Computational Physics: Homework 1

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Problem 1

Introduction

In this problem we created a plot of the Mandelbrot set. The Mandelbrot set created iteratively using the equation

$$z' = z^2 + c \tag{1}$$

where z is a complex input number and $c = x + iy$ is another complex number used to create the output, z'. For a pair of x and y values we create the complex number c and start with $z = 0$. We then iterate using equation (1) and if $|z| > 2$ then the point at (x, y) is **not** in the Mandelbrot set.

Methods

For our purposes we made a evenly spaced grid in x and y ranging from -2 to 2 with which the values for c were made. For each point, we iterated a maximum of 100 times to check if the point at (x, y) was in the set. At first our grid size was 100x100 but it was ultimately increased to 750x750 to produce the final plots.

To keep track of whether an (x, y) pair was in the set, an array of zeros, Z, of size (N, N) was created where N is the size of the x and y grids. If, $|z|$ was ever greater than 2, the corresponding point in Z was left as 0. If, after 100 iterations, the value for $|z|$ was less than 2, the corresponding point was given a value of 1. This method was used to make a 'binary' Mandelbrot set where points are considered either 'in' or 'out'. Additionally, a Mandelbrot 'density' plot was made where the value in Z was incremented based on the number of iterations before $|z|$ becomes larger than 2.

Results

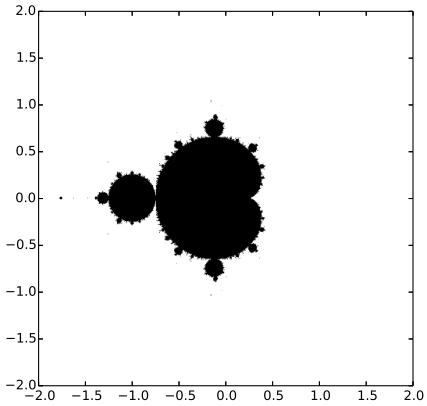

Figure 1: 'Binary' Mandelbrot image. The black region contains the points where $|z| < 2$

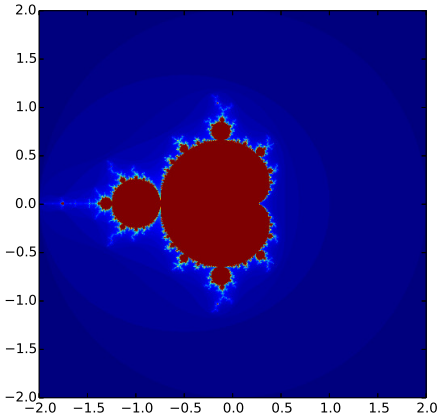

Figure 2: ν_{RF} vs B_H for ^{85}Rb

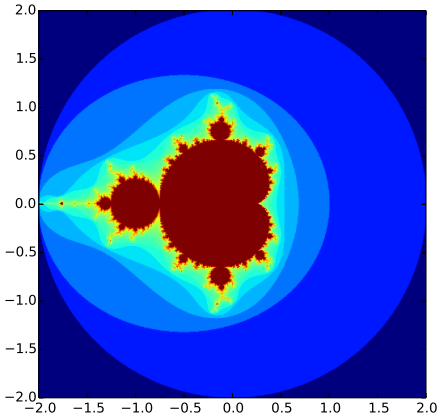

Figure 3: ν_{RF} vs B_H for ^{87}Rb

Problem 2

Introduction

In this problem we wrote our own linear least squares fitting code.

Methods

stuff

Results

plots