



CAASTRO Newsletter Edition 11, August 2014



INTRODUCTION FROM CAASTRO DIRECTOR

Sadly this will be the final time I write to you through this newsletter: in the coming weeks I'll be stepping down as CAASTRO Director, and then in December 2014 I'll be moving to Toronto, Canada, to take up a new role as Director of the Dunlap Institute for Astronomy and Astrophysics.

The process of selecting and appointing a new CAASTRO Director has required a number of administrative steps in conjunction with the Australian Research Council, but is now nearing its conclusion.

Very soon we expect to receive official confirmation of this appointment, and my successor will then take up the reins. Because my departure to Canada is not until December, there will be a solid period of overlap with the new Director, and you can expect a smooth and seamless transition. From a scientific perspective, I hope to very much remain engaged in CAASTRO once I move to Toronto, and will take up a new role as a CAASTRO Partner Investigator.

Meanwhile, CAASTRO's research, outreach and other activities have continued to accelerate. As I write this, the CAASTRO team has already published 71 papers in 2014, compared to 77 papers in all of 2013. Of our recent results, my personal highlights include the spectacular [first data release from SAMI](#) (see story below), an extraordinary measurement of [motion by just 9 km](#) at a distance of 1300 light years, and the new [machine learning algorithms for automatic transient classification](#) developed by recently graduated CAASTRO PhD student Kitty Lo. Amongst our many upcoming events, of particular note is the [national series of town halls on the Large Synoptic Survey Telescope \(LSST\)](#) that we will be convening and sponsoring in October, with the aim of discussing possible Australian membership of this exciting upcoming project. The LSST Project Director and LSST Project Scientist will both be flying out from the USA for the week to participate in this series of meetings. We are now commencing our final round of recruitment for CAASTRO postdoctoral positions, with one job currently open and another six to be advertised shortly. Keep an eye on [caastro.org/jobs](#) for details.

On the outreach front, I'm thrilled that our ["Astronomer in Residence program"](#) is now in full flight at Uluru (see story below), and am pleased to announce that we have received a grant of \$195,000 from the Federal Government to grow our successful [CAASTRO in the Classroom program](#). I offer my

congratulations to our omnipresent outreach coordinator Wiebke Ebeling on adding to her family, and welcome Helen Sim and Jacinta den Besten to CAASTRO, who are managing many of our outreach activities for the rest of the year, while Wiebke is on maternity leave.

There are a lot of activities and events on our schedule for the rest of 2014 (see details below), but of particular note is the Australian Government's mid-term review of our centre, which the Australian Research Council will conduct at CAASTRO HQ in Sydney on 12 Nov 2014. We have already begun extensive preparations for this, and I'm grateful to those of you who have agreed to participate.

Let me close by emphasising how rewarding the CAASTRO experience has been for me. Astronomy is ultimately about people as much as it is about data and calculations, and it has been a privilege to work alongside so many talented individuals. The best part of CAASTRO has been getting to be in close proximity to the energy and drive of all our students and postdocs: you're the engine room that has made this centre so dynamic and productive.

