Plasma tubes drifting over our heads

Physics student makes a stunning discovery

BY VERITY LEATHERDALE

“Scientists believed these structures existed but...we’ve provided visual evidence that they are really there.”

By creatively using a radio telescope to see in 3D, astronomers have detected the existence of tubular plasma structures in the inner layers of the magnetosphere surrounding the Earth.

“For over 60 years, scientists believed these structures existed but by imaging them for the first time, we’ve provided visual evidence that they are really there,” said Cleo Loi of the ARC Centre of Excellence for All-sky Astrophysics (CAASTRO) and School of Physics at the University of Sydney.

Ms Loi is the lead author on this research, undertaken as part of her award-winning undergraduate thesis and recently published in Geophysical Research Letters. In collaboration with international colleagues, she identified the structures.

“The discovery of the structures is important because they cause unwanted signal distortions that could, as one example, affect our civilian and military satellite-based navigation systems. So we need to understand them,” Ms Loi said.

The region of space around the Earth occupied by its magnetic field, called the magnetosphere, is filled with plasma that is created by the atmosphere being ionised by sunlight.

The innermost layer of the magnetosphere is the ionosphere, and above that is the plasmasphere. They are embedded with a variety of strangely shaped plasma structures including, as has now been revealed, the tubes.

“We measured their position to be about 600 kilometres above the ground, in the upper ionosphere, and they appear to be continuing upwards into the plasmasphere. This is around where the neutral atmosphere ends, and we are transitioning to the plasma of outer space,” explained Ms Loi.

Using the Murchison Widefield Array (MWA), a radio telescope located in the Western Australian desert, Ms Loi found that she could map large patches of the sky and even exploit the MWA’s rapid snapshot capabilities to create a movie - effectively capturing the real-time motions of the plasma.

“We saw a striking pattern in the sky where stripes of high-density plasma neatly alternated with...
Science Alliance wishes Year 12 students all the best in their final exams. To assist students achieve the best results, we have two exciting upcoming HSC revision opportunities in areas of Biology, Chemistry, Physics, Earth and Environmental Science and Senior Science.

Kickstart in the School Holidays
The Kickstart Science Workshops are aimed at HSC science students. Kickstart workshops give HSC students a chance to do experiments and demonstrations of key ideas in the syllabus that are difficult to do in the classroom. Kickstart Biology, Chemistry and Physics are running in the June School Holidays at the University of Sydney (Camperdown campus). Students can register individually to attend these sessions. For more information and to make a booking please visit sydney.edu.au/science/outreach/high-school/kickstart/school-holidays

Sydney University & STANSW HSC Science Revision Days
The University of Sydney is hosting the The Science Teachers’ Association of NSW 2015 HSC Science Revision Days. The event brings together students with highly qualified science teachers to prepare them for the Higher School Certificate Examinations. Experienced presenters, who have been involved in all stages of the HSC process, will deliver workshops providing students with hints and strategies to enable them to improve their HSC performance in Physics, Biology, Chemistry, Earth & Environmental Science and Senior Science. For more information visit sydney.edu.au/science/outreach/high-school/stansw/revision-days

stripes of low-density plasma. This pattern drifted slowly and aligned beautifully with the Earth’s magnetic field lines, like aurorae,” Ms Loi said.

“We realised we may be onto something big and things got even better when we invented a new way of using the MWA.”

The MWA consists of 128 antenna ‘tiles’ spread over an area roughly three by three kilometres that work together as one instrument - but by separating the signals from tiles in the east from the ones in the west, the astronomers gave the MWA the power to see in 3D.

“This is like turning the telescope into a pair of eyes, and by that we were able to probe the 3D nature of these structures and watch them move around,” said Ms Loi.

“We were able to measure the spacing between them, their height above the ground and their steep inclination. This has never been possible before and is a very exciting new technique.”

This ability adds yet another accolade to the MWA’s name after it had already proven its worth as a powerful precursor instrument to the Square Kilometre Array (SKA), and now the MWA’s 3D vision has the potential to provide many more in-depth analyses of the formation of plasma structures.

