CAASTRO Newsletter Edition 12, 2014

INTRODUCTION FROM CAASTRO DIRECTOR

It's a pleasure to introduce this latest edition of the CAASTRO Newsletter. As you know, Prof. Bryan Gaensler stepped down as CAASTRO Director on 15 September 2014 in preparation for his move to Canada as the new Director of the Dunlap Institute for Astronomy and Astrophysics at the University of Toronto. I took over as CAASTRO Director on the same day, and I am grateful to all those at CAASTRO who helped to make the transition as smooth as possible. I have been involved with CAASTRO since its earliest days, and am excited by the possibilities which lie ahead. I look forward to working with all of you over the coming years.

Bryan Gaensler's contributions to CAASTRO as its Foundation Director have been immense, and we were glad to have the chance to acknowledge them in a formal way when we farewelled him at the recent CAASTRO retreat in Queensland. Bryan will remain involved with CAASTRO as a Partner Investigator when he moves to the University of Toronto, and plans to return to Australia regularly.

The past few months have been particularly busy with preparations for the ARC's Mid-Term Review of CAASTRO, which took place in Sydney on 12 November. While we do not yet have the formal report from the review panel, the informal feedback which they gave us on the day was very positive. Members of the review panel were enthusiastic about all aspects of CAASTRO's activities, including the excellent collaboration between nodes, the enthusiasm of our students and postdocs, and the success of our mentoring and outreach program. They especially commended CAASTRO's gender equity activities, saying that our work in this area was a model for other organisations to emulate. I would like to express my thanks to all of you who travelled to Sydney to meet the panel and helped to make the day a success, and to Kate Gunn and the admin team for ensuring that the day ran like clockwork. Thanks are also due to the CAASTRO Advisory Board and their Chair, Dr Alan Finkel, both for their valuable support in preparing for the review and for travelling to Sydney to meet with the review panel.

The 2014 CAASTRO Annual Retreat took place in relaxing surroundings at Twin Waters, Queensland, from 19-21 November, attended by almost 100 members of CAASTRO. We enjoyed a stimulating program of science talks and networking activities, including invited talks from overseas visitors Prof. Volker Springel (Heidelberg) and Dr Huib Intema (NRAO).

The ASA's inaugural Pleiades Awards were announced earlier this month. These awards recognise organisations in Australian astronomy that take active steps to advance the careers of women through focused programs and strive for sustained improvement in providing opportunities for women to achieve positions of seniority, influence and recognition.

CAASTRO was one of only two organisations to win a Silver Pleiades award, and the feedback from the awards committee noted that: "We consider CAASTRO to be a leader in encouraging greater gender equity in astronomy in Australia, and many of the initiatives taken up by the project, such as encouraging flexible and part-time working, have been picked up by other astronomy groups." It was also gratifying that all our Collaborating Universities also all achieved Bronze Status, and CAASTRO"s two Australian Partner Organisations also gained awards with a Silver award to AAO and Bronze to CSIRO Astronomy and Space Science. This outstanding result is a tribute to the efforts of Bryan Gaensler, Kate Gunn and the CAASTRO Executive over the past three years, as well as the recent work of CAASTRO's Gender Action Committee. Congratulations to all those involved.

Congratulations to CAASTRO Executive member Brian Schmidt on the award of the 2015 Breakthrough Prize for Fundamental Physics, which was presented at a star-studded ceremony in California last month. The prize was shared with a larger team, including CAASTRO PIs Warrick Couch and Reynald Pain and AIs Brian Boyle and Chris Lidman.

CAASTRO researchers continue to be highly productive, with the number of our publications increasing every year. Over 80 papers have been published in the first ten months of 2014, and 2015 looks certain to be another bumper year as new projects and facilities come online.

I wish all of you a restful and relaxing holiday break, and a happy and successful New Year in 2015.
Elaine Sadler
CAASTRO Director

RESEARCH UPDATE

Largest-ever study of galaxy motions

In general, galaxies 'go with the flow': they move further apart as the Universe expands. But that's not the whole story. Galaxies are also drawn together by gravitational attraction. And this gives them an additional component of motion.