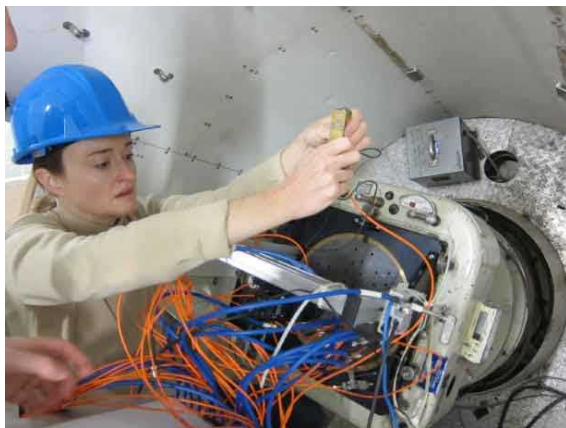
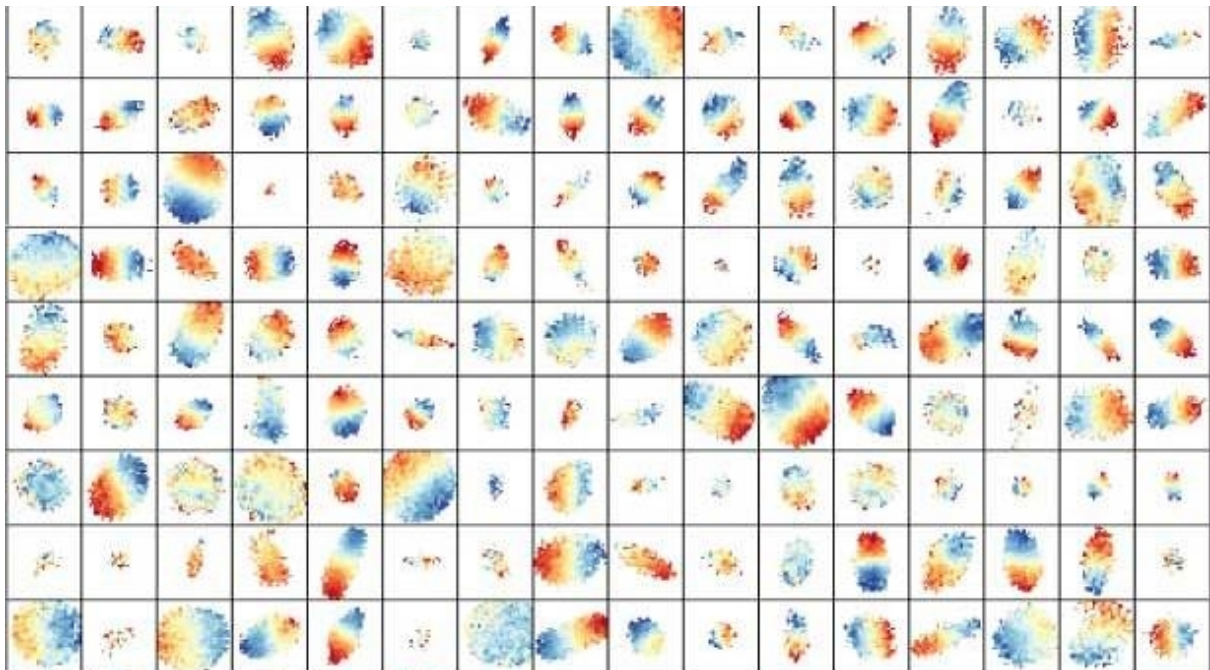
RESEARCH UPDATES

SAMI Data Hit The Streets

On 24 July 2014, the SAMI survey team released its first public tranche of data (the Early Data Release or EDR). This comprises fully calibrated data cubes for 107 galaxies with a range of masses, redshifts and morphologies, along with the basic parameters of each galaxy. The early-release data, along with papers describing the data, the parent sample and the data processing, can be downloaded from [the survey website](#).

SAMI is the Sydney–AAO Multi-object Integral field spectrograph, an instrument jointly developed by researchers at the University of Sydney and the Australian Astronomical Observatory. It combines the power of an integral-field unit with that of a conventional fibre-based system for a spectroscopic survey, allowing spatially resolved spectroscopy: SAMI has 13 IFUs, each with a field of view of 15". SAMI is fitted to the Anglo-Australian Telescope at Siding Spring Observatory.

The SAMI Galaxy Survey, one of CAASTRO's marquee projects, is an ongoing integral-field-spectroscopic survey of ~3400 low-redshift ($z < 0.12$) galaxies, covering field and group galaxies in the Galaxy And Mass Assembly (GAMA) survey regions and a related sample of cluster galaxies. Observations began in March 2013 and are scheduled to continue until mid-2016. More than 1000 targets have been observed to date — twice as many as the largest previous sample. SAMI data have already been used for studies of galactic winds ([Fogarty *et al.* 2012](#)) and the relationship between kinematic morphology and galaxy environment ([Fogarty *et al.* 2014](#)).



Clockwise from top:

1. Some of the first galaxies studied with SAMI. The colours show the variation in Doppler shift across the face of each target. . Image credit: L. Fogarty and the SAMI team. **2.** The 4-m Anglo-Australian Telescope, the largest optical telescope in Australia, with Steve Chapman, a staff member of the Australian Astronomical Observatory, which owns and operates the telescope. Photo: Fred Kamphues. **3.** Dr Julia Bryant (CAASTRO/University of Sydney) installing SAMI on the Anglo-Australian Telescope. Image credit: SAMI team

