker and easier without sacrificing the integrity of the program, after which I made some adjustments to the system to make it run smoother faster and potentially on a scale as high as a one hundred by one hundred grid of atoms. Dr. Dharshana indicated that he would like to introduce to the program a sort of heat sink so that we could increase kinetic energy at certain points and have it spread outward and eventually get absorbed by the heat sinks. Dr. Dharshana and I also discussed the possibility of implementing a graphical user interface to allow a user to manipulate the simulation as it was running.

## Week Two

Monday, June 23

On Monday I worked on implementing a heat sink into the simulation in order to drain or add heat into the sample in the simulation. After finishing the heat sink function I started to modify the kinetics method in order to take into account activation energy as a requirement to preform a switch between two atoms. Today I worked to make the simulation more efficient in order to run smoother and on a larger scale.

Tuesday, June 24

On Tuesday I finished creating a user interface, which can be employed to manipulate the simulation while it is running. After creating the U.I., I began to expand the model to three dimensions in order to make a more realistic simulation.

Wednesday, June 25

On Wednesday I worked on the simulation to try and create three-dimensional clusters of gold atoms. I began work on expanding the kinetics function to allow angular movement of atoms. In the afternoon I spoke to Dr. Buddhi and he told me

about his work with Gas Cluster Ion Beams, and he said that perhaps we could do a small experiment in the future.

Thursday, June 26

On Thursday I worked on debugging, and optimizing the simulation. I have also have begun on a second simulation on the subject of crystal growth on amorphous atom arrangements.

Friday, June 27

On Friday I finished debugging the gold cluster simulation and further worked on the crystal simulation. Today I was able to successfully build three-dimensional gold clusters on a twenty by twenty by twenty grid as well as implement a function that would allow the heat to spread through the model without requiring the atoms to move.

## Week Three

Monday, June 30

On Monday I continued my work on planning how to implement a way of multi-threading the three-dimensional diffusion model. I have a few ideas I plan to work on that show some promise in multi-threading the model. I was also able to fix some bugs I found in the crystal growth model. Among the adjustments I was able to make to the crystal growth model was the ability for atoms to have an adjustable range with which they can sense surrounding atoms alignments.

Tuesday, July 1

On Tuesday I spent much of my time modifying the crystal growth simulation to optimize its efficiency and in the process found and removed some bugs in the program. At lunch I attended a seminar over cosmology with Dr. Dubois and the other Quark Net participants. In the afternoon I worked to try and create a more efficient color gradient for the crystal growth simulation.

Wednesday, July 2

On Wednesday I finished the method that would allow atoms to sense the alignment of their neighbors over an adjustable range. Later I started learning the fundamentals of vector algebra so that I could write programs with three dimensional programing.

Thursday, June 3

On Thursday I finished a tutorial about vector algebra and matrix data manipulation and have found it most enlightening. I have made some slight adjustments to some code in the simulations and after which I have made some advancements into a method that will hopefully allow for multi-threading of the diffusion model on an adjustable scale. Today I started some work on a program that will hopefully allow me to adjust matrices in ways that will eventually allow me to create three dimensional graphics.

## Week Four

Monday, June 7

On Monday I finished a method which would allow me to add, subtract, and multiply matrices. I also implemented a method which would allow me to manipulate matrices with scalars. I also started work on a graphical interface, which would provide a place to begin work on three-dimensional graphics coding.

Tuesday, July 8

On Tuesday I finished the graphical interface for the three-dimensional graphics program, after which I attended a lunchtime seminar on the topic of superconductivity. I began work on a coordinate system to graph points with which I could create shapes in three dimensions.

Wednesday, July 9

On Wednesday, I worked to debug the three-dimensional graphics program. After debugging and over lunch I read some articles on the topic of artificial neural networking in C++ and ways of implementing it into software in an attempt to familiarize myself with both. After lunch I left at 12:50 to take my driving test.

Thursday, July 10

On Thursday I was able to implement methods, which would extend the three-dimensional graphics program to allow the creation of three-dimensional graphics. Later I implemented methods, which would allow me to have limited control of perspective with which I would be able to view the three-dimensional objects from varying angles and depths. I was able to animate three dimensional objects to allow them to transition on X, Y, and Z axis.

Friday, July 11

On Friday I was able to complete the methods necessary to rotate three-dimensional objects on one or more axis while allowing them to move along one or more axis. After I debugged the three-dimensional program, using what I learned, I was able to update the visual interface of the diffusion simulation to scale the model to the window in order to avoid wasting space.

## Week Five

Monday, June 14

On Monday I observed an experiment which Iram conducted, and afterwards I started work on my ending presentation. I completed the outline of the presentation in PowerPoint and have started adding and editing it. In the afternoon I started working to learning the programing language C#.

Tuesday, July 15

On Tuesday I worked on my presentation all morning. At lunch I attended a seminar with the Quarknet group on the topic of Solar cells. After the seminar I resumed my work on the presentation and later went on to work with C#.

Wednesday, July 16

On Wednesday I started collecting screenshots for the presentation and later finished the PowerPoint and resumed my work with C#. I wrote many simple programs which demonstrate many of the core concepts of the language.

Thursday, July 17

On Thursday in the mourning finished putting the finishing touches on my PowerPoint finalizing it. In the afternoon I worked on Visual studios with C# and wrote several programs further enhancing my understanding of the language after which I read several tutorials on the language. I worked to try to install some three _dimensional graphics development libraries for java so I could better code three-dimensional software.

Friday, July 18

On Friday in the morning I wrote a few C# programs and read a few tutorial articles on the language. I successfully grasped the concept of delegators, threading and Graphical user interfaces in the language and started working on Key bindings in the language. I made a few adjustments to the Power points finalizing the presentation.