AAO

OBSERVER

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Warrumbungles declared Australia's first Dark Sky Park

Globulars are missing stars | Faint star cluster probed | Potentially habitable planets

Director's message

Warrick Couch

At the end of my message in the last issue of *AAO Observer*, I made mention of a new Strategic Plan for the AAO being under development. I am very pleased to report that it has now been completed and will shortly be made available to the Australian astronomy community as well as the AAO's other key stakeholders. For those of you who attended the 50th Annual Scientific Meeting of the Astronomical Society of Australia held at the University of Sydney at the beginning of July, you will have heard me talk about the Plan and the future strategic directions it sets out for the AAO over the next 5 years and beyond. Given these are so important in the context of the AAO's role as Australia's national optical astronomy observatory and how it serves its user community, I will use this message as a further opportunity to communicate the key strategies contained within the Plan and their underlying rationale.

One of the great strengths of Australian astronomy is its cohesive and well-coordinated approach to setting out its scientific aspirations and associated research infrastructure priorities via its Decadal Plans. This year marks the start of a new Decadal Plan, *Australia in the era of global astronomy (2016-2025)*, which has a very strong overarching theme of astronomy becoming a much more global science over the next decade, and Australia needing to be a key participant in international telescope facilities and partnerships if it is to remain at the forefront of astronomical research. This theme comes through strongly in the key future directions for the AAO articulated within the Decadal Plan, in particular: growing its instrumentation development and construction capability to maximize Australia's engagement and scientific influence in international facilities, and expanding its role in supporting Australia's use of international optical/infrared telescope facilities, both the 8m class now and the ELT class (viz GMT) in the future.

But it is not just the Decadal Plan that sets the AAO's strategic agenda. As a division within the Department of

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Front cover photo Credit: Vertical Milky Way over the Anglo-Australian Telescope. Image obtained on 30th June 2016 at 22:04 AEST (14:04 UTC) using a CANON 5D Mark III with a 14mm f2.8 wide lens. Single 30 seconds exposure at 3200 ISO. Besides the conversion from RAW to JPEG, no further image process was applied. Credit: Ángel R. López-Sánchez (AAO/Macquarie University)

Industry, Innovation and Science, the AAO's Strategic Plan must also reflect the Department's key objectives and purpose, particularly in delivering on the government's priorities for this portfolio. Here we are most strongly guided by the recently announced National Innovation and Science Agenda (NISA), as well as the National Science and Research Priorities.

The new Strategic Plan therefore sets the AAO on a course in which its roles will evolve in accordance with the Decadal Plan, and at the same time has it contributing strongly to the government's objectives in the science, innovation and industry domains. This is built upon the following 6 key strategies: (i) Increasing the AAO's engagement in international facilities through instrument construction, supporting telescope users, and expanding research and technological partnerships; (ii) enabling world-class research both on national and international facilities; (iii) building innovative capability through its instrumentation R&D program and partnering with industry and universities; (iv) becoming 'data central' in hosting an archive for storing and distributing all optical/infrared data sets from telescopes the AAO operates/supports; (v) protecting the dark sky environment at SSO; (vi) strengthening STEM skills and awareness, capitalising on the AAO's dynamic research/technology environment and outreach program.

Of course any plan is only as good as the ability to implement it. In this respect, there is really only one strategy outlined above where I see significant challenges lying ahead in its delivery. This concerns the ability of the AAO to continue to enable world-class research on the AAT – a key element of strategy (ii). Although not called out as one of the highest priorities of the Decadal Plan, it nonetheless envisages the AAT continuing to be operated as a national facility until GMT comes on-line at the end of the decade. If it is to do so, then it must meet two fundamental requirements: its instrumentation cater for the Australian community's research needs, and its scientific output continue to be internationally competitive and high impact. These require new instruments to be built for the AAT on a time-scale no later than ~2020, and here the two highest priorities of the community are HECTOR – a spectrograph capable of deploying ~100 IFU's over a 3 degree field of view at the prime-focus of the AAT – and VELOCE – a precision Doppler spectrograph for measuring sub-meter per second velocities in low mass stars. The cost of building VELOCE is ~$4M, which can likely be covered by ARC LIEF grants and Departmental funding, and indeed the construction of the first of its 3 arms is well underway, funded by a LIEF grant.

HECTOR on the other hand is much more challenging, with the full 3dF, 100 IFU version estimated to cost ~$25M. This is well beyond the means of Departmental funding or ARC LIEF grants. At the moment the only funding alternative would be NCRIS monies allocated by AAL. However, the NCRIS allocations AAL is likely to receive over the next 3-4 years will not be sufficient to fund both HECTOR and Australian 8m access (in addition to all its other commitments e.g. radio astronomy, e-Research). So in the absence of a new funding source, hard decisions need to be made. These include consideration of cheaper de-scope options for HECTOR (a "2dF" version costing ~ $15M, or a "1dF" version costing ~ $3M), and/or finding international partner(s) willing to contribute to the cost of HECTOR in return for time. I very much welcome input from the community on these very important choices!

While we face this challenge with the AAT, another important related element of the Strategic Plan – protecting the dark sky environment at SSO – will be assisted enormously by the recent recognition of the Warrumbungle National Park (WNP) as an International Dark Sky Park, not just the first in Australia but also the first in the southern hemisphere! Furthermore, the AAO has received $100K from the NSW State Government to raise awareness of updated planning policies relating to lighting control that have now come into force in the surrounding Orana Region. The new planning policies support the Dark Sky Park initiative in promoting sky-friendly lighting, and will feed into stage 2 of the project: the development and submission of a second application to have Siding Spring Observatory incorporated into the Dark Sky Park. More detail on this development and its implications can be found in Fred Watson's article on page 14 of this issue. Indeed we are hugely indebted to Fred (as AAO's Head of Lighting & Environment), as well as Marnie Ogg (Manager of Sydney Observatory), for coordinating and writing the successful Dark Sky Park application.

Finally, to comment briefly on two other factors that will come into play in the implementation of the Strategic Plan: the future governance of the AAO (and Australian astronomy), and the government's current road-mapping exercise for national research infrastructure. The special Astronomy Governance Working Group established by the Department has now completed its work of producing detailed implementation plans for two possible governance options: consolidation of optical and radio astronomy into either a subsidiary company of CSIRO or a corporate Commonwealth entity. These implementation plans are now being used to inform the Department's considerations of what is the best way forward. The road-mapping exercise has been requested by the government to determine Australia's national research infrastructure needs over the next decade to ensure it remains globally competitive. It will be critical for Australian astronomy to be strongly engaged in this road-mapping, not just to make known what its research infrastructure needs are over the next decade, but also because the process will address many of the key issues hugely relevant to astronomy – funding of national facilities, funding of access to international facilities, defunding and decommissioning of existing facilities, and governance.

HERMES sheds light on the lives of the oldest stars in the Universe

Ben MacLean (Monash University)[1]

Fig 1. Over 120 stars in M4 were observed with HERMES at the AAT. (Credit: Wide Field Imager attached to the MPG/ESO 2.2-metre telescope at ESO's La Silla Observatory).

Some of the oldest stars in the Universe are found in tightly packed groups of up to a million stars, known as globular clusters. Despite decades of study the formation of these clusters remains a puzzle to astronomers today. Now a group of Australian astronomers (and an international collaboration) have shown that the story is more complicated than we thought.

HERMES is the newest instrument on the AAT and provides a unique set of capabilities. The high-resolution spectroscope enables astronomers to measure the detailed chemical composition of stars and HERMES can do this for up to 392 stars at a time.

In a study recently published in the Royal Astronomical Society Journal an international group of astrophysicists led by the author, a PhD candidate from the Monash Centre for Astrophysics, used HERMES to observe the largest ever sample of stars in their final stages of life in the nearby globular cluster, Messier 4 (M4, shown in Figure 1).

The team – which includes researchers from Monash University in Melbourne, the AAO, and the Max Planck Institute for Astrophysics (MPA) in Garching, Germany – determined sodium and oxygen abundances in these stars. This publication presents the first chemical results using HERMES, demonstrating its cutting edge capabilities.

The sodium and oxygen abundances in a star are tracers of a much more complex process. Globular clusters were once thought to be simple stellar populations with all stars being coeval, and thus having the same composition. They are now known to contain multiple subpopulations (typically two, as in M4), each with distinct chemical compositions. It is the low atomic mass elements (C, N, O and Na) that vary significantly between the populations, with differences up to ~1 dex in some cases. These star-to-star variations within a cluster create the well-known C-N and Na-O anti-correlations.

A large sample of red giant branch (RGB; these stars have inert He cores and H shell burning) and asymptotic giant branch (AGB; inert C/O core, He and H shell burning) stars were observed (CMD in Figure 2) spectroscopically, and the chemical abundances of Fe, Na and O were determined for each star.

The team found that in M4 the lives of half of its stars end prematurely, failing to evolve to their final stage, the AGB. Rather, they skip this phase entirely and evolve directly into White Dwarfs (WD), most likely from the Horizontal Branch (HB; core He burning, H shell burning). These stars were found to be rich in sodium and depleted of oxygen. In contrast, those with typical Population II abundances survive to the AGB. The relative distribution of Na and O abundances of stars in the respective giant branch phases can be seen in Figure 3.

Similar observations of stars failing to reach the AGB have been made for other clusters, but only for clusters with extreme chemical peculiarities. The expectation was that this peculiar behaviour would not occur in M4 due to its otherwise normal properties. It is therefore very surprising to see such a vast difference in the expected lifetimes of the stars in this normal cluster.

These findings may present a major shortcoming in standard stellar models, which do not predict this behaviour (that of so-called 'AGB avoidance'). While it is well understood that HB stars will evolve directly to the WD phase if the envelope is thin enough (T_{eff}~15,000K), the stars in M4 that appear to follow this pattern only have effective temperatures on the HB up to ~9000K and should have retained more than enough envelope mass to enable AGB evolution.

Ultimately, the reason why the members of only one of these two subpopulations survive to stellar old age is still a mystery, and may be key to understanding the formation of globular clusters, and the evolution and structure of stars.

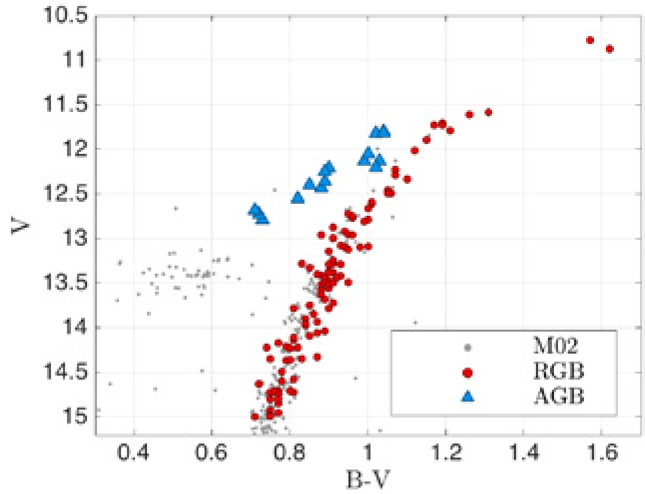


Fig 2. Colour-magnitude diagram of the Messier 4 sample. M02 refers to the full photometric sample that the observations were based on.