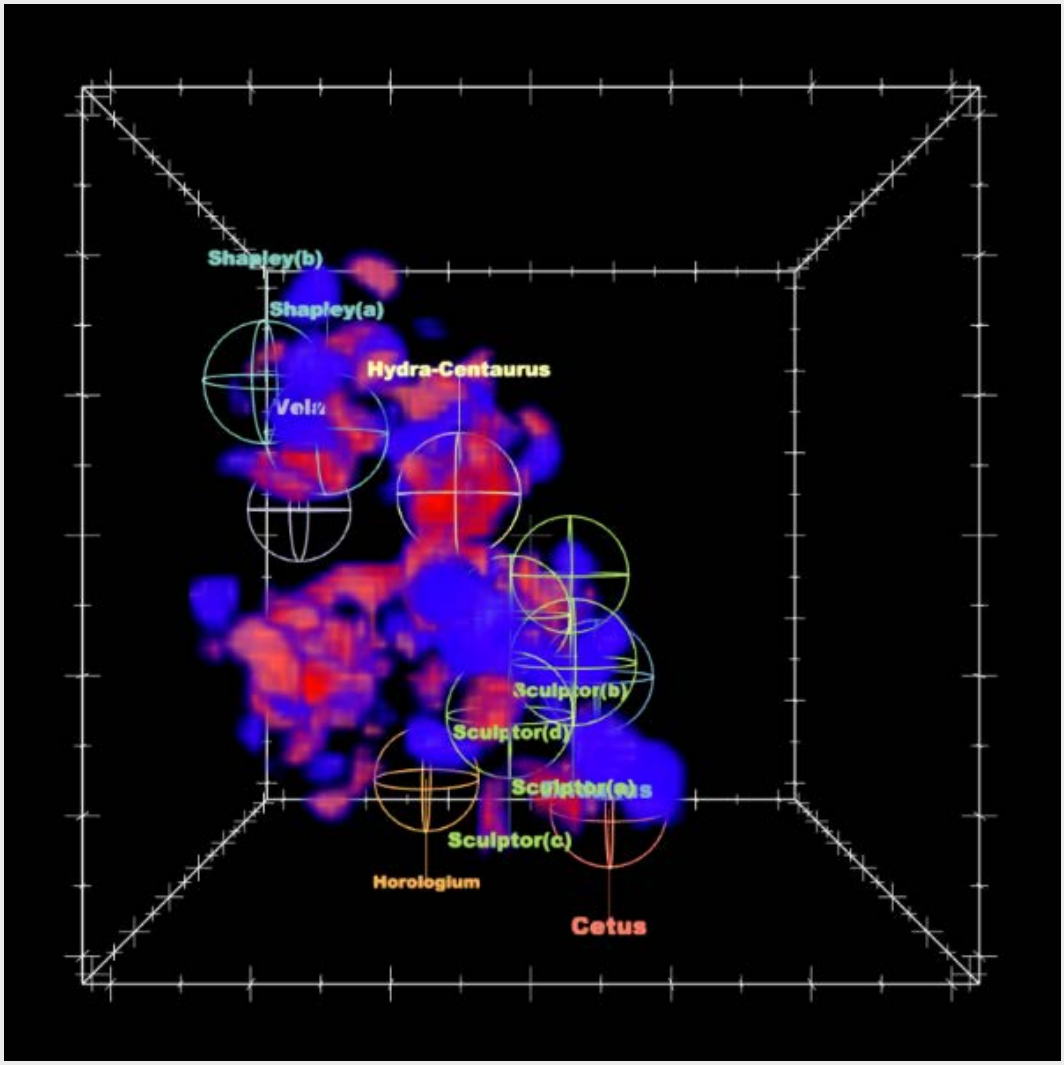
By measuring the speed and direction of galaxies' individual movements, researchers can map the gravitational forces that are tugging on the galaxies, and so determine how matter, seen and unseen, is distributed. Researchers recently used this technique to define the 'Laniakea supercluster': the relatively nearby galaxies, including our Milky Way, that are being drawn together by gravitational attraction.

Now Christopher Springob (ICRAR/UWA) and colleagues have publicly released data on the movements of almost 9,000 galaxies—double the number measured by the largest previous homogeneous study of this type. And those galaxies are spread over a region that is 1.5 billion light-years across and nearly ten times the volume of the Laniakea supercluster. The size of this survey will allow researchers to test for the first time if our local region is representative of the Universe as a whole, and whether our standard

cosmological model correctly predicts galaxy movements.

Publication

Christopher M. Springob, Christina Magoulas, Matthew Colless, Jeremy Mould, Pirin Erdoğdu, D. Heath Jones, John R. Lucey, Lachlan Campbell, Christopher J. Fluke. "The 6dF Galaxy Survey: Peculiar Velocity Field and Cosmography". http://arxiv.org/abs/1409.6161



The 'smoothed' dataset of galaxy motions. Red indicates regions where galaxies are moving away from us and blue, regions where galaxies are moving towards us. Labels refer to superclusters of galaxies. The box is 1.5 billion light-years on each side. Interactive 3D plots of the data.

Painting neutrinos into a corner

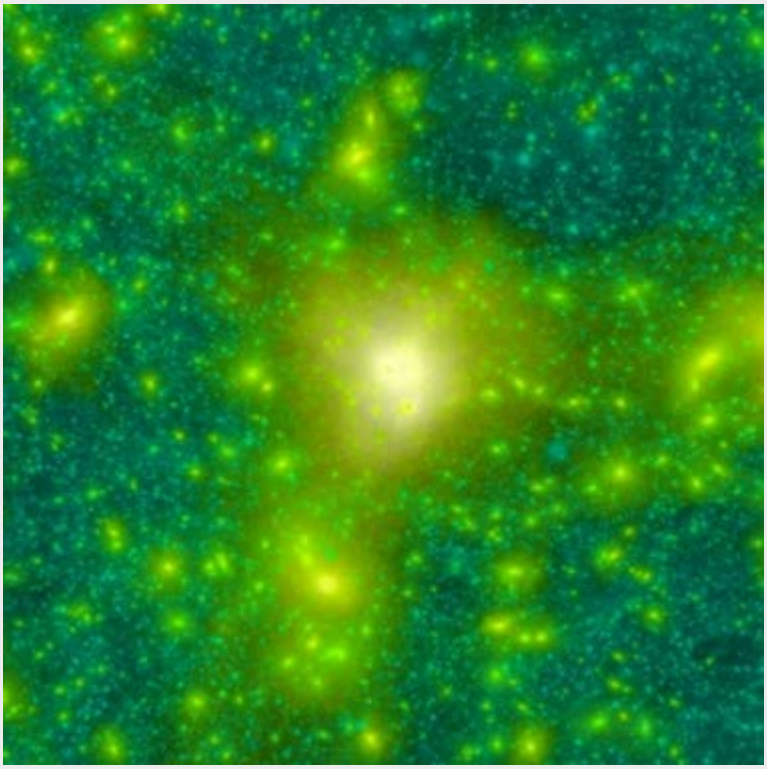
As elementary particles go, *neutrinos*—'little neutral ones'—are not newcomers: they were proposed by physicist Wolfgang Pauli in 1930 and revealed by experiment in 1956. The 'Standard Model' of particle physics says they are massless. However, experiments and observations have shown otherwise. This makes the neutrino the only confirmed particle that doesn't fit the Standard Model (which is otherwise extremely successful).