“It is to Cleo’s great credit that she not only discovered this but also convinced the rest of the scientific community. As an undergraduate student with no prior background in this, that is an impressive achievement,” said Ms Loi’s supervisor Dr Tara Murphy, also of CAASTRO and the School of Physics at the University of Sydney.

“When they first saw the data, many of her senior collaborators thought the results were literally ‘too good to be true’ and that the observation process had somehow corrupted the findings, but over the next few months, Cleo managed to convince them that they were both real and scientifically interesting.”

Ms Loi has been awarded the 2015 Bok Prize of the Astronomical Society of Australia for her work. View the video of Cleo’s work here.
We must inspire the next generation of scientists.

The Federal Minister for Industry and Science has officially launched a teaching academy dedicated to excellence and innovation in the teaching of mathematics, science and technology.

Last night Professor Ian Chubb, the Chief Scientist, gave an official address at the opening of the STEM Teacher Enrichment Academy at the University of Sydney, the first of its kind in Australia.

STEM refers to science, technology, engineering and mathematics.

A recent Australian Industry Group report forecast STEM job demand — ranging from mining engineers to chemists, software programmers to agricultural scientists — to grow at almost twice the pace of other occupations.

“We must inspire the next generation of scientists and ensure that our graduates have both the academic foundations and the best practical skills to succeed in business or industry.”

The Academy is the brainchild of anonymous donors, who gave $5 million to make it possible. They were inspired to encourage young people to consider advanced STEM skills as vital to their future prospects.

They had seen how in-service training of teachers overseas had been successful; they recognised a need in Australia, and knew we could make it work here too. They decided that the University of Sydney - with our tradition of excellence in training teachers - is just the place to do it and we are honoured to be able to realise their vision,” said Dr Michael Spence, Vice-Chancellor and Principal of the University of Sydney.

The Academy draws on expertise from three of the University’s faculties.

In collaboration with highly-experienced teachers and principals advising the Academy we are perfectly positioned to contribute to the future of STEM education,” said Associate Professor Anderson.

The faculty of Education and Social Work, provides outstanding expertise in teaching and learning; the Faculty of Science offers its experience and understanding of recent developments in science; the Faculty of Engineering and Information Technologies helps teachers incorporate real-world problem solving examples into their teaching.

The Academy also offers new teachers professional development and mentoring to become STEM ambassadors. In the USA, the NASA Pre-Service Teacher Institute has had outstanding success with this model.

All teachers participating in the Academy will also have ongoing access to an online centre providing events, advice and resources.

Learn more here.
During my PhD, I had novices come into the lab to smell and taste lots of wines. In most cases, we had them in the lab for an hour and they didn’t learn much. But if they stayed just 30 minutes longer they started to show signs of improvement and after four hours, they were doing really well. They weren’t experts by any means, but it didn’t take them years to get the hang of it, either.

No expert became an expert by drinking only their favourite wine. Branch out, be willing to try new things. Try wine by the glass at bars and restaurants rather than buying a whole bottle. Try wines made from different grapes, from different regions and countries.

Odour memory is quite robust but, just like any other type of memory, it is prone to interference and forgetting. Instead of relying on your memory to compare the wine you’re drinking now to the one from last week, open up a few different bottles at the same time so you can directly compare them.

The main skill of wine experts is consistently putting a name to an odour. Wines that smell like blackcurrant aren’t made from or with blackcurrant and they don’t look like blackcurrant. It’s hard to identify a smell when you can’t visually associate it with the obvious source. In fact these wines contain chemicals that, when isolated, smell very much like blackcurrant.

So get a friend to go through your pantry and pick out various herbs and fruits. Smell and taste them with your eyes closed and try to identify them. Learn from feedback. It’s hard but you’ll improve over time.

Not sure what peach tastes like in a Chardonnay? Add a little bit of syrup from a can of peaches to your next
glass. Then you'll get an idea of what the flavour tastes like in wine. Gradually reduce the amount you put in until you can find that flavour without any additive. There are hundreds of possible odours coming out of a glass of wine including chocolate, green olive, eucalyptus and coffee!

You might be a food or perfume expert but you'd still have to separately master wine and its associated lingo.

Wine expertise is all about linking an odour or flavour with its recognised name. Experts share information using similar terms whereas novices generally can't describe wines very well and don't know many of the experts' tasting terms.