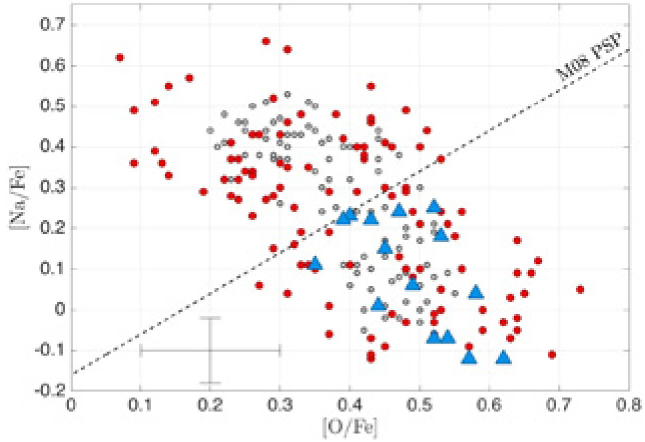


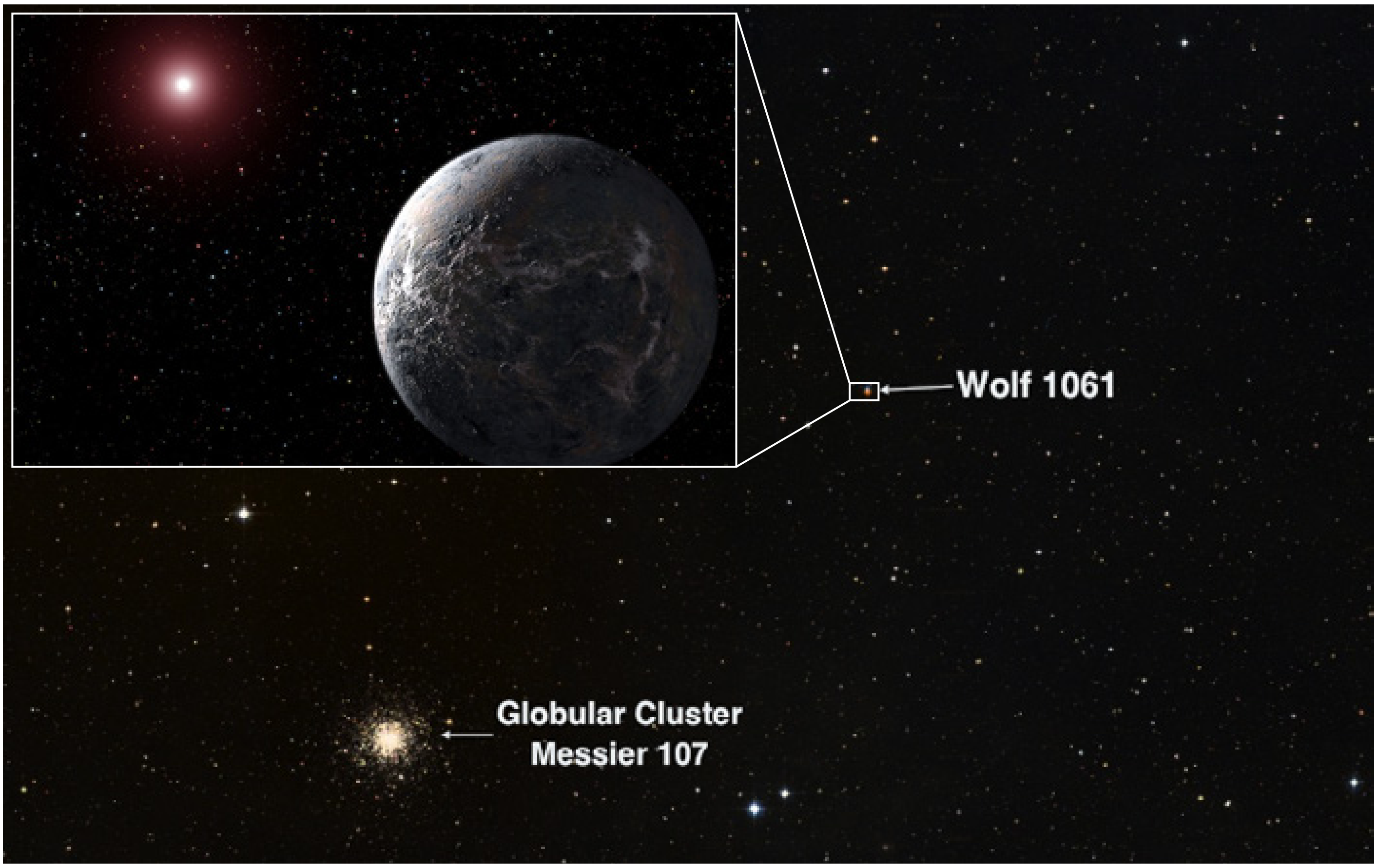
Fig 3. Na abundance vs. O abundance. The Na-O anti-correlation can be seen, along with the paucity of Na-rich/O-poor AGB stars. The grey points are from a comparison study of RGB stars, while the dashed line represents the separation point of the bimodal distribution of RGB stars.

Further reading

MacLean, B.T. et al., 2016. An extreme paucity of second population AGB stars in the "normal" globular cluster M4. MNRASL 460(1), L69–L73. Available at: http://mnrasl.oxfordjournals.org/content/460/1/L69.abstract.

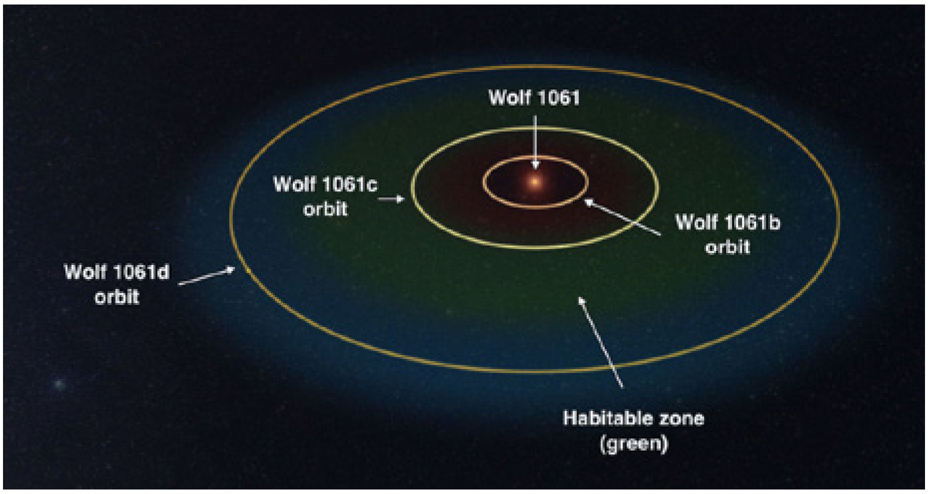
Finding Our Closest Potentially Habitable Exoplanet

Duncan Wright (AAO)/UNSW) and Chris Tinney (UNSW)



There are few areas of research more fundamental to humanity's understanding of our place in the Universe than the search for habitable environments outside our Solar System.

The 'Holy Grail' of exoplanetary detection is finding a planetary environment orbiting another star similar to that found here on Earth – i.e. a rocky planet that orbits its star at a distance that allows liquid water to exist on its surface. The range of orbital distances at which this happens are usually referred to as the Habitable zone or the Goldilocks Zone, so-called because if the orbital separation of planet and star is too small, the planet will be too hot for liquid water, while if it is too large the planet will be too cold and all water will be locked up in solid ices and inaccessible to biological systems.



Top: Image of the region of the constellation Ophiucus containing Wolf 1061, with inset showing an artists impression of the potentially habitable planet Wolf 1061c.
Photo: Aladin sky atlas and CanadaJournal

Above: A simulation of the Wolf 1061 system assuming coplanar planets. The planet orbits are shown along with red, green and blue shading demonstrating the estimated too hot, potentially habitable, and too cold orbital regions around the star respectively.

For stars like our Sun, the Goldilocks Zone lies at orbital periods near one year, which makes the reflex Doppler signature too small to be detected by even the most advanced instruments currently available.

However, by targeting stars lower in mass (therefore lower in luminosity) than our Sun, the detectability of any potentially habitable planets can be drastically improved. For low-mass M dwarf stars the Goldilocks Zone shrinks to shorter periods, resulting in much larger Doppler reflex velocities.

In late 2015 research led by Dr Duncan Wright of the Australian Astronomical Observatory and the University of New South Wales along with the rest of the Exoplanetary Science Team at UNSW obtained a breakthrough result in this endeavour: the discovery of three planets orbiting the low-mass star Wolf 1061, which lies just 14 light years from the Sun in the constellation of Ophiuchus.

Excitingly, one of these three planets is both low enough in mass to be potentially rocky, and orbits Wolf 1061 in the so-called Goldilocks Zone – that is, it orbits its low-luminosity 'M dwarf' host star at a distance which could allow liquid water to exist on the planetary surface. These factors combine to make the planet Wolf 1061c the closest potentially habitable planetary environment to our Sun yet discovered.

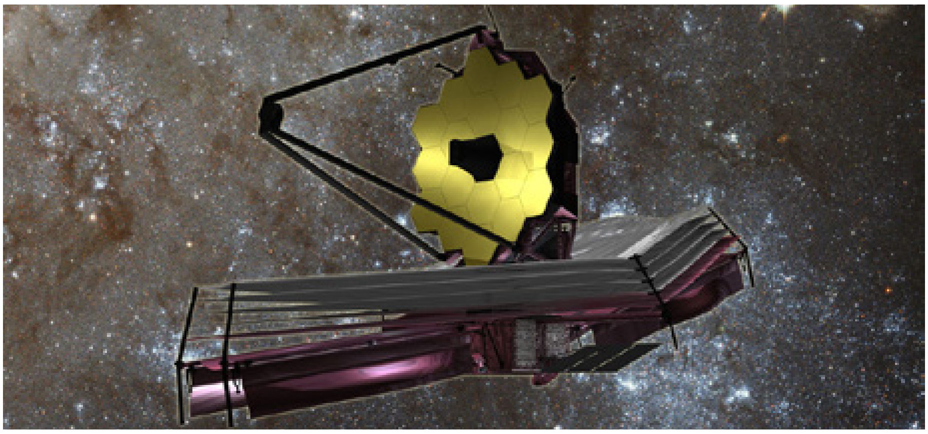
A particularly exciting feature of the Wolf 1061 system is its closeness to our Sun at just 14 light years – this will make it one of the highest profile targets for future generations of large, ground-based or space-based telescopes that are able to detect bio-signatures (i.e. observable signatures of biological activity) like NASA's forthcoming James Webb Space Telescope, as well as the forthcoming 25m Giant Magellan Telescope in Chile in which Australia is a 10% partner.

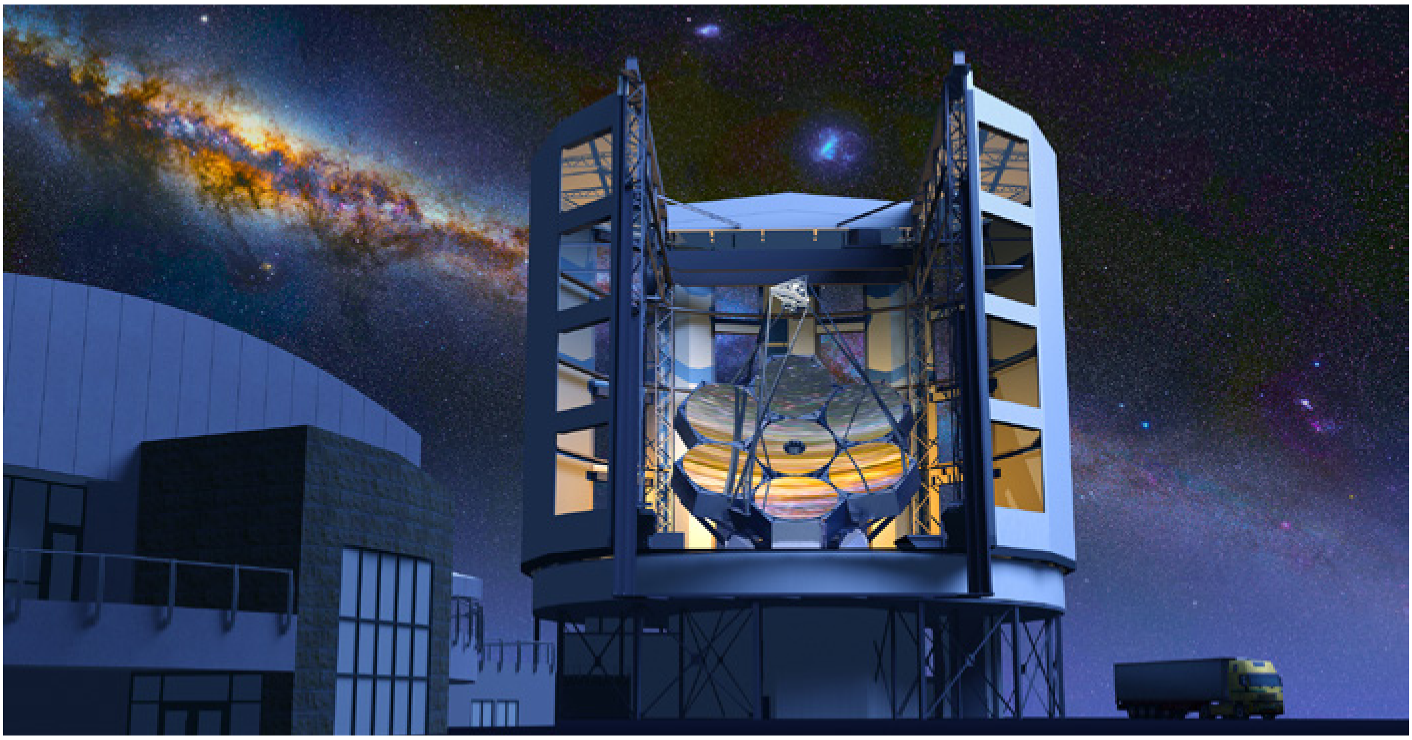
The research relied on more than a decade of archival data from the ESO HARPS spectrograph in Chile, one of the most precise and stable spectrographs in world. Using new analysis methods, developed by Dr Wright, the team improved the precision of the Doppler velocities which enabled the detection of the low mass planets (all 3 planets have amplitudes <2m/s).

