



# Dec 31.

## Finished First Draft of Axion Code

After some debugging, I finished all the problems with array shapes, and adapted the old plotting code (which compares numerical and theoretical derivative) to the present problem (which compares numerical and theoretical second derivative). Surprisingly, the numerical second derivative can be cheaply computed using “`derivative_sample`” on itself twice (not a very accurate algorithm); it works really well.

All of this were stored in an independent “DYM” sub-folder. I got to the point where I just needed to run the code for a few different cases. Unfortunately, I kept getting extraneous solutions that solve the equation of motion but are clearly not domain wall solutions. I am very sure that Erich should be right that these domain walls must exist, and it is my fault that the equation of motion that I derived is wrong. Nevertheless, I sent an email to Erich, explaining to him the extraneous results I got, and my suspicion of a wrong equation of motion. I sent him the equation I used.

Erich replied very quickly. He is glad that I am responding to this project so fast. And indeed, he claims that my equation of motion is missing a negative sign. However, I do not understand his explanation of my mistake. He speaks in a language of varying the energy, while I believe I should be varying the Lagrangian. I have to go through the math again.

But Erich reminded me that I don’t have to reply today. It’s new year eve afterall! So I stopped and went out to celebrate for the evening.