

Discovering new forces at the Large Hadron Collider

Our present understanding is that forces of nature are mediated by gauge bosons (photons for electromagnetic, gluons for strong, and W and Z for weak interactions). In this project we will explore how a new kind of force can be detected using colliders like the Large Hadron Collider currently running in Geneva.

To see the presence of these new forces, we need to understand what the signatures at a collider look like. The most striking signature is in the form of a resonance in the scattering cross section.

We will begin by deriving the cross section for electron-positron scattering via a neutral, massive gauge boson. Using this expression, we derive the production cross section at the current LHC run with the new gauge boson coupling to quarks instead of electrons. We will use a well-known tool used in particle physics called Madgraph to integrate over the parton distribution functions and plot the dependence of the cross section on mass of the resonance. We then examine how searches are performed at the LHC and derive the lower limit on allowed mass based on the cross section limit published by the experiments.

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