Homing in on Higgs: Michigan researchers predict summer discovery (w/ Video)

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(Phys.org) -- Whether the Higgs boson exists could be settled by the end of summer, say University of Michigan physicists involved in the search for the missing piece of particle physics' Standard Model.

"We're zooming in," said Jianming Qian, physics professor in the College of Literature, Science & the Arts. "We are increasing the data set and improving our search algorithms. With certain luck, we may be able to discover it this summer, but it depends on nature."

Qian is one of the 28 U-M researchers involved in experiments at CERN's Large Hadron Collider (LHC) in Switzerland. He'll spend most of his time through August in Geneva, where more than 1,000 scientists from around the world have been looking for Higgs since the collider turned on about four years ago.

The LHC is the largest and highest-energy particle accelerator ever built. In its 17-mile tunnel, researchers are smashing protons and other particles together to break them into their components. They're studying the wreckage with two camera-like particle detectors. Major components of one of them, ATLAS, were designed and built at U-M.

ATLAS records 300 events every second, Qian said.

"We're looking for interesting anomalies in a huge amount of data," he said.

The Higgs search in ATLAS is organized in five subgroups, and it is the job of U-M physics doctoral student Aaron Armbruster to combine the results from these groups. From this unique vantage point, Armbruster could be the first person to see Higgs' signal.

"First by a few minutes," he clarified.

Having been in love with physics since reading Stephen Hawking in high school, Armbruster counts himself lucky to be on this project right now.

"People have been looking for Higgs for the past 40 years," he said. "It's more or less by chance that in my two or three years as a graduate student, I'm working on it when we'll be able to say whether it's here or not. It's an exciting time."

This is physics' biggest thrill since the Standard Model fell into place in the 1970s, said U-M theoretical physicist Gordon Kane. Kane, who wrote the 1989 Higgs Hunter's Guide, has been charting the path to the elusive particle since 1976.

The Higgs, he explains, is a linchpin of the Standard Model—the overarching physics theory that describes the laws of nature and the nature of matter. Its discovery would prove the theory's prediction of how certain elementary particles obtain mass.

"There are Higgs mechanisms, Higgs fields and Higgs bosons," Kane said. "The Higgs field is an audacious idea. It says that the universe doesn't have a state that has nothing in it. In its basic vacuum-like state, it's filled with a Higgs field. Interactions with that field are essential for quarks and other mediators of forces to get mass."

Quarks are particles that combine to make the protons and neutrons that, together with electrons, make atoms. Higgs bosons are Higgs field

particles, similar to how photons are particles of electromagnetic radiation, or light, Kane said.

During the past six months, results from CERN as well as from Fermilab's Tevatron particle accelerator near Chicago have provided some evidence that Higgs is real. But these results weren't strong enough to claim a discovery. They weren't statistically significant to five standard deviations, Kane said. He predicts that the new experimental runs that started in April will provide enough data to achieve that level of certainty by the end of summer.

"I'll bet any amount there's a discovery," he said.

Knowing whether Higgs exists is important in a deep sense, Kane said.

"When we understand our world, we function better in it," he said. "One of the great historical analogies is that after Newton's laws, you knew that the sun would come up every day whether you contributed to the church or not. It was a law of nature that people couldn't tamper with. If we understand the universe better and better, our place in it will get more and more clear to us. And for me, there's a huge dignity that comes with being able to understand. I find that wonderful and exciting."

The LHC is an international effort including more than 8,000 scientists from at least 85 countries. The Michigan Group is believed to be the largest single institutional group in the LHC project. In addition to Qian, other U-M physicists deeply involved in the ATLAS experiment are professors Homer Neal, Bing Zhou, Junjie Zhu, J. Chapman and Rudolf Thun. Five research scientists and four engineers are involved, as are six post-docs and seven graduate students. More than 50 U-M undergraduate students have been involved as well. Kane is the Victor Weisskopf Distinguished University Professor of Physics as well as a professor in the School of Art + Design.

Provided by University of Michigan