This precise Doppler velocity work is preparation for the upcoming Veloce instrument that will be a new stabilised high-precision Doppler velocity spectrograph on the AAT coming in late 2017. Veloce will focus its exoplanet search on nearby bright M Dwarf stars similar to Wolf 1061 and will be a key instrument in the follow-up of the many exoplanet candidates that NASA's Transiting Exoplanet Survey Satellite, a follow-up to the Kepler mission, will provide from early 2018.

The forthcoming James Webb Space Telescope (below) and Giant Magellan Telescope (bottom) will provide astronomers with facilities able to probe the Wolf 1061 system for the signatures of biological activity.

Photo: NASA, GMTO





Probing the low mass regime of globular clusters for multiple populations using the AAT

Jeffrey Simpson (AAO) and Gayandhi De Silva (AAO/University of Sydney)

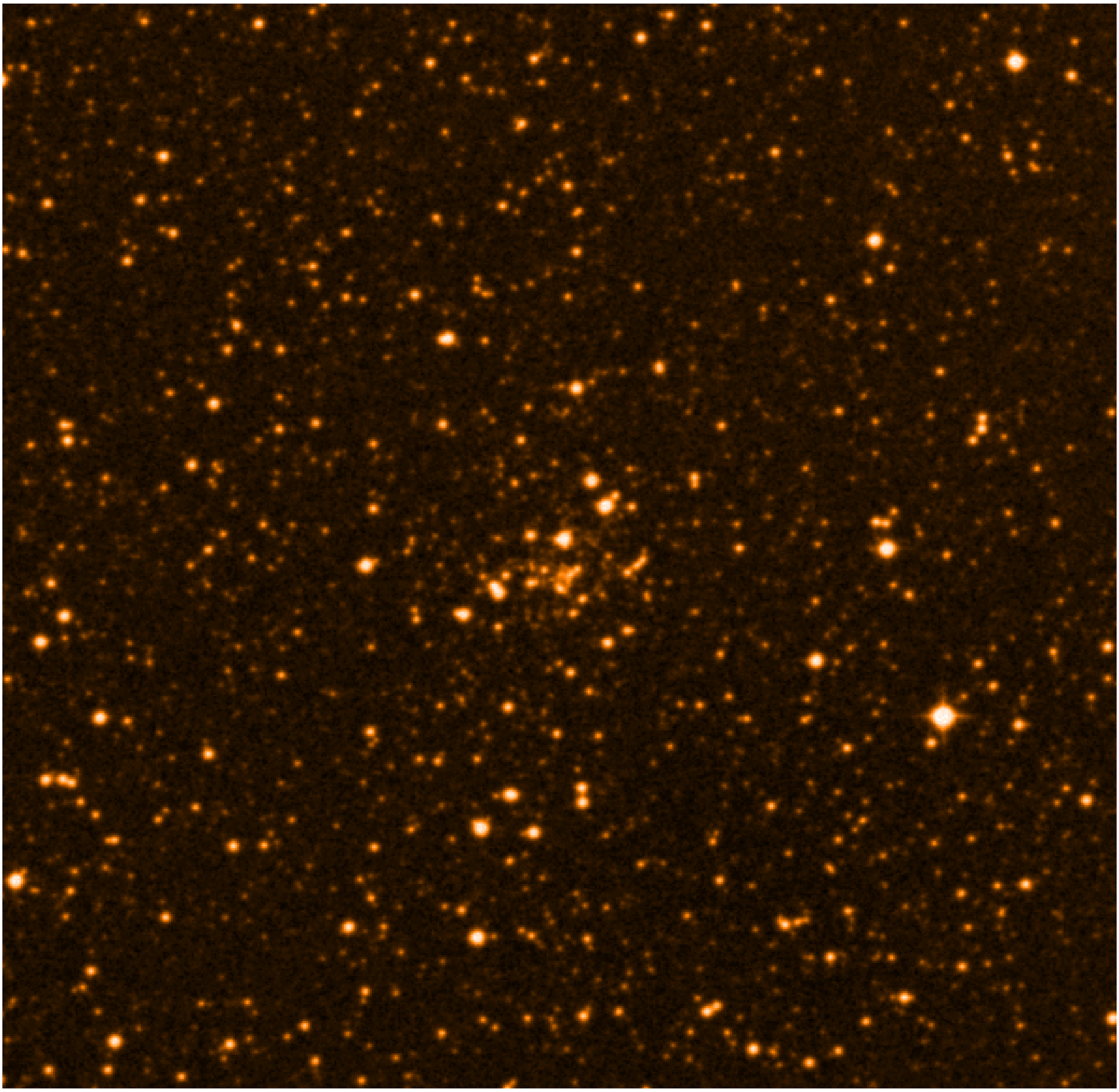


Figure 1: DSS image of the ESO452-SC11. Image is 10 arcmin square.

The Milky Way Galaxy is home to about 160 known globular clusters, with many discovered only with deep imaging surveys. Those clusters discovered recently tend to be faint and/or diffuse objects that can be difficult to study spectroscopically because it is hard to distinguish the member stars from the field stars along the line of sight. One such cluster is ESO452-SC11 (Figure 1), which had been the subject of only four published studies since its identification in 1981.

Typically globular clusters have total stellar masses larger than 100,000 solar masses, but the available photometry of ESO452-SC11 indicates that its mass is perhaps one tenth of this. Such a cluster mass is more typical of open clusters, and therefore ESO452-SC11 is of great interest for understanding the formation and evolution of stellar clusters, in particular the differing chemical histories of these open and globular clusters. Unlike globular clusters, open clusters do not show light element abundance variations. An unanswered question in stellar cluster research is what is special about the globular cluster environment compared to that of open clusters which would cause this.

Our interest in ESO452-SC11 was initially piqued when the GALAH survey happened to observe a single star at the cluster position. The lack of a published radial velocity for the cluster meant that it was not possible to be certain this star was in fact a member of the cluster. Therefore searches of archival spectroscopic data were undertaken. We were able to find two previously unpublished sets of spectra: 360 stars in and around the cluster with AAT/AAOmega; and ten stars with Keck/HIRES spectra. Analysis of these spectra identified an overall systemic radial velocity for the cluster of 17 km/s and the identification of eight members from their common radial velocity. Unfortunately the star observed by GALAH was not in fact a member.

In order to identify further members, we made further use of the wide-field, multi-object capabilities of the 2dF/AAOmega to observe another 1000 stars in and around the cluster in July 2016. It was hoped to identify stars that have been gravitationally lost from the cluster as well. From the archival and these new observations, we now have found a total of 11 members of the cluster (Figure 2), which is likely a complete census of all of the stars in this cluster brighter than the horizontal branch. This number is very small compared to a typical cluster which could have 100s of such stars.

As well as being able to identify members of the cluster from their radial velocity, the spectra from AAOmega and Keck allows us to investigate the chemistry of the stars, to probe the possibility of multiple populations in this cluster. Because this cluster has such a low mass, it would provide constraints on possible relationships between the mass of the cluster and the extent of its multiple populations.

CN and CH molecular features are readily visible using the 580V grating of the blue camera of AAOmega (Figure 3), and can be used as evidence of multiple populations via light element abundance spreads. We have explored the HIRES spectra, which suggest a possible Na abundance spread in the cluster, but with only 5 stars with reasonable signal, this is not conclusive (bottom panel of Figure 4).

As the new AAOmega spectra were acquired within the last month, only a preliminary analysis has so far been performed, and with only 11 stars, the conclusions drawn are tentative. There does appear to be potentially a range of CN abundance for stars of the same colour. This would make this cluster the lowest mass stellar conglomeration with light element abundance spreads, indicative of multiple populations of stars.

Further analysis is required, and we will be applying for time on larger telescopes available to Australian researchers thanks to the International Telescope Support Office. This will allowed us to acquire higher resolution spectra of as many members as possible to understand the elemental abundances of this faint, low-mass cluster of stars.

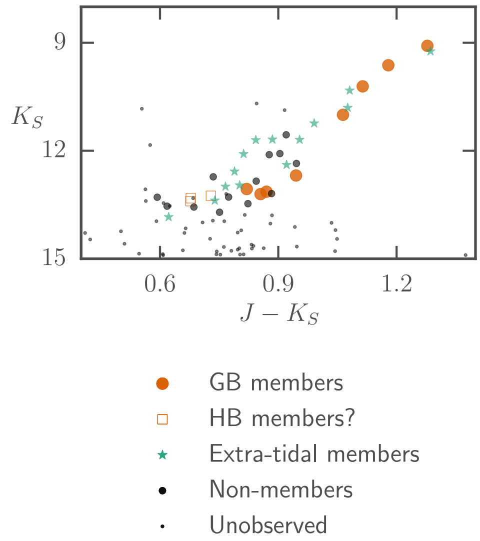


Figure 2: Colour-magnitude diagram of the cluster from 2MASS. The upper giant branch is clearly sparsely populated. Some extra-tidal members have been tentatively identified from their radial velocities and metallicity estimates.

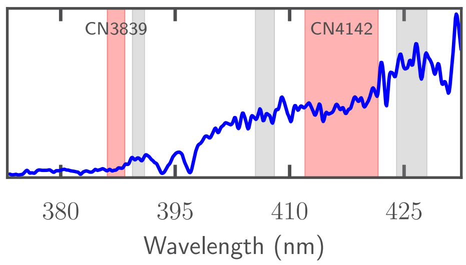


Figure 3: Portion of the spectra from AAOmega for one star highlighting the CN and CH molecular regions.

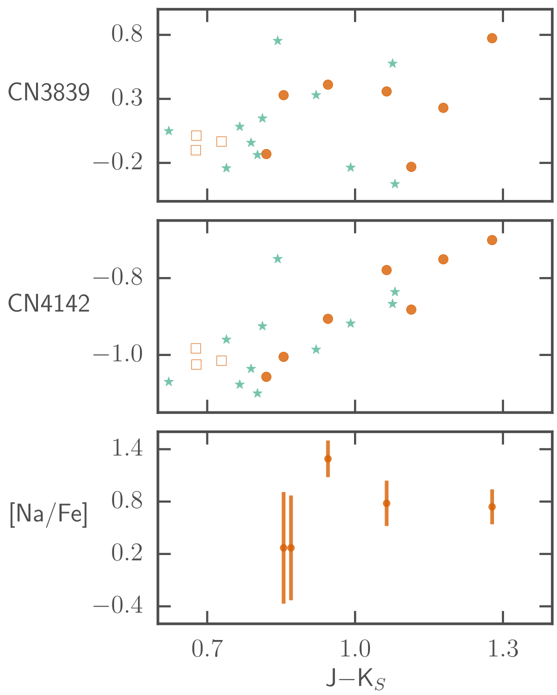


Figure 4: Preliminary values for the CN and [Na/Fe] abundance of the member stars.

