Physics 325 — Scientific Computing — Fall 2016 — Lab 04

September 16, 2016

Exercise 1. Radioactive Decay with Euler

Write a program that calculates the numerical solution to the equation $\frac{dN}{dt} = \frac{-N(t)}{\tau}$ where τ is the half-life of the element. Calculate and plot N for values of t from 0 to 1000 years for a sample of 10^6 atoms with a half life of 75 years (use h=1 year). Check to see if the value after 100 years is consistent with the analytic solution to this equation. Create two plots, one using a linear scale for the y-axis and one a log-scale, to plot the number of atoms vs. time (investigate the Pyplot semilog function)**(10 points)**

Exercise 2. Radioactive Decay with RK2

Write an RK2 version of the program from Exercise 1. Assume that you have a sample of Radon-222 (Ra 222) with a half life of 3.82 days. Suppose a sample of air taken from a basement has about 250 Ra-222 atoms per milliliter of air. Using a suitable h, have your numerical program determine how long after the sample is taken that the Ra-222 level drops to below 100 atoms/mL assuming no new Ra222 atoms are introduced. **(10 points)**

Exercise 3. Multiple Variables

Write an RK2 program that solves the following system of equations -

$$\frac{d\theta(t)}{dt} = \omega(t)$$

$$\frac{d\omega(t)}{dt} = -10\ sin(\theta(t))$$

for $0 < t < 20$. Create and save a plot of both θ(t) and ω(t). **(10 points)**