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Lehman Scientists Part Of Significant Finding In Particle Physics And Astronomy

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Lehman College is a collaborating institution in The Pierre Auger Observatory in Pampa Amarilla, Argentina, the largest cosmic ray obse in the world. The observatory tracks and observes particle showers produced by ultra-high energy cosmic rays.

Lehman Professor Luis Anchordoqui and Research Associate Tom Paul, are members of the Observatory's prestigious 500-member collaboration of world-class scientists, and recently contributed to what could be a potentially significant discovery in the world of parti physics and astronomy They both are part of the Lehman Department of Physics and Astronomy.

The duo is part of a team that according to the journal Nature, have found that "particle showers caused by natural ultra high energy co in Earth's atmosphere, produce more muons—heavier cousins of the electron, than current physics models can explain."

The work of the collaboration could help science to explain previously unexplained physics phenomena. The results, were published in October, in the journal, Physical Review Letters, entit "Testing Hadronic Interactions at Ultrahigh Energies with Air Showers Measured by the Pierre Auger Observatory." Anchordoqui and Paul are optimistic about the research's future potentia have to be sure that this is a real effect and not a random fluctuation," says Anchordoqui. "As we get more evidence, even if it grows slowly, it gets more and more exciting. If our findings a significant, then we are looking at some new physics that we haven't yet anticipated."

It has long been suspected that high energy collisions producing muons, which have a mass about 200 times that of an electron, are exceeding particle physics model predictions, produci "30% to 60% more muons than simulations based on the Large Hadron Collider (LHC) results predict" according to Nature. The LHC is operated by CERN, the European Organization for Nu Research, in Geneva, Switzerland and is the highest energy collider on the planet.

Ultrahigh energy cosmic rays (UHECR) are extremely energetic particles, comprised of atomic nuclei, originating from unknown sources in the universe. Their energies far exceed those av at man-made accelerators. To better understand the muon excess, the Auger scientists studied these cosmic rays collisions with air molecules and in an energy regime about ten times hi than the energies reached at the LHC. When UHECRs impact the Earth's atmosphere, they initiate a secondary cascade of particles producing what is known as an extensive air showers. ("Some of these particles arrive at the Earth's surface and can be directly detected," says Anchordoqui and Paul. "The EAS can also be viewed by sensitive telescopes, since the particle cas excite the nitrogen molecules in the air, causing them to emit ultraviolet light.

The Auger Observatory used both Water Cherenkov Tank Detectors and fluorescence light telescopes to observe the air showers.

A major upgrade to the Pierre Auger Observatory called "AugerPrime" will increase sensitivity and make future measurements even more precise. "If this anomaly in the shower muon cont confirmed, it could indicate hitherto unknown nor unobserved physical processes are taking place at energies inaccessible to the LHC," according to Anchordoqui and Paul.

It will take many more years of research and experiments to determine if this rain of muons is a measurement fluke or "something unexpected going on, such as the creation of a new stat matter," according to Science News.

Anchordoqui and Paul have both been working on this study as part of the observatory collaboration for many years. Anchordoqui, who is from Argentina, is a founding member of the collaboration and began working for Auger, as a graduate student in 1995. Paul has been involved with the collaboration for 16 years. "There are a lot of people to learn from, it's not like ha two or three people writing a paper or doing an experiment," explains Paul about working with 500 other scientists. "You have all of these people with differing ideas and everything has to internally reviewed."

Paul is one of three task leaders focusing on data processing analysis, and overseeing the effort for the main analysis software framework setup and supervised the writing of 400,000 lin code. The work of the data processing analysis task enabled other scientists to interpret data from the instruments, such as energy arrival direction. He helps maintain the software that re the measurements of each UHECR shower.

Anchordoqui is a theoretician who designs models for analysis, and served on the Auger publications committee from 2005 to 2010. He works on the theoretical interpretations of the resu

The team's lead Auger physicist Glennys Farrar is a professor of physics at NYU. Funding came from the National Science Foundation. (NSF) "We know what this is not," says Andchordoqu not a normal effect. Current models cannot explain it. We need something new to explain it. It's exciting to find out what it could be."

In a recently published paper entitled,"Strange Fireball as an Explanation of the Muon Excess in Auger Data," Anchordoqui speculates that Auger detectors may be hearing the echo of the primordial plasma, a hot soup of dense matter in a state of quasi-free quarks and gluons, the elementary particles that make up ordinary protons and neutrons. Anchordoqui co-wrote the p with Physics Professors Haim Goldberg and Thomas J. Weiler, respectively of North Eastern University and Vanderbilt University.

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