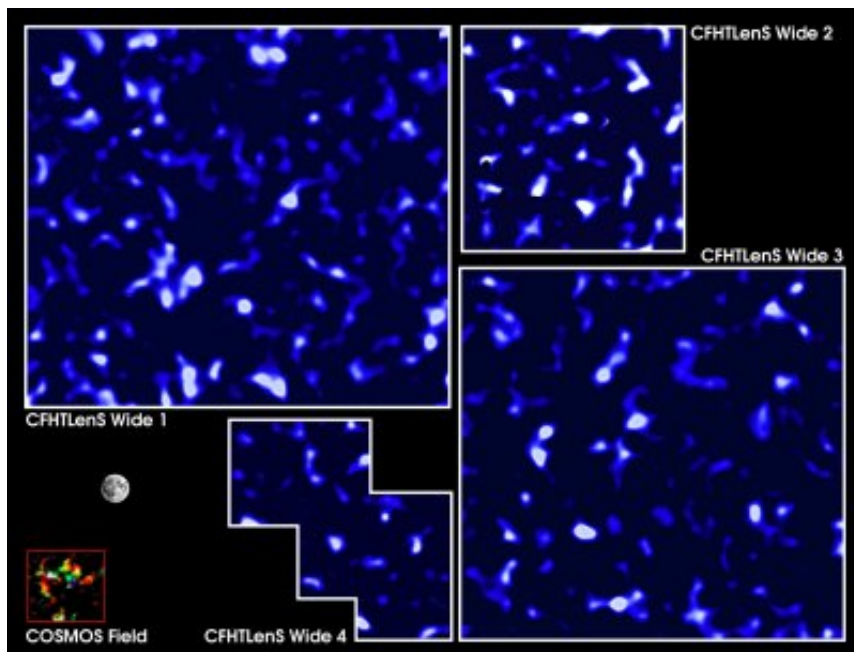
The Known Unknowns of Dark Matter Annihilation

While gamma-ray telescopes and cosmic ray detectors search for the products of dark matter annihilation in the local Universe, CAASTRO Affiliate Dr Katherine Mack (University of Melbourne) has considered how dark matter annihilation could affect the formation of the first stars and galaxies in the Universe. In [her recent publication](#), she has asked the question, "When is dark matter annihilation at its peak?"

In the early Universe, dark matter begins to come together via gravity to form "halos" – quasi-spherical clumps in which galaxies and clusters form. The annihilation rate depends on the square of the halo density, so a high-density halo has a much higher rate of annihilation than a low-density halo. Over time, more halos form and become denser while, at the same time, the Universe expands and gets less dense. The question then becomes, "Is the annihilation rate higher at early times when the Universe is denser,

or at late times when halos are more common and denser?"

The answer, according to Dr Mack's research, depends on the unknown properties of the dark matter halos. She has shown that we need to understand the formation of dark matter halos better before we can accurately predict their effects on early stars and galaxies. Using halo parameters drawn from the literature, she found that uncertainties up to factors of 10,000 exist for the annihilation rate during the time of the first star formation. These uncertainties include the density distribution within the halos and the size of the smallest halos that form. They also make it hard to say when the "smooth" component of the annihilation, from dark matter distributed diffusely in the Universe, is overtaken by the "clumpy" component from individual halos.



Dark Matter Cosmic Web; credit: NASA, ESA, P. Simon and T. Schrabback). Full Moon to scale; credit: L. Van Waerbeke (UBC) and C. Heymans (UE)

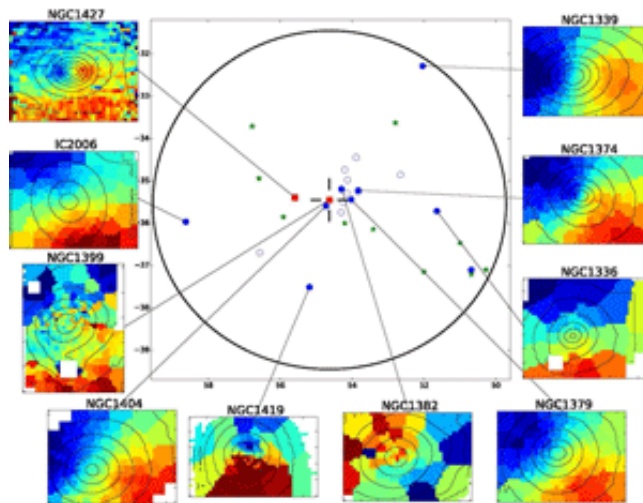
For more information on the CoEPP-CAASTRO Joint Workshop please [click here](#)

The Majority of Galaxies in the Fornax Cluster are Fast Rotating Disks

CAASTRO researcher Dr Nicholas Scott (University of Sydney), along with CAASTRO Partner Investigator Prof Roger Davies (University of Oxford) and a team of international astronomers, have used the Wide Field Spectrograph on the Australian National University 2.3m telescope to study the stellar kinematics of galaxies in the nearby Fornax cluster. [The team found that the majority of galaxies in the cluster are disk-like fast rotators or spiral galaxies](#), with slow rotators making up only 7% of the total population.