Many studies show no difference between the smelling sensitivity of novices or experts. Essentially, experts smell and taste the same things novices do, but they're better at processing the information. Similarly, chess experts can look at the same board as novices but will determine which pieces are immediately relevant more quickly - it's a processing advantage.

Although price isn't the best indicator of quality (which is fairly subjective), it is often the case that more expensive wines better reflect where they come from. And learning about wine regions is part of being an expert. Wine experts aren't just good at tasting wines. They also know a lot about how it's made, where it's made, and all the other things that you read in wine books.

A lot of people avoid wine-tasting games because they are afraid to fail. But it's OK to make mistakes. A famous French experiment in which white wine was artificially coloured red with odorless dye wrong-footed lots of experts. It highlighted the impact of our thoughts and expectations on what we taste in a wine - it's almost like they 'drink the wine with their eyes'. Even experts can get it wrong but they more often get it right.
First World Problems: Ancient Solutions

A modern take on ancient Aboriginal knowledge in response to the book *D’harawal Seasons and Climatic Cycles* (by D’harawal Elder Aunty Fran Bodkin)

BY SHANNON FOSTER, D’harawal Saltwater Knowledge Keeper

It’s June. According to the four seasons of the European calendar it’s winter. Summer is over, the cold weather has moved in, plants have become dormant and all of the animals are hibernating. Really?

So why am I scraping sticky, squashed berries off the bottom of my ugg boots and dodging (not easy in uggs) the violent onslaught of territorial, nesting native birds? Perhaps the answer lies in the ancient knowledge of the local Aboriginal people, my family, the D’harawal.

For over 20,000 years the people of the D’harawal Nation have inhabited the area from the southern shores of Sydney Harbour to as far south as Jervis Bay and inland up to 50kms or more. Here in the Sydney basin the D’harawal clans shared the land and its unique resources and knowledge with their neighbours including the Cadigal, the Cammeraigal and the Wangal.

With this 20,000 years of observation the D’harawal have devised a system of deciphering the natural indicators of the Sydney region in order to anticipate seasonal, climatic change. We now recognise this as the Six Seasons of the D’harawal.

At this time of year — around May, June or July — the Time of the Burrugin or echidna begins in Sydney and you can expect short, cold frosty days. The season is signified by the mating of the echidna and the flowering of the delicate blooms of the burringoa or gum tree (*Eucalyptus tereticornis*). During this time male echidnas can be found forming long lines behind females as they follow her through the bush hoping to mate. Now, you may not find amorous echidnas roaming the streets of Sydney, but you will definitely notice the many Australian native birds that also start their nesting season at this time — after all, it is kind of hard not to notice the aggressive swooping and screeching of the territorial native miners and magpies as they try to take your eyes out while you collect the mail. And if the birds aren’t enough to deal with, then dusting the delicate, white gum flower snow off the windscreen of your urban assault vehicle before you get going in the morning is a sure way to start the day with maximum irritation.

As the Time of the Burrugin ends and you find yourself now going insane scooping wattle flowers out of your infinity pool and dealing with the deafening noise of the cockatoos tearing the trees to shreds, then you can safely say it is the next season which is the Time of the Wiritjiribin or lyrebird. The days are cold and windy and the lyrebird is busy nesting and calling in preparation for the arrival of a mate. It is a time when the Sydney landscape is iridescent with the intense yellow flowering of the golden wattle. And oh, what a sinus inducing combination! High winds and soft, fluffy, honey scented, high-pollen-count flowers. Achoo! To the power of ten.
So if hay fever isn’t keeping you awake, the nightly rantings of our next featured animal certainly will. The next season, the Time of the Ngoonungi or flying fox marks the arrival of warmer weather, but it’s still a little fresh for what is commonly known to Europeans as spring. When the Gymea Lily has come into full bloom and the flowers are starting to dry up, it is time for the D’harawal to make their way out to the coast to sing the whales home from their migration. Evidence of thousands of years of this journey has been documented by the D’harawal in the extensive rock engravings of southern right whales and orcas on the sandstone outcrops along the Sydney coastline.

