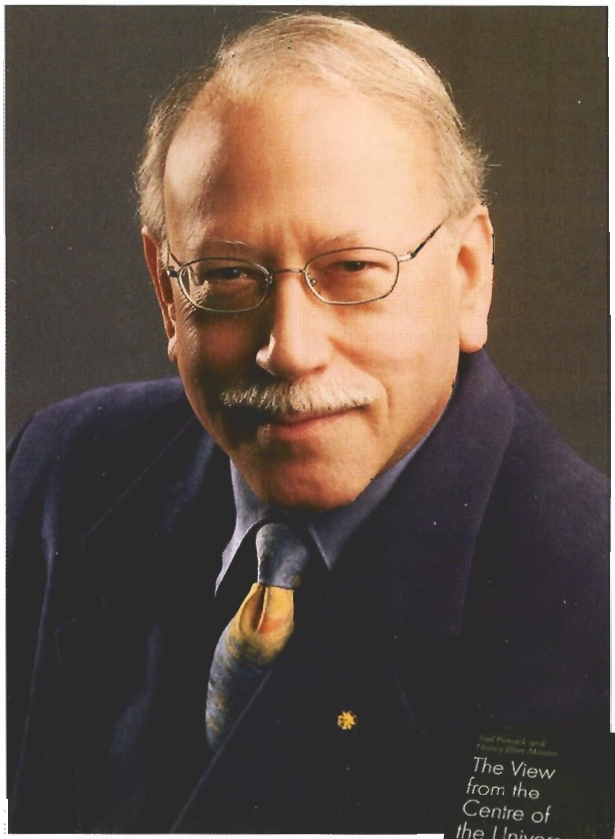
Night Life

Joel Primack established the theory of cold dark matter. He tells **Sarah Reed** how Europe is leading the way to understanding our Universe



Cosmology is a subject that didn't make a lot of scientific progress until the late 1970s, which is when I started to get into it. We now know that the entire visible Universe represents only about half of one per cent of what's actually there. We don't know what most of the Universe is, but we know what its properties are and what effect it has had on the evolution of the Universe. About 70 per cent of what makes up the Universe is what we often call 'dark energy', and about 25 per cent is something we call 'cold dark matter' – a term that I coined. The rest is non-shining, normal matter.

George Blumenthal, a colleague at the University of California, Santa Cruz, and I first came up with cold dark matter theory in 1983, but we called it 'long free-streaming length dark matter' then. When I went to a conference in France to present our work, I talked to Dick Bond, the director of the Canadian Institute for Theoretical Physics, who had done some similar work independently. He also had a cumbersome name for the theory and we realised that if we wanted people to talk about it we needed a catchy name. I don't remember exactly how, it was probably over a few beers, but we started calling it hot, warm and cold dark matter. I used that terminology in my talk and it caught on.

Seeking dark matter

Cold dark matter simply means that the dark matter was moving very slowly when the Universe was young, which preserves the density fluctuations – the seeds of the galaxies we see today – that were present in the early Universe. In contrast, hot dark matter would allow the density fluctuations to spread out until the Universe expanded enough for it to cool. The first structures that would form in a hot dark matter universe would be superclusters (large groupings of galaxies), but we now know that superclusters formed fairly recently and they're not even gravitationally bound. In a cold dark matter universe, galaxies form first, and these are old; they formed billions of years ago.

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There's a very good chance that dark matter will be made in the laboratory when the Large Hadron Collider turns on next year in Geneva. The US has been at the forefront in particle physics for many decades, but we basically said, 'no, we're not interested in this anymore' when we cancelled our next particle accelerator. And there's a real danger the US is doing a similar thing in space by focusing on putting people back on the Moon and giving up on all the deep space, cosmological exploration.

President Bush announced in January 2004 that he had decided the highest priority for NASA is to put people back on the Moon, and eventually on Mars. That completely refocused the agenda for NASA and they've made severe cutbacks on funding for all kinds of pure science.

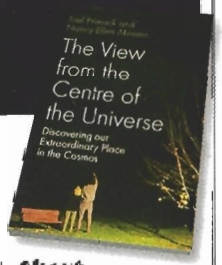
I was asked to chair a committee for the American Physical Society to examine whether this is a good idea. Many leading astronomers in America were on the committee, including a lot of planetary scientists. At our first meeting we immediately and unanimously agreed that the Moon/Mars programme was a disaster. It didn't make sense, not even from the point of view of planetary exploration.

The thing that's so disgusting to me about putting people back on the Moon is that it's been done before. What more are we going to get out of it? We could bring back some more Moon rock, but we haven't yet analysed all the rocks we brought back last time! Why do we want to do that again? Scientifically it's completely useless. Luckily, Europe isn't going in that direction. It will continue to do the best science, doing things that haven't been done before, which is great news for cosmologists all over the world, including me.

More problems to tackle

Nowadays my research has moved away from dark matter. We think we have a basic picture of how the Universe evolved and what it's made of, but we don't really understand how galaxies formed. There are two kinds of structures in galaxies: spheroids (elliptical galaxies and the bulges in spiral galaxies) and discs. We understand discs, but we don't know how spheroids form.

Also, it has been understood now for more than 10 years that supermassive black holes are associated with the spheroids. The supermassive black holes have a mass approximately one thousandth the mass of the spheroid, but we don't know why. This is one of the biggest questions in cosmology, and that's what I'm working on now. ✪



About Joel Primack

Joel and his wife Nancy Ellen Abrams have recently written a book called *The View From The Centre Of The Universe*. On next month's coverdisc you can listen to an interview with Nancy about the book and the impact of cosmology on culture.

PAUL SCHRAUB