Combining their result with complementary studies of galaxies in other clusters, they found that slow rotators mainly reside in the dense cores of galaxy clusters. By controlling for other galaxy parameters, such as mass, they concluded that migration due to dynamical friction cannot be solely responsible for the over-representation of slow

rotators in the centres of clusters but that a more complex mechanism is required. The researchers suggest that slow rotators either preferentially form in the centre of clusters – so they do not need to migrate – or they merge into the cluster as a central group galaxy – so the relevant mass for dynamical friction is the group mass, not the galaxy stellar mass.



Velocity Map of galaxies in the Fornax Cluster (Scott et al. in MNRAS, 2014)

The Dish Detects Star Fuel Reservoirs Around Radio Monsters

CAASTRO researchers Dr James Allison and Prof Elaine Sadler, together with their University of Sydney third-year student Alex Meekin, [have used HIPASS data to search for cold clumps of hydrogen in galaxies that host the most radio-bright supermassive black holes](#). These clouds of hydrogen pass in front of the radio-emitting plasma and absorb some of the radiation, manifesting as a silhouette in the radio signal.

Using a robust technique developed by the [FLASH \(First Large Absorption Survey in HI\) team](#) at the University of Sydney, the team carried out a survey of over two hundred radio galaxies. In four of these, they detected hydrogen absorption, all of which are amongst the most radio bright and which are known to have lots of cold material in the form of dust and molecular gas.

In one galaxy, hydrogen absorption was found for the first time - its silhouette in the radio signal indicating that the hydrogen is located in an obscuring disc that is of similar orientation to the edge-on disc of stars seen in the optical images. As has been noted in previous such surveys, these detections seem to be dominated by those radio sources that are small and powerful, concentrating their radio emission behind the hydrogen gas.

Importantly, these results indicate that imminent early-science surveys with the Australian Square Kilometre Array Pathfinder (ASKAP) will be able to detect strong hydrogen absorption in such galaxies at much earlier times in the history of the Universe.

GENDER ACTION COMMITTEE

CAASTRO's Gender Action Committee meeting had its first face-to-face meeting on 26 May 2014. The committee is made up of Elaine Sadler (USyd), Rachel Webster (UMelb), Cathryn Trott (ICRAR/Curtin), Fang Yuan (ANU), Evan Keane (Swinburne), Iraklis Konstantopolous (AAO), Jessica Bloom (USyd), Kate Gunn (USyd) and Brian Schmidt (ANU, Chair).

Despite many innovative ideas surrounding Gender Equity having been incorporated into CAASTRO, the committee was confronted with the fact that overall participation rates within several categories of CAASTRO membership were not representative of the broader community, and were skewed male. Specifically, the number of funded researchers, Partner Investigators (PIs) and Associate Investigators (AIs) all are below reasonable expectations based on the percentage of women who fill that part of astronomy.

To this end, the committee believes we could improve the representation of women in CAASTRO by:

- asking all CAASTRO nodes to think about how to attract strong female candidates for positions, and to report on their efforts and outcomes in upcoming advertisements.
- to put effort in progressing outstanding female PI memberships
- to ensure that female CAASTRO affiliates are not more appropriately AIs
- to ask Theme Leaders if there are appropriate people to bring in as PIs, AIs or affiliates, emphasising the lack of women in these roles currently.

The committee also considered what was an appropriate role for the Gender Action Committee to fill within CAASTRO, given that each institution serves as the legal employer for CAASTRO members and has their own regulations. The committee decided that it could best serve CAASTRO by helping improve the prospects for women to navigate the leaky pipeline between PhD and tenured researcher. Initiatives to be further considered include:

- offering programs to CAASTRO members about leadership, focusing on women
- improving and finalising CAASTRO's diversity policy
- offering a 'I need support now!' program for female CAASTRO members including students
- holding a CAASTRO Women's day associated with the Annual Retreat or as a separate activity
- having a CAASTRO Women's lunch at each node each year
- ensuring that CAASTRO engages with the Women in Astronomy Chapter of the ASA and continues to network with similar groups about novel ideas for CAASTRO implementation.

