

Homework Assignment #1

(*Due Date:* Monday, September 04, 12:40 pm, in class)

1.1 *Nickel Isotope Decay* (10 pts.)

The ${}^{56}_{28}\text{Ni}$ isotope β^+ -decays with a half-life of $T_{1/2} = 6.075$ *days* (recall that the “lifetime” $\tau = 1/\Gamma$ as introduced in class is related to the half-life by $\tau = T_{1/2}/\ln 2$; show this explicitly!). The initial size of the sample consists of 500 *grams* of ${}^{56}_{28}\text{Ni}$ (recall that 1 *mol* of a substance, which has a mass corresponding to the atomic mass-number in *grams*, contains $N_A = 6.022 \cdot 10^{23}$ particles).

- (a) Write a FORTRAN code to numerically calculate the activity of the sample, defined as $R(t) = -dN/dt$, over the first 1 *month*. Use a time-step width of 6 *hours*. Plot the result in appropriate units using GNUPLOT together with the exact (analytical) solution in the same graph. Attach both the plot and your fortran source code.
- (b) Increase the time-step width to 2 *days* and replot. Is the accuracy of the numerical solution still acceptable? (e.g., what is the percentage deviation from the exact result after 2 half-lives?)