Now Signe Riemer-Sørensen (University of Oslo) and her colleagues David Parkinson and Tamara Davis

(both University of Queensland) have painted neutrinos even further into a corner. By adding extra data from the WiggleZ survey to the dataset used by the Planck team, they have pushed the upper mass limit down to 0.18 eV—an improvement of over 25%.

Publication

Riemer-Sørensen, Signe; Parkinson, David; Davis, Tamara M. "Combining Planck data with large scale structure information gives a strong neutrino mass constraint." Physical Review D, Volume 89, Issue 10, id.103505. http://arxiv.org/abs/1306.4153



A simulation of the Universe, generated from data from the WiggleZ survey. Credit: Gigaparsec WiggleZ Survey Simulations; Greg Poole/Swinburne University

Hints of a pulsar in SN1987A

CAASTRO celebrated the 25th anniversary of SN1987A earlier this year, at the 'Supernovae in the Local Universe' meeting. For almost all of the quarter century since the star exploded, astronomers have been on the look-out for a pulsar within the supernova remnant. Now a paper by Giovanna Zanardo (UWA) and colleagues presents the most intriguing signs to date that there may be one there after all.

Using ALMA (the Atacama Large Millimeter/submillimeter Array) and ATCA (the Australia Telescope Compact Array), Giovanna and her colleagues examined the radio emission, both thermal and non-thermal, across the remnant. Across the transition from radio to far infrared, both the synchrotron/dust-subtracted images and the spectral energy distribution suggest emission additional to the main synchrotron component and the thermal component originating from dust grains.

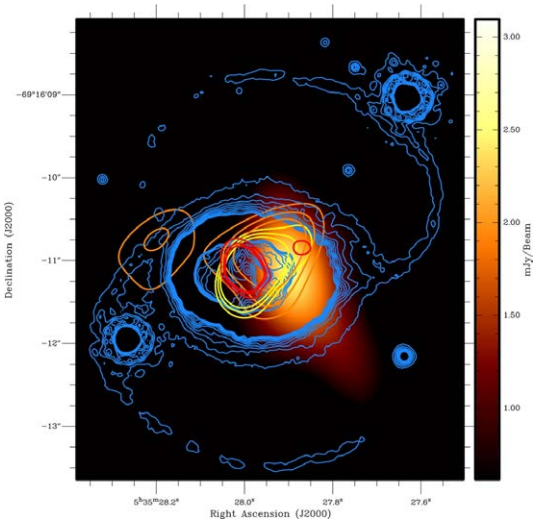
While this excess could be due to free-free flux or emission from grains of colder dust, the spectral energy distribution is better fitted by a second flat-spectrum synchrotron component. This implies that the excess emission could arise from a pulsar wind nebula. The excess emission appears mainly within the western regions of the remnant, suggesting that, if there is an embedded pulsar, it may lie at a westward

offset from the explosion site.

What's needed to clinch this, says CAASTRO Deputy Director Lister Staveley-Smith (UWA), one of the paper's authors, is confirmed pulses, whether at centimetre radio wavelengths, in the millimeter regime, or at optical or X-ray wavelengths. "We are trying with Parkes," he said, "but there is a lot of ionised material to look through."

Publication

Giovanna Zanardo *et al.* "Spectral and morphological analysis of the remnant of supernova 1987A with ALMA & ATCA." *ApJ* **796,** 82 (2014) doi:10.1088/0004-637X/796/2/82



Comparison of the diffraction-limited images of SNR 1987A at 102, 213, and 345 GHz, as obtained after subtraction of the scaled model flux density at 44 GHz, with the optical image of the remnant. In detail, the residual image at 102 GHz (brown–yellow color scale) is overlaid with the contours outlining the residual images at 213 GHz (orange) and at 345 GHz (yellow). To locate the main sites associated with dust emission, the diffraction-limited image at 672 GHz is also outlined (red). Images at 213, 345, and 672 GHz are overlaid with contours at 3σ, 4σ, and 5σ flux density levels. The HST image (Larsson et al. 2011) is outlined via contours (blue) that highlight the structure of the outer rings, the equatorial ring, and the ejecta. (Figure 5, Zanardo et al. 2014)

CAASTRO Theme Updates 2014

Evolving Theme:

The SAMI Galaxy Survey is in full swing with an early data release of 107 galaxies in July this year. In addition four early sicence papers were published. These discoveries ranged from a large-scale galactic wind in a normal star-forming galaxy to a study of the dynamics of a large sample of galaxies, suggesting that group environments are very important to galaxy formation.