Characterization of the HERMES resolution with a photonic comb

Janez Kos (SIFA), Christopher Betters (SIFA, SAIL), Sergio Leon-Saval (SIFA, SAIL) and the GALAH collaboration

The HERMES spectrograph is in its third year of operation on the AAT, successfully being used by the GALAH survey (GALactic Archaeology with HERMES), as well as many other projects. As part of the reduction and calibration of GALAH spectra we constructed resolution maps showing the measured resolution of reduced spectra depending on wavelength in each of the 392 science fibres of 2dF and in each of the four cameras of HERMES. The resolution was originally measured via emission lines from thorium and xenon arc lamps, but due to several issues the results were ambiguous. Therefore we decided to measure the resolution with the help of a photonic comb that produces a much more controlled spectrum. In March and April 2016 we were given four days of daylight time at the AAT while 2dF was mounted on the telescope and connected to HERMES to probe the resolution with a photonic comb.

Resolution via a thorium-xenon arc lamp

The GALAH survey (Martell et al. 2016) dataset includes hundreds of images of the thorium-xenon arc lamps. These are primarily used for the wavelength calibration of observed spectra. Because the lines of the arc lamp are unresolved, the resolving power can simply be calculated from the lines' measured widths. However two main problems arose. First, the quality of the arc spectra: they have low signal-to-noise ratios with only a few strong lines and sampling of about 4 pixels per resolution element. Second, the unknown properties of the xenon lines which dominate the arc spectrum. Xenon lines have never been used in visible and near-infrared spectroscopy, and so there are no available high resolution studies of the xenon spectrum. These problems resulted in ambiguous results where it was impossible to tell whether spectral ranges with lower resolution were due to HERMES' optics or blended xenon lines.

The top panel of Figure 1 shows a resolution map produced via arc lines (and the bottom panel shows an incomplete map produced with the photonic comb). Note how the resolution profile looks wavy in the wavelength direction (left-to-right), something not expected by the designers of the spectrograph. A varying resolution between fibres and between slitlets (groups of 10 fibres) is seen as well. More details about this map and maps for other three arms can be found in Kos et al. (2016, submitted).

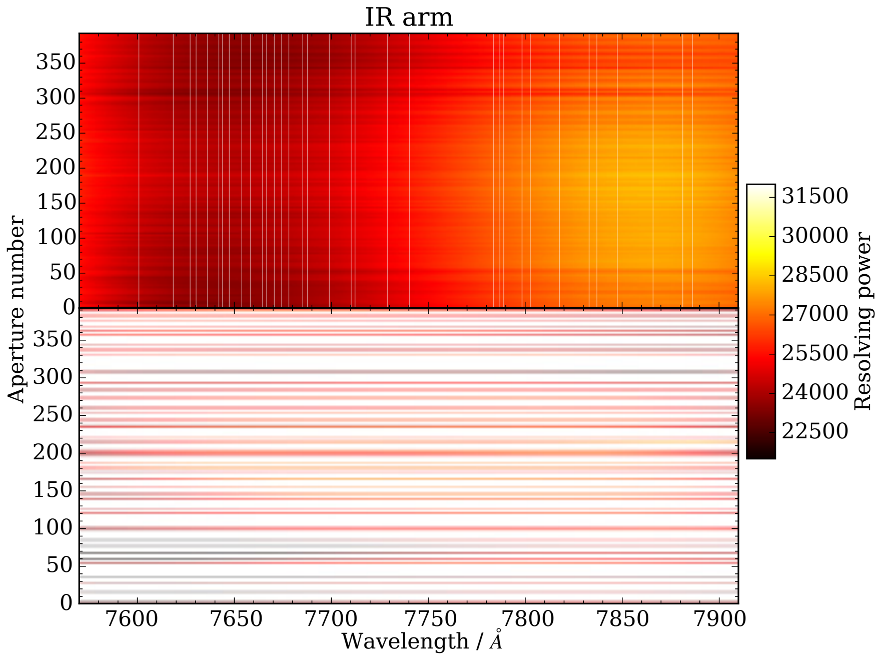


Figure 1: Resolution maps produced via thorium-xenon arc lines (top) and with a photonic comb (bottom). Bright vertical lines in the top panel show positions of Th-Xe arc lines used in production of the map. Only 43 fibres were probed with the photonic comb, so the bottom map is incomplete. Aperture number follows the fibres from 1 to 400, excluding 8 fiducial fibres used for guiding only. The colours signify the resolving power ($R = \lambda/\Delta\lambda$). Similar maps for other 3 arms can be found in Kos et al. (2016, submitted). For the photonic comb measurements some known low resolution fibres were probed on purpose, and the rest of the fibres were selected randomly.

The photonic comb

A photonic comb is a device that produces an emission spectrum with known shapes and separation between the peaks. It can be designed in a way that produces more usable peaks than normally found in an arc spectra and because the separation between the peaks is larger than their widths, there is no concern about blending. Part of a captured image showing four fibres illuminated by the photonic comb is shown in Figure 2 and its spectrum is shown in Figure 3.

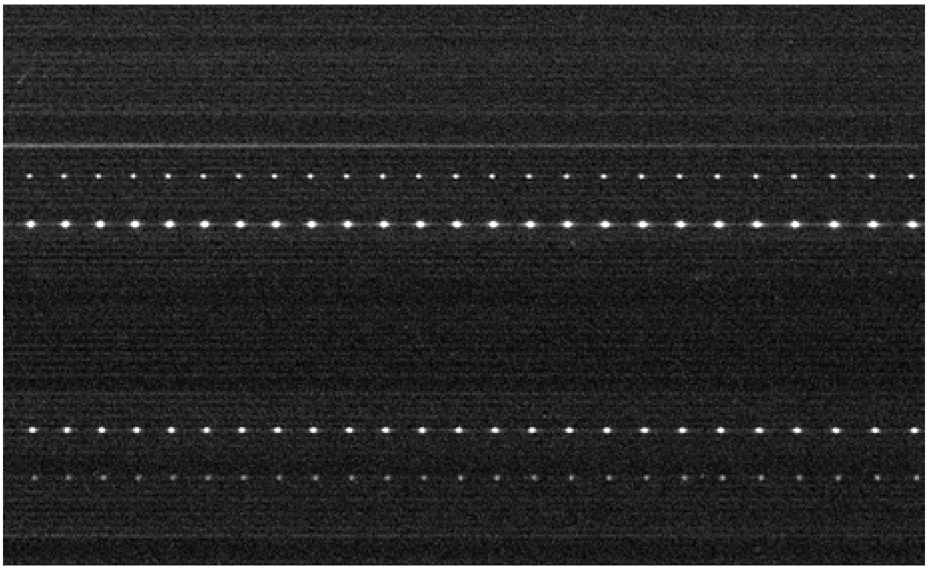


Figure 2: Part of the IR image showing the photonic comb spectrum in four fibres (ones with a dotted patern). The four fibres are unevenly illuminated, so there is different recorded flux in each fibre. The weak flux in the fibres unilluminated by the photonic comb is from the ambient white light inside the telescope dome.

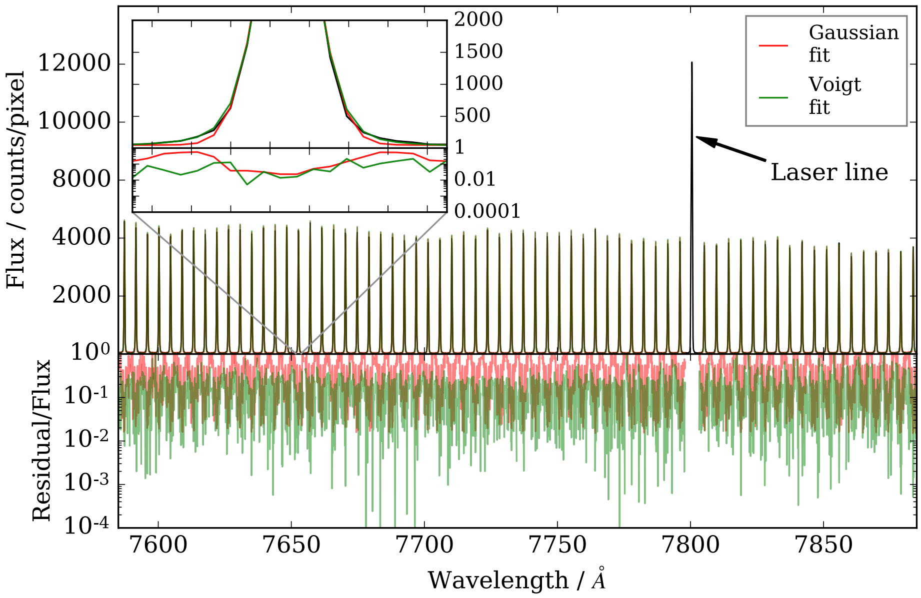


Figure 3: Spectrum produced by the photonic comb. The marked line is the Rb laser line. The laser does not shine directly into the fibre, but due to its strength some light scatters off the dome and into the fibres. The inset shows one typical line in detail. Red and green lines show fitted Gaussian and Voigt profiles and their residuals in the top and bottom panels, respectively. Only the IR arm spectrum is shown here. The spectra in the green and red arms of HERMES looks similar, but have somewhat less signal and no laser line of course. Unfortunately the blue arm spectra are not useful for our application because the photonic comb produces too weak a signal at those wavelengths.

The photonic comb spectrum is generated by coupling white light into a single-mode fibre-based broadband Fabry-Perot etalon. This produces a spectrum with peak separation of 4 Å at 7800 Å and 2.5 Å at 5700 Å with a width of the peaks of approximately 1.1 Å. The etalon is enclosed within a small thermoelectric cooler that is used to stabilize the transmission spectrum. To stabilize the photonic comb spectrum we use a Doppler-free saturation absorption spectroscopy setup (Preston 1996) that allows simultaneous measurement of the rubidium D2 hyperfine transition lines and a transmission line of the photonic comb using a tunable laser. This rubidium transition is known to be extremely stable and is an excellent absolute wavelength reference. The photonic comb spectrum is transmitted to the spectrograph using a series of single-mode fibre switches to swap the input and output of the etalon between a white light source or the tunable laser and to feed either the spectrograph or Rb locking setup, respectively. As a precaution the setup was limited to monitoring the etalon in between exposures to avoid coupling the tunable laser into the spectrograph. These measurements indicated stability on the order a few m/s over each exposure.

The photonic comb is coupled to an optical fibre that guides the light toward the 2dF where a lens focuses the light into one or several fibres of the 2dF system. Because the photonic comb has a very limited power, only a few fibres can be illuminated at once before unrealistic exposure times are required to capture the spectrum. In our experiment we chose to illuminate only one fibre at a time, which allowed us to produce a spectrum with thousands of counts per pixel in the peaks with one two-minute long exposure. Only 43 fibres could be probed in the four days of given telescope time on one plate, but it was enough to show that a photonic comb is by far a superior tool for measuring the resolution compared to the arc lamp (if the time required to sample the fibres with the photonic comb is ignored). The photonic comb produces peaks with a Lorentzian shape with wide wings that can be resolve with HERMES. This was taken into account when the resolution was measured.

The resolution profiles obtained from the photonic comb spectra show the expected bell-like shape with no waviness as in the Th-Xe arc line maps. The fibre to fibre variations, however, appear to be real. Another trip to the AAT is planned in the near future to probe all the fibres with a slightly modified photonic comb in order to be able to finish the experiment in a timely manner.

