Diabologic: Higgs
by Frank Dolinar

Prior to the mid-1960s, there was a veritable zoo of unique sub-atomic particles that appeared to have no discernable relation to one another. None, that is, until Dr. Murray Gell-Mann codified his theory, known as the “Eightfold Way” (alluding to the Eightfold Path of Buddhism), that organized subatomic particles into families and led to the prediction and subsequent famous discovery of the Ω^{-} (Omega minus) particle. For this work, Dr. Gell-Mann was awarded the Nobel Prize in Physics in 1969.

Follow-on work by Gell-Mann and other researchers led to theoretical descriptions and experimental confirmation of quarks, among other discoveries. Many of these theories dealt with furthering the proofs of what is known as the standard model, which describes and explains the “Big Bang” that created our universe and the time immediately thereafter.

The standard model does a good job and seems to have nailed down the theoretical explanations with solid, verifiable experimental evidence across the board… except for one little problem. Physicists have theorized the so-called “Higgs” field but have yet to experimentally find the Higgs particle. It is the only particle of the standard model not yet observed.

When a field, such as the electric field exists, theory states that there must be a particle to carry (i.e. to be the physical embodiment of) that field. In the case of the electric field the particle is the electron, the understanding of which makes our modern electronic gadgets possible.

According to theory, the Higgs field gives all bits of matter in the universe their mass. Having said that, I have to admit that this assertion is a bit disconcerting. Isn’t mass a fundamental property of matter? What does it mean to have a field and a particle that gives all the matter in the universe its mass, including itself? I simply don’t know.

The community of physicists thinks it does know. They have built what is arguably the most complex and expensive device in all of human history – the Large Hadron Collider (LHC) at CERN in Switzerland. The LHC is the largest, most powerful particle accelerator in the world. Construction has been completed and the preliminary testing of the systems needed to operate this new laboratory is underway. When it becomes operational later this year (2008), the LHC’s goal will be to confirm the existence of the Higgs particle by accelerating protons, the particles at the center of the hydrogen atom, to nearly the speed of light (186,000 miles per second, or – if you prefer – 300,000 kilometers per second) and then creating head-on collisions of these particles to see what the debris looks like.

Why do physicists need the LHC? The answer has to do with the most famous equation in all of physics, Albert Einstein’s $E=mc^2$, which says – in simple language – that the energy equivalent of a bit of matter is calculated as its mass times the speed of light (designated as ‘c’) squared. This is a very big number. Theory expects the Higgs particle to be considerably more massive than the rest of its “family”. It will take more energy to create it in the debris of the collisions.

There have been questions about the safety of the LHC. I believe they are unfounded. It’s my opinion that the LHC will work flawlessly as a laboratory for high-energy particle physics.

I don’t know if the LHC will find the Higgs particle. If it does, then the last bit of proof for the standard model will have been found and we pretty much know how the universe works.

If the Higgs particle is not found, then I believe that somewhere in the last three hundred years of theory and experiment the discipline of physics has missed some (perhaps tiny) detail and our understanding of how the universe works is flawed. Such a flaw, if it exists, it will need to be found and corrected.

From my point of view, failure to find the Higgs particle using the LHC could be the most exciting development in physics in decades.