Black magic

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BLACK MAGIC?

Ken Tapping, 28th February, 2017

Imagine this. You have just made a careful measurement and you did a calculation, but the two do not agree. Not only do they disagree, they hugely disagree. You check the measurement again, and you redo the calculation, and you get the same discrepancy. Then someone suggests you need to add the right amount of "Magic Stuff X" to your calculation to make it agree with the measurement. However, apart from making the calculations agree with the measurements, Magic Stuff X is totally invisible. That sort of explanation is extremely unsatisfactory in that it does not really explain anything. What makes it worse is that you need to add a huge amount of "Magic Stuff X"; several times more than the stuff you are actually measuring. This situation is not a daydream; it is exactly what we are facing with "Dark Matter".

For decades we have known the rotation rates of distant galaxies are far too high to agree with the gravitational attraction of the material in them. We calculate how much material is needed to provide the required gravitational attraction to hold the galaxies together, and then measure how much material we can see, and find it is only about 15% of what is needed. Those galaxies should be flying apart. If the other 85% is present, it seems to be totally invisible, so we call it "Dark Matter".

Most of space is cold and dark, so an obvious starting point was to assume that dark matter is simply ordinary matter that is not being illuminated by anything. However, to be invisible to us it would have to not produce or absorb radio waves, infrared, visible light, ultraviolet radiation or X-rays. In addition, it would have to remain invisible when lying in front of anything that might back-light it. If dark matter were just normal matter, we would have found it. We haven't. It remains a convenient source of gravity to make the calculations work, but frustratingly, nothing much else.

What makes this issue even worse is that dark matter, even if we don't know what it is, seems to be a key ingredient in our universe forming and evolving the way it has. Mix two parts real, visible matter and eleven parts dark matter and we have the recipe for making galaxies, stars and the complex network of strings and clusters of galaxies we see with our telescopes.

The two main ideas we are working on at the moment is that dark matter is made up of "weakly-interacting, massive particles, or WIMPS". The other is that there is no dark matter; the problem lies with our understanding of gravity. Both these possibilities are being vigorously pursued.

To search for new elementary particles, like the Higgs Boson or the WIMP, researchers are using high-energy particle accelerators such as the Large Hadron Collider, located near Geneva, under the border between Switzerland and France. So far nothing like a WIMP has been found.

Newton's concept of gravity works well for calculating the positions of planets and for navigating our way around the Solar System, but we find that under certain conditions small discrepancies turn up between calculations and measurements. Einstein came up with a new concept of gravity as part of his General Theory of Relativity, which accounts nicely for these discrepancies. It is possible that under certain conditions general relativity can be grossly wrong?

Just invoking Magic Stuff X to account for the structure of the universe is not scientifically satisfying at all. On the other hand, knowing the universe is still loaded with big, fundamental questions is reassuring. It's like reading a really good book and knowing that we still have a huge number of pages left for us to read.

Mars and Venus lie in the Southwest after sunset. Venus is very bright. Mars, redder and fainter, lies close to its left. Jupiter rises around 10pm. The Moon will reach First Quarter on the 5th.

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