References:

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Janez Kos, et al., The GALAH survey: The data reduction pipeline, submitted to MNRAS (2016)

Daryl W. Preston, Doppler-free saturated absorption: Laser spectroscopy, Am. J. Phys. 64, 1432 (1996)

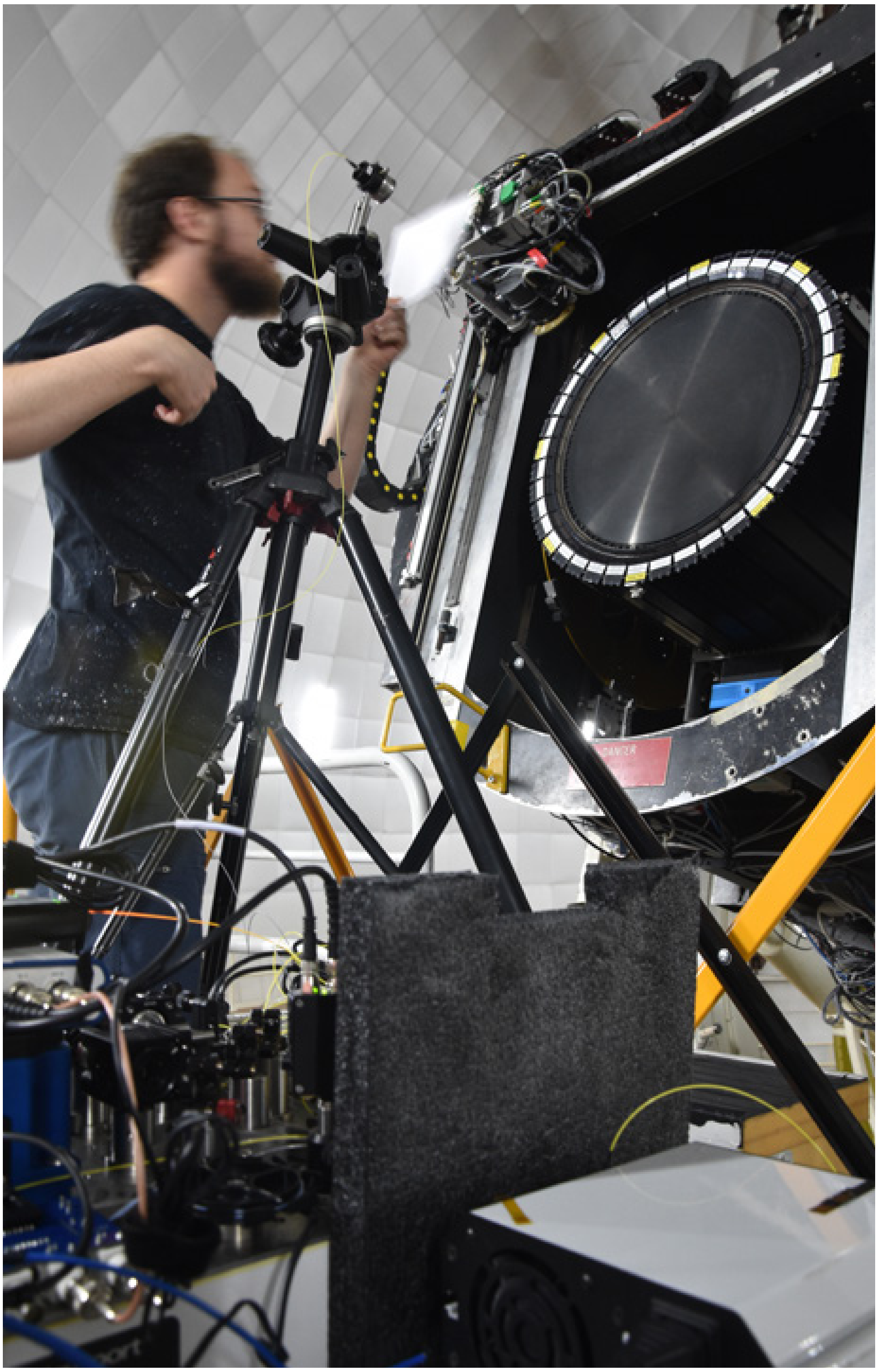


Figure 4: Chris Betters aligning the setup. Part of the photonic comb is visible in the foreground. On the tripod is a fibre leading into a lens assembly used to direct the photonic comb light into the 2dF fibres.

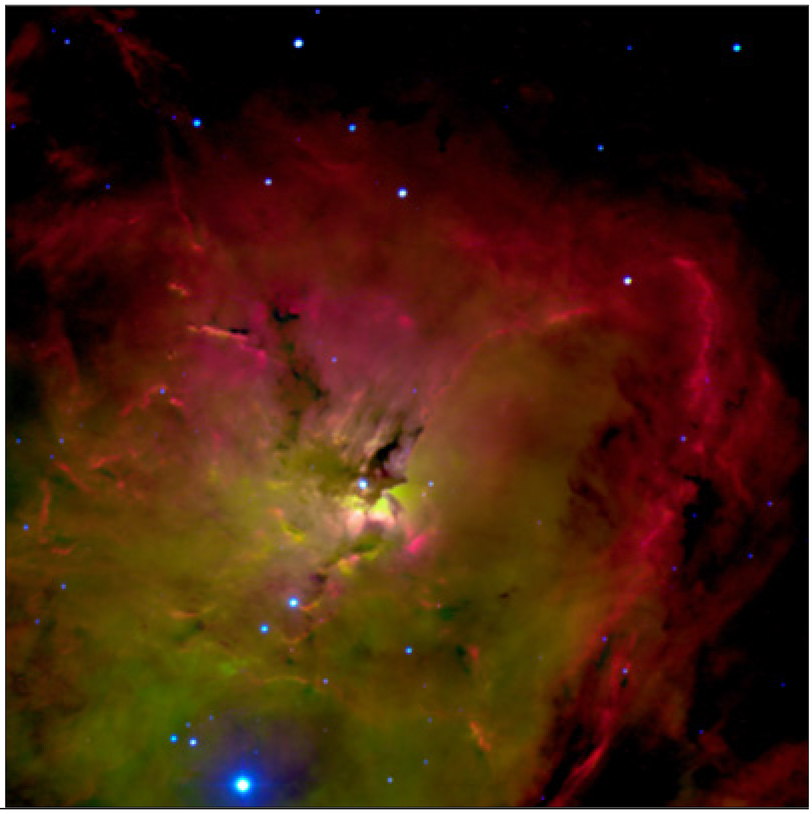
The new CACTI camera on 2dF

Ángel R. López-Sánchez (AAO / Macquarie University) and
Steve Lee, Robert Patterson & Robert Dean (AAO)

CACTI is an imaging system mounted in the 90 degree tumbled position of 2dF on the AAT.

On this page are two of the images acquired with this new system. It is still in the testing phase currently.

Spiral galaxy NGC 4027 located at around 75 million light years in Corvus (The Crow). This barred spiral galaxy, also identified as Arp 22, identified as a peculiar galaxy by the extended arm, is thought to be the result of a collision with another galaxy millions of years ago. This image is the "First Light" of the new CACTI. This colour image used B (4 x 120 s, blue) + V (6 x 60 s, green) + R (6 x 60 s, red) filters. The data were taken on 11 May 2016 as part of an "outreach exercise" via social media. Credit: Ángel R. López-Sánchez; Night assistant at the AAT: Andre Phillips (AAO).



M8, also known as the Lagoon Nebula. Data taken at 6 am AEST on 15 May 2016 (during the morning nautical twilight). Colour image using B (4 x 2s, blue) + [O III] (8 x 30 s, green) + H-alpha (6 x 30 s, red) filters. Credit: Ángel R. López-Sánchez; Night assistant at the AAT: Kristin Fiegert (AAO)

New light on dark skies

Fred Watson (AAO)

The Milky Way sets over Siding Spring Observatory on the edge of the Warrumbungle International Dark Sky Park. (Courtesy Ángel López-Sánchez, AAO.)

Two years ago, in the AAO Observer, David Malin and I wrote about the work of the Siding Spring Dark Sky Committee in endeavouring to maintain the pristine skies above the Observatory. We described the Committee's role in industry monitoring, education and advocacy in good lighting – as well as its efforts to maintain an effective regulatory framework. The article highlighted two important pieces of unfinished business: the development of new state planning legislation to replace the ageing Orana Regional Environmental Plan No. 1, and a bid to have the Warrumbungle National Park recognised as Australia's first International Dark Sky Park. It is now a great pleasure to be able to report that both these undertakings have successfully come to fruition.

Laying down the (new) law

The legislative protection of the Observatory's dark sky is the responsibility of both state and local government, with the NSW Department of Planning and Environment (DPE) providing the overarching structure. From 1990 to 2016, this existed as the Orana Regional Environmental Plan (REP) No. 1, which extended development controls to a distance of 100 km from the Observatory. Deemed a State Environmental Planning Policy (SEPP) when REPs became obsolete in 2009, the REP No.1 has now been repealed in accordance with legislative changes.

While responsibility for drafting new legislation rests with Parliamentary Counsel, the Dark Sky Committee has liaised closely with the DPE and relevant Local Government Authorities to ensure appropriate levels of protection for Siding Spring. As a result, the new legislation has now been enacted in three legal instruments, which took effect on 10 June 2016 (see Appendix).

Important though these documents are, they do not make the most riveting reading. To counter this, the Dark Sky Committee has worked closely with the DPE in the preparation of a Dark Sky Planning Guideline, which explains the new legislation in practical terms. The Guideline was also gazetted by the NSW Government on 10 June 2016, and includes full details of the steps needed to comply with the new regulations (Figure 1).

While the legislation applies specifically to the four Local Government Authorities surrounding Siding Spring (Coonamble, Gilgandra and Warrumbungle Shires and the new Western Plains Regional Council), the Guideline introduces the Orana Dark Sky Region within which controls can be imposed on certain types of development. This extends to a limit of 200 km from Siding Spring (Figure 3).

The Guideline explains good lighting principles, with simple explanatory diagrams (Figure 2) and clear explanations of issues such as the environmental benefits of lower colour-temperature (i.e. less blue-rich) light sources.

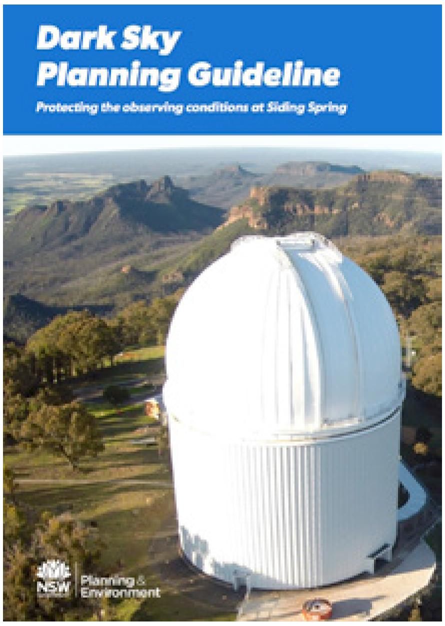


Figure 1. Cover of the new Dark Sky Planning Guideline issued by the NSW Department of Planning and Environment. It can be downloaded via: http://www.planning.nsw.gov.au/Policy-and-Legislation/Environment-and-Heritage/Dark-Sky-Planning

Growing awareness of good lighting

While the world-class standards introduced in the new legislation represent an Australian first in night-sky protection, the main task remains winning hearts and minds in the broader community. There is growing appreciation of the financial and environmental cost of wasted upward light spill, and the proposed revision of two long-established Australian/NZ Standards is a good example of this. AS 4282 and AS/NZS 1158 deal respectively with the effects of obtrusive lighting and the lighting of roads and public spaces. Hitherto, they have not included the damaging effects of upward light-spill, but the appropriate Standards Committees are now being recalled with that issue among the proposed revisions. There is representation on the Standards Committees by both the Siding Spring Dark Sky Committee and the Astronomical Society of Australia.

