Australasian Science
February, 2009
Page: 44
General News
Region: National
Circulation: 9000
Type: Magazines Science / Technology
Size: 307.82 sq.cms
Monthly

Cosmic Coincidence Is Not So Surprising

Rocks like the one that Chas Egan and Charlie Lineweaver are holding are a prerequisite for intelligent observers of the Universe, and took billions of years after the Big Bang to form.

The "cosmic coincidence" is the term given to the observation that we seem to exist at an odd point in the Universe's history. Shortly after the Big Bang, the Universe was dominated by radiation. However, "radiation dilutes faster than matter," says Dr Charley Lineweaver of the Australian National University's Research School of Astronomy and Astrophysics.

As time went on, matter is thought to have come to dominate the Universe's energy budget. However, the density of matter also fell away, leaving dark energy (which changes little, if at all) to become the largest share of the matter and energy in the Universe.

The cosmic coincidence lies in the fact that the point where the proportions of matter and energy in the Universe crossed appears to have occurred relatively recently. The question arises as to whether we should read anything into the fact that we happen to be around so close to this crucial point?

Lineweaver and Chas Egan say that there is no need to twist models of the Universe to explain the cosmic coincidence as it is an inevitable function of the point where observers intelligent enough to notice it can evolve. Lineweaver puts it like this: "If you are walking along a lonely road and you see no cars for ages and suddenly two cars come from opposite directions and cross just near you that seems an odd coincidence. However, if you are waiting at a crossroad and suddenly four cars emerge and all reach the crossroad at just the same time that is much more of a coincidence. And if there are ten cars... So some coincidences are more unlikely than others."

Lineweaver and Egan previously showed that our closeness to the crossover point is remarkable if you plot the changes in energy density on a logarithmic time scale. Such a coincidence needs to be explained, which they did by showing that terrestrial planets could only develop around the point where the concentration of dark energy and matter cross over. If we assume that intelligent observers can only appear when there are terrestrial planets formed to support them, our closeness to this point makes sense.

However, this previous work from the pair used what is now considered standard cosmology. Although this standard history for the evolution of the Universe is dominant, it is not unchallenged, and a number of alternatives known as dynamic dark energy (DDE) models have been proposed.

In order to deal with the coincidence, proponents of some of these alternatives have modified their cosmologies so that matter and dark energy track each other or oscillate in relative concentrations. Rather than us existing close to a one-off point in the Universe's history, these theories propose that dark energy and matter have often, or always, been close to equal in the Universe.

In a new paper published in *Physical Review D,* Egan and Lineweaver extended their work to apply to all DDE models under the assumption that observers arise a few billion years after terrestrial planets appear. "We have shown that this effect is so strong that the coincidence problem vanishes for any dark energy model that fits current observational data," Egan says.

"The results are important for the direction of dark energy research. It means we can focus on other problematic aspects of dark energy with some confidence that there is a reasonable explanation for the coincidence problem, regardless of what dark energy turns out to be."