When the whales have finished their migration, the D’harawal know that the hot, stormy weather is coming and the next season, the Time of the Parra’dowee or short finned eel begins. While the D’harawal are observing the migrations of the eel and go out prawning on moonless nights, Sydney siders would be best to bring their washing in off the line before the afternoon sets in because the storms will arrive out of nowhere. This season is wet and warm, flooding is common so don’t camp near rivers, carry an umbrella and remember to put your car windows up even on the driest, brightest sunny days.

Coming right up will be January and February which will not surprisingly be hot, and not altogether dry, this is the Time of the Burran or kangaroo. While Sydney siders are decimating sausages, steaks and rissoles on the Weber, the D’harawal are cleverly forbidden to eat meat. Hunting occurs in the morning, eating occurs in the night and food poisoning occurs on the hot days in between. Not only that, but it’s bushfire season and the lighting of fires is forbidden by the D’haramuoy or Keeper of the Flame.

So if you’re not indulging your inner carnivore, what can a hungry D’harawal eat? Paleo enthusiasts will be beside themselves to hear that finger staining dianella berries are now plump, juicy and ripe. The tubers of flowering plants are fat and delicious and the witchetty grub is a high protein delicacy found in the trunks of the banksia trees here in Sydney.

Coming right up in March, April and May, before the European designated winter period, is the high humidity Time of the Marrai-gang, the spotted tail or tiger quoll, a small Tasmanian-devil-like marsupial that can be heard growling and screeching in the night on the lookout for a mate. The lilli pilli is berrying (not at all dormant considering it is technically autumn) and the magenta, crunchy, miniature-apple-like fruits are a favourite for birds, animals and members of the clan. Sadly though, you won’t see the nocturnal quoll on your late night dash to Woolies as the spotted quoll is now virtually extinct in the Sydney region, but you can bet your life if you’re scraping hardened, purple bat and bird lilli pilli poo off your car, the Time of the Marrai-gang has well and truly settled in.

As you notice the overripe lilli pilli berries start to fall from the tree and stain the unsealed, natural stone pavers in your recently renovated alfresco dining area, we have come full circle and the Time of the Burrugin returns. All Sydney siders know to enjoy the cool because before you can say “go get the Karcher” another year will pass and the Time of the Lilli Pilli Bat Poo will be back again and you would be smart to take the sound, ancient advice of the D’harawal (via this modern, concrete Koori) and give your car a good wax and polish. Believe me, it is much easier to scrape partially digested, berry jam concrete off a clean, well-polished car.
Happy international year of light to you all!

BY ADAM SPENCER,
MATHEMATICS AND SCIENCE AMBASSADOR

It’s ok if you didn’t know – we’re all very busy – but 2015 is the UNESCO International Year of Light (and Light-Based Technologies).

Let’s be honest, light rocks! There’s still a lot we don’t know about it, and we are constantly striving to harness more of its potential, but the centrality of light to human existence can’t be doubted.

One of the most enjoyable events I’ve convened as the University’s Ambassador for Mathematics and Science was ‘Enlighten: Our brightest minds reveal how light transforms your life’. The event occurred in late May in the Great Hall and showcased the research of six of the University’s best and brightest who work with light.

Astrophysicist Dr Tara Murphy spoke on working on the Square Kilometre Array; psychologist Professor Bart Anderson blew minds with his optical illusions; illumination designer Associate Professor Wendy Davis talked about lighting the homes of the future; biologist Professor Min Chen shared the hidden potential of light in photosynthesis; robotics engineer Dr Ariell Friedman spoke on light in the darkest recesses of the deep ocean; and optical physicist Dr Darren Hudson ‘Mr mid-infrared fibre laser’ took the packed audience on a journey through what light means to us.
A highlight of the night was that outside the Great Hall, the annual Vivid Sydney festival of light and sound was in full swing and as we adjourned to the cloisters to sample some of the hands-on activities and displays of our speaker’s work, members of the public unaware of the event we’d hosted walked on through and took part. Trust me, seeing yourself in infrared light never gets dull!

This was a perfect example to me of what our University does and must continue to do well. Not only are we a home for tremendous minds and research, we also recognise the importance of sharing that work with policymakers, friends of the University and the scientists of tomorrow.

