Classwork 13

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I. SOMBRERO POTENTIAL

Problem Specifications. Simulate the x and y coordinates of a ball in a double well potential (also known as the "sombrero" potential). Variables to consider are the balls mass, m, and the ball's friction as it rolls, $f_{\text{drag}}(\dot{x}) = -\nu\dot{x}$. The "sombrero" will be shaken back and forth repeatedly with a driving force $f_{\text{drive}}(t) = F\cos(\omega t)$.

According to Newton's Second Law, the ball must satisfy the equation of motion:

$$m\ddot{x} = f_{\text{hat}}(x) + f_{\text{drag}}(\dot{x}) + f_{\text{drive}}(t) = x - x^3 - \nu\dot{x} + F\cos(\omega t)$$

II. THE SOLUTION

Solution. In order to compute the coordinates of the ball in motion we used the Runge-Kutta 4th Method. This method accurately predicts each subsequent x and x value by considering the approximations before and after the desired value. By using this method we were able to graphically represent the ball's x and x values over the course of its motion. The graphs below represent the ball at different starting values: $x0$ is the starting x position of the ball, $y0$ is the starting y position of the ball, and F which is the force of the shake.

A. Our Graphs

□

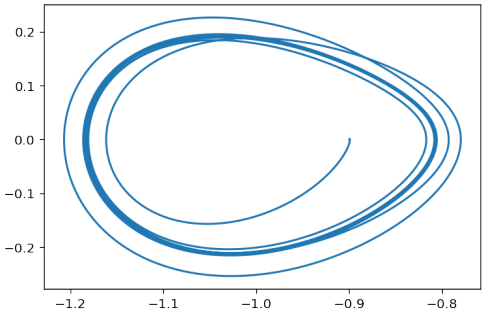

FIG. 1. $x0 = -0.9$, $y0 = 0$, $x0 = 0.18$

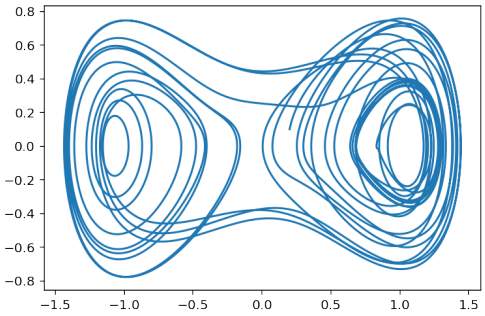

FIG. 2. $x0 = 0.2$, $y0 = 0.1$, $x0 = 0.25$

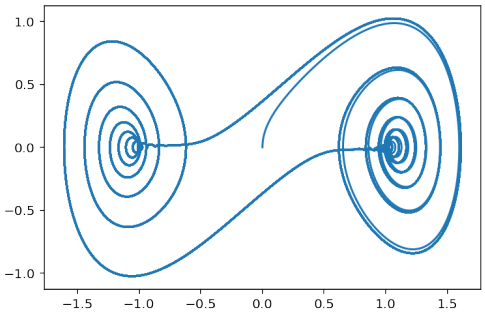

FIG. 3. $x0 = 0$, $y0 = 0$, $x0 = 0.4$

The movement of the this graph uses a slightly modified version of the code from $RK4_2$, where our N value is multiplied by a value of 1000 up from 50.