PHYSICS

2ASK THE QUESTION- BEYONDEINSTEIN
Nome: David Ruzicka
Email: Fourruz@aol.com
Question: With the concept of supersymmetry, is it possible that our universe is a \"particle\" within a supersymmetric universe?

Hi David.
Though there are presently no experimental indications to guide us in this question, theoretical ideas based on superstring theory do postulate the existence both of extra spatial dimensions and of supersymmetry. In many of these theories, the 3-dimensional space in which we live is a membrane-like structure, called a D-brane, that is embedded in a fundamentally higher-dimensional universe. Loosely speaking, a D-brane is where the ends of open strings are attached. Normally, the full universe then has 9 or 10 spatial dimenions, plus 1 time dimension. The object we live on, the D-brane, would be a 3-dimensional so-called hypersurface inside this space. While the D-brane is not exactly a particle, it has some properties like particles. It can have charges on it. It can have a certain tension. It can have waves on it, and it can even have a finite `thickness' in the extra dimensions. All this, of course, is pure speculation :)

Sincerely,
Peter Skands

16 ASK THE QUESTION- BEYONDEINSTEIN
Nome: Richard Stoner
Email: richard.stoner@btinternet.com
Question: Can someone explain how, in the theory of inflation, the expansion rate of the universe exceeds \"c\"? Does the value of c increase at that time to accommodate the high rate of expansion?

Hi Richard.
You don't have to go to inflation theory to find things moving apart at speeds greater than c. Consider the present universe. It is expanding, though slower now than in the inflationary period. Still, whatever the expansion rate, if you pick two points that are far enough apart, they will appear to be separating from each other at a speed greater than c. This in no way violates relativity. The reason is, that these points, which are receding from each other faster than the speed of light, now as well as back when inflation happened, **cannot** communicate with each other – they are not in `causal' contact, as we say. They are outside each other's observable universe. Whatever happens at one point **cannot** affect anything at the other point, hence relativity is still in good shape.

Best wishes,
Peter Skands

HIGGS

Name: Dennis, Appleton, Wi
Email: trulayne@new.rr.com
Question: What can cause the higgs field to exist in a way that it can cover the entire universe?

Hi Dennis.
That's a good question. I could say: we don't know. But that's a lousy answer. In fact, it's not just the Higgs field that we believe covers all of space. ALL fields stretch infinitely far, at least according to quantum field theory, even electron, photon, and quark fields. It's just that MOST fields, all the other ones besides the Higgs field, are zero over most of space – hence they might as well not really be there. An electron field is peaked around the atom where it sits and is very very small everywhere else. The odd thing about the Higgs field is thus not that it fills all of space, but that it is non-zero over all of space. We believe this was not always so, and that it has to do with a symmetry that was broken in the early universe. In the beginning, the Higgs field was probably zero everywhere, or at least its average was zero (there are always quantum fluctuations around the average, and in the very early universe those can be pretty big). The Universe later underwent a phase transition (still within the first fraction of a millisecond), where the so-called electroweak symmetry was broken, and the `vacuum' decayed into a new state – the state that we find it in today, with a non-zero Higgs field. But as I started out by answering, we don't really know how this happened. There are many possible theories out there for explaining the underlying mechanism of electroweak symmetry breaking – it is something like a holy grail at the moment – some involve new matter and/or forces, others involve new (broken) symmetries, and yet others involve new dimensions of space-time. and perhaps we will soon be able to test whether any of these ideas make sense, in experiments at Fermilab and at CERN.

All the best,
Peter Skands

6ASK THE QUESTION- BEYONDEINSTEIN
Nome: A Rigby
Email: a.rigby2@ntlworld.com
Question: re higgs if you say that a higgs particle is coalessing out of the higgs field there is no reason to assume they are all going to be the same size in effect the higgs particles are all the known matter particles.

Hi Ribgy,
That's a great question! Yes, it would be extremely appealing to explain all fundamental matter in terms of just one field. That's related to another of the holy grails of theoretical physics, the possible unification of matter and forces. However, just with the standard Higgs field it unfortunately doesn't work. You see, the Higgs field has certain charges under each of the fundamental forces. For instance, it does not interact via the strong interaction at all. So strongly interacting particles cannot be made of Higgs stuff. Also, it has no lepton or baryon number, so again, particles with such quantum numbers can then not be made of Higgs stuff, and so on. There is another fundamental distinction between elementary particles; some are fermions (they have a so-called spin equal to a half-integer number), and some are bosons (they have integer spins). Electrons are examples of fermions, and photons are examples of bosons. The Higgs field is a bosonic field, so you could not create any fermions out of it. For these reasons, you really need all the standard elementary particles, in addition to the Higgs field.

Hope this clarifies it a little,
Peter

Name: eman from Egypt
Email:emanaly@yahoo.com
Question: I have a question about Higgs particle
I f the limit of Higgs boson is within 114 Gev ,why it has not been
discovered yet?
Thanks alot

Hi Eman,
The experiments have excluded a Higgs boson with a mass less than 114 GeV, at least within the framework of the Standard Model of Particle Physics. That's just another way of saying that nothing has been discovered below 114 GeV. So we really believe that, if the Higgs boson exists, and if it is the way the Standard Model predicts it to be, then it must have a mass greater than 114 GeV. Such a particle would probably be discovered at the next round of accelerator experiments. In some other theories, the experimental bound is less strict, and the Higgs could be lighter, and still have avoided discovery at earlier experiments, for instance due it, in these theories, having invisible decays or just different decays which make it harder for the experiments to see a clear signal that it was there at all. That is, in many of these cases, earlier experiments actually **did** produce Higgs bosons, but they could not **tell**!!! I guess that's what you call tough luck.

Best wishes,
Peter

22 ASK THE QUESTION - BEYOND EINSTEIN
Nome: Lukasz
Email: stepien50@poczta.onet.pl
Question: One of the topics in high energy physics is experimental confirmation of existence of Higgs boson. What about the case of negative verification of the existence of it ? Are there some ways of saving of Standard Model ?

Hi Lukasz,
If neither the Tevatron at Fermilab nor the upcoming LHC accelerator at CERN find evidence for the Higgs, then there must be something very strange going on – an interesting case! As I mentioned in the show, all our "best" theories predict one (or more) Higgs bosons that should show up in the experiments. Of course, theoretical physics is about figuring Nature out, and there is no indication that Nature is not capable of handling her numbers – so if no Higgs shows up, then there has to be a theoretical description to match as well; it is then just a matter of finding it, which may not be so easy. So, the short answer is no. If we do not find the Higgs at these experiments, then we would know that something is wrong with the Standard Model. We would have to modify it in some way, and which way that would be would hopefully then be indicated by discoveries of things other than a Higgs boson.

Peter