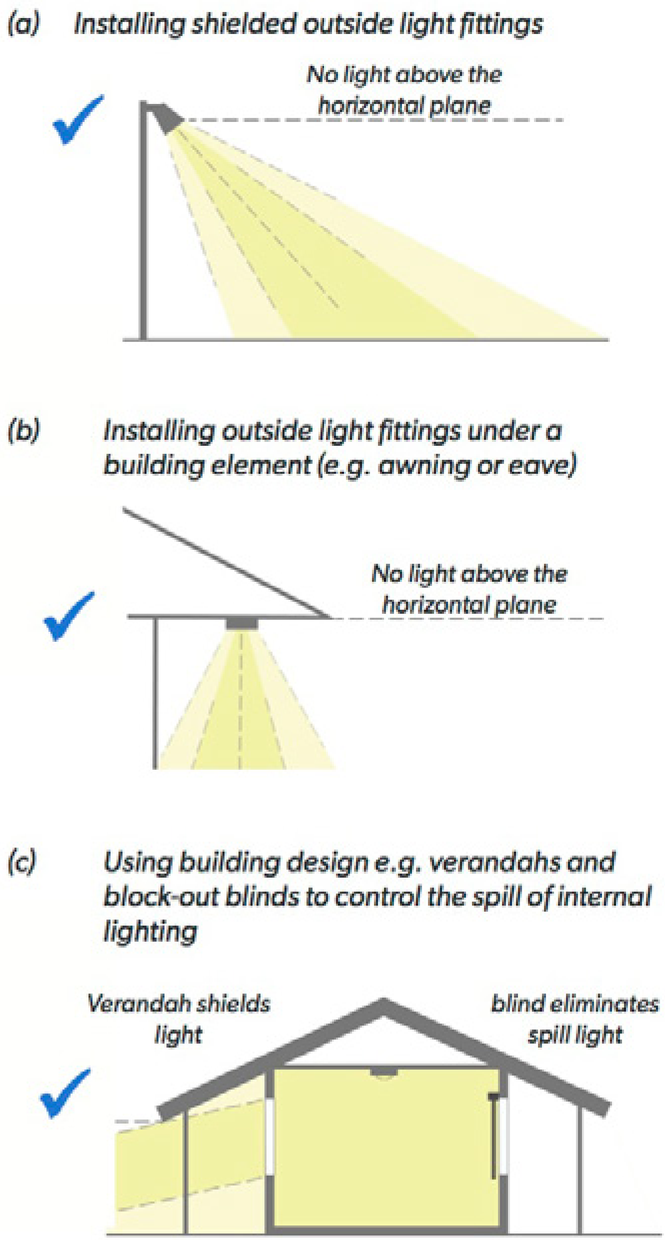


Figure 2. Simple explanatory diagrams illustrate principles of good lighting within the Dark Sky Planning Guideline. (Courtesy NSW Department of Planning and Environment.)

Other new developments in raising awareness of lighting issues are the recent American Medical Association announcement concerning the detrimental effects of blue-rich LED street lighting (AMA 2016) and the release of an updated world atlas of artificial night-sky brightness (Falchi et al., 2016)

The new atlas demonstrates that more than 80% of the world's population, and more than 99% of the U.S. and European populations live under light-polluted skies. Moreover, the Milky Way cannot be seen by more than a third of the world's population, including 60% of Europeans and almost 80% of North Americans.

Australia's first Dark Sky Park

The peak advocacy body for good outdoor lighting is the International Dark Sky Association (IDA), which runs the International Dark Sky Places program recognising the planet's accessible, pristine skies. The IDA also acknowledges communities with "exceptional dedication to the preservation of the night sky".

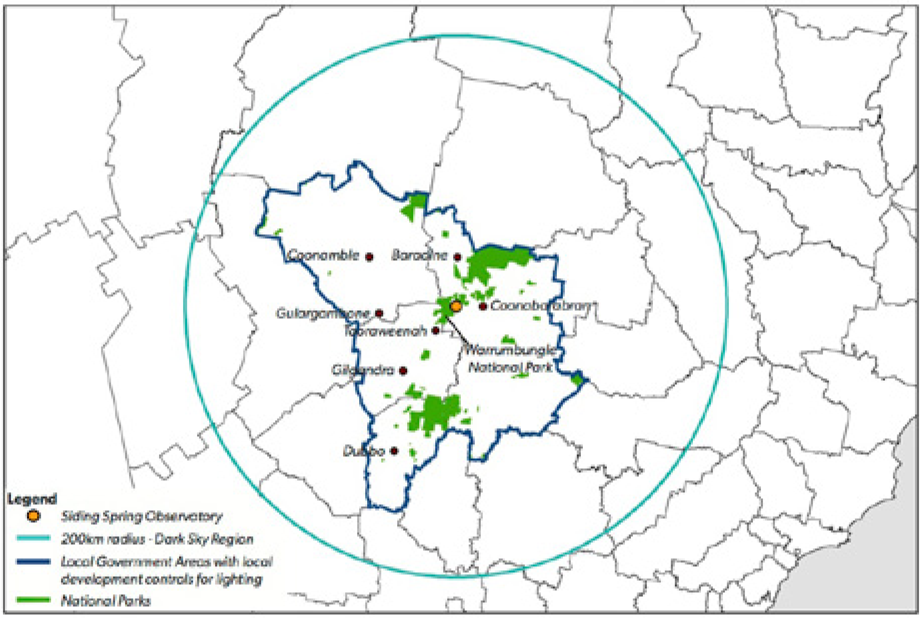


Figure 3. Map delineating the four Local Government Areas with local lighting controls, together with the 200km-radius Orana Dark Sky Region. (Courtesy NSW Department of Planning and Environment.)

The IDA's Dark Sky Places certification process is modelled on other conservation and environmental designation programs, such as the UNESCO World Heritage Sites and Biosphere Reserves. Indeed, the International Dark Sky Places program earned the IDA an Environmental Excellence Award in 2015.

The award was granted by the National Association of Environmental Professionals (NAEP), and is for outstanding environmental contributions in the area of public involvement and partnerships. As of 2015, ten Communities, 22 Parks and nine Reserves had received International Dark Sky designations, comprising more than 43,000 square km on four continents. With the recent award of International Dark Sky Park status to the Warrumbungle National Park (WNP), that extends the successes to five continents.

The plan to apply for Dark Sky Park status for the WNP goes back several years, but it was only in 2015 that work on the proposal began in earnest. It was carried out by a small committee, chaired by myself and including representation from the National Park as well as the SSO Dark Sky Committee. The project was coordinated by Marnie Ogg, Manager of Sydney Observatory.

The criteria for International Dark Sky Park status are strict, and the 112-page application included a photographic inventory of lighting installations, night-time satellite imagery, night-sky imagery and brightness measurements, public night-sky awareness events, community activities and letters of support.

At the end of April, the Committee was notified of the success of the application, with the WNP being awarded Dark Sky Park status at Gold-tier level (the most stringent in terms of freedom from light pollution).

With the Dark Sky Park now formally recognised, a second application will be submitted to IDA to extend the designated area to include Siding Spring Observatory. While the Observatory shares a boundary with the WNP, the initial application was limited to the Park itself. This was to avoid delaying the preparation of the application, with the risk that another park might take the honour of being Australia's first International Dark Sky Park.

The DPE has provided significant funding that will assist with the implementation of the new legislation provisions. This will include stakeholder and community education in respect of dark skies planning requirements, setting up and facilitating regional forums for builders and lighting engineers, and the preparation of publicity material promoting the new lighting guidelines and the. It is a remarkable and much-appreciated vote of confidence in the region's role in good lighting advocacy.

ACKNOWLEDGEMENTS

It is a pleasure to thank past and present members of the Siding Spring Dark Sky Committee for their tireless support in the quest to keep Siding Spring dark. Current membership is Ashley Albury, Donna Burton, Brad Condon, Doug Gray, Zoe Holcombe, Robert Jehu, Peter Verwayen and Reg Wilson. Thanks are also due to the staff of the NSW Department of Planning and Environment involved with the dark sky legislation, including Azaria Dobson, Jessica Holland, Danijela Karac and Jarrad Tulloch. Colleagues in the National Parks and Wildlife Service are also thanked, particularly Mark Fosdick, Mark Peacock, Robert Smith and Michael Wright. Thanks are due to Marnie Ogg, who coordinated the IDA application, and the large number of people who supported it, including Matthew Colless, Warrick Couch, Steve Lee, Neville Legg, Ángel López-Sánchez, David Malin, Peter Small, Will Watson, and representatives of the Coonamble, Gilgandra and Warrumbungle Shires and the city of Dubbo. Lastly, it is a pleasure to thank John Barentine of IDA for his invaluable guidance in finalising the submission.

References

American Medical Association, 2016. 'AMA Adopts Community Guidance to Reduce the Harmful Human and Environmental Effects of High Intensity Street Lighting', http://www.ama-assn.org/ama/pub/news/news/2016/2016-06-14-community-guidance-street-lighting.page, 14 June 2016.

Falchi, F., Cinzano, P., Duriscoe, D., et al., 2016. 'The new world atlas of artificial night sky brightness', Science Advances 10 Jun 2016, Vol. 2, no. 6, http://advances.sciencemag.org/content/2/6/e1600377.full

Appendix

The legal instruments protecting Siding Spring are:

State Environmental Planning Policy (Integration and Repeals) 2016 http://www.legislation.nsw.gov.au/EPIs/2016-310.pdf

Standard Instrument (Local Environmental Plans) Amendment (Observatory and Defence Facility) Order 2016 http://www.legislation.nsw.gov.au/EPIs/2016-309.pdf

Environmental Planning and Assessment Amendment (Siding Spring Observatory) Regulation 2016 http://www.legislation.nsw.gov.au/regulations/2016-303.pdf

New remote observing stations for the AAT

C. Lidman (AAO), N. Bennie (AAO), M. Boulton (ICRAR), R. Dean (AAO), T. Farrell (AAO), C. Ramage (AAO), B. Roberts (RSAA), A. Robothom (ICRAR), K. Sealey (AAO), K. Sebo (RSAA), and B .Tucker (RSAA)

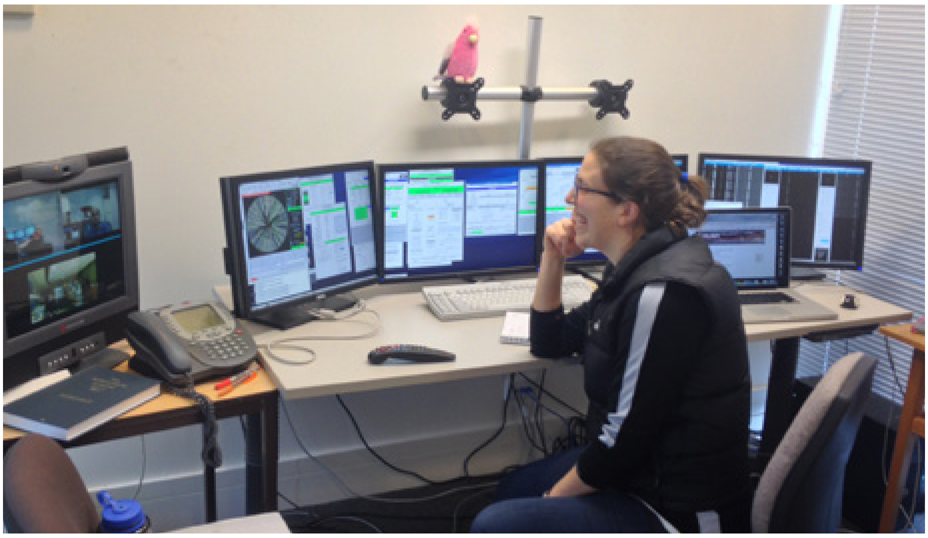
Observing from the remote control room located at the AAO offices in North Ryde has become a popular alternative to travelling to the AAT and undertaking the observations from site. Started at around the time of the massive Wambelong fire that hit the Warrambungle Mountains in 2013 (see the articles in the February 2013 edition of the AAO Observer), remote observing from North Ryde now accounts for a bit more than half of all observations that are done with the AAT.

