



# Dec 30.

I spent the first day back in Toronto working at office, McDonald, and cafe. I got some good work done. First, I designed and implemented a storage system.

## Storage System

When the solver function is called, a solution folder path (“title”) is generated, which is just a string that describes the path to a folder whose name records all the parameters of the specific solution. All of these solutions are in a “Results” parent folder.

Once this is done, the code will check whether such folder path already exists. If it does, this means this solution has already been generated before. Then the code creates a black-box object that allows the user to “view” the solution, by which I mean view all property as well as compute and display energy density etc. This black-box object is called a “Solution Viewer”, and it just takes the file address of the solution folder. At the moment, I leave it as a black-box and will implement it later.

If the folder path does not exist, then the solver code will go through the normal relaxation protocol, generate a solution, and store all the core data in a giant dictionary. This dictionary includes the field solution, the parameters, the error array, the number of loops, etc. It will not include any properties that need to be computed after the solution is found. I call this the “core dictionary” and it will not be altered once a computation is done.

Then the solver code will create an instance of the above mentioned “Solution Viewer”, and this time, it will take the solution, computes all of its derived properties, such as plots, energy density, energy, laplacian check, and stores all the results and images in the same folder as the dictionary.

## Solution Viewer - Beginning

Then I started writing the solution viewer. This is going to be a slower but not hard process. The reason is that it is almost completely adapted from the old “solution field” code. But since this code is so long, it will take a while for me to digest and tweek it.

## Interruption by Axion Side Project (All side project titles will be red)

At 2 pm, just as I was about to get into solution viewer code, I was interrupted by an email from the boss himself. He is now working on a new paper about axion, and wants me to check something about domain wall in this new but similar theory using my code from the summer. This is a small but tedious task. I have to take the old code, understand it, rewrite something to make the new domain wall solution. Erich believes it will cost one afternoon, but I think it will be a full day of work.

I got quite interested and started right away. I spent hours reading up the detailed precursor note he sent me, which explains the context of the physics and some equations leading to Lagrangian and energy of

the system. I followed and filled in detail derivation for most of it (which I will not reproduce here, at least not today).

Then I started to code up this problem. I spent about 5 hours of the evening on this in total today. I got to the point where I coded up the equation of motion, but realized there is a discrepancy between my new way of storing vector fields in the confining string project (points are columns, vector components are rows) and the way the old “domain wall” code (points are row, components are columns). So while writing the equation of motion code, I did it wrong. I have to change it all tomorrow. This is so tedious!