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Higgs could reveal itself in dark-matter collisions

Dec 10, 2009 3 comments

Wonder scope Could FERMI add the Higgs to its successes?

For particle physicists analysing the first data from CERN's Large Hadron Collider (LHC) in Geneva, it is the €4.3 bn question: is there a particle known as the Higgs, which endows all others with mass? But now a study suggests that there might be a far cheaper method of finding the answer – and gargantuan particle accelerators don't get a look-in.

According to Marco Taoso of CERN and colleagues, the famed Higgs could be leaving its imprint in the light produced in collisions of dark matter, the substance believed by most scientists to make up the vast majority of the universe's mass. In fact, the researchers think we could be seeing the tell-tale spectral signatures of the Higgs in this way within a year – so sooner, potentially, than the LHC unscrambles data on the elusive particle.

Look to the skies instead

The LHC was built to search for a wealth of new physics but its foremost target has always been the Higgs. The only fundamental particle in the Standard Model yet to be discovered, the Higgs – or more precisely its associated field – is supposed to "stick" to other particles and thus give them the property of mass. Many particle physicists have been hoping that the LHC's expected collision energies of 14 TeV will be powerful enough to finally unearth the Higgs, and in doing so wrap up the Standard Model.

However, Taoso's group, which includes members in the US at Argonne National Laboratory, Northwestern University in Illinois and the University of California in Irvine, thinks experiments searching for traces of dark matter might get there first. Dark matter is thought to make up more than 80% of the matter in the universe but it does not interact with light (hence being "dark") so its presence has only been inferred from its gravitational effects on normal matter.

Most models of the universe suggest that dark matter was more prevalent in the distant past, and this has led physicists to assume that dark-matter particles have been annihilating one another through collisions. Although dark matter itself doesn't interact with light, such an annihilation could generate a photon and another particle, possibly the Higgs.

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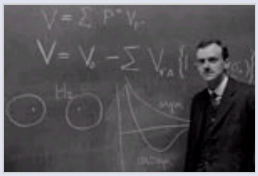

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The researchers claim that detecting this Higgs would be a matter of spotting the partner photon with an energy reflecting the Higgs's mass. If their calculations are correct, gamma-ray telescopes like Fermi might see the first evidence within a year.

Likely to trigger debate

"It is certainly possible to imagine that the Higgs could be produced in dark-matter annihilation," says Andy Parker, an experimental high-energy physicist at Cambridge University. "In fact, there must be a whole range of hypothetical processes which would produce features like lines or shoulders in the gamma-ray spectrum, using Higgs or other particles to provide the fixed mass required for a spectral line,"

The idea, however, is likely to come under scrutiny from some members of the dark-matter research community. Taoso's group has considered just one of several candidates for the dark-matter particle – the "heavy neutrino". Other dark matter candidates would not annihilate in the right way to produce a Higgs.

For some, this issue makes the research a little too speculative. "While it is an interesting idea, I would be very surprised if the Higgs boson were actually seen in this way," says David Miller, a theoretical physicist at the University of Glasgow.

Indeed, even if Fermi did find evidence for the Higgs, Taoso's group admits that particle colliders would be required to "decisively" identify the particle associated with the spectral line. But with the LHC only just beginning to churn out high-energy data, particle physicists may be surprised to find that the first hints of the Higgs come not from below ground, but from far above.

A preprint of the research can be found on the *arXiv* preprint server.

About the author

Jon Cartwright is a freelance journalist based in Bristol, UK.

3 comments

Add your comments on this article

1 **Hamish Johnston**
Dec 14, 2009 10:27 AM
Bristol, United Kingdom

Editor's note

All comments on this article have been deleted because most of the comments did not comply with the following guidelines.

1) Comments should be relevant to the article and not be used to promote your own work, products or services.
2) Please keep your comments brief (we recommend a maximum of 250 words).
3) We reserve the right to remove excessively long, inappropriate or offensive entries.

I apologize to those who left comments that were within the guidelines, but discussion had deteriorated to the point where it had very little to do with the news article.

Hamish Johnston
Editor, physicsworld.com

Reply to this comment · Offensive? Unsuitable? Notify Editor

2 **steffen.schaefer**
Dec 14, 2009 1:06 PM
Marseille, France

Quote:

> *Originally posted by* ***Hamish Johnston***
> All comments on this article have been deleted because most of the comments did not comply with the following guidelines.
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>
> Hamish Johnston
> Editor, physicsworld.com

Sometimes I use news articles from PhysicsWorld for my lectures because they allow to connect coursework to ongoing research. However, I do find the posted comments sometimes a little disturbing and not very helpful for the students.

I would therefore appreciate very much if there were a button on the webpage to fold the comments away.

Steffen Schäfer
Univ. Aix-Marseille
France

Reply to this comment Offensive? Unsuitable? Notify Editor

3

RMULDAVIN
Dec 15, 2009 4:46 PM

Fermi Diagrams and Pictorial Models

I confess to skimming the essay and matching it with my favorate pictorial models, the "felt" (flat equal lateral triangle) and the HUGS (Higgs' Universal Gravity Strings), so for my records I printed out three pages, the Abstract and the (5) Discussion and Outlook.

The physicsworld.com comments, the 250 word recommendation, is proper for pairing or paring down linear streams of words, and leaving the linear stream of symbols for the SM and "zoo" of "particles" assoicated with mathematical models.

So the comments that "... models may be probed by the Fermi/GLAST satellite and ground-based Cherenkov telescopes." seem appropriate.

Roger Penrose's commnets that when he goes to conferences with other mathematicians, those that engaged in the verbal math confuse him or puzzle him(?).

Roger Penrose is pictorial, judgeing from his work on tiles.

Thus to meet the 250 word max and to be constructive:

(1) "felts" can be representative of the Chemical Elements when modeling as polyhedron, and a single felt can be "wafered", two and three "thick": 1-, 2-, and 3-felt wafers would be very compact, thus rationalizing them as the femions compacting by the Pauli Princile;

(2) The idea that the Higgs' "particle" can be "broken" into smaller parts as measured by the frequencies of the exiting "photons" makes sense to my mind by considering each connection gravity string to itself being divisalbe into smaller 1/3^-k powers, that is, continunity is sustained by considering the g-string as unbreakable, but it is divisable.

Best, rm

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