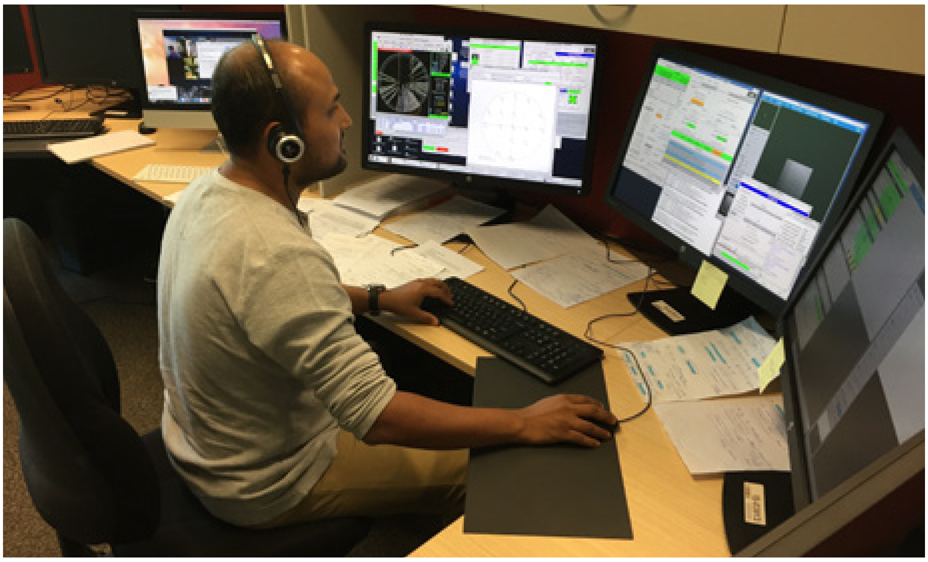
Early last year, it was decided to set up additional remote observing stations at other locations, with the aim of testing how well this would work elsewhere, and with an eye to setting up further remote observing stations at other institutes. In collaboration with ICRAR in Perth and the RSAA in Canberra, we have set up two remote observing stations, one in Western Australia and the other in the ACT.

The setups at ICRAR and RSAA mimic closely the setup in North Ryde. One set of screens is used to control the instrument, while another set of screens is used to prepare the observations. Communication occurs via a Polycom. Remote access to the computers at the telescope site is only allowed on the day of the observations and this connection is managed by the site staff. They only allow connections to the instrument computer when they are ready and when it is safe to do so.

Observing from these stations has gone well. We have had a number of successful runs, and even had a few runs where all three remote stations (North Ryde, ICRAR and RSAA) are connected with site simultaneously.

Remote observing has not been designed to replace observing from the telescope. We do require people who have not been to the telescope in the last two years to go to the telescope to observe.





This is not only to ensure observers remain familiar with using the AAT and its instruments, but also in recognition of the need to maintain a healthy level of in-person exchange between astronomers who use the telescope and the staff at site who work so hard to make sure the telescope and instruments are ready for use 365 days of the year.

If your institute is interested in setting up a remote observing station, then please register your interest by contacting the AAO Director at director@aao.gov.au.

Top: Katie Schlesinger at the remote observing station at RSAA

Bottom: Prajwal Kafle at the remote observing station at ICRAR

The Story of Light at Vivid Sydney 2016

Ángel R. López-Sánchez (AAO / Macquarie University)

Following the success of our sold-out event *The Story of Light – The Astronomer's Perspective* for Vivid Sydney Ideas 2015, the AAO continued its collaboration with Vivid Sydney 2016, organizing *The Story of Light – Deciphering the data encoded in the cosmic light*. This event was held at the PowerHouse Museum in Sydney on Sunday 29th May 2016. More than 160 people attended this special event, where five early career astronomers talked about:

- Astronomy and Big Data
- the light and light-based technologies developed in Australian astronomy for both optical and radio telescopes
- the tools, platforms, and techniques used for data analysis and visualization
- how astronomers create simulation data; how some of these techniques are being used in other research areas
- and the major scientific contributions toward our understanding of the Universe.

Astronomers have been pioneers in developing "Data Science" techniques to make sense of huge data deluges, and many of these techniques are now used in non-astronomical and non-scientific areas.

The event was hosted by Alan Duffy (Swinburne University) with Ángel López-Sánchez (AAO/MQU) talking about optical astronomy, the AAO, surveys, and big data; Vanessa Moss (USyd/CAASTRO) discussing radio astronomy, the ASKAP and big data; Luke Barnes (USyd) telling the audience about simulating, analysing and visualizing astronomical data; and Liz Mannering, (AAO/ICRAR) explaining astronomy data archives, the All-Sky Virtual Observatory and other virtual observatories.

The overall message was that the information encoded in the light emitted by stars, gas, and galaxies provides the key for understanding the Universe. For decades astrophysicists have developed novel approaches to exploring the light of the Cosmos, most recently through data-intensive techniques, analytics and visualization tools to extract the information collected by extremely sensitive telescopes and instruments. Using some of the world's most powerful computers, astronomers create simulations to reproduce the atmospheres of planets, exploding stars, galaxy mergers, and even the evolving Universe. Linking observations at optical and radio wavelengths, data collected by space telescopes in other wavelengths (X ray, ultraviolet, infrared) and the theoretical modeling and simulations of astrophysical phenomena, continues to provide astronomers with a rapidly growing data resource that presents challenges in the era of data-intensive research.

After the short talks, the panel welcomed questions from the audience (and even from Twitter using #SoLVividSydney) for a discussion session about Light and Astronomy and the Australian contribution to the improvement of our understanding of the Universe.

The full video of the event is now publicly available on the AAO's YouTube channel (https://www.youtube.com/watch?v=TXwfbN0Hsuc). We thank AAO/ITSO Research Astronomer Caroline Foster for help in recording and editing the video and Jenny Ghabache (AAO) for taking the photos of the event.

The five astronomers speaking during our "Sydney Vivid Ideas: The Story of Light" started at the Powerhouse Museum, Sydney, 29th May 2016. From left to right: Luke Barnes, Alan Duffy, Vanessa Moss, Liz Mannering and Ángel López-Sánchez.

The Lecture Theatre a few minutes before our "Sydney Vivid Ideas: The Story of Light" started at the Powerhouse Museum, Sydney, 29th May 2016. Photo credit: Jenny Ghabache (AAO)

ITSO Corner

Stuart Ryder (International Telescopes Support Office, AAO)

Proposal Statistics

A total of 5 Gemini proposals were received by ATAC for Semester 2016B, the same number as for 2016A. Due to a significant imbalance in demand between Gemini South and Gemini North a supplementary call for proposals was issued, which attracted a further 5 proposals and 1 resubmission. There were 4 proposals for Gemini North, and 6 for Gemini South. The 3 Gemini South nights in 2016B went to student PI-led proposals from Daniela Opitz (UNSW) and Erik Kool (Macquarie University) to use GeMS+GSAOI, while 1 night on Gemini North went to Rob Sharp (ANU).

Magellan demand in 2016B was comparable to that in 2016A, with 9 proposals seeking 19 nights for an oversubscription of 2.7. Unlike recent semesters the demand for Baade now exceeds that of the Clay instruments.

A total of just 17 proposals were received by KTAC in its second semester, half the number received in 2016A. As with Gemini, a significant imbalance in demand between Keck 1 and Keck 2 led to the decision to issue a supplementary call for 2016B proposals which generated a further 6 proposals. There were 14 proposals for Keck 1 and 9 for Keck 2. The oversubscription for Keck 1 was 1.8, while for Keck 2 it was 1.3. Total dark time was oversubscribed by 2.5, grey time by 0.4, and bright time by 2.1. MOSFIRE, OSIRIS and NIRC2 were the most requested instruments, while ESI and NIRSPEC had the fewest requests. KTAC met on 13–14 April to rank the 2016B proposals. The top-ranked proposals all got their requested shares of AAL, ANU, and/or Swinburne nights, apart from one AAL-led proposal (with some ANU involvement) which required an extra half-night from ANU. AAL is currently conducting a review of the KTAC process following its first two semesters.

Keck observer travel

With effect from Semester 2016B the default mode of observing with the Keck telescopes is remotely from Swinburne University of Technology (or eventually from the ANU's Research School of Astronomy & Astrophysics), provided the PI (or their designated Australian-affiliated observer) meets the eligibility criteria, i.e. they have observed with their scheduled instrument from Waimea within the past 2 years. While this change is driven in part by a smaller travel budget in 2016/17, there are a number of good reasons to make use of remote observing whenever possible:

- Reduced jet-lag and time spent away from home, making this a more efficient and family-friendly option.
- There is little difference in practice between observing from the Keck Observatory headquarters in Waimea (which is itself remote from the telescopes on Mauna Kea) and from an Australian mainland site.
- Greater use of Swinburne's facility by external users will assist in the maintenance and upgrading of this facility.

ITSO will continue to support users who are not yet eligible to remote observe with Keck (particularly students and early-career researchers) in the usual way – see https://www.aao.gov.au/itso/keck/travel.

ITSO Staffing

Dr Richard McDermid, the joint ITSO/Macquarie University Lecturer in Astronomy, took up his Australian Research Council Future Fellowship in June 2016. Richard has kindly offered to continue lending his immense experience with Gemini and IFU spectroscopy in general as an Honourary Associate of ITSO. ITSO and Macquarie University are keen to maintain this relationship, and will be employing a replacement joint lecturer.

AGUSS

The Australian Gemini Undergraduate Summer Studentship (AGUSS) program offers talented undergraduate students the opportunity to spend 10 weeks over summer working at the Gemini South observatory in La Serena, Chile, on a research project with Gemini staff. They also assist with queue observations at Gemini South itself, and visit the Magellan telescopes at Las Campanas Observatory. Applications will close on 31 August 2016, see https://www.aao.gov.au/science/research/students/gemini for updates and further information.

2016 Observational Techniques Workshop

Details about the highly-successful 2016 ITSO/AAO Observational Techniques Workshop can be found in a separate article in this edition of the AAO Observer by Caroline Foster-Guanzon (see page 24). In April/May 2017 we anticipate holding another ITSO science symposium to highlight the latest Australian-led research being conducted with international telescopes supported by ITSO including Gemini, Keck, Magellan, and Blanco. Subscribe to https://www.aao.gov.au/itsonews.xml for updates.

Telescopes overview

ITSO Information Officer Elaina Hyde has compiled a "one stop shop" of all the Australian and international telescopes on which Australian-based astronomers can apply for time, either through ATAC, KTAC, or ANU. This is expected to be of particular benefit to students and researchers who may be new to Australia, and includes links to the instrumentation available, proposal deadlines, and submission procedures. Please visit https://www.aao.gov.au/telescopes-australia and let us know what you think.

The Australian Gemini Image Contests

Richard McDermid (Macquarie University/AAO)

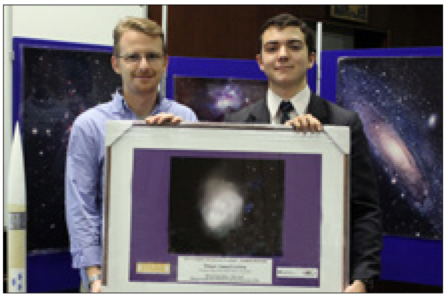
Australian Gemini Cosmic Poll 2015 winning object NGC 3310. Image credit: AAO ITSO office, Gemini Observatory/AURA and T.A. Rector (University of Alaska Anchorage)

With the conclusion of queue-mode access to Gemini Observatory, 2015 marked the last foreseeable round of the Australian Gemini Image Contest – a public outreach initiative started in 2009 by the then Australian Gemini Office (AusGO, now the International Telescopes Support Office, ITSO). The concept behind this competition was to engage school students in modern astronomy, having them experience the challenge of selecting and proposing a little-known target to observe with the 8m Gemini telescopes, and competing with other schools to be selected by a committee of professional astronomers and educators to have their object observed. The winning proposal would use up to one hour of Gemini time that was competitively allocated for the Contest through the standard Australian Time Allocation Committee (ATAC) process, with the observations configured by ITSO staff and executed in queue-mode by Gemini.

The contest has resulted in some stunning and engaging astronomical images that have adorned the covers and pages of this newsletter, articles in astronomy magazines and websites, annual reports from our national institutions, and even the Australian Astronomy Decadal Plan 2016–2025. This is in addition to the many school visits by professional astronomers to present image prints to the winning students, and to conduct "Live from Gemini" video-conference class sessions with the enthusiastic staff at the Gemini Observatory. Contest images have even been published in professional journals, either directly with credit to the students and AusGO/ITSO support staff, or through their presence in the Gemini Science Archive.

