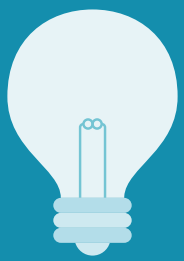
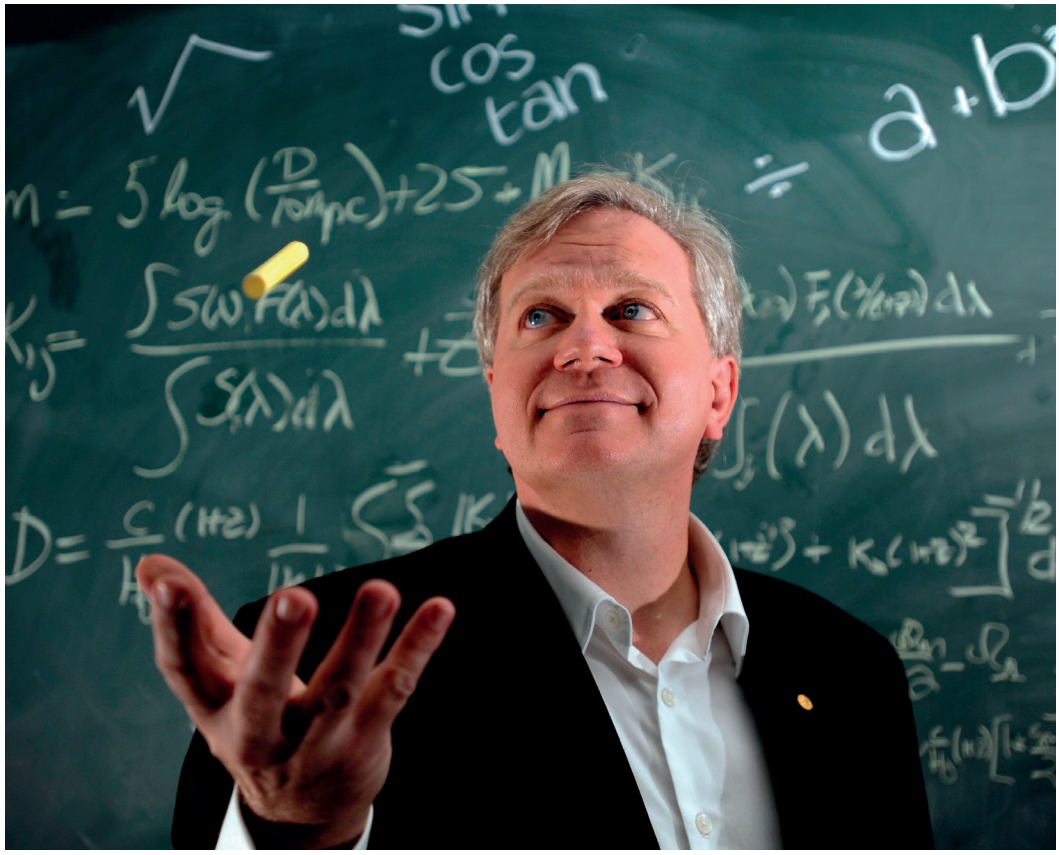


THE **STORIES**

09



FAIRFAX SYNDICATION

Brian Schmidt

Proving That The Universe Is Speeding Up

Nobel Prize winning astrophysicist, and newly appointed Vice-Chancellor of the Australian National University (ANU), Brian Schmidt says conferences have been an invaluable part of his life's work; work that has radically reshaped our understanding of how the universe functions and where it may be headed.

"Astronomy without conferences would mean a bunch of little people working on things without understanding what everyone else in the world was working on, so they are absolutely core to what we all do."

What Schmidt and his fellow researchers have 'done' to earn them the Nobel Prize in Physics was to challenge and disprove one of the most basic assumptions upon which their field of science had been based.

Thanks largely to Einstein's 1915 theories on the forces of gravity, there has been general consensus that, although the universe is still expanding, its rate of expansion is slowing, perhaps for eternity, or perhaps eventually stopping and then reversing – into something of a pre-'big-bang' cosmic arrangement.

But in 1994 a handful of cosmic scientists began tracking and recording massive exploding stars called supernovae and soon found themselves trying to make sense of unanticipated research findings that challenged this long-held assumption of a decelerating universe.

American born, but a self-proclaimed and now official Australian, Schmidt credits Australia's approach to science and discovery for giving him the freedom to explore and expand upon what their research was telling them, but admits even he doubted the validity of their initial findings because they went against all he'd previously been taught to be true.

