My PhD Thesis

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Contents

Chapter 1

Introduction

I don't really know how to make an abstract or something like that, and I know I'll have some other template to use when I actually start writing my thesis, but for the sake of having a place to put thoughts that may be useful later, here goes. . .

If you're looking for a central narrative with which to tie together your thesis, you could, of course, use the whole "making things faster" angle you've been playing so far. But I think a more enriching, exciting, and satisfying approach would be to emphasize that you are doing fission calculations for *rare* nuclei. That's cool because you work in a facility for *rare* isotopes! And it's just one of those things that is interesting and fashionable in the field in general right now. The introduction to the platinum-178 paper has a good discussion about the importance of trying to understand fission in regions of exotic isospin ratios, and how simpler models tend to be less reliable in those regions. That covers both the platinum and the r-process project motivations (at least partially), and oganesson is just interesting because of how heavy it is.

Chapter 2

Nuclear Density Functional Theory

Since nuclei are quantum mechanical systems, they can in principle be described using the Schrodinger equation. However, in practice one finds this type of description difficult or impossible, for two reasons:

- In order to use the Schrodinger equation, one needs to know how to describe the interaction between particles, such as between protons and neutrons. However, protons and neutrons are made up of quarks and gluons, which interact via the strong nuclear force. Consequently, an analytic expression for the nucleon-nucleon interaction analogous to the $\frac{1}{r}$ form of the Coulomb interaction is not available. Finding different mathematical expressions which can describe the interaction between nucleons continues to be an active area of research [**?**]

- Even when an interaction is known, nuclei are large systems made up of many protons and neutrons. Solving the Schrodinger equation directly quickly becomes computationally intractable as the number of nucleons increases.

2.0.1 Skyrme Interaction

2.0.2 Density Functional Theory

2.1 Microscopic Description of Nuclear Fission

Should I describe these here, or in the sections when they actually get used?

2.1.1 Potential Energy Surfaces

2.1.2 WKB Approximation

2.1.3 Langevin Dynamics

Chapter 3

Two fission modes in 178Pt

Bimodal fission in 178Pt?

3.0.1 Experiment

This project was done in conjunction with an experiment that was performed...

Chapter 4

Cluster decay in 294Og

This was done in a 4D space consisting of the coordinates $(q_{20}, q_{22}, q_{30}, \lambda_2)$

4.0.1 Cluster Decay

4.0.2 Synthesis of Og

Chapter 5

R-process

I'll say some stuff about r-process nuclei here

Bibliography