We have an even more exciting result now, with a brand new detection of HI gas in a young radio galaxy, witnessing its adolescent state over 4.6 billion years ago. We have used the optical data from the Gemini South Telescope to establish that some of the gas from neutral ISM has been caught up in an outflow that is being driven by the radio jets towards us. This is the first blind detection of HI absorption with the ASKAP BETA array and has demonstrated the unprecedented quality of the telescope and Murchison Radio-astronomy Observatory for exploring more 7 billion years of galaxy evolution

In October 2014, after several short deployments in remote locations of Western Australia, the BIGHORNS system equipped with periodic log spiral antenna was permanently deployed at the Murchison Radio-astronomy Observatory (MRO). So far, nearly two months of multi-purpose science quality data were collected. The data are under analysis which aims in assessing the significance of the ionospheric effects on the detection of the global Epoch of Reionisation (EoR) and eventually obtaining

constraints on the EoR. The data collected at the MRO are also used for studying other phenomena, such as RFI statistical analysis and propagation monitoring, which are essential for the SKA-low activities.

Dark Theme:

The CAASTRO Dark Theme saw a very successful year of research in 2014. A number of key results were produced across all the Dark Theme projects, and major observational and theoretical campaigns within the Theme made major progress during the year.

In the Peculiar Velocity Surveys project, the final 6dFGSv (6dF Galaxy Survey velocities) sample of peculiar velocities was released (Chris Springob) along with a thorough description of the velocity field of nearby galaxies. 6dFGSv was also employed to measure the bulk flow of the local universe (Morag Scrimgeour) and for the first time to measure the growth rate of structure on scales larger than ~100 Mpc (Andrew Johnson). A complementary measurement of the local bulk flow was made using the 2MTF (2MASS Tully Fisher) sample of galaxies (Tao Hong).

The Dark Theme also produced several important results in Type Ia Supernovae project. Richard Scalzo produced a series of papers that modeled the bolometric light curves of nearby SNe Ia to measure the ejected mass, and thus progenitor mass, of these SNe. Importantly, he showed that SNe Ia arise from two populations: one consistent with the (expected) Chandrasekhar mass, and another strongly favouring sub-Chandra mass progenitors. Meanwhile, the OzDES survey (PI: Chris Lidman) conducted a successful second year of collecting SN Ia host galaxy redshifts with the AAT, and is preparing a number of papers for publication in 2015.

The Large Scale Structure project made important progress on a number of research efforts. These include numerous results form the WiggleZ survey, such as improvement of the BAO measurement using the technique of reconstruction (Kazin), measurement of the Hubble constant evolution using radial BAO techniques (Kazin, Davis, Sanchez, Blake), joint measurement of growth of structure with BOSS (Marin), measurement of cross-correlation with lensing (Beutler), and use of the galaxy bispectrum to constrain non-gaussianity (Marin, Blake). Data from the GAMA survey is also being used for a number of research efforts in progress, including measurement of power spectra with a clipped density field, and using voids for an Alcock-Paczynzski test and cross-correlation with outflowing galaxies.

Finally, 2014 saw the official formation of the Dark Theory and Simulations project. Jun Koda developed the COLA (COmoving Lagrangin Acceleration) code to produce fast simulations for testing many cosmologies quickly, and employed the code to show that upcoming peculiar velocity surveys will indeed be competitive cosmological probes. Katie Mack presented the "known unknowns" of dark matter annihilation and the resulting uncertainties on what signal strength might be expected from cosmological dark matter annihilation. And work is underway to improve the accuracy of power spectrum models as well as create new models in different theories of gravity.

Dynamic Theme:

The Dynamic Theme has been very energetic over the past few months and progress has been made on all four of the major projects.

Some pulsars highlights include: as part of one of the SKA Pre-construction Working Groups, the development of the pulsar timing engine for the central signal processor is making good progress (Barr). An artificial neural network to classify pulsar survey candidates has been developed to improve the detection accuracy of the Parkes Pulsar survey (Morello, Barr) and using the upgraded Molonglo

telescope, which is commissioning its new digital receivers and GPU-based high performance computer backend, there is now daily timing of 15 pulsars with 10 μs precision (Flynn, Jankowski). In addition to this using Very Long Baseline Interferometry at low frequencies and speckle patterns of pulsars, it is possible to see the motion of the pulsar spinning (Pen, Macquart)

Fast radio bursts (FRBs) continue to be a highlight. The 1000-hour Survey for Pulsars and Extragalactic Radio Bursts (SUPERB) is now taking data and making real-time detections with full polarisation information. Up to 10 telescopes are poised to respond to triggering of a multi-wavelength campaign. A collaborative agreement with the gravitational wave experiment LIGO has been reached (Keane). The most exciting discovery of an FRB in real-time with the Parkes telescope has been achieved. Alerts were given to several telescopes although no counterparts were detected this time. The first detection of circular polarisation from an FRB was made (Petroff). In addition the MWA is now running an FRB detection/imaging pipeline (Tremblay, Tingay).

Optical transient discovery and follow-up is progressing well. A study of the range of ejected mass distribution of Type Ia supernovae (SNe) has discovered that the masses of the progenitor stars may play an important role in the supernova explosion characteristics. These SNe are crucial standard candles for cosmic distance estimates. (Scalzo). Research on the collision rates of white dwarfs and the implications has been also been undertaken (Baumgartner)

In Slow radio transients a strategy to optimise the observing program of ASKAP/SKA surveys for slow transients is being developed (Macquart), and a study of radio transient source classification based on their luminosity and time dependence has been made (Keane). A metric to compute the expected probability of detecting short-term variable sources with the MWA has been calculated (Trott).

