LEVERAGING MULTI-MESSENGER ASTROPHYSICS FOR DARK MATTER SEARCHES

By

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Today

ABSTRACT

I did Dark Matter with HAWC and IceCube. I also used Graph Neural Networks

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I love my friends. Thanks to everyone that helped me figure this out. Amazing thanks to the people at LANL who supported me. Eames, etc Dinner Parties Jenny and her child Kaydince Kirsten, Pat, Andrea Family. Roommate

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INTRODUCTION

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CHAPTER 2

DARK MATTER IN THE COSMOS

2.1 Introduction

Dark Matter (DM) has been a whispering problem in physics for almost 100 years. Anomolies have been detected by way of weird galaxy behaviour, budding Cosmology, and more [NEEDS A SOURCE]. It was sometime in 1930's when the super duper smart Zwicky measured that it was defintely there. It's kind of a big deal because we have no idea what the nature of this stuff and there's a lot of it. According to Lambda CDM, the most legit model, [NEEDS A SOURCE]DM is about 85% [FACT CHECK THIS], of all mass in the universe. It's called dark in fact because we cannot see it. [NEEDS A SOURCE]Finding out what the hell it is, is an active field of research and hopefully it interacts with the standard model.

Here's what we do know about DM so far. . . DM is dark, it doesn't interact readily with light. DM also doesn't interact noticably with the other standard model forces (EM, Strong, Weak) at a rate that matters [NEEDS A SOURCE]. DM is cold. By cold I mean that it is most likely not moving at relativisic speeds like neutrinos and photons. [NEEDS A SOURCE]If it was moving that fast, the structures we see like galaxies would be much more diffuse than what is observed. [NEEDS A SOURCE]DM is old. DM played a critical role in the formation of the universe and the structure within it. [NEEDS A SOURCE]We know this from Cosmology and computer universe simulations [NEEDS A SOURCE].

The search for DM is basically summarized by trying a bunch of different models and performing measurements of all kinds to test them. These models of course have to nominally agree with the known observations seen over the last century. Whenever we perform a test and don't see anything, the parameter spaces gets more contrained. I discuss some of the ideas ad approaches further on. I Especially discuss the models that are relavent to my thesis.

2.2 Evidence for Dark Matter

Let me show you why we're pretty sure DM is a thing and why it might be particle like in nature. My thesis focuses on WIMP dark matter which is one of the better motivated things out there.

2.2.1 First Clues: Stellar Velocities

THE STARS ARE MOVING TO FAST AAAAHAHHAHA

2.2.2 Mounting Evidence for Dark Matter

SPACE TIME CURVY THE UNIVERSE IS A SIMULATION. THE WIGGLES IN GEOMETRY ARE THICCCC

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