A science lesson from the dawn of the universe

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While many academics in Ireland and the UK were snowbound at home earlier this month, an intriguing controversy was breaking in the world of physics.

In an article in *Nature* on March 1st, an international group of astronomers based in Western Australia reported the discovery of a radio signal thought to emanate from the so-called "cosmic dawn" – the epoch when the first stars switched on.

In their study of the cosmic microwave background (a faint, ubiquitous, primordial radiation in the sky left over from the early universe), the group detected a signal thought to represent the absorption of this radiation by the very first stars when they formed many billions of years ago. This would be a notable result in itself, as it forms a new piece of supporting evidence for the big-bang model of the evolution of our universe – but the really exciting part is that the long-sought signal was much larger than expected, an effect that is attributed to the presence of dark matter.

For decades now, cosmologists and astronomers have assumed that much of the matter in our universe takes the form of dark matter. A plethora of observations suggest that the cosmos is permeated by this mysterious material that cannot be seen (or heard) by telescope, but is manifest by its gravitational effect on other bodies. Indeed, our best models of the evolution of the universe all assume the existence of dark matter. However, the direct observation of the material, or of the particles responsible for it, has proved remarkably difficult. Thus the new result could represent a very significant scientific advance.

Mini-controversy

If the observation stands, that is. Since the announcement of the Australian experiment, a mini-controversy has broken out in academic coffee rooms around the world and on the internet. Beneath the restrained tones of collegiate scientists, a marked tone of scepticism can be detected.

I find the debate fascinating because it highlights the inherent scepticism of scientists towards new results. For example, a common concern is the simplicity of the "kit", ie the smallness of the apparatus used by the group. Several commentators have declared themselves surprised that such a table-top instrument could have detected a signal that has to date eluded expensive instruments mounted on billion-dollar satellites. Others find it strange that a "little-known" group could have achieved such a spectacular first in this highly competitive field. Still others wonder if the group have truly eliminated all spurious signals in their data (expected due to interference from our own galaxy and other effects).

As always, time will tell. Astronomers worldwide will study the new data in great detail, and it will soon be known if sufficient account was taken of spurious signals. If so, one can expect that a similar signal will soon be detected by other groups with their own instruments.

This is how science works. The default position of the community is generally one of scepticism – an extraordinary result is accepted only if it can be replicated to the satisfaction of other practitioners in the field, a stage sometimes known as the context of justification. Even if the result is replicated, one can expect the interpretation of the data to be questioned by theoreticians for some time.

Some modern philosophers of science such as Thomas Kuhn and Paul Feyerabend have argued that the acceptance of new results in science is heavily influenced by societal factors such as the status of the researcher and the reputation of their institution. I think there is some merit to this argument as regards the initial response to a new finding. However, I doubt whether such influences count for much in the longer term. Over time, a new result is accepted only if it is reproduced by other groups.

My own criticism of the practice of science is that once a new discovery is accepted, we tend to reserve all honours for the pioneers who were the first to discover it, with subsequent experiments seen as "confirmation work". This is quite misleading, as the unsung follow-up work carried out by other groups worldwide plays a crucial role in confirming the discovery. Science is at heart a community activity!

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