Nem Negash

Prof. Lima

PHYS 220

February 23, 2022

Homework 1 Report

Question 1

For Question 1, we were tasked with creating a python program that could calculate given summations, S(up) and S(down), and create a log-log plot of the equation $(S\,(up) - S\,(down)\,)/(|S\,(up)\,| + |S\,(down)\,|)$ against each n value. Figure 1 shows the generated plot from the program. Based on this plot, we can see that the downward sum is generally more precise than the upward sum.This is due to the rounding error that occurs when adding floating point numbers. This is due to the fact that there is a rounding error when adding floating point numbers. Floating point numbers are 32 or 64 bit numbers, and these bits are split into three sections called the sign bit, the exponent bits and the mantissa bits.When adding two floating numbers the result is going to have a bigger exponent than the numbers being added. Since the mantissa can only have a certain number of bits, the bits on the lower end of the smaller number are no longer going to be in the range that the mantissa represents, thus they will be dropped off. If you begin with the smaller numbers first, your error will become bigger and bigger. If you begin with the larger numbers first, your error will become smaller and smaller and therefore will leave you with a more precise number at the end.

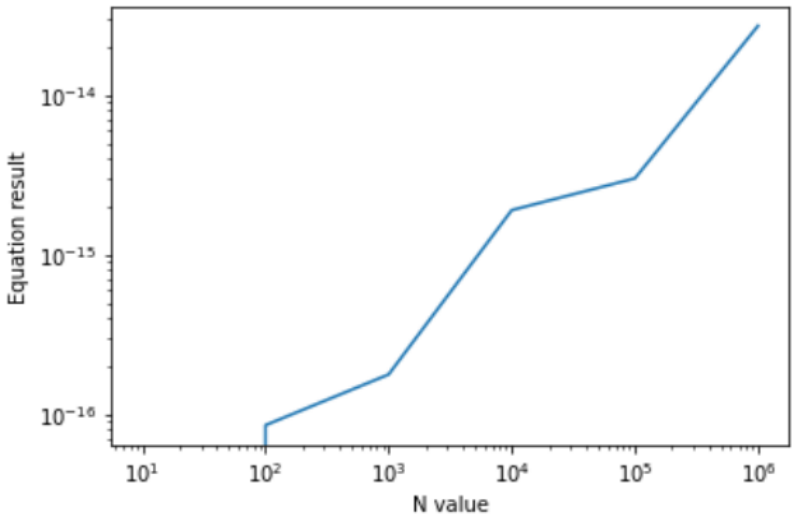

Figure 1: Question 1 Results

Question 2

For Question 2, we were given a data set that states the decacy activity at a given time. Our job was using the data to figure out how many unstable atoms there are in the sample and calculate the Chi-squared value for either one, two, or three unstable atoms. Figures 2, 3, and 4 show the plots of using the curve_fit function to find the optimal values to give the line of best fit for either one, two, or three unstable atoms. The scatter plot in each graph represents the data set we loaded into the program.

