Particle Physics/Simulation and Analysis Project for Sr. Design Class

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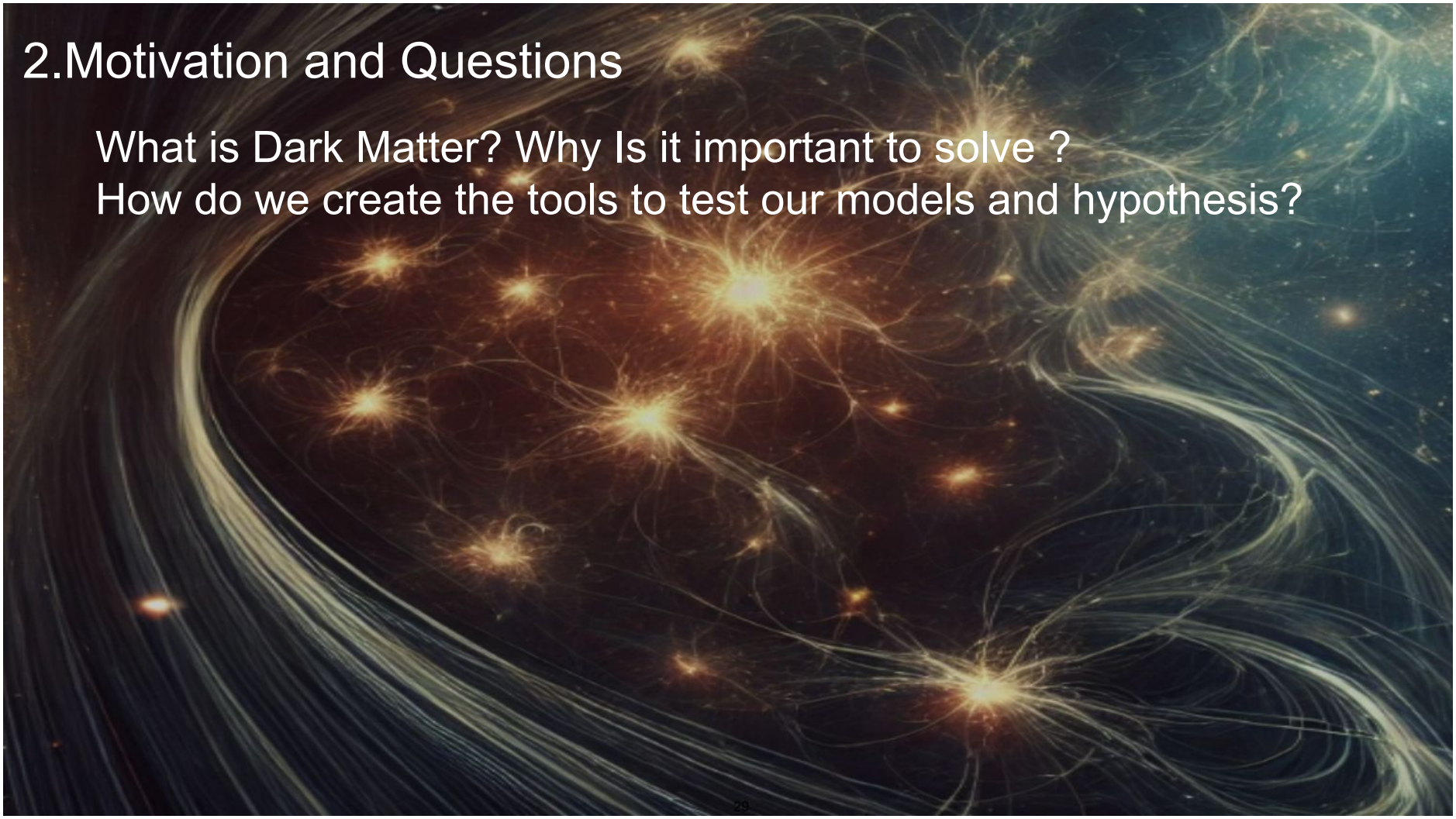
Project 1: Analysis & Dark Matter Physics Simulation for the Dark Photon