Roger Ressmeyer / CORBIS

CAASTRO OUTREACH PROGRAM

This term saw a very busy National Science Week with our industry partners, Voyages Indigenous Tourism, as we sent four prominent astrophysicists to the Uluru resort for the Astronomy Weekend hosted by Dr Karl Kruzselnicki. Then down in the Yarra Ranges we once again worked with the Mount Burnett Observatory for their astronomy festival, Stars in the Yarra Ranges. Six members of CAASTRO gave talks at the four evenings throughout the week, talking about astronomy and their research to the locals. Videos of all these events can be found on the CAASTRO YouTube channel. We also sponsored the Science Alert tour by Commander Hadfield, A Space Oddity, with Prof Brian Schmidt and Dr Katie Mack making appearances with the famous astronaut during his Sydney and Canberra shows.

Meanwhile, this year the Astronomer in Residence program continues to forge ahead with a total of 14 astronomers spending two weeks each with Voyages helping out with the astronomy program and telling the public about their research. While we are taking a break over the next few months, next year's program will be extended to 18 residences and a whole new group of astronomers. Follow the program on Twitter @CAASTROatUluru

Pint in the Sky has produced a new episode and we look forward to Alan Duffy and Katie Mack talking about all facets of astrophysics on their podcast next year.

Last month was the CAASTRO ARC mid-term review and we really enjoyed showing off all of our amazing outreach programs over the last four years. The committee was very impressed with the enthusiasm everyone spoke about these initiatives, from students to directors, let alone the programs themselves. We are extremely proud of our Outreach program and we look forward to improving and expanding it in 2015.

The Annual Retreat is always a great way for all members of CAASTRO Australia-wide to catch up and talk science. We held our annual ECR workshop the day before, where Early Career Researchers looked at project management and implementation. The ideas were very creative; one project included building a life-size Death Star. Great to see our ERC's thinking outside the square. During the retreat we also had a 60 second smart phone video competition where each group had to "Pitch their Research". What resulted were more creativity, humour and fierce competition. All the videos are now up on our YouTube channel.

Uluru Astronomy Weekend, 22-24 August 2014

For the closing weekend of National Science Week, I was lucky enough to be part of a brilliant astronomical outreach event at Uluru (Ayers Rock). It had been widely advertised and so the resort was packed – not just with amateur astronomers but with families and individuals who wanted to combine a trip to this national icon in the Red Centre of Australia with a taste of what cutting-edge science has to offer. For three days my colleagues and I gave talks and participated in discussions, gave guided tours of the sky, and just sat and chatted with people over the odd beer or two.

Prof. Steven Tingay from Curtin University got schoolkids and grandfathers working together to build a real working radio telescope then and there. Prof. Bryan Gaensler from Sydney University showed how the extreme Universe can stretch our minds, while Prof. Rachel Webster from Melbourne University exposed the Dark side of the Universe. And I described the depth and complexity of ancient Aboriginal astronomical knowledge, which has not only provided Aboriginal people with calendars and navigation, but shows how Aboriginal people thousands of years ago figured out how the sky works.

The highlight for me was probably the panel sessions, in which members of the audience would toss us some curly question about the Universe, invariably resulting in an argument between the astronomers on stage, brilliantly hosted by science celebrity Dr. Karl Kruszelnicki. "What's the next Big Discovery?" "Dark Matter!", "Dark Energy", "No it's something we haven't thought of yet!"

Or maybe the highlight was when someone over dinner asked me about the expansion of the Universe, something that had puzzled them for years: "Where's the centre of the expansion? What's it expanding in to?". Questions like these are bread and butter to most astrophysicists, and it's incredibly satisfying to work through that knowledge in a one-on-one discussion with someone with a thirst for understanding.

Or was the highlight standing under the ink-black sky, pointing out the Aboriginal "Emu in the Sky" constellation, hearing the unprompted gasps of amazement as people suddenly "got it" for the first time. No, don't look at the stars, look at the dark spaces in between, and it's not that big, it's T-H-A-T big!

Or perhaps the highlight was when I was describing my own research on the evolution of galaxies, and I suddenly saw it from the perspective of the audience. In our work-life as astrophysicists, we tend to immerse ourselves so deeply into our subject, so focussed on the details, that we sometimes lose the big picture of why this is important, how privileged we are to be employed to tackle some of the biggest questions in the history of the Universe. One of the things I love about outreach is that it reminds me why I do astrophysics!

These were many other highlights, too numerous to list here. Transplanting cutting-edge astrophysical knowledge into a magical place with incredible landscape and stunning ink-black skies, immersed in an Indigenous tradition going back thousands of years, was a brilliant coup.

As we caught our plane back to Sydney, I found out from my fellow-passengers, who had been in the audience, that they had enjoyed it as much as I had! But I wonder if they realised that I had also learned as much from the weekend as they had?
Professor Ray Norris

Student Committee Update

In 2014 the CAASTRO Executive decided, in agreement with CAASTRO students, to create the CAASTRO Student Committee. This committee was established with the purpose of increasing interaction between students and other groups within CAASTRO, and thereby improving the overall outcomes for CAASTRO students.

The Committee consists of a member from each Node, and represents the full diversity of CAASTRO membership. This means that every student has a local representative to whom they can relate their concerns or ideas, and that the full range of values and perspectives is represented.

The first meeting of the Committee was held in October, under the Chair of COO Kate Gunn, and established the Terms of Reference and elected Steven Murray (WUWA) as the first student Chair. We have established two broad objectives, namely the promotion of student involvement, and the representation of student concerns to the Board.