In writing this piece, I am painfully aware that the event was tremendously oversubscribed and some of you reading this may well have missed out. Please don’t feel aggrieved – I can assure you that there is a tremendous array of events run by the Faculty of Science that you might enjoy. For example on Wednesday 19 August ‘Time After Time: Measuring evolution with molecular clocks’ is happening as part of the Sydney Science Forum. Hop online at sydney.edu.au/science/outreach/whats-on to find out more and get yourself a seat at this free event.

Anyway until we next meet, happy International Year of Light. Shine on!

Images of the Enlighten event held in the University of Sydney’s Great Hall and Quadrangle. Photos: Edwina Jones
It’s a very rare event when optical physics, visual neuroscience and textile technology combine to take over the Interwebs, but it almost happened in February 2015.

I'm talking about the famous Blue Dress. It's the one that two people can look at, but one sees it as blue and black while the other sees it as white and gold. More accurately, this happens only in this photo. The blue and black dress looks blue and black in the shop window.

(Spoiler Alert – it’s 'just' a lovely optical illusion.)

It all began with a wedding on the Scottish island of Colonsay. The mother of the bride wore a dress bought from a British retailer, Roman Originals, for 50 Pounds. The bride posted a photo of the soon-to-be-famous blue and black dress online. Very rapidly, this optical illusion became famous and even warranted its own hashtag #TheDress. At its peak, over two-thirds of a million people were looking at this photo at the same time on Buzzfeed. Celebrities were polarised in their views. Taylor Swift Tweeted that she was “confused and scared” and saw a blue and black dress. Kim Kardashian saw a white and gold dress, while her husband, Kanye West saw a blue and black one.

So what’s going on? It’s a six-part answer – with five definite Do-Knows, and one Don’t-Know.

First, the dress is actually blue and black. If you use the picture-editing app called Photoshop, you can analyse individual pixels and see that the dress is in fact blue and black.

Second, the eye is easily fooled with perceiving shades and colours. The eye-brain combination is NOT good at judging the absolute
colour of anything, but it's excellent at comparing. So while you can’t accurately estimate that the wavelength of a colour is exactly 575 nanometres, you can say whether it’s more red than another colour. There are so many optical illusions that use this. For example, the same chess piece can look black or white, depending on its background colour.

Third, in fact, the eye-brain combination tries really hard to maintain what the visual neuroscientists call 'colour constancy'. Consider a white sheet of paper. It just reflects whatever the ambient light colour is. It will be white in bright sunlight, but under the red lights of a nightclub it will be red.

But this change of colour bothers your brain. So your brain has evolved colour constancy, where it ‘adjusts’ or compensates for the ambient light, removes the reddish influence of the nightclub lights, and suddenly the sheet of paper looks white – even though it’s reflecting red light and actually looks red.

Colour constancy is a survival advantage. A red apple always looks the same colour, whether that particular food item is in the shade or in sunlight.

So what you ‘see’ is a combination of three factors – what the true colour of an object is, plus any colours right next to it, plus the overall ambient lighting.

Fourth, the photo of the now-famous blue and black dress is, purely by accident, beautifully ambiguous. There is no bare skin – which always gives you a good idea as to the true colour. There are no other dresses in the photo, such as a white wedding gown, which could give you a clue.

All you get is the fabric of the blue and black dress – and an out-of-focus band of background brightness on the right side of the photo. This might make you think that the front of the blue and black dress is in shadow.

But, at the top of the dress is a bolero jacket of shiny fabric that is partly reflective. This is essential for helping to create this optical illusion. Visual neuroscientists call the mirror-like reflections on the shiny part of an object ‘specularities’.

Specularities can give you the best clue as to the actual colour of the ambient light. In this case, the specularities give you the impression that the dress was well-illuminated from the front.

Fifth, we can now put it all together. If you assume that the front of the dress is in shadow (thanks to the bright blurry background light), your brain will apply colour constancy and remove the blueish hue of the shadow – and bingo, the dress is white and gold.

But if you assume that the front of the dress is well lit (thanks to the shiny reflections on the top panel of the dress), you will see the dress as blue and black.

So that’s what we know.

