Researchers continue search for elusive new particles at CERN

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Though sought at much higher energies than before, researchers at Texas Tech University associated with a Compact Muon Solenoid (CMS) experiment at CERN's Large Hadron Collider (LHC) continue to seek the elusive new particles, which, if found, could answer some of the most profound questions about the structure of matter and the evolution of the early universe.

Sung-Won Lee, an assistant professor of physics at Texas Tech and a member of the university's High Energy Physics Group, said researchers have not given up finding any possible hints of new physics, which could add more subatomic particles to the Standard Model of particle physics.

Their findings were published recently in *Physical Review Letters*. Their results are the first of the "new physics" research papers produced from the CMS experiment at LHC.

"So far, we have not yet found any hint of the new particles with early LHC data, but we set the world's most stringent limits on the existence of several theorized new types of particles," said Lee, who co-led the analysis team searching for these new particles.

Currently, the Standard Model of physics only explains about 5 percent of the universe, Lee said.

"The Standard Model of particle physics has been enormously successful, but it leaves many important questions unanswered," Lee

said. “Also, it is widely acknowledged that, from the theoretical standpoint, the Standard Model must be part of a larger theory, known as ‘beyond the Standard Model,’ which is yet to be experimentally confirmed.”

Finding evidence of new particles could open the door to whole new realms of physics that researchers believe could be there, such as string theory, which posits that subatomic particles such as electrons and quarks are not zero-dimensional objects, but rather one-dimensional lines, or “strings.” It could also help prove space-time-matter theory, which requires the existence of several extra spatial dimensions to the universe as well as length, width, height and time.

One of the most popular suggestions for the ‘beyond the Standard Model’ theory is Supersymmetry, which introduces a new symmetry between fundamental particles, he said. Supersymmetry signals are of particular interest, as they provide a natural explanation for the “dark matter” known to pervade our universe and help us to understand the fundamental connection between particle physics and cosmology.

Furthermore there are a large number of important theoretical models that make strong cases for looking for new physics at the LHC.

“Basically, we’re looking for the door to new theories such as string theory, extra dimensions and black holes,” Lee said. “None of the rich new spectrum of particles predicted by these models has yet been found within the kinematic regime reachable at the present experiments. The LHC will increase this range dramatically after several years of running at the highest energy and luminosity.

“I believe that, with our extensive research experience, Texas Tech’s High Energy Physics Group can contribute to making such discoveries.”

More information: *PRL* paper: prl.aps.org/abstract/PRL/v105/i21/e211801

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