"When we first started seeing the data (more than 3 years after embarking on the experiment), I remember just thinking, 'Oh jeez, we've made a mistake. What have we done wrong?'"

Over the next several months, Schmidt, who led the international collaboration, High-Z Supernova Search Team, worked with Dr Adam Riess from the Space Telescope Science Institute in the US, checking and rechecking every step they'd taken, searching for the source of their error,

but every time the conclusion was the same: the distant exploding stars were showing that the universe was speeding up, rather than slowing down.

In other words, the speed at which our universe was expanding was actually increasing over time – not decreasing – as had previously been assumed.

Their discovery of the accelerating universe was of such significance that in 2011 Schmidt and Riess, and Saul Perlmutter (who led a rival US team that had reached the same conclusion as Schmidt's team in 1998), were jointly awarded the Nobel Prize in Physics. It was one of the few times the prize had gone to astronomers, and according to National Geographic, was perhaps the most important scientific discovery of the last quarter of the 20th century; the most important of the previous quarter century being the discovery of DNA.

So why is this new information so important, and how does it help us into the future?

Essentially, apart from resolving a lot of the previous problems of cosmology and giving clearer, more accurate directions for future research, the observations led scientists to ask what was causing the acceleration, and hence laid the groundwork for the discovery of 'dark energy' – a previously undetected form of matter with very low density.

Difficult to measure or validate in laboratory testing, there are two leading models that explain dark energy, but both agree that the common characteristic is that it must have negative pressure, and that it acts upon itself in a repulsive manner.

In simple terms, it is this negative pressure that has gravity pushing this energy (which pervades all of space) apart at an ever increasing rate over time.

And whilst these discoveries are only the first step in predicting what our universe's final outcome might be, these scientists have at least set us on a path of greater understanding and uncovered a previously unseen force that is already determining the fate of distant celestial giants.

Brian Schmidt was born in Montana in 1967, the only child of parents just out of their teens. He developed a love of science whilst pottering in the lab and collecting specimens in the wild with his father, who was working on his PhD as a fisheries biologist. From his mother, a champion debater with qualifications in speech and communications, he learned how to move and motivate others with words. The young family shifted house constantly as he grew, and by 14 he had called 13 different places home, which gave him confidence in new situations and taught him how to easily make friends.

Initially leaning towards a career in meteorology, he shifted to astronomy after a school placement at a weather bureau left him disappointed. Bored with the party scene as an undergrad at the University of Arizona, he took on extra subjects (doing two degrees in the time most people take to do one), conducted his own research projects on the side, and still had time at his disposal to pursue his love of bread and pastry making. After graduating with great academic results, he moved to Harvard, where he did a Masters and then a PhD in Astronomy, and says it was only then that he really began to do serious science.

It was also then that he was introduced to conferences, and quickly came to understand the important role they could play in his life.

"My adviser, Robert Kirshner, came up to me in 1990 and said, 'You need to go to this conference in Les Houches, France' – in the middle of the French Alps – I looked at him and said I didn't have enough money to go, but he said, 'Oh no, no, I'll pay. You'll go there and you'll learn and you'll do stuff.'"

Whilst at Les Houches, Schmidt had the opportunity to meet experts in his field and make important connections with other researchers working on similar projects. One such connection was with a student from Chile, who was being supervised at the time by renowned US (and Chilean-based) astronomer, Nicholas Suntzeff.

"He invited me to visit him, so about a year later I went off to Chile for six weeks. I became very good friends with Nick while I was there, and after that I visited them on a regular basis and of course we'd meet up at conferences and things along the way, so it just became a very close relationship.

"It was my first conference experience, and to this day, one of the best. It was amazing, and brought me in contact with all of the leaders of the field and really those leaders – those relationships persist to this day."

He says conferences are the sites where you really find out what's going on in astronomy; what's leading us, what's important, where ideas mix.

"Science is so international; you have to travel. The internet is not perfect. You cannot spend weeks in conferences with people via the phone; it just doesn't work. You have to travel if you're going to communicate ideas. And so as a scientist you get to travel. I remember being overwhelmed at being able to do that."

Schmidt says Suntzeff became one of his mentors, and in 1994 they co-founded the High-Z (Z means redshift) Supernova Search Team, which led to the Nobel Prize.

