Dark Matter Analysis Master Test Plan

Team

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DM-SeniorDesign

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3. Introduction

This is the Master Test Plan for the Dark Matter Analysis Senior Design Project. This plan will address only those items and elements involved in data production, collection, and comparison. The focus of this test plan is to ensure that the analysis algorithms provide as much detail as needed to compare correctly with existing data and prove the reproduction of dark matter (positron) while also allowing stream of the process in generating the data for the possibility of testing many different masses in the initial electron collision.

This project will have three levels of testing, simulation, data collection, and data analyzation. The details of each level with be further explained in the approach section of this test plan document.

The timeline for this project is seven months, with any delays in success of simulation software potentially having tremendous effects on the test plan.

4. Software Risk Issues

There are some components of the Dark Matter simulation that are not in control of the senior design Dark Matter analysis software group but must be kept in mind.

- MadGraph is an application installed via github which provides simulation data of protons colliding. As a group we must use this software as one of our main

  sources of data, however we can keep in control the seeds being used to produce the data so that it matches up with the actual reconstructed data.
- EIC-Shell is an interface that provides the proper tools and libraries to analyze reconstructed data, we will need to keep this shell up to date to have the latest functions and capabilities for analyzing our data generated.
- Root is a virtual machine that allows for visualization of the colliding simulation also downloaded through github. Root does not work on all devices so specific operating systems will be needed to run this software.

5. Features to be Tested

The following areas will be focused on during testing of the analysis scripts.

- HepMC data organization process
- Reconstructed data organization process
- Data graphing process
- Testing of different masses processes
- Streamlining of the process

6. Features not to be Tested

The following list of areas will not be specifically addressed. All testing in these areas will be indirect because of other testing efforts.

- Data simulation

  Data being simulated in this process is done using commercially available software, this tool used to acquire what is needed to complete the senior design project.

- Data generation

  Data generation is created using the same commercial software and does not need direct testing for the same reason of this software being a tool already tried and tested to get the needed data.

- Data reconstruction
  Data reconstruction is acquired using another source of commercial software, so designing and testing this software would be outside the scope of this senior design project.

7. Approach

7.1. Testing Levels

The testing for the analysis of dark matter senior design project will consist of data organization, comparison, and reproduction. We plan on having all three members responsible for testing given the group constraints and timeline of the project. With everyone testing different aspects of the testing process this gives a swift and effective timeline for testing our software.

DATA ORGANIZATION will be done by Jacob and will be approved by the graduate students overseeing the project. All correct data organization standards for EIC and ROOT production will be provided to the tester before the software responsible for data collection can be tested and corrected.

DATA COMPARISON testing will be performed by Sam and will be approved by the graduate students overseeing the project. Data organization needs to be approved before the testing of comparison can occur, the comparison is between data given by a study done online and our data needs to match on some level with that data. The results of data organization as well as the online study data will be given to the tester of data comparison.

DATA REPRODUCTION testing will be performed by the team combined and will be approved by the graduate students overseeing the project. This testing will prove the reproducibility of data collected given different rules in the simulation. Different sets of criteria for the particle accelerator will be provided to the testers of reproduction so that scripts can be run parallel to each other. This testing can be done once results have been obtained from data organization and comparison testing.

Scripts written to analyze the dark matter data will enter reproduction testing once they have passed organization and comparison testing, a script must pass these parameter in order to have the chance at reproducing correct results given difference constraints in another simulation. Once a script has passed this phase of testing the customer can then use these scripts in researching the behaviors of dark matter. These scripts will be written in a way for a non-programmer to run and use these scripts given they understand the nature of electron collisions (ie physics professors).

7.2. Test Tools
- ROOT will be used to compile and run all reconstruction scripts.
- Python IDE will be used to run all hepmc scripts.
- EIC-SHELL will provide all necessary libraries for gathering data and testing graphs.
- The data points of the particles will be generated using the software Madgraph, which then will be scraped with scripts to analyze behavior of every potential particle.
- Once acquiring a HEPMC file, it will be run through a PIPLINE to generate a reconstructed file which will be compared to existing research.

7.3. Meetings

The senior design team will meet once every week to discuss overall progress to date and identify any errors or problems as early as possible. A specific block of these meetings will be reserved for discussion of testing existing scripts and discussion with graduate students to be certain for the correct methods of testing. Additional meetings may be called in the case of an emergency.

7.4. Measures and Metrics

All of the following information will be collected by the group during the build and test process. This information will provide a foundation for correcting bugs and errors, this information will also be available at every weekly meeting to be discussed upon.

- Defects by module and severity.
- Defect Origin(Requirement, Design, Code) ● Time spent on defect resolution by defect.
- Defects located at higher levels that should have been caught at lower levels.

8. Item Pass/Fail Criteria

The test process will be completed when a specific item passes requirements. Data gathered and organized will be compared with pre-existing IEE standards on data in the analysis of dark matter. Finding accurate comparisons means that this item has passed the criteria. Failing to have similar results will end in a revision of that item until it produces similar results. Data comparison will test with the criteria of similarity to pre-existing research notes on the analysis of dark matter. The data produced must have be similar in comparison by at least 80% to pass the test case. Otherwise, the item will be revised. Data reproduction will need to produce exact same type of results given different data sets. Given that an item can produce the same output style accurately to that data set across different scenarios that item will pass. Otherwise, that item will be revised.

9. Test Deliverables

Organization test plan

Comparison test plan

Reproduction test plan

Script prototypes

Defect/Incident summaries

10. Remaining Test Tasks

Task	Assigned To	Status
Create organization test plan	Entire group	complete
Define comparison rules	Entire group	In progress
Verify Prototypes of scripts	Entire group	In progress
Create Reproduction test plan	Entire group	Not started

Define Reproduction situations	Entire group	Not started

11. Training Needs

It is preferred that there be at least one person working on testing at all times, meaning each person gets a part time schedule to work on testing. In order to provide adequate testing on every level the tester will need to be trained in the following key areas:

- Testers will need to be trained on the operations of HepMC and how the file will be produced/organized. Knowledge of this will be useful in determining whether the scripts picked out the correct information.
- Testers will also need to know how to run the scripts so that they can see the output on their own machines.
- Testers will need to be trained on reading the correct data in research nots(ie. The physics aspect of reading the data). This knowledge is necessary for comparing our own created data to online given data.
- Testers will need to know how to automate running the scripts multiple times to simulate reproductive results.

12. Responsibilities

	Jacob	Sam	Nikhil	Whole Team
Organization test documentation	X			
Comparison test documentation		X		
Reproduction test				X
documentation				
Script design review		X		

Script Requirement review			X	
Prototype reviews				X
Test procedures and rules				X

The whole senior design team will generally be responsible for overall testing rules and actions, but when discussing specific documentation such as design and requirements they will be assigned to specific member of the team.

13. Schedule

The testing schedule runs alongside the timeline of the project. The key tasks of the project are detailed within the milestone matrixes, and the testing of these completed tasks will be done as progress on the next tasks is undergoing. Coordination between team members on the results of testing one tasks will be crucial to the successful identification of dark matter. These timelines consist of milestone 1 being completed by Feb 23, milestone 2 being completed by March 30, and milestone being completed by April 20.