In the first few months, the Committee has agreed on several initiatives under the rubric of the broad objectives. These include holding annual sessions with third-year and new postgraduate students to advertise the work of CAASTRO and inform them of the role they can play in it, development of a student "cheat sheet" to bring students up to speed on their role and priviledges in CAASTRO (housed on a dedicated web-page), and monthly local-area meetups for all CAASTRO students (and potentially postdocs) for the purpose of networking and brainstorming ideas.

We look forward to a productive first year for the Committee, with clear benefits for the students of CAASTRO.

MEMBERSHIP UPDATE

CAASTRO now has 160 members. We welcome our latest team members:

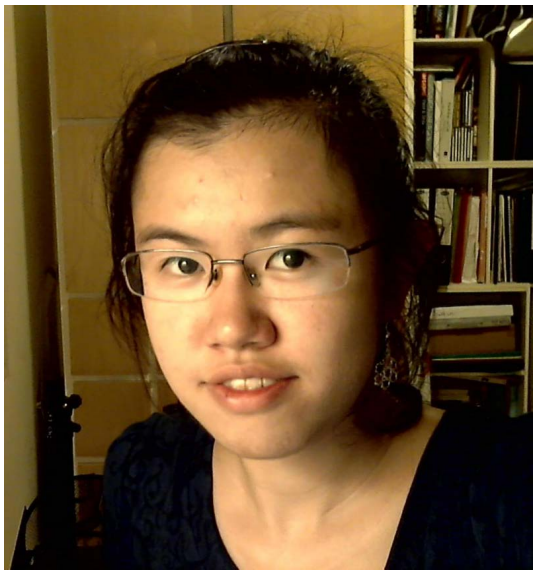
Dr Laura Wolz, University of Melbourne

Dr Ixandra Achitouv, Swinburne University of Technology

Dr Dan Taranu, University of Western Australia

Dr Antonia Rowlinson, CSIRO

CAASTRO MEMBER PROFILES



Cleo Loi (USYD) PhD Student

I joined CAASTRO at the beginning of 2014 as an Honours student at the Sydney Institute for Astronomy, supervised by Tara Murphy. For my undergraduate degree at the University of Sydney I majored in physics and mathematics, and minored in IT. During my Honours year I was a member of the Murchison Widefield Array (MWA) Collaboration. The MWA is an innovative low-frequency radio telescope. One of the challenges facing radio observations at low frequencies is the distortion of radio waves arising from propagation through the Earth's plasma environment.

Waves and density irregularities in the plasma can cause refraction and scintillation of radio waves, and this may pose difficulties for the automated cross-matching and light-curve classification of radio sources.

The aim of my Honours project was to quantify the effects of these distortions on MWA transient science goals. Reassuringly, it turned out that typical levels of plasma fluctuation produce angular offsets smaller than the telescope resolution, and so are not large enough to affect cross-matching. The physically compact size of the MWA reduces the risk of decoherence, and so measured variations in flux density are mostly dominated by image RMS. An unexpected and eye-opening outcome of my project was the realisation that the MWA is in fact an exquisitely sensitive probe of the Earth's plasma environment. Its huge field of view enables it to image the ionosphere and plasmasphere on regional scales, something which has not been possible before with other radio telescopes. I am excited by the novel capabilities that the MWA and similar instruments have to offer, and look forward to seeing where they will take us in the future.

Jacinta den Besten (UMEL), Education and Outreach

My studies at University of Melbourne were at the School of Physics in condensed matter physics and proton diffraction. While there, I

developed a love for teaching and completed my Dip Ed in Physics, Science and Mathematics.

From there I taught secondary school and with my students, discovered the world of astronomy. A family break meant that in 2011 I started looking for work and ended back in the School of Physics, but this time on an outreach program called Telescopes in Schools. CAASTRO has been a long time sponsor of the TiS program and helping out Wiebke on some of her Outreach commitments while she took her own family break was an easy and enjoyable role to step into. I have enjoyed the extra challenges CAASTRO have provided, the great opportunities and getting to know so many astronomers Australia wide.

Edward Macauley (UQ), Research Staff

I joined CAASTRO this September as a new postdoc at the University of Queensland. I've previously worked as a postdoc at the University of Sussex and the University of Oxford - where I was also a PhD student. My main research interest is testing fundamental physics with cosmological surveys. I'm particularly interested in peculiar velocities and weak lensing surveys, because both methods map out the dark universe directly, via purely gravitational effects. My previous research has focused on peculiar velocities, studying bulk flows and the growth of density fluctuations. I'm currently working to analyse and combine tracers of gravitational lensing and supernova peculiar velocities from the OzDES survey. This should improve the accuracy of the supernovae as standard candles, and also provide new cosmological insights directly from the fluctuations.

AWARDS AND RECOGNITION

Associate Professor Tamara Davis, who leads CAASTRO's 'Dark' theme, is to receive the 2015 Nancy Millis Medal for Women in Science from the Australian Academy of Science. The Nancy Millis Medal recognises early-and mid-career women scientists who have demonstrated exceptional leadership and established an independent research program in any branch of the natural sciences. It honours the contributions made to science by the late Professor Nancy Millis

AC MBE FAA FTSE and recognises her importance as a role model for aspiring female scientists in Australia.

Professor Brian Schmidt shared the 2015 Breakthrough Fundamental Physics award for 2015. The prize was shared with a larger team, including CAASTRO PIs Warrick Couch and Reynald Pain and AIs Brian Boyle and Chris Lidman.

