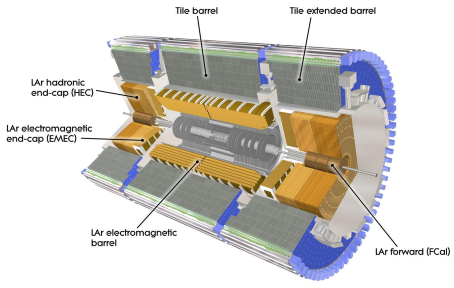
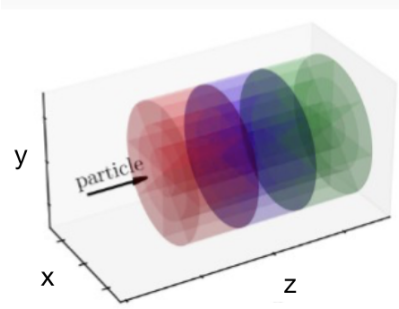
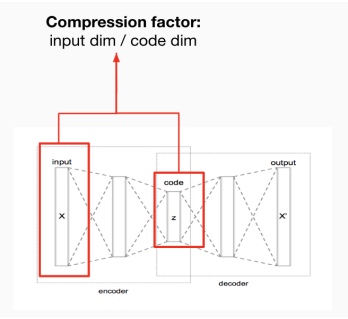
Within particle physics, particle collisions can be experimentally detected and imaged with calorimeters or computationally simulated with current mathematical and physical models. Comparisons between simulated collisions and experimental results can provide new information about the presence of new particles like the Higgs-Boson, and allow researchers to modify current theories of particle physics. A major problem with both collider experiments and simulations are the resource costs to conduct them. More glaringly, given the current Monte-Carlo simulations the need for CPUs to handle the growing amounts of data will increase by 25 times by 2040. The current methodology to conduct these simulations are simply computationally expensive to keep up with the growing amount of data. Our team had worked to tackle these problems by creating a model to speed up simulations based upon previous existing architecture. The previous model was a generative diffusion model and we used its architecture and implemented an autoencoder and a latent diffusion model. Its current state was successful in speeding up the simulation process. With our autoencoder, we trained 6 different training models on a dataset of images. We attempted to utilize our autoencoder to encode, or compress the image, and train our models to decode, or enlarge the image back to its original shape, accurately on a variety of compression factors. We measured their losses to track how much we can compress an image without sacrificing model accuracy. We generated visual plots for comparison of our autoencoder's performance "CaloEncoder" to a control performance "Geant4." We hypothesized that compressing the original images before the generative diffusion process would increase the speed of its process. We began the next steps in beginning to implement the latent diffusion model to experiment and record its speed-up time compared to the original diffusion model.



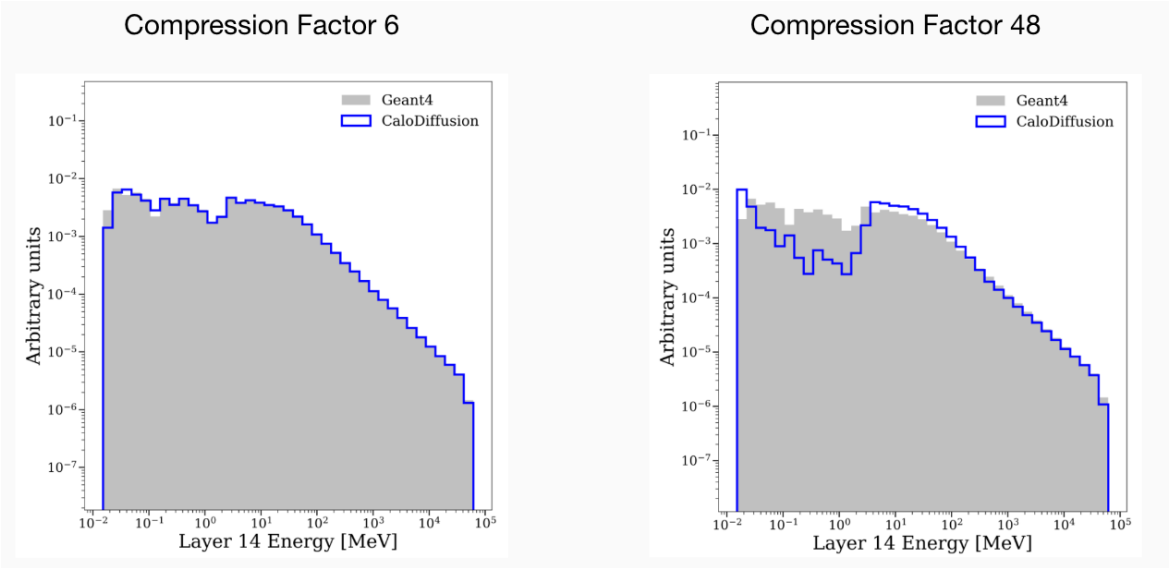
Visualization of Calorimeter



Visualization of Energy Shower



Schematic of Autoencoder



Visualization of Performance of Autoencoder Compared to Geant4 Simulation