The Committee encourages feedback from anyone in CAASTRO about the group's recommendations, and is eager to receive other ideas for implementation.

Brian Schmidt
Chair

CAASTRO EDUCATION AND OUTREACH

We continue to work hard at communicating our research to the public: we have issued [three press releases](#) since the last newsletter, while 20 news stories will soon appear as part of the third edition of the “[CAASTRO Reader's Digest](#)”. We have used our press releases as an opportunity to showcase our capacity digital media, through our video “[Computers beat brainpower when it comes to counting stars](#)” and via an animation of [a spinning pulsar](#) (a clip from our [new animation library from Swinburne Astronomy Productions](#)). The pulsar animation has proved particularly popular with the media and the public, and has picked up more than 26,000 views since it was published just a few weeks ago.

Our partnerships with [Voyages Indigenous Tourism](#) on our “[Astronomer in Residence](#)” and “[Astronomy Weekend](#)” programs has progressed immensely in the past few months. Eight CAASTRO astronomers have now each spent a fortnight at Uluru, sharing their experiences via the new [@CAASTROatUluru](#) Twitter account. and providing their valuable feedback to CAASTRO Education & Outreach for improvements. Through until November, another six CAASTRO members will participate in the program. For the “Astronomy Weekend” at the end of [National Science Week](#) in August 2014, we will send four of our senior scientists to Uluru to be part of a diverse and entertaining program of public lectures, panels and hands-on astronomy demonstrations.

Since the last newsletter, the CAASTRO Education & Outreach team has also contributed to the [Australian Astronomy Decadal Plan 2016-2025](#), as part of the Working Group on Education, Outreach and Careers. The CAASTRO Mentoring Program has been recognised as a particularly positive example to the Australian astronomy community, along with our collaborative approach to outreach and the reliable communication of our research outputs.

CAASTRO in the Classroom

The first session of our new “[CAASTRO in the Classroom PLUS](#)” program was a significant success, with the incredible Aina Musaeva talking about electromagnetism to 150 students in schools from Katoomba to as far afield as Norfolk Island.

We are now offering an expanded lecture series to schools across NSW throughout the rest of the year, featuring topics such as 'Moving About', 'The Cosmic Engine', 'Space', and 'Astrophysics'. We have also now signed an agreement with the Queensland government, to bring our program to our northern neighbours.

Astronomer in Residence at Uluru: A First-Hand Account

On the 11 May 2014, I flew to Uluru to spend two weeks at the Voyagers Ayers Rock Resort as part of CAASTRO's Astronomer in Residence program. I was only the third

participant in this program, so I didn't really know what to expect. Flying in to Uluru airport is an experience in itself. As you come in for approach, you get a birds-eye view of the Rock and Kata Tjuta (aka The Olgas) out the window, all surrounded by the rich red sand that is so characteristic of central Australia.

During my stay I worked closely with Mike Dalley, who manages the astronomy components of the various tours at the resort. Two of the tours are entirely about experiencing the night sky, one for families and another aimed more at people who are looking for more of that "wow" factor (as Mike puts it).

The flagship tour is the Sounds of Silence, where the audience sips sparkling wine while watching the sunset over Uluru to the sound of a didgeridoo, before sitting down to a buffet dinner. This includes a tour of the sky by laser pointer as the after-dinner entertainment. Finally, there's the Tali Wiru fine dining experience that involves a sky tour with a more indigenous focus. I contributed to the nightly astro tours as well as to the Sounds of Silence experience. My job was to field any questions of a deeper scientific nature as well as to help the team set up and pack up the telescopes.

During each afternoon, Mike and I manned a stall in the resort's town square, where we talked to guests and locals alike about the tours and about astronomy in general. Each day we trained a small solar telescope with an H-alpha filter on the Sun, plus another 9-inch telescope on Venus (when we could find it). We spent the rest of the time cajoling passers-by to have a look, not that it took a lot of convincing.

On average we spoke to around 30-60 people per day. The most common question (after looking through the solar telescope) was "what are those frilly things around the edge of the Sun?" (the answer, courtesy of Google, was solar prominences). The second most common question was "why are you here and what are you selling?". My typically response was that I was there to tell people how we are using public funding to do awesome astronomy research. Not a single person I spoke to thought this was a waste of taxpayer dollars.