CAASTRO student Samuel Hinton has just made many astronomers' lives a whole lot easier—and has won an award for his trouble. Samuel, a software engineering student at the University of Queensland, has received the 2014 Student Thesis prize given by the Queensland chapter of the Institute of Electrical and Electronics Engineers (IEEE).

For his thesis Samuel developed new software for a CAASTRO-supported project, the OzDes redshift survey. Called *Marz*, the software greatly speeds up the process of obtaining redshifts from the OzDes observations.

"The user can simply drag and drop a FITS file into the program, and the file is then automatically processed and redshifted using a cross-correlation algorithm—a modified version of Ivan Baldry's *Autoz* algorithm," Samuel said.

Caption: Professor Tapan Saha (UQ), Chair of IEEE Queensland, presents Samuel Hinton with his award at the IEEE Queensland 2014 Annual General Meeting on 3 December. Credit: IEEE Queensland

"There is an HTML5 interface on top, allowing users to verify automatic redshifts, perform manual redshifting, mark spectral lines, and more." To the delight of its users, the software is written as a client-only website, meaning that no installation, upgrades or upkeep is necessary. "To my knowledge, it is the largest existing client-only web application for scientific analysis of data," Samuel said.

Different telescope instruments generate FITS files of different formats, and Marz is currently specific to the AAOmega spectrograph, which OzDes uses. "But it would be very easy to extend it to other instruments, if I had a sample file from another survey," said Samuel.

"I would hope that many aspects of *Marz* could become standard: communication via a REST interface, delegation of work to web workers, using a proper MVW framework, separation of UI and scientific processing into separate services, and so on. It isn't a perfect program, but I think it would be a fantastic base for anyone trying to do something similar."

Samuel's thesis also won the GroundProbe Prize ('Best in microwave, photonics and communications') at the UQ Innovation Showcase event in November.

CAASTRO is delighted to receive a Silver Pleiades Award in 2014 from the ASA Women's Chapter, which recognise Australian institutions' efforts to advance the careers of women in astronomy. The awards were launched in August 2014 during the Australian Women in Astronomy workshop. Inspired by

the UK's Athena Swan program, they are given by the Astronomical Society of Australia (ASA) to organisations that take steps to improve gender equity in the workplace.

RECENT EVENTS

CoEPP/CAASTRO Joint Workshop Summary. Stawell VIC, 28-30 September

In 2012, the first joint workshop between the ARC Centre of Excellence for Particle Physics on the Terascale (CoEPP) and the ARC Centre of Excellence for All-sky Astrophysics (CAASTRO) took place, highlighting a number of promising avenues for collaboration and exchange of ideas between the two centres.

The 2nd joint workshop, which occurred at the Seppelts Winery in the rural Victorian town of Great Western in September 2014, was an opportunity to build on those collaborations and to make concrete plans for an exciting new opportunity in dark matter research. In addition to bringing together local and international experts on all aspects of dark matter research, the workshop was also designed around introducing the scientific community to a proposal for a dark matter detector in the Stawell gold mine.

In November, 2013, members of Melbourne and Swinburne Physics groups began talks with the managers of the mine to discuss the possibility of using a portion of the mine as an underground physics lab. While dark matter detectors are already operating underground in many locations in the Northern Hemisphere, a Southern Hemisphere detector will give us crucial new information in the attempt to understand and identify possible dark matter signals discovered by other experiments. Having our own dark matter detector could bring Australia to the forefront in the quest to identify dark matter and study its properties. Attendees at the workshop included members of a preliminary collaboration with scientists at the INFN in Italy, where the Gran Sasso lab is located, as well as the Science Attaché for the Italian Embassy.

Discussions at the workshop touched upon the radiation and cosmic-ray-shielding conditions at the Stawell mine, both of which appear to be acceptable. The next steps are the formation of an official collaboration and the securing of funding for equipment and researchers. We have already received encouragement (and complimentary bottles of wine!) from the local Stawell council, and several public meetings have shown a great deal of community support.

Research talks at the workshop made it clear that there's still a lot of work to be done in our understanding of dark matter. On the observational side, inconsistencies between models and observed properties of small-scale dark matter systems (such as dwarf galaxies) are still vexing, as pointed out by invited speaker Manoj Kaplinghat (UC Irvine). Sydney's Geraint Lewis described an even more puzzling problem – the discovery of great co-rotating planes of satellite galaxies around the Milky Way and Andromeda, in apparent disagreement with expectations of dark matter behavior. We also heard from Melbourne's Christian Reichardt about work to study dark matter in the cosmic microwave background and from Adelaide's Gary Hill and Gavin Rowell about the prospects for dark matter indirect detection via neutrino and gamma-ray signals.

On the theoretical side, the field is wide open for new ideas about dark matter's fundamental nature. Several speakers discussed dark matter models beyond the supersymmetric neutralino, which is looking less and less favored due to the LHC's failure to detect signatures of other supersymmetric particles. University of Melbourne and CoEPP theorists Nicole Bell, Raymond Volkas, and Robert Foot presented alternative ideas on dark matter models

The second day of the workshop was devoted mainly to the nuts and bolts of dark matter detector design and implementation, highlighting the opportunities for CoEPP and CAASTRO researchers to get involved in the emerging Australia-Italy collaboration. Between this direct detection prospect and our existing investments in new astroparticle physics observations, it's certainly an exciting time to study dark matter in Australia!