Project 2: Mapping for a Cylindrical Micro-Resistive Well Detector used for Dark Matter Searches at the EIC

FLORIDA TECH Jefferson Lab UNIVERSITY of VIRGINIA Brookhaven National Laboratory

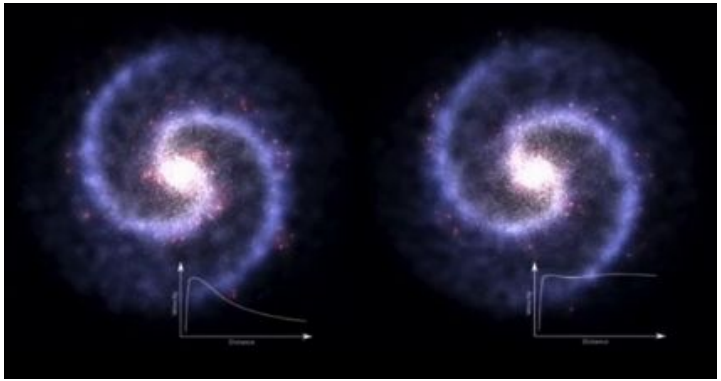
2.Motivation and Questions

What is Dark Matter? Why Is it important to solve ?
How do we create the tools to test our models and hypothesis?

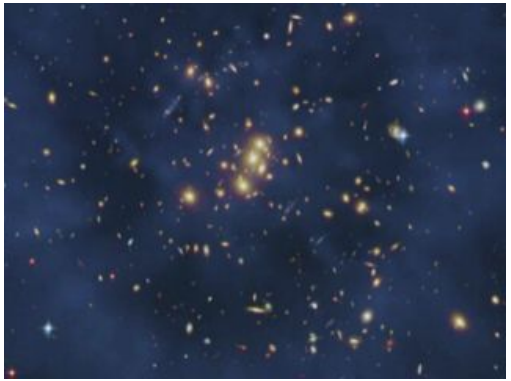


Dark matter is an invisible and hypothetical form of matter that does not interact with light

Gravitational Lensing



Galaxy Rotations

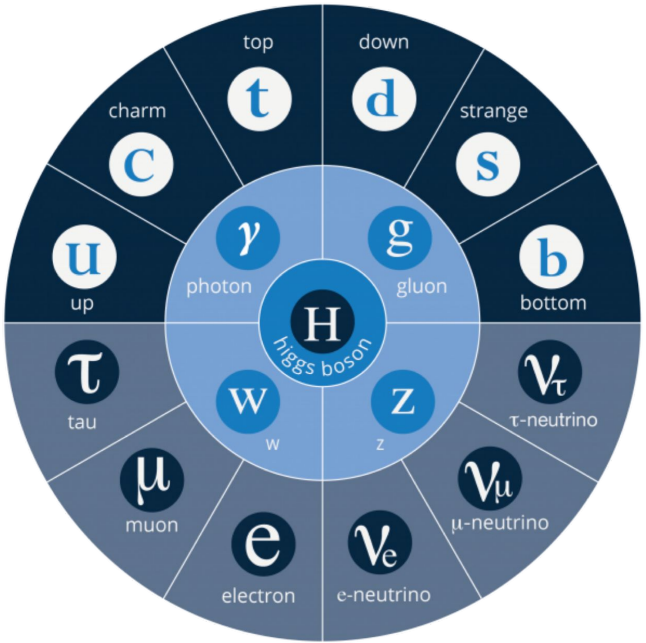


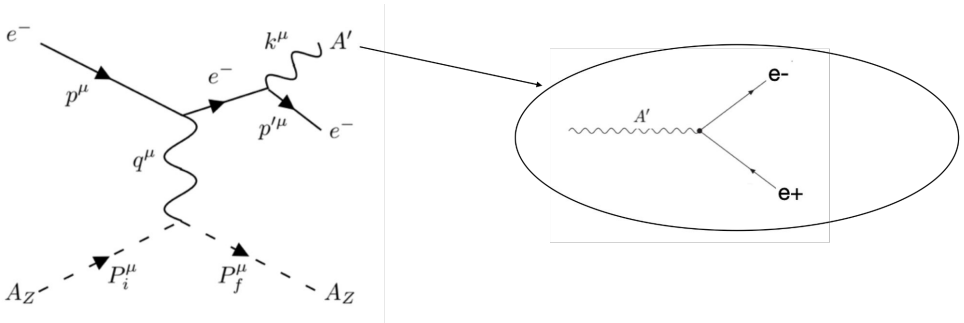
Galaxy Clusters

All Indicates the presence of unseen mass!