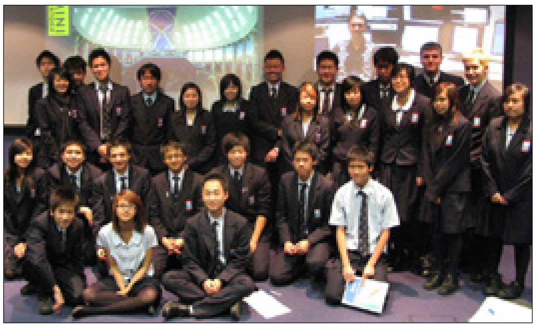
Such was the success of this program that it was extended to the national amateur astronomy community in 2013, with the formation of a separate division of the contest for members of the public. Taking advantage of the deep appreciation and knowledge of the night sky held by the Australian amateur astronomy community, this also resulted in observations of many wonderful objects that may otherwise have been overlooked by large telescopes. In addition, winning enthusiasts could have a one-on-one online 'master class' in the processing of their data by the seasoned Gemini outreach image specialist, Dr Travis Rector of the University of Alaska.

To further broaden the impact of the contest and attract the interest of a wider audience, the 2015 contest tried a slightly different approach. Using the online science engagement platform Thinkable.org, the ITSO team put together a series of short videos about different types of astronomical objects that would make compelling images when observed with Gemini. Subscribers could then 'vote' on the type of object they would like to see observed. This 'Australian Gemini Cosmic Poll' ran for two weeks, together with a drive of activity through social media channels like Twitter and Facebook.



2014 Student contest: The peculiar galaxy NGC7727. Winner: Jointly won by Ivanhoe Girls' Grammar School Astronomy Club; right (Melbourne) and Samuel Carbone, Trinity College; left (Perth). Winning images were presented by the author. https://www.aao.gov.au/news-media/news/winners-2014-student-gemini-image-contest

2013 Student contest: The spiral galaxy IC5332.
Winner: Isobelle Teljega, from St Margaret's Anglican School (outside Brisbane, QLD)
http://www.gemini.edu/node/12081#title5



Left: 2009; The Glowing Eye Nebula (NGC6751)

Above: Winner; Year 10 student, Daniel Tran, of PAL College in Cabramatta, NSW.
http://www.gemini.edu/node/11329

Below: 2010; The colliding galaxies NGC 6872 and IC 4970
Winners; Astronomy Club of the Sydney Girls High School

Left 2011; The barred spiral galaxy known as NGC 7552

Above: Winner; Benjamin Reynolds (right), from Sutherland Shire Christian School in Sutherland, NSW. Presented with the winning image (enlarged on the left) by then AusGO staff member Chris Onken.
http://www.gemini.edu/node/11697

In that short time, news of the Poll entered over 50,000 different individual social media feeds, primarily of high school-aged users. The Poll itself has been viewed over 7,000 times, and received over 100 registered votes. This level of exposure and engagement exceeded all previous competition entries combined, as well as drawing people's attention to the work of the AAO through ongoing social media interactions tracking the progress of the observations. The most votes went to the 'Individual Galaxy' video made by Dr Elaina Hyde, resulting in a beautiful detailed image of NGC 3310, (the opening image of this article), revealing shells of stars encasing elongated spiral arms of star formation.

So what's next for the outreach and education activities of ITSO? The Australian Gemini Image Contest formed a key part of ITSO's outreach activities, and gave Australian school students and amateur astronomers an incredible opportunity to use one of the world's largest astronomical observatories. Generating such excitement and enthusiasm for astronomy within the public and schools community remains a key part of the ITSO mission. We are always looking for new ways to engage the public with the pioneering science being done in Australia using the array of world-leading telescope facilities available to its researchers. If you have ideas for outreach activities that you think would accomplish these goals, get in touch with us at: itso@aao.gov.au.

To see the full collection of contest images, see

https://www.aao.gov.au/itso/outreach

Top Left and Above: 2013 Amateur contest: Gum 85 Nebula.
Winner: Paul Fitzgerald (right), being presented his winning image by Fred Watson.

Below: 2014 Amateur contest; The planetary nebula IC 5148. Winner: Steve Crouch (ACT)
https://www.aao.gov.au/news-media/news/winner-2014-gemini-image-contest-amateur-division

The ITSO/AAO observational techniques workshop was a hit

Caroline Foster (AAO)

Participants and presenters of the 2016 ITSO/AAO Observational Techniques Workshop.

The International Telescopes Support Office (ITSO) and the AAO recently ran the 2016 ITSO/AAO Observational Techniques Workshop. It took place 3-6 May 2016 at the AAO headquarters in North Ryde and was sponsored by Astronomy Australia Limited and the AAO.

The primary aim for the workshop was to provide training and information to Australian-based PhD students and early career researchers about optical/infrared facilities available to Australian astronomers. The topics covered were broad and included data archives, tips on writing successful proposals, hands-on tutorials, data reduction methods, and analysis tools. Participants also got the chance to test their newly acquired skills during the data reduction challenge (see the facing page for the winning images).

A total of 38 participants attended the workshop, along with 19 presenters. Registered participants were primarily PhD students and early career researchers, but also included more seasoned astronomers and instrument scientists.

The workshop organising committee was comprised of chair Caroline Foster (AAO), Stuart Ryder (AAO), Richard McDermid (Macquarie), Simon O'Toole (AAO), Chris Lidman (AAO) and Elaina Hyde (AAO). This committee handled the organisation and coordination of this meeting helped by several AAO staff and members of the astronomical community.

ITSO and the organising committee wish to extend a special thanks to Kathleen Labrie (Gemini Observatory), Andy Green (AAO), Jenny Ghabache (AAO), Helen Woods (AAO), the AAO IT team and the multitude of presenters from the AAO staff and beyond. We also extend our thanks to all attendees for making the workshop a success and our efforts worthwhile.

Followers of the AAO Facebook page, Twitter @AAOastro and #ITSOaao would have noticed a significant spike in activity during the workshop. If you have missed the action, you can catch up on https://storify.com/AAOastro/otw2016-itsoaao where all tweets related to the workshop have been recorded.

The program along with slides and material from the various presentations can be found on the workshop website at https://www.aao.gov.au/conference/OTW2016. All sessions were recorded and are available online through the AAO YouTube channel.

Congratulations to the winners of the data reduction challenge, Ben MacLean (Monash University) and Danica Draskovic (Macquarie University), for their winning images in the "true to science" (above) and "Picasso" (below) categories, respectively. Participants had to download the data for NGC 6872 from the Gemini archive, reduce it and combine the three bands to produce the colour image.

News from North Ryde

Jeffrey Simpson

Our latest cohort of undergraduate winter fellowship students have arriving. Working with Chris Lidman is Lizzie Elmer (University of Nottingham) and Glenn Wagner (Oxford University); working with Jeffrey Simpson is Jaime Andrés Alvarado Montes (Universidad de Antioquia). As always, these internships will hopefully be extremely useful for students and supervisors alike.

We bid a fond farewell to Keith Shortridge. Keith had been working at the AAO in the software group since 1984 and officially retired July 2016. In his time at the AAO he has worked on Figaro data reduction system, the DRAMA data acquisition system, the Astroshare, ADASS, and ASCL organisations. He is not dropping out of astronomical software completely, and will be setting up a small bespoke software operation, and hopes to continue to do work for AAO.

Another retirement from the AAO was Don Mayfield. As he put it, he is "really" retiring after 41 years, of which the last 8 years were casual.

Katrina Sealey and Andrew Hopkins received 2016 People Management and Leadership Awards from the Department. Katrina received her Leadership Award for having "transformed the AAO Research IT team into a cohesive team that is now perceived in a favourable light both inside and outside the AAO". Andrew received his People Management Award for "outstanding team management and excellence in promoting diverse individual strengths and skills". The Secretary of the Department presented Katrina and Andrew with their awards at a special ceremony at Industry House in Canberra on 21 July.

Our inaugural Shaw Visitor, Alastair Edge (Durham) has joined us. He arrived 27 June and will be visiting until September. During his time with us, he will be working on a range of galaxy evolution and instrumentation projects with many members of the staff.

Last, but in no way least, during the 2016 Annual Scientific Meeting of the Astronomical Society of Australia (ASA) the SAMI instrument team was the winner of the ASA's inaugural Peter McGregor Prize for "exceptional achievement or innovation in astronomical instrumentation".

Letter from Coonabarabran

Zoe Holcombe

Hello Everyone,

February

Katrina Harley and her partner Tom welcomed Ben into the world on the 28th February; Millie just adores her new brother.

We then welcomed our new Electronics Technician Ben Wilkin to the AAT. He was thrown straight into his new role in helping take out the mirror for aluminising. Ben comes from Adelaide originally and was in the Navy for 11 years as an electronics technician. Ben plays for Dubbo Rams in the State League Basketball side every weekend.

March

The annual Advisory Committee visited site over two days and were treated to the AAO Site hospitality.

Our next new staff member Jenny Riding arrived at the AAT. Jenny will be doing software engineering and night assisting. She is a radio astronomer working on her PhD using the MWA. Jenny and her husband bought a house in Coona with their dog Kappa, who got to see snow for the first time in June!

Above: Wade Sutherland with his 2016 NSW Training Awards certificates

Above: Darren Harris, Wayne Clarke, Tony Antaw, Raelene Suckley and Carl Holmesby 'enjoying' the dusting of snow.

April

The new ANU lodge is starting to take shape now. One of the main jobs was the pouring of the slabs which took place over a few days. Please make sure that if you need to go into the fenced off area that you get permission first as it is a construction site.

June

Wade Sutherland had considerable success in the 2016 NSW Training Awards for the New England Region. He was both one of the fourteen "Apprentice of the Year" finalists, and received an "Excellence in Electrotechnology" Award.

At the end of June we got lucky with a light dumping of snow. Driving up in the morning it was still trying to snow but by 10am it had mostly disappeared.

July

The AAT Flat Field panels were taken down and loaded onto the AAT Truck by the Mechanical Team. The panels will then taken to Mudgee be painted on one side with special all-wavelength reflective paint as part of a new calibration system being implemented.

The Dark Skies Committee at SSO have been keeping a very big secret since March. The Warrumbungle National Park was named the 1st Dark Skies Park in Australia at the start of the month. A big thank you to Fred Watson and Marnie Ogg (see Fred Watson's article on Page 14) and also to the SSO Dark Skies Committee and the Warrumbungle National Park Committee. The Park will help to protect the dark sky environment around Site and also bring extra tourists to the town.

The 2016 Melbourne Cup made a quick and early appearance at the AAT on the 12th July. A few lucky staff made themselves available for photos with the $175000 18-carat gold cup. Note that it was white gloves only when holding the cup and extra grip when taking it out on the Catwalk in very windy conditions!

Above: Zoe Holcombe holding on tightly to the Melbourne Cup.

StarFest

Organising for this year's annual StarFest is well under way. Science In The Pub will kick off the weekend's activities on Friday 30th September, with the panel comprising of Dr Lisa Harvey-Smith, Dr Elisabete Da Cunha & the AAO's very own Dr Ángel López-Sánchez. Fred Watson will MC the event.

On Sunday 2nd October Dr Amanda Bauer will be giving the 2016 Bok Lecture. All the information can be found at the StarFest Webage www.starfest.org.au or follow us on Facebook www.facebook.com/StarfestSidingSpring .

If you would like to help out over the weekend or have an idea for a display at Open Day, please get in contact with one of the StarFest Committee members or myself.

See you next time...

Three spiral galaxies from Lyon Galaxy Group #455: NGC 7232 (upper right), NGC 7232B (left), and NGC 7233 (centre). These objects were selected by Ryan Soares, from Perth's Trinity College (WA), the winner of the 2012 Australian Gemini Image Contest.

Credit: Australian Gemini Office/Gemini Observatory/AURA.

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