MWA Workshop, Sydney, NSW, 15-16 October

The MWA expansion workshop was held at CAASTRO headquarters in Redfern on the 15th and 16th of October. The purpose of the workshop was to share the MWA Director Steven Tingay's vision for future phases of expansion for the MWA and for science teams to discuss exciting new science programs that could be supported by an enhanced MWA.

The workshop was well attended with representatives from all the MWA key science programs along with representatives from CASS, CAASTRO and the MWA Board. The presentations covered a myriad of topics from ambitious new science like detecting the cosmic web to practical issues of maintaining radio quietness at the Murchison Radio-astronomy observatory.

The meeting concluded with MWA Staff Scientist Randall Wayth presenting a proposed timeline for concluding array configuration discussions and the Director's plan for securing funding and expansion in 2015. The MWA continues to go from strength to strength.

The workshop program and copies of most talks can be found at the CAASTRO meeting archive: http://caastro.org/event/2014-mwa-workshop

Annual Retreat, Sunshine Coast QLD, 19-21 November

Take 90 CAASTROnauts, a lagoon and a beach in Queensland, stir lightly, and what have you got? The fourth annual CAASTRO retreat, which was held from 19 to 21 November at the Novotel resort at Twin Waters on the Sunshine Coast.

The event could also have been dubbed *The Festival of the Shorts*. People were giving them (short talks, most of 15 minutes or less), making them (short videos, now showing as (As)tropfest on Youtube), and of course wearing them, as befitted the balmy Queensland weather. Fortunately there was nary a mosquito.

The program packed in overviews of the CAASTRO themes, detailed talks on projects within the themes, and free-ranging panel discussions, including an overview of the opportunities in Australian astronomy. We also had the pleasure of hearing from invited speakers Volker Springer (Heidelberg University), who spoke on hydrodynamical simulations of galaxy formation—in particular, how they've progressed in the last few years—and Huib Intema (National Radio Astronomy Observatory), who talked about how to correct for ionospheric distortions when making low-frequency radio observations.

Although the program was crowded with science, time was also found for a speed mentoring session and, on the Friday, an informal breakfast for women in CAASTRO. In another step forward for gender equity, the prizes for [best poster, best talk, best student talk and best student poster] were all won by women - Rebecca McElroy, Emily Petroff, Cleo Loi and Mayouri Rao - and no-one batted an eyelid.

Many of the projects discussed at the meeting, such as SAMI, some of the MWA projects, and the upgrade of MOST, were still being planned at the time of previous CAASTRO retreats, but are now beginning to produce results—to the clear satisfaction of both speakers and listeners.

And to the satisfaction, no doubt, of now-former Director Bryan Gaensler. He was farewelled in style at the conference dinner, with Lister Staveley-Smith (UWA), Anne Green (Sydney), Steven Tingay (Curtin) and new Director Elaine Sadler (Sydney) all praising his leadership. Australia's loss is Canada's gain.

Despite being jam-packed, the conference ran very smoothly, thanks to the hard work of the CAASTRO A-team (who, like the proverbial duck, looked calm on the surface but were paddling hard underneath). Special thanks are due to Kylie Williams, CAASTRO events guru, who shouldered much of the load, especially the planning and preparation for the event.

The 2015 retreat will be held during 18-20 November, in the Blue Mountains of New South Wales. You may have to wear long trousers, but it'll be another short and sweet event. See you there!

Running a Successful Research Project Workshop, 18 November

CAASTRO held its annual Early Career Researcher and Student Professional Development Day on Tuesday 18 November 2014 at the University of Queensland. Approximately 30 participants learnt about "Running a Successful Research Project". This training day was facilitated by Phil Crosby of CSIRO and assisted by Kate Gunn of CAASTRO.

Phil started the day by explaining to the group the basic components of a project, and how a critical path affects the success of a project. In order to be an effective project manager, participants leant that they need to manage their resources and budget to achieve their goals on time. In order to show what they had learnt, teams showed their creativity in defining and then pitching a number of new projects, including "Building a Death Star" and the new AELT – the "Australian Extremely Large Telescope" to name just two.

The teams then turned their attention to critiquing a current CAASTRO Project Plan, Brian Schmidt's "Dynamic D3 project plan - optical transient discovery and follow up". This allowed participants to see what is required in documenting research projects and to provide feedback on the most effective way of communicating this. Gantt charts were also discussed.

Progress reporting on projects allowed teams to communicate to stakeholders how their projects were progressing. This activity again provided a creative outlet, with the discovery of Type 3a SN supernovae and the discovery of an Ultra-Fast Optical Burst listed as milestones, and many risks (and mitigation strategies) identified around infestation of Bogong moths (and their mating habits), succession plans, and bush fires.

By the end of the day, participants were comfortable with defining the scope, objectives, key success criteria, deliverables, reporting and risks of projects. We wish them well in their future projects.

UPCOMING EVENTS

Perth Simulated Galaxy Cluster Workshop, 23-27 March 2015, Perth, WA, Australia
OzSKA: Radio astronomy in the next decade: 8-10 April 2015, University of Melbourne, VIC, Australia
ADASS XXV: The 25th Annual Astronomical Data Analysis Software and Systems Conference: 25-30 October 2015, Sydney, NSW, Australia
CAASTRO Annual Retreat, 18-20 November 2015, Leura, NSW, Australia

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Wishing all CAASTRO members happiness these holidays and for the year ahead.

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