Another important connection established while at Harvard was with Australian economics PhD candidate Jenny Gordon, whom he married in 1992. One rule they agreed upon was that they both needed to find work in the same city – so when Brian was offered a three-year position at Mt Stromlo at the Australian National University in Canberra, Jenny (today an economist with the Australian Productivity Commission) jumped at one of the many opportunities that Canberra afforded her.

But the first Australian to win a Nobel Prize for Physics in nearly 100 years, and now Vice-Chancellor at ANU, says he came close to leaving the field altogether in 1997: his post coming to an end, Schmidt applied for a research fellowship, but only succeeded in achieving fourth in line for the position.

"It was looking like I might have to return to the States for work or, more likely, do something else, but then, interestingly, the other three people who'd been ranked ahead of me turned it down, so they gave it to me! It was very soon after that I helped discover the accelerating universe, and so I guess my career was pretty well solidified from there on."

Schmidt says it's the personal interactions that occur at conferences that are the most important element, and one which technology can't provide.

"You might be able to support interactions with other people with technology one-on-one or even group-to-group, but you can't have 2 000 people or even 200 people show up on a video link. I've done those and they're terrible! They've really been bad."

He says technology has a place for supporting ongoing collaboration, but only once a personal relationship has been established in a setting such as a conference.

"What I find is if I build a relationship with someone in person at a conference, then I can follow it up with Skype or hopefully a TelePresence-like technology that's a bit better, and that way, you can maintain that relationship. But you do need to meet people in person that you're working with, in my opinion, every year or so, and then you can have those regular meetings by video."

He also believes one's potential to learn from attending a conference is much greater than that which can occur from reading research papers.

"When you read papers, it's dry, and it's hard to separate out the interesting bits from the non-interesting bits. They tend to be single things without a lot of reference to everything else. But at conferences, people are putting their latest work into context with everything that everyone else is doing, so you can really get a snapshot of the field as it is at that time, in a way that you just don't get from any other avenue."

And for students trying to get their head around new and complex concepts, Schmidt believes conferences are even more valuable in terms of their ability to make content stick.

"If you've got a student, and you tell them to read a million articles, maybe one per cent will be useful for them.

"But if you send them to a conference, then they get an instant snapshot of where the whole field is, which is much more useful."

Schmidt, who attends many conferences across the world each year and hosts quite a few in Sydney with his own team, says he comes away from most conferences with a list of new ideas or questions to investigate.

"To be honest, many of my ideas come from attending conferences and I just go out with a list of things I need to think about."

In fact, Schmidt estimates an astounding 75 per cent of all research papers he's written have one way or another come out of a conference.

He says that, whilst the concept of an accelerated universe wasn't a specific idea gleaned from a conference, the collaborations he established with the people he met at conferences, as well as some of the applications he has used in the projects, have definitely made a huge contribution.

"Some of the gamma ray burst stuff that I've done, which are the biggest explosions in the universe, came from a conference I attended.

"I realised I could develop some of the technology they were using, combine it with a telescope we had here in Australia, and use some of the software from the accelerating universe project to look for transient objects quickly, so the conference jump-started that research, and that's probably the second biggest thing I've done in my career."

He says seeing technology used by others at conferences can open up windows in your mind as you imagine the applications you can find for it in your own area of research.

"You'll see someone using a new piece of equipment somewhere in the world, and you'll realize you'd be able to use it here.

"At the moment we're looking at [a] new type of imager much stronger than ours which came specifically from talking to someone at a conference about how it could be used. It was a new technology, a new infrared sensor technology that can essentially take images at many hundreds of times per second, which is a new thing we just weren't able to do in the past.

"Now, thanks to the conference, we know about it and want to bring it to Australia.

"It's kind of hard to pick examples about where and how conferences have helped, because they're just such an important part of literally everything we do."

So, for Schmidt, whose theory of an accelerating universe brought him and his team a place in the record books and international acclaim, and whose discoveries have focused the astronomical community upon completely new horizons, just how important have conferences been – not only to his own career but to the inspiration, creation and diffusion of ideas and knowledge throughout the scientific community?

"Well, I think they're pretty close to ten out of ten," he insists.

"I mean, without conferences, productivity would dramatically drop, so to me, they're pretty much essential. And as far as my own career goes, that first conference I went to in France was such a special moment, and an amazing opportunity because it just set the stage for my whole career, and you only get one of those in your life ... [It's] why I always make sure that my students are able to go to them. It's one of the things I prioritize over almost anything else."