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# Physicists have opened up a thrilling wonderland



Anjana Ahuja



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This could be the missing link between the visible and invisible universe, writes Anjana Ahuja



A sublime coincidence slipped by unnoticed last month. While audiences were thrilling to premieres of Tim Burton's film *Alice Through the Looking Glass*, in which Alice steps into a strange world where everything is "contrariwise", physicists in Hungary announced they had possibly found the key to an unseen portion of the universe.

The results, which are a talking point in laboratories the world over, are remarkable because they might point to the existence of a fifth fundamental force. The current model for nature's physical laws allows for four forces: the electromagnetic force, the strong nuclear interaction, the weak nuclear interaction, and gravitation. A fifth would, literally, be a force for revolutionary change.

In truth, a revolution is a little overdue. The reason is so-called dark

matter, the hidden stuff that makes up more than 80 per cent of the mass of the universe. Astronomers know it is there because of the gravitational effect it exerts on celestial bodies, but it behaves differently from the matter that makes up the visible world.

One way of investigating matter is to engineer collisions between particles, and then detect the particles that flutter out of the debris; this is how the elementary Higgs boson particle was conjured up at Cern. To this end, Attila Krasznahorkay at Hungary's Institute for Nuclear Physics, fired protons at lithium isotopes, which produced unstable beryllium nuclei. These beryllium nuclei then decayed, as expected, into electron-positron pairs that flew away from each other at various angles.

But, anomalously, these electron-positron pairs seemed to have a fondness for shooting away from each other at 140 degrees. The simplest explanation was a new, intermediate particle in the radioactive decay mix. Calculations suggested a mass of 17 megaelectronvolts (MeV), around 7,000 times lighter than the Higgs boson.

While the Higgs was forecast to exist, this new nimble particle was not. That is why the team spent three years checking their results before going public. It is, as Alice muses while being bamboozled by the Red Queen, exactly like a riddle with no answer.

One exciting possibility is that the new particle is a missing link between our familiar world of matter and the unseen world of dark matter. One theory is that it is a "dark photon", the carrier of an as yet unidentified force that might be connected with dark matter. A reanalysis led by Jonathan Feng at the University of California, Irvine, does not quite support the "dark photon" suggestion but does back the idea that it represents a fifth force operating over super-short distances.

The finding has also piqued the curiosity of those on the DarkLight project, who are exploring the "dark sector" (both dark matter and dark energy), and are looking for dark photons at between 10 and 100 MeV. They will now target 17 MeV as a priority, in an attempt to unmask the same particle.

To say that confirmation would be thrilling is an understatement. The theories of physics may be elegant but they are incomplete, capable of explaining only a small fraction of the observable universe. To uncover a new particle that straddles our visible world and the invisible world of dark matter would unlock a new realm of physics.

Even so, both visible and dark matter together account together for less than half of what we know exists in our universe. The biggest constituent is thought to be dark energy, which, contrariwise, might have nothing to do with dark matter. The more we learn, the more mysterious things become. The White Queen, who took pride in believing six impossible things before breakfast, would surely be clapping her hands in delight.

*The writer is a science commentator*