CAN YOU

Believe it?

WITH ASSOCIATE PROFESSOR DEREK LEINWEBER

Probably certain

Yes, the logic behind the universe is fuzzy...

BELIEVE it or not, science-fiction humour writer Douglas Adams actually got his perspective of the universe right. No, the answer to life, the universe and everything has not yet been proved to be 42. But his idea that the universe is fundamentally weird appears to be true . . .

He writes: "The Infinite Improbability Drive is a wonderful new method of crossing interstellar distances in a few seconds; without all that tedious mucking about in hyperspace. As the Improbability Drive reaches infinite improbability, it passes through every conceivable and non-conceivable point in every conceivable and non-conceivable universe simultaneously. In other words, unless you set the coordinates of where you want to end up, you're never sure where you will end up or even what species you will be when you get there. It's therefore important to dress accordingly."

Adams' take on a space engine can actually be applied to throwing a ball: take a moment to ponder how the ball knows where to go.

I suppose you could say that it is simply responding to well-known laws of physics – mass, acceleration, lift, drag and gravity forces.

But at the most fundamental level – and we're talking subatomic here – there is another explanation.

The science of quantum mechanics would suggest that, in fact, the ball took every possible path in travelling from the thrower's hand to the catcher's.

This includes some paths that you might not think of right away. For example, one should include the improbable path where the ball drops to the ground, skims over the blades of grass and pops up into the catcher's hand.

The point is, that while every path must be considered, some paths are more likely than others. The relative importance of a particular path is governed by quantum mechanics.

In our common, everyday, human-scale of experience the points we can travel through are constrained to a very narrow range. While the more bizarre paths are indeed sampled, their contribution to reality is extremely small.

But at the quantum scale – involving distances of 0.000,000,000,1m or less inside atoms – many paths are simultaneously explored by particles like electrons as they move about.

Perhaps the best example is the famous double slit experiment where electrons pass between two slits in a material before being detected. Experiments have shown that a single electron passes through both slits simultaneously, emerging on the other side to interfere with itself and create interesting patterns in the detector.

At the leading edge of modern theoretical physics, quantum field theories are used to describe the world.

The success is amazing with theory able to describe some experimental results to an astounding precision of one part in a million million, i.e. one part in 1,000,000,000,000.

A key feature of these theories is the need to consider all possible configurations of the particles and find the configurations that are probable. The world is understood to be a simultaneous sorting of all these possibilities into most likely and least likely.

The University of Adelaide's Centre for the Subatomic Structure of Matter (CSSM) calculates the structure and properties of protons, neutrons and more exotic states of matter using these principles.

Since a proton is composed of quarks held together by gluons, theorists at the CSSM create probable configurations for gluons and then probe the manner in which these confine quarks within the proton. The success of these theories leaves no doubt that our world is fuzzy at the smallest scales ever probed. An electron in a material is partially in several places all at once.

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Infinite improbability