And finally for Item Six – which is what we don't know.

Why do some people assume shadow and a white dress, while others assume brightness and a blue dress? We don’t know. As far as we know, it’s not related to your emotional state of mind, or your intelligence or emotional intelligence.

As in all visual illusions, we’ve been blinded by the light...

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A number of recent industry reports identify an urgent need for Australia to lift its performance in the area of science, technology, engineering and maths (STEM). All those looking for ways to encourage their students to consider pursuing STEM studies need look no more. The verdict is out – the future will be powered by STEM. But Australia is lagging and unless some worrying trends are reversed, we won’t have the STEM graduates we need to meet future demands.

Many business leaders have taken up the mantra espoused by Professor Ian Chubb, the Chief Scientist of Australia, that Australia’s collective ability to innovate in the age of disruption relies on a stronger commitment to advancing STEM skills. Speaking at the National Press Club in May, the Business Council of Australia’s Chair Catherine Livingstone cited a publication from McKinsey: “We have reached the point where a confluence of trends, digital disruption, shifts in the locus of economic power, globalisation and demographic change - each of which on their own would rank among the strongest economic forces the global economy has ever seen, are casting our world into a completely different reality.”

Ms Livingstone said that the gap between the digital literacy of Australia’s young people and that of competitor nations is increasing. “If we want increased productivity and participation, we need urgently to embark on a ten year plan to close that gap. This will be essential to tackling structural youth unemployment,” she said, calling for foundational STEM skills to be introduced into the primary and pre-primary curricula.

“By STEM skills, I mean maths and science, yes, but also computer coding, computational thinking, problem solving and design thinking.”

International benchmarks
Research released by the Australian Industry Group shows a steady decline in educational standards, with Australia underperforming in maths and science in international benchmarks for primary and high school. Even more concerning is our ranking last on international comparison of university and business innovation partnerships from the OECD. Another paper from PWC reports that while 75 per cent of the fastest growing occupations, including those in the creative industries and humanities, will require STEM related skills and knowledge, only 16% of high school graduates pursue degrees in STEM disciplines. In launching its STEM paper, PWC’s CEO Luke Sayers warned that today’s skills shortage will worsen if business and industry continue to ignore the digital disruption that is transforming the global economy and making many of today’s jobs redundant.

“Business is already struggling to find the right skilled talent for their workforce, and digital disruption is putting more jobs at risk,” he said, reflecting on his personal interest in this issue from the perspective of a parent. “If we do not act quickly, our children will pay the price for our failure to adapt and respond.”

He said Australia does not need more accountants and lawyers, professions among the 40% of jobs that are at risk of becoming automated in the near future, and remarked that PWC, a global consulting company, is in the process of reinventing itself in preparation for the day in which accounting will be automated. He also indicated that the company would be looking to hire more STEM graduates in future to ensure that people with strong critical thinking ability and problem solving skills can progress into senior roles.

The verdict is out – the future will be powered by STEM.
Adding its voice to the debate is BHP Billiton, who has announced a $22 million partnership with the Australian Mathematical Sciences Institute to encourage women and girls to study maths. CEO Andrew Mackenzie said the program aims to change the perception that girls are less suited to maths and other STEM subjects than their male colleagues.

“Australian industry knows that STEM professionals are vital to our future prosperity, national productivity and global competitiveness,” he said.

With 123,000 employees worldwide, many of them STEM professionals, BHP Billiton is also taking steps to ensure a pipeline of young people who choose to study STEM subjects – including women.

What can teachers do?

So what is the role of education amidst all these calls to action? And how can teachers help develop appropriately skilled STEM students who will be able to meet the complex challenges of the future economy? These are questions for which there are no easy answers.

Supporting STEM teachers, particularly those who teach maths, has been identified as a key priority. The introduction of mathematics prerequisites for tertiary study is being hotly debated, and making the curricula more interesting are just a few of the responses. In terms of how teachers can get more youngsters engaged with STEM subjects and the exciting career paths that will align with the jobs of tomorrow, there are lots of ideas about how to make subjects more appealing and bring technology into the mix.