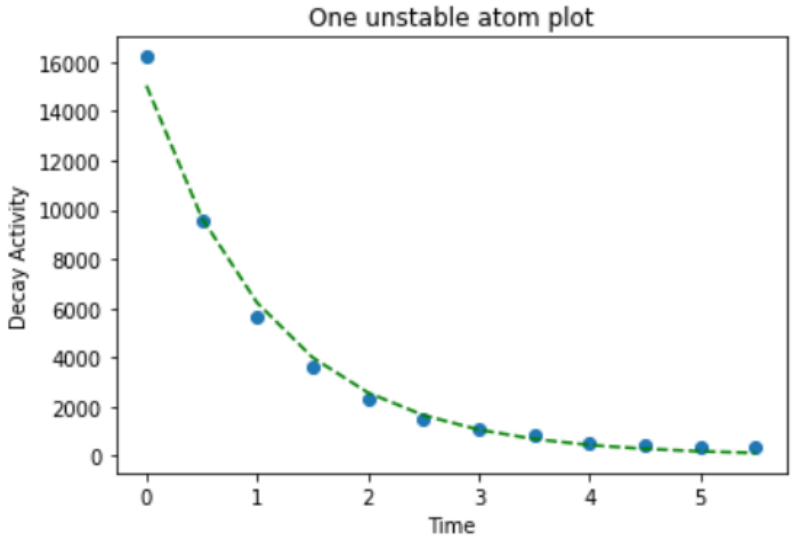

Figure 2: One Atom Fit

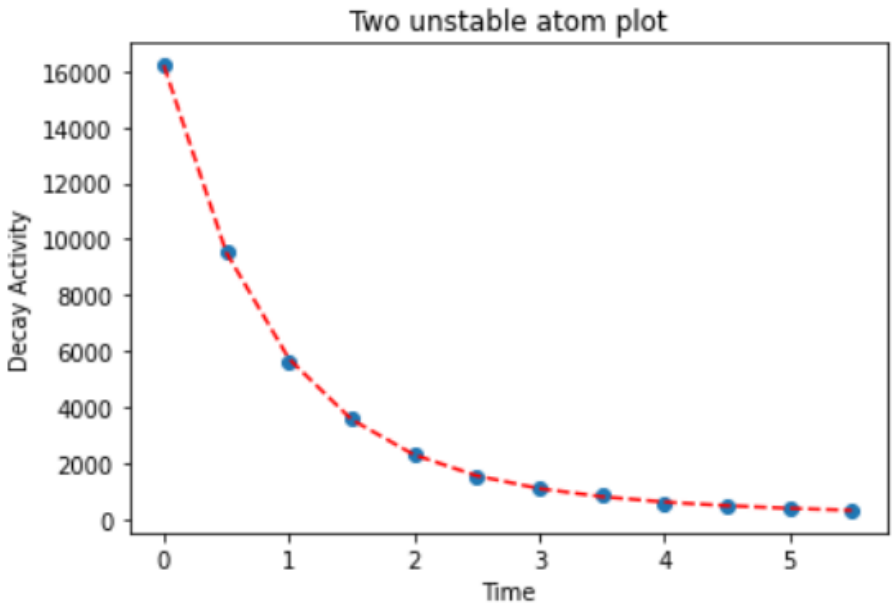

Figure 3: Two Atom Fit

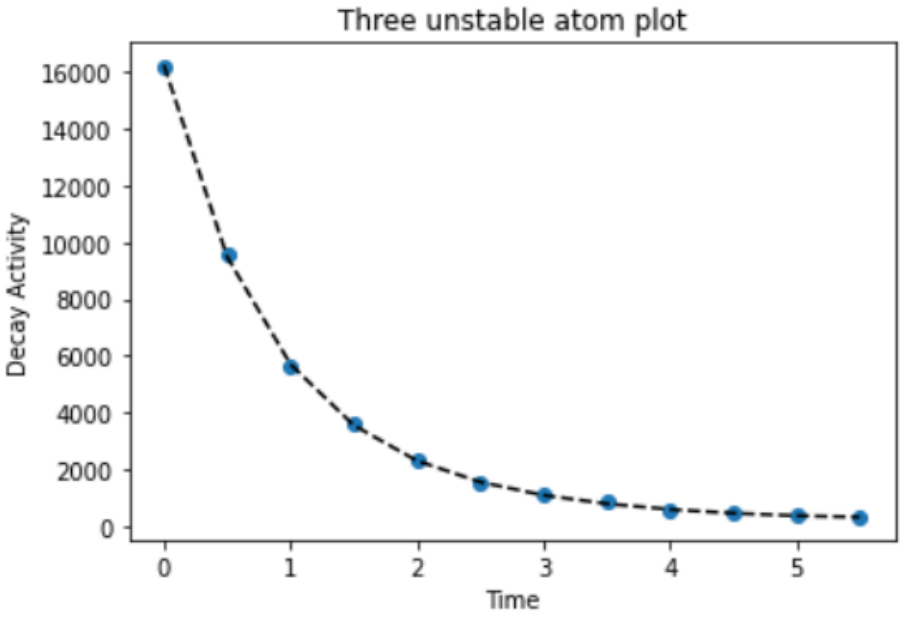

Figure 4: Three Atom Fit

```
N = 12
Chi-squared value for 1 unstable atoms: 586.9667838908101
Chi-squared value for 2 unstable atoms: 12.483604645241773
Chi-squared value for 3 unstable atoms: 10.164069838067242

In [29]:
```

Figure 5: Chi-squared values for 1, 2, and 3 unstable atoms

As shown above, the line of best fit looks like it could either be two atoms, Figure 3, or three atoms, Figure 4. To get a better estimate of which one we can use the calculated Chi-squared values to determine which of the two is the better fit. We can see the Chi-squared value for two unstable atoms is closer to the N value than the three unstable atoms one. Therefore, the best model would be the two unstable atoms one.

References:

Improving accuracy: A look at sums. (n.d.). Retrieved February 23, 2022, from http://alex.uwplse.org/2015/10/16/improving-accuracy-summation.html