- The bending of light by massive objects reveals the presence of unseen mass that's warping spacetime.
- Stars in galaxies orbit the center much faster than they should based on the visible matter alone.
- The movement of galaxies within clusters also indicate unseen mass.

Dark Sector Standard Model



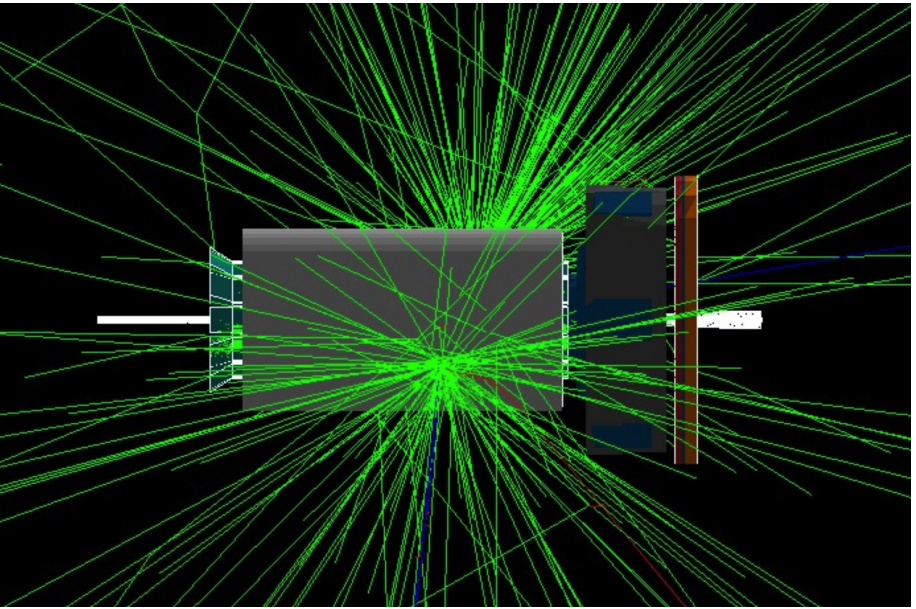


Beyond The Standard Model Questions:

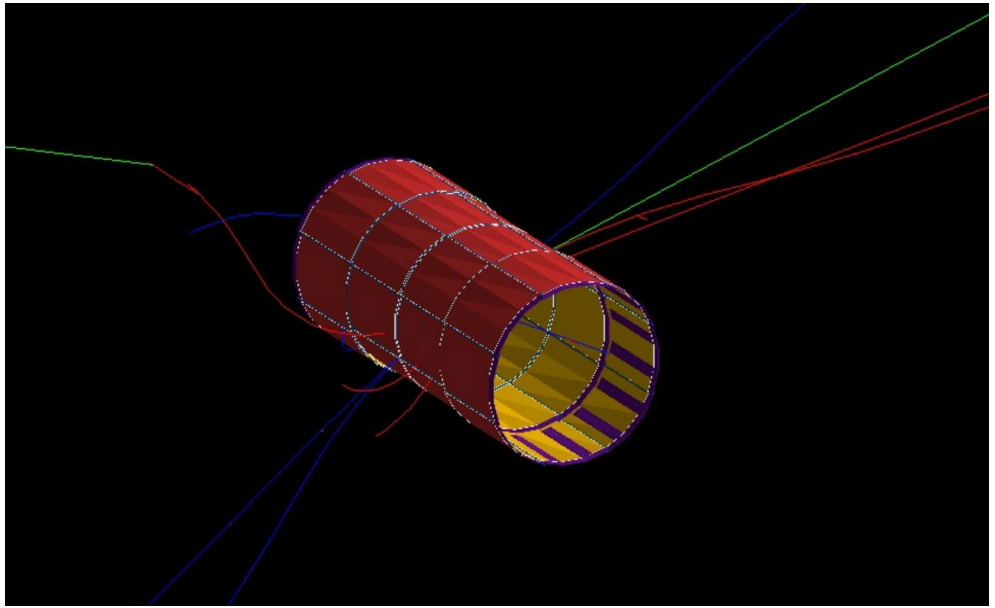
Could dark matter have a hidden dark sector with interactions similar to the Standard Model, and if so, how might it manifest at high energies?