Presenters at a Sydney conference dedicated to Improving STEM Education & Skills urge schools to offer integrated learning around problem solving in addition to teaching subjects in silos. Projects that involve all disciplines, including computer studies, English, art and design, have been highly effective in engaging students to solve real world problems. Dedicated STEM days are used by many schools as a way to foster energy and excitement and bring teachers from different disciplines together to support and learn from each other. Realising that today’s students are digital natives, many schools have found that incorporating technology and design bringing computer coding into projects helps spark interest.

With a crowded curriculum and so many assessment tasks to complete, finding the time to deliver integrated STEM learning is not easy. But many teachers are finding ways to get more creative in their approaches to STEM learning with great results.

The Inspiring Australia initiative in NSW is managed by University of Sydney in partnership with the Commonwealth Department of Industry and NSW Trade & Investment. Find out more about the Inspiring Australia program in NSW
Like many pests, cane toads are killed in their thousands in Australia every year, especially by community-based ‘toad-busting’ groups. New research has now revealed the most humane way to do it.

“We need to offer a humane death to the toads - it’s not their fault they were brought to Australia 80 years ago - but until now nobody has been sure how to do it,” said Professor Rick Shine, from the University of Sydney’s School of Biological Sciences.

He is lead author on research showing that a once-popular method, currently outlawed nationally and internationally by animal ethics committees as inhumane, is actually a simple and ethical way to kill a toad. The research by the University of Sydney, Monash University and the University of Wollongong is published today in the journal Biology Open.

The researchers implanted small data-loggers in the brains of cane toads to measure any pain responses. They then put the toads into a refrigerator for a few hours, before transferring them to a household freezer. The toads quietly slipped into unconsciousness as they froze, and their brains did not register any evidence of pain during the process.

Professor Shine said: “This procedure was a widespread method for humanely killing amphibians and reptiles for many years until about 20 years ago, but animal ethics committees decided it was inhumane because the animals’ toes might freeze while their brains were still warm enough to detect pain. However, our work shows that in cane toads at least, the toad just drifts off into torpor as it cools down, and its brain is no longer functioning by the time its body begins to freeze.”

Researchers generally kill animals like cane toads humanely by using specialised chemicals, but these chemicals are not available to the general public. The research provides a simple solution to a difficult dilemma for the Australian community in areas that struggle with large populations of cane toads, such as in the Kimberley region of Western Australia, the Darwin region of the Northern Territory, and coastal Queensland.

“Current ethics regulations recommend that the general public kill cane toads by hitting them on the head with a hammer - but a slight misjudgement may result in severe pain for the toad, and a splash of toxic poison up into the hammer-wielder’s eyes,” Professor Shine said.

“Popping toads into the fridge for a few hours to cool down then moving them to the freezer beside the ice cream is kinder and safer for everyone involved.”

A short video of Professor Shine explaining the findings can be seen here.
TIME AFTER TIME: Measuring Evolution with Molecular Clocks
Presented by Associate Professor Simon Ho, School of Biological Sciences, Faculty of Science, the University of Sydney

Associate Professor Simon Ho will reveal how molecular clocks use statistical modelling to describe the evolutionary process at the genomic level. Important areas of research can benefit from molecular clocks, such as the emergence and evolution of viruses, and impacts of humans and climate change on evolution. Discover how molecular clocks are uncovering our past and predicting our future.

CATCH CO₂: Getting Creative about Climate Change
Presented by Dr Deanna D’Alessandro, School of Chemistry, Faculty of Science, the University of Sydney

Dr Deanna D’Alessandro will reveal her work with Chinese, European and US colleagues to push carbon capture technologies to the demonstration phase and into industry. Can we make our fossil fuel energy sources a little less harmful with carbon capture?

GALLOPING GENES: Equine Genetics in the Racing Industry
The 2015 JD Stewart Lecture
Presented by Dr Natasha Hamilton, Faculty of Veterinary Science, the University of Sydney

Find out when Dr Natasha Hamilton shares her research on genes for galloping and DNA for dashing. Dr Hamilton investigates the genetics underlying not only racing performance, but also novel traits such as career length and susceptibility to certain diseases. Find out if there really is such a thing as pedigree perfection and race winning genes.

Register here: sydney.edu.au/science/outreach/forum