

Project:

Analysis & Dark Matter Physics Simulation for the Dark Photon

Team Members:

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- Samuel Rock, [srock2023@my.fit.edu](mailto:srock2023@my.fit.edu)
- Jacob Woods, [jwoods2022@my.fit.edu](mailto:jwoods2022@my.fit.edu)

Faculty Advisor:

- Pietro Iapozzuto, [piapozzuto2015@my.fit.edu](mailto:piapozzuto2015@my.fit.edu)

Clients:

- Dr. Marcus Hohlman - Physics Professor
- Pietro Iapozzuto - Graduate Student with Dr. Hohlman
- Other Graduate Students

Progress of Current Milestone (Matrix):

| Task  | Completion % | Nikhil | Sam | Jacob | To do   |
|---|--------------|--------|-----|-------|---|
| Complete pseudorapidity, momentum, azimuthal, energy, and past related graphs with updated background subtracted signal of dark matter at the end of EIC pipeline | 0%           | -      | -   | -     | Bring everything together with background subtraction at the end of the pipeline                          |
| Explore 10-20 different invariant masses and have them get run through the simulation pipeline  | 100%         | -      | 50% | 50%   | -   |
| Visualize the invariant masses to identify most probable dark matter invariant mass, and incorporate the background subtracted                                    | 50%          | 50%    | -   | -     | Get cleaner images, and be able to see the scattered electrons' paths with the origin and collision point |
| Created Bash scripts to run MadGraph, extract decay values, and run c_tau and output.root across different HepMC files and  | 100%         | -      | 50% | 50%   | -   |

|                       |      |   |   |      |   |
|-----------------------|------|---|---|------|---|
| directories           |      |   |   |      |   |
| MadGraph low mass fix | 100% | - | - | 100% | - |

Discussion (at least a paragraph) of each accomplished task (and obstacles) for the current Milestone:

- Task 1: Not accomplished/no progress made, moved to Milestone 3.
- Task 2: Ran invariant masses through the pipeline to produce more data.
- Task 3: Had initial trouble removing gamma rays without removing other dark matter data, but was able to remove gamma rays and see some positive and negative charge paths
- Task 4: Produced bash scripts to run MadGraph multiple times for different mass values for epsilon and dark matter parameters, extract the decay value of the 1023 particle, and run the c\_tau program and output.root file to gather output from HepMC files given by MadGraph.
- Task 5: Previously MadGraph would not allow us to set the mass output to anything below  $1 \times 10^{-2}$ . Having the scripts set a number of parameters before hand, this obstacle was overcome allowing for longer Decay times.

Discussion (at least a paragraph) of contribution of each team member to the current Milestone:

- Nikhil Chaba: Displayed Visualization of the particle collider
- Samuel Rock: Wrote a bash script to extract the decay value of 1023 from a HepMC file, wrote a bash script to run a c program and root file on a HepMC file, and wrote part of Milestone 2 Evaluation and Presentation.
- Jacob Woods: Wrote a bash script that runs MadGraph multiple times using different masses for epsilon and dark matter parameters for madgraph simulation, and also wrote part of Milestone 2 Evaluation and Presentation.

Plan for the next Milestone (Matrix)

| Task  | Nikhil | Sam | Jacob |
|---|--------|-----|-------|
| Complete pseudorapidity, momentum, azimuthal, energy, and past related graphs with updated background subtracted signal of dark matter at the end of EIC pipeline | -      | 50% | 50%   |
| Streamline the process  | 1/3    | 1/3 | 1/3   |
| Get cross section comparison at generator level, at reconstruction level, Pseudorapidity (Eta),   | 1/3    | 1/3 | 1/3   |

|   |      |   |   |
|---|------|---|---|
| momentum transfer for each invariant mass that is put in pipeline |      |   |   |
| Visualization of Tracks   | 100% | - | - |

Discussion (at least a paragraph) of each planned task for the next Milestone:

- Task 1: Bring everything together at the end of the pipeline and learn how to apply background subtraction
- Task 2: Make the process from start to end of the pipeline easier
- Task 3: Compare visualizations and data on different levels
- Task 4: Visualize tracks

Date(s) of meeting(s) with Client during the current milestone:

3/18

Client feedback on the current milestone

- Very good progress on visualization and pinpointing the most probably mass
- Understand what the graphs are being made more clearly and why we use histograms
- Know more physics nomenclature
- In presentation practice being more fluid
- Be careful not to confuse  $etA$  with epsilons and mass, epsilon is a parameter

Date(s) of meeting(s) with Faculty Advisor during the current milestone:

2/24, 3/3, 3/10, 3/17, 3/18