No in-depth analysis to simulate a dark photon using the current ePIC detector geometry simulation environment has been attempted !

3. Approach ：Using the Epic Detector Reconstruction Environment

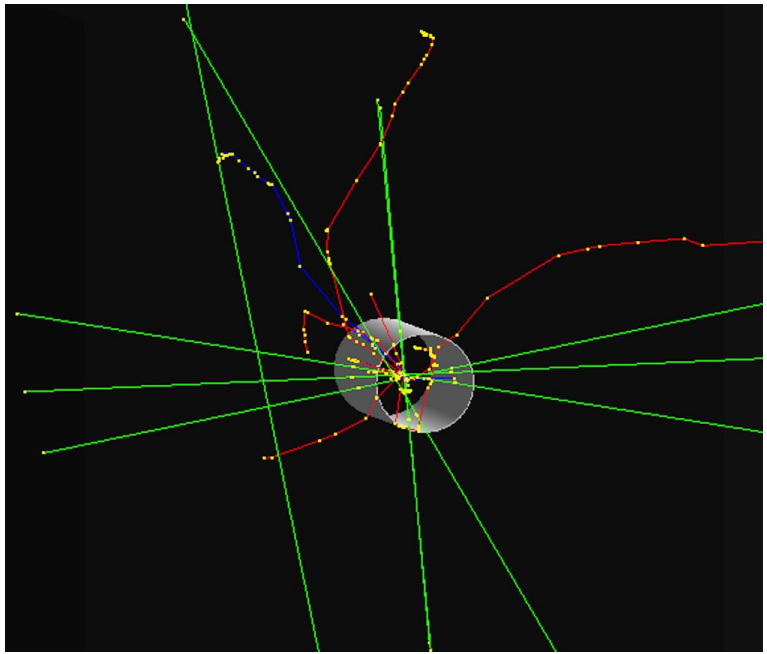


Full Epic Detector Simulation with Neutral Particles



Inner Barrel MPGD with Dark Photon Model

Goals for Project 1:



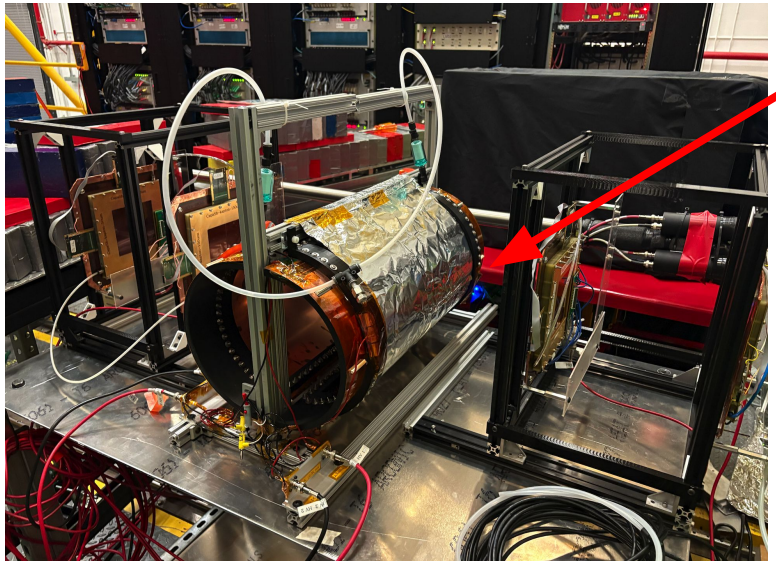
Geant4 Simulation Cylindrical Argon Shell Detector

