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Popular Writing assignment
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The Search for Light Dark Matter

Dark matter is a yet unknown form of matter, thought to make up around 83% of the mass of the Universe. There have been many experiments that tried to find the particles that dark matter is made of, but none were successful so far. The discovery of dark matter particles would be truly epic in its impact on how we all view the Universe and everything inside it. It would be a whole new form of matter to explore, and could bring a new golden age of physics. Children in the future would learn about the discovery, and many great scientists would emerge during humanity's journey to further study it.

The Light Dark Matter eXperiment (LDMX) is a brand new, yet unbuilt experiment to find dark matter particles. It will search for dark matter that is heavier than an electron but lighter than a proton. This kind of dark matter is called light dark matter, hence the name of the LDMX. The LDMX will search for light dark matter by colliding electrons with tungsten - a very heavy element - to see what kind of particles will be formed. The collisions will then be carefully reconstructed so the scientists can see exactly what happened. If light dark matter does exist, it means that we will be seeing some collisions where a mystery particle is formed and flies away undetected. The way we can recognise this happening is by seeing that there is missing momentum and energy that the dark matter carried away from the particles that we did detect.

The LDMX consists of two phases. In the first phase, the collisions will be at an energy of 4 GeV. This means the electron hits the tungsten so fast it's as if it came from 4 lightning bolts stacked on top of each other. In the second phase, the energy is turned up to 8 GeV. It is advantageous to use higher energies because it gives us a clearer picture of what's happening. We also expect events that are trickier to recognise to occur less often at these higher energies. An example would be a case where the electron creates a photon, which creates a neutron that might sneak away without being detected.

The purpose of this project is to analyse simulations of collisions in the LDMX, so that once the experiment is up and running at 8 GeV, we can identify collisions where

dark matter was created. Therefore, I will be identifying ways in which the collisions are different at 8 GeV compared to 4 GeV, and the telltale signs of dark matter creation at this higher energy. With the results of this project, scientists of the LDMX will be able to identify events where dark matter is created, and weed out events where it wasn't. This way, the second phase of the LDMX can be realized. This phase could potentially discover light dark matter, which would be the discovery that defines the decade, if not the century.