Computer simulation of a collision between two protons in the LHC!

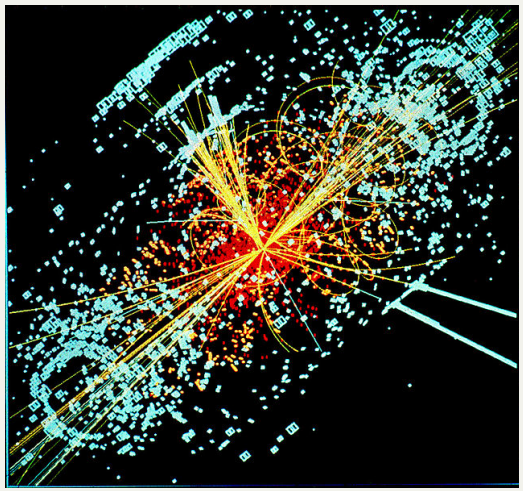

Image by Lucas T aylor, CERN

574 Feet Deep Underground

Image by Fanny Schertzer

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Physics Brochures Series by Sarah Marie Bruno, '16
Distributed Courtesy of X-Raise Cornell and NASA/New York State Space Grant Consortium.

Why is your backpack so heavy...

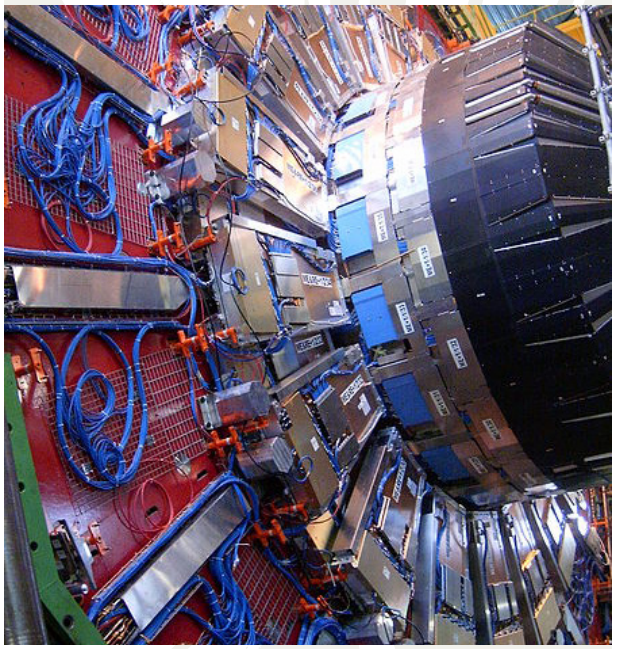


Image by Arpad Horvath

The Higgs Boson!

HELPING TO FURTHER

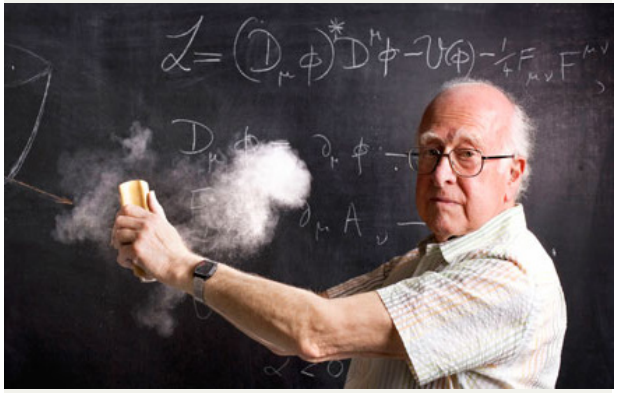
PUBLIC UNDERSTANDING

OF PHYSICS CONCEPTS

The Higgs boson:

Did you ever wonder why your backpack is so heavy? Is it your math book? No! It's the Higgs boson! All of your textbooks are made of many tiny particles, which interact with the Higgs boson to gain mass. All matter has mass, which is why we can experience a force due to gravity when we try to pick up something heavy and feel it pulling back down on us. Even in outer space where there is no gravity and astronauts do not weigh anything, they still have mass.

You might have thought that particles just naturally have mass, but physicist Peter Higgs predicted in 1964 that there is a specific particle responsible for giving other particles their mass. Almost 50 years later, this proposed particle was finally found at the Large Hadron Collider in Switzerland!



Professor Peter Higgs (Photo: Murdo MacLeod)

The Large Hadron Collider is a huge underground circular machine located beneath Switzerland and part of France. Protons are accelerated around the circle and are made to smash into one another.

These collisions cause the protons to react, producing new particles, including the mysterious Higgs boson. Unfortunately, the Higgs decays rapidly into other particles, called "decay products," so scientists had to search for these decay products, rather than the Higgs itself. After years of searching, they finally identified the particle, confirming Peter Higgs' prediction.

Geneva, Switzerland—the circle marks where the Large Hadron Collider lies underground.

You may still be wondering how one particle can give another particle mass. The Higgs boson creates something called the Higgs field, which exists everywhere. As particles move through the Higgs field, they gain mass. The more a particle interacts with the Higgs field, the more massive it becomes. This is sort of like trying to move a marble through molasses. The molasses provides resistance, making it harder to accelerate the marble, as if the marble itself were becoming heavier and harder to move. When it is difficult to get something moving, stop it from moving, or change the speed at which it moves, the object is said to have a large inertia. Inertia is proportional to mass (objects with greater mass have more inertia). Just like the molasses gives the marble inertia, the Higgs boson gives particles inertia and, as a result, mass. So, next time your backpack feels impossibly heavy, blame that Higgs boson!

Circular tunnels lie deep underground inside the Large Hadron Collider. (Photo by Juhanson)