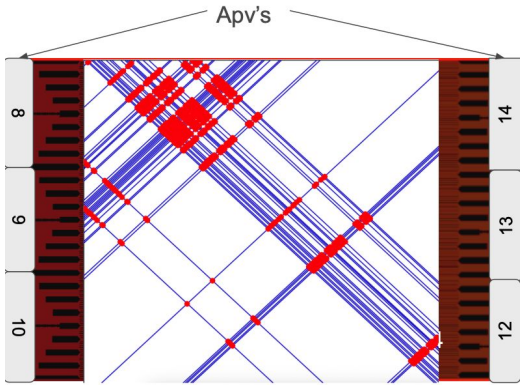
-Modify the current ePIC detector inner barrel tracker xml file to incorporate a cylindrical argon shell

-Choose a small set of mass and lifetime values to run through simulation to see most probable mass of Dark Photon, and location of displaced vertex.

-Perform Study of Signal (Dark Photon vs Backround (other particles)

Project 2: Mapping for Cylindrical Micro-Resistive Well Detector





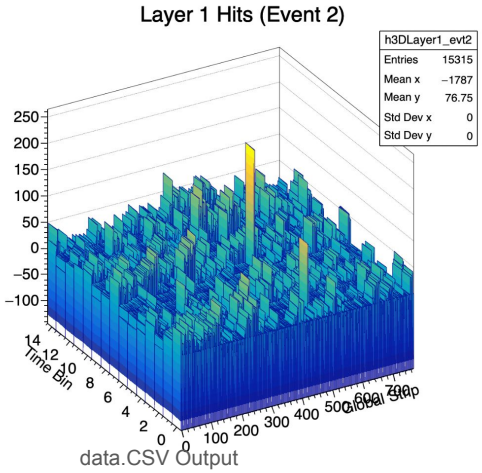
evtID	nch	detID	strip	apvID	planeID	etaSector	adc0	adc1	adc8	adc9	adc10	adc11	adc12	adc13	adc14	adc15
1	2048	2	0	3	0	0	59	59	32	31	-7	-68	-75	-61	-22	0
1	2048	2	1	3	0	0	-36	5	74	45	15	-17	-32	-34	-18	0
1	2048	2	3	3	0	0	-50	-5	84	62	22	1	-28	-33	-27	0
1	2048	2	4	3	0	0	67	74	-10	0	-27	-47	-46	-35	-1	0
1	2048	2	5	3	0	0	-26	4	81	49	10	-10	-18	-26	-13	0

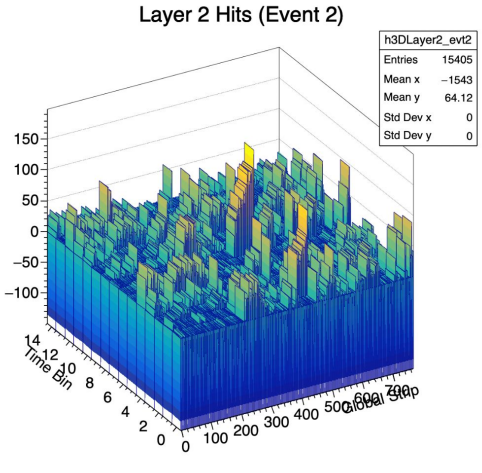
Goals For Project 2:

-To achieve accurate mapping of pulse hits to strips on the device via C++ script

-Help characterize the efficiency of the detector

-Repete for 2 different setup and all event data taken.





Needed Knowledge and Skill

For EIC Dark Matter Simulation Project: Linux, Bash, Troubleshooting Skills, Software Implementation, Basic, Geant4. Getting EIC software to work.

Detector Mapping Project : C++ , Python, Root. -Attend Weekly HEP lab meeting

Student will learn skills and abilities used to be in Computational/Software/Simulation physics

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