Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *The dark side.*

Well, dark energy is in the news again. Scientists confirm the nature of dark energy. Well really what's been confirmed, by yet another line of evidence, is that the universe is expanding with a uniform acceleration. So all the nay sayers who were alleging that you can't be sure that type 1a supernovas are really standard candles are left without a lot of ground to stand on.

So there you go, the universe is expanding with a uniform acceleration. I mean, I'm convinced - I thought the supernova findings were fairly compelling. But you can't just go from this to saying that we have confirmed dark energy exists - after all the whole idea of the term dark is to acknowledge that we haven't the faintest idea of what we are dealing with.

There are some fundamental problems with appealing to an invisible energy source as the driving force for the universe's accelerating expansion. All forms of energy we know of are thermodynamic - essentially energies that either heat things or do work – a process that itself dissipates waste heat anyway. So if dark energy is anything like conventional forms of energy, we can presume it does the work of expanding the universe - but it does so without producing any waste heat, meaning that it works at 100% efficiency - and essentially it appears out of nowhere to fill empty space with a perfectly even consistency. So if we are going to accept that an energy that behaves in this manner, we will need a major rework of the laws of thermodynamics.

Now some say that dark energy must be some kind of a repulsive force, some even describe it as anti-gravity. But real gravity has very obvious physical effects on the contents of the universe – it bends paths of light, it draws together, compresses or even spaghettifies massive objects.

If dark energy was really a repulsive force that pushed things away from each other – you should expect to see very obvious physical effects arising from that. For example, galaxies being pushed away from each other would have one side compressed inwards, as though an invisible hand was pushing forcefully upon them, to overcome each of those galaxy's substantial inertia. And nope – we don't see anything like that.

Others have suggested that dark energy might be some kind of field that pervades all of space-time and acts like a negative pressure. The logic of this is that since a positive pressure compresses - a negative pressure expands. Thinking in terms of pressure does help to explain why dark energy fills the universe with such an even consistency. But at the same time, it would be more logical to say that a negative pressure results from the expansion of volume - rather than it being the thing that drives the expansion of volume.

What is quite clear from observing the expansion of the universe, is that gravitationally unbound structures are being moved apart. But it's as though those structures are not actually being moved *through* space-time – instead new space-time is forming between them.

So, from this context, the expansion of the universe can be just as well be explained as new space-time appearing out of nowhere, rather than new energy appearing out of nowhere.

I’m not really sure what that means – but let’s think about why we do need invisible energy out of nowhere to explain the universe?

As is by now painfully well recorded Albert Einstein developed his general relativity field equations and was puzzled that they predicted the universe's geometry wasn't static. So he mucked about with the cosmological constant to make it static. Then Edwin Hubble found observational evidence that the universe was expanding. Einstein went woops, biggest blunder - and everyone else went off to try and figure out if there was going to be a big crunch or whether the universe was going to expand forever.

For Einstein his blunder was that he didn't just leave the equations alone to say what they were already saying - since the equations were already predicting that space-time had a strange, innate tendency to change. So, we really shouldn't be saying hey about that Einstein, he was right after all. No, Einstein was right that it was a blunder.

Anyhow, after Einstein kind of faded out of the conversation - others started running with his field equations. Einstein field equations essentially seek to balance what space-time is doing with what the mass/energy density, that is within that space-time, is doing. There are hundreds of variations of the equations and these still dominate cosmological thought and theory today – so the real lesson here is that one blunder didn't cost Einstein the ball game.

Anyhow, on the left-side of the Einstein field equations, that represents space-time geometry is the term Lambda - which is the cosmological constant Einstein mucked about with. In an accelerating expansion universe Lambda operates to make space-time expand – which means the mass/energy density on the right side of the equation should become diluted - since in an expanding universe, the density of its contents should decline.

And that good listeners is the problem. When we observe the shape of the universe - say with the Wilkinson Microwave Anisotropy probe (or WMAP) – the universe is flat, which doesn’t make a lot of sense. An expanding universe with declining mass/energy density should adopt a hyperboloid shape (which is like the 3D shape of a saddle) - at least that's what the math says.

So to account for the fact that the universe clearly is flat we need more mass/energy density - and there's not just enough visible stuff out there to account for this. In fact, there's not nearly enough. This line of thinking is the basis of the standard pie chart that says the universe is 73% dark energy, 23% dark matter and 5% baryonic matter. We call the dark energy component ‘energy’ because it has to be evenly distributed, rather than generating the sort of gravitational clumping that we expect of both dark and light matter.

But in this context, dark energy just plays a back-filling role - sustaining the universe's mass/energy density in the face of expansion. So arguably, people have just decided to also assign dark energy the role of driving the accelerating expansion of the universe, because otherwise we haven’t a clue why it’s doing that. But in the absence of any plausible mechanism for how the input of invisible energy could drive the creation of more space-time volume, it’s hard to see what justification we have to jump to that extraordinary conclusion.

So look, astronomers have once again confirmed that the universe is expanding with a uniform acceleration - and jolly well done. The mechanism that underlies that expansion and the reason why universe still remains flat in the face of that expansion are genuine puzzles.

And puzzles are good things, interesting problems that drive science. But when the square peg keeps not fitting that round hole, maybe it’s time we started looking for some different kinds of pegs.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, www.cheapastro.com. Cheap Astronomy offers an educational website where sometimes it's OK to admit that we don't know bleep. No ads, no profit, just good science. Bye.