Maybe it wasn't the Higgs particle after all

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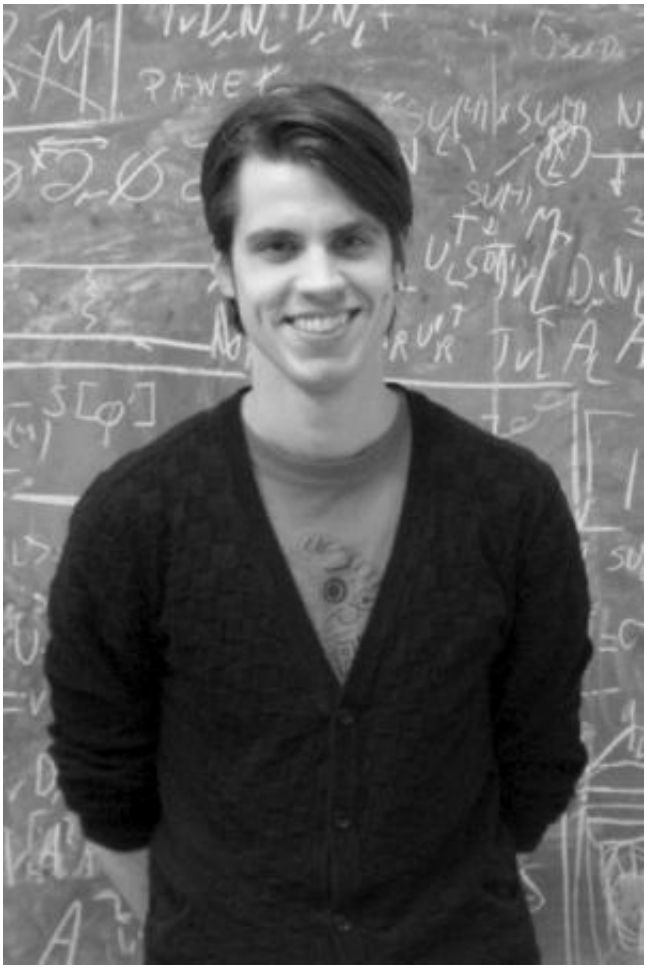

Associate Professor Mads Toudal Frandsen, University of Southern Denmark
Credit: University of Southern Denmark

Last year CERN announced the finding of a new elementary particle, the Higgs particle. But maybe it wasn't the Higgs particle, maybe it just

looks like it. And maybe it is not alone.

Many calculations indicate that the particle discovered last year in the CERN particle accelerator was indeed the famous Higgs particle. Physicists agree that the CERN experiments did find a new particle that had never been seen before, but according to an international research team, there is no conclusive evidence that the particle was indeed the Higgs particle.

The research team has scrutinized the existing scientific data from CERN about the newfound particle and published their analysis in the journal *Physical Review D*. A member of this team is Mads Toudal Frandsen, associate professor at the Center for Cosmology and Particle Physics Phenomenology, Department of Physics, Chemistry and Pharmacy at the University of Southern Denmark.

"The CERN data is generally taken as evidence that the particle is the Higgs particle. It is true that the Higgs particle can explain the data but there can be other explanations, we would also get this data from other particles", Mads Toudal Frandsen explains.

The researchers' analysis does not debunk the possibility that CERN has discovered the Higgs particle. That is still possible - but it is equally possible that it is a different kind of particle.

"The current data is not precise enough to determine exactly what the particle is. It could be a number of other known particles", says Mads Toudal Frandsen.

But if it wasn't the Higgs particle, that was found in CERN's particle accelerator, then what was it?

"We believe that it may be a so-called techni-higgs particle. This particle

is in some ways similar to the Higgs particle - hence half of the name", says Mads Toudal Frandsen.

Although the techni-higgs particle and Higgs particle can easily be confused in experiments, they are two very different particles belonging to two very different theories of how the universe was created.

The Higgs particle is the missing piece in the theory called the Standard Model. This theory describes three of the four forces of nature. But it does not explain what dark matter is - the substance that makes up most of the universe. A techni-higgs particle, if it exists, is a completely different thing:

"A techni-higgs particle is not an elementary particle. Instead, it consists of so-called techni-quarks, which we believe are elementary. Techni-quarks may bind together in various ways to form for instance techni-higgs particles, while other combinations may form dark matter. We therefore expect to find several different particles at the LHC, all built by techni-quarks", says Mads Toudal Frandsen.

If techni-quarks exist, there must be a force to bind them together so that they can form particles. None of the four known forces of nature (gravity, the electromagnetic force, the weak nuclear force and the strong nuclear force) are any good at binding techni-quarks together. There must therefore be a yet undiscovered force of nature. This force is called the the technicolor force.

What was found last year in CERN's accelerator could thus be either the Higgs particle of the Standard Model or a light techni-higgs particle, composed of two techni-quarks.

Mads Toudal Frandsen believes that more data from CERN will probably be able to determine if it was a Higgs or a techni-higgs particle.

If CERN gets an even more powerful accelerator, it will in principle be able to observe techni-quarks directly.

More information: Technicolor Higgs boson in the light of LHC data. *Phys. Rev. D* 90, 035012th Alexander Belyaev, Matthew S. Brown, Roshan Foadi, and Mads T. Frandsen. journals.aps.org/prd/abstract/ … 3/PhysRevD.90.035012 . On Arxiv: arxiv.org/abs/1309.2097

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