On the last day of my two-week adventure, we set up a third telescope pointed at the moon, and had over 170 people stop by to have a chat or to look through the telescopes. A record 40+ people signed up for the astro tour that night, which we followed with an impromptu astrophotography workshop for interested guests.

The Uluru Astronomer in Residence program was a fantastic experience. I spent two weeks in an amazing part of Australia under the darkest skies you could imagine, talking to a huge number of people who have a real curiosity and interest in what we do. I gained a lot of knowledge of the night sky that was previously lacking (I'm an X-ray astronomer by training), learned a lot about indigenous culture (including how to throw a boomerang and a spear), met some of the local wildlife (including a backpack stealing dingo) and, on my days off, explored Uluru and Kata Tjuta.

Sean Farrell



Image credits: Sean Farrell.

MEMBERSHIP UPDATE

CAASTRO now has 165 members. We welcome our latest team members:

- **Ms Jacinta den Besten**, University of Melbourne
- **Ms Shivani Bhandari**, Swinburne University
- **Dr Ilana Feain**, University of Sydney
- **Mr Mike Dalley**, Ayers Rock Resort
- **Ms Angela Garcia**, Swinburne University
- **Dr Chris Flynn**, Swinburne University
- **Ms Cleo Loi**, University of Sydney
- **Mr Vincent Morello**, Swinburne University
- **Ms Vanessa Moss**, University of Sydney
- **Ms Mayuri Rao**, ANU
- **Ms Seonaid Rodgers**, Curtin University
- **Dr Mara Salvato**, MPE
- **Ms Helen Sim**, University of Sydney
- **Mr Adam Thomas**, University of Queensland
- **Mr David Valcin**, ICRAR UWA
- **Mr Vivek Venkatraman**, Swinburne University

CAASTRO MEMBER PROFILES

Attila Popping (ICRAR UWA)
CAASTRO Postdoctoral
Researcher

In early 2014, I commenced as a CAASTRO postdoctoral scientist in Galaxy Evolution at ICRAR UWA. I received my PhD in 2010 from the University of Groningen and CSIRO. I then spent most of 2010 as a postdoctoral researcher at the Laboratory of Astrophysics of Marseille, before moving back to Australia as a Super Science Fellow at ICRAR UWA. My research mostly focuses on radio astronomy and the distribution or evolution of neutral hydrogen (HI) gas in the Universe, for which I have written observational, technical and simulation papers. We live in a very exciting time for radio astronomy, with the development of several new major telescopes, most significantly the Square Kilometre Array. I am involved in most of the major neutral hydrogen surveys on SKA precursors, and am very interested in the development of these facilities.



Candy Wu (U. Queensland) Administration Officer

I was born and grew up in China, where I got my Bachelors degree in Management. I came to Australia in 2006 to study for a Masters of Commerce degree at the University of Queensland, majoring in accounting and applied finance. I have worked for UQ since 2009 in Finance and HR, and also as a tutor in Accounting. I become the administrator for CAASTRO's UQ node in March 2014, a role which I've found stimulating and challenging. I'm very proud to be working for UQ and to have been able to join the CAASTRO family.



Mayuri S. Rao (ANU) CAASTRO PhD Student

I work in observational cosmology, with a focus on the cosmic microwave background

(CMB), recombination, and reionisation cosmology using radio astronomy. I also work on developing precise algorithms for foreground subtraction and for recovering weak, broad, spectral features from observed sky spectra. I am interested in detecting spectral distortions in the CMB, especially those expected to arise from primordial hydrogen and helium recombination. With a background in electronics engineering, I am interested in receiver design, with an emphasis on the estimation of systematics and on the derivation of effective calibration techniques.



RECENT EVENTS

SkyMapper Workshop, 7-9 April 2014

Almost fifty people came together for three days in the beautiful Commonwealth Solar Observatory Building at Mt Stromlo outside Canberra, to attend a CAASTRO workshop on the SkyMapper telescope. SkyMapper had been met with great expectations for several years, while a diverse range of challenges delayed it time and again. The telescope finally started its long-awaited survey only weeks before the workshop. It was thus a good time to bring together the builders and users of the survey, and it was a refreshing boost to morale to see great interest and commitment on all sides.

After the workshop's opening, CAASTRO Director Bryan Gaensler reminded us of SkyMapper's cornerstone role in CAASTRO and its synergy with a host of other Australian all-sky projects. Brian Schmidt ran through SkyMapper's 10-year history in less than 20 minutes, and brought back memories of giant bushfires, broken filters and ladybug invasions. Christian Wolf updated us on the current plan and progress, now that the telescope has been successfully commissioned and the survey strategy revamped, the progress of other projects, and updated science priorities.

The afternoon of the first day was dedicated to technical and performance aspects including ideas for maximising the quality of data distributed to the community. The highlight of this session was a demonstration by Simon Murphy (formerly Mt Stromlo, now Heidelberg) of how the SkyMapper data will be accessed through the Virtual Observatory, which now offers some powerful and versatile tools.

On the morning of the second day, SkyMapper's work on variable phenomena was discussed, ranging from the supernova survey to target-of-opportunity alerts, including GRBs, FRBs, and soon even possibly gravitational waves. Brad Tucker (Mt Stromlo) introduced a session on SkyMapper's support for the now extended mission of the Kepler Space Telescope, the world's most powerful tool for the study of microvariability. This session was packed with initiatives for exploiting synergies between SkyMapper and Kepler.

The afternoon was fully devoted to the subject of galaxy evolution, which today focuses on a holistic approach to understanding all the components that contribute to a galaxy's evolution. This includes active nuclei, the fate of gas in light of feedback, and the complications introduced by dust. The session also covered multi-wavelength

approaches, combining SkyMapper observations with data from the Australian SKA Pathfinder, from spectroscopic instruments and from the German-Russian eROSITA mission, with which SkyMapper had recently signed a Memorandum of Understanding.

The final day brought the focus back to one of SkyMapper's core strengths: the mapping of stars and the structure of the Milky Way. Mike Bessell (Mt Stromlo) reported on the early discovery of the most metal-poor and pristine star known in the Universe; it had been found in early observations of SkyMapper and made front-page news only two months before. Finally, Gary da Costa (Mt Stromlo) led the meeting to a conclusion.

There is strong support for the SkyMapper team to focus on an early data release in 2015 (this will have only a preliminary calibration but will crucially cover the whole sky to shallow limits), before progressing to the longer-term plan. SkyMapper is now an Australian national facility, with an ARC LIEF grant led by CAASTRO paying for its operation over the next five years. The workshop was thus also an opportunity for the new SkyMapper Executive Committee to meet informally for the first time. Overall, the workshop made clear that the community's enthusiasm for SkyMapper is strong and that there is a growing interest in the science opportunities that it offers. A great confluence of ideas and helpfulness has proven that, after a long wait, the investment in the project is now paying off.

Christian Wolf

ASA Student Prize Winners

We congratulate our CAASTRO students who won major talk/poster prizes at the annual scientific meeting of the Astronomical Society of Australia held in Sydney over 21-25 July 2014:

- **Best poster:** Anthea King, "AGN as high-redshift standard candle candidates and the role of OzDES"
- **Best talk:** Emily Petroff, "The first real-time FRB: multi-wavelength follow-up of a fast radio burst"
- **Runner-up talk:** Ben McKinley, "Modelling of the Spectral Energy Distribution of Fornax A: Leptonic and Hadronic Production of High Energy Emission from the Radio Lobes"

Ben revived the tradition from the 1980s of giving an ASA talk entirely in verse. A video of Ben's presentation is at http://youtu.be/IN_aZnHuSYI.

UPCOMING EVENTS

- [Supernovae in the Local Universe](#), Coffs Harbour NSW, 10-15 August 2014
- [Uluru Astronomy Weekend](#), Ayers Rock Resort NT, 22-24 August 2014
- [CoEPP-CAASTRO joint workshop](#), Seppelt Winery VIC, 28-30 September 2014
- ["Extended capabilities for the MWA"](#), Sydney NSW, 15-16 October 2014.
- [Large Synoptic Survey Telescope \(LSST\) Roadshow](#), Sydney, Canberra, Melbourne and Perth, 27-31 October 2014
- CAASTRO Advisory Board meeting, Sydney NSW, 6-7 November 2014
- CAASTRO Mid-term Review, Sydney NSW, 12 November 2014
- [CAASTRO Annual Retreat](#), Twin Waters QLD, 19-21 November 2014
- ADASS XV, Sydney NSW, 25-29 October 2015