



CAASTRO Newsletter Edition 8, August 2013



Introduction from CAASTRO Director

CAASTRO's flagship research programs are very much now in full swing. The SAMI galaxy survey was [recently awarded 150 nights on the Anglo-Australian Telescope](#) over the next three years, with which the SAMI team aims to obtain spatially resolved spectroscopy of more than 3000 galaxies. Already SAMI has studied many hundreds of galaxies, with several papers on these sources now being written. Meanwhile, the [Murchison Widefield Array \(MWA\)](#) was [formally launched last month by Science Minister Senator Kim Carr](#), and has now begun its observing programs on the Epoch of Reionisation, transients, solar science and continuum surveys. And there have been some exciting developments in the world of fast

transients: not only were CAASTRO astronomers part of the team [who announced a population of fast extragalactic radio bursts](#) in a paper published in Science last month, but early results from the [Square Kilometre Array Molonglo Prototype \(SKAMP\)](#) suggest bright prospects for a much more sensitive survey for this enigmatic new phenomenon, to commence in 2014. Check out our [news stories](#) and [latest papers](#) for lots of other recent research results.

Our outreach programs continue to grow. If you haven't seen it yet, I encourage you to watch some of our new ["Pint in the Sky" YouTube series](#), in which Alan Duffy and Katie Mack head down to the pub, have a chat, and answer questions about the Universe. Our ["CAASTRO in the Classroom" program](#) is now in the hands of Jamie Farnes and Shane O'Sullivan; this term we've ramped up to weekly sessions, in which schools from all over New South Wales have participated. And for [National Science Week](#), we co-hosted special events in Sydney and Canberra with special guests including [Phil Plait \("the Bad Astronomer"\)](#), [Elise Andrew \("I F****ing Love Science"\)](#) and [Henry Reich \("Minute Physics"\)](#).

Our first annual science conference, ["Reionisation in the Red Centre"](#), took place a few weeks ago at Uluru, and was a fantastic success. Big thanks to Stuart Wyithe, Kate Gunn, Kim Dorrell, Kylie Williams and to everyone else who organised this, for ensuring everything run so smoothly. With that now behind us, we're now busy preparing for our next annual conference, ["Supernovae in the Local Universe: Celebrating 10,000 Days of Supernova 1987A"](#), which will be held in Coffs Harbour in August 2014 – registration will open in December 2013. And looking even further ahead, I'm pleased to announce that CAASTRO will be hosting the 2015 annual conference on [Astronomical Data Analysis Software and Systems \(ADASS\)](#), which will take place in Sydney in October 2015.

There have been a few recent changes in personnel in Australian astronomy. Accordingly, Chris Blake

and Matthew Colless both have new roles in CAASTRO as Chief Investigators, while Warrick Couch has become a Partner Investigator. Looking to 2014, we plan to hire about a dozen new CAASTRO postdocs, some to maintain and grow our capacity in existing efforts like MWA and SAMI, and others to begin new projects in areas such as HI intensity mapping, OzDES and the ASKAP early science program. [Look for the job advertisements](#) from around 1 October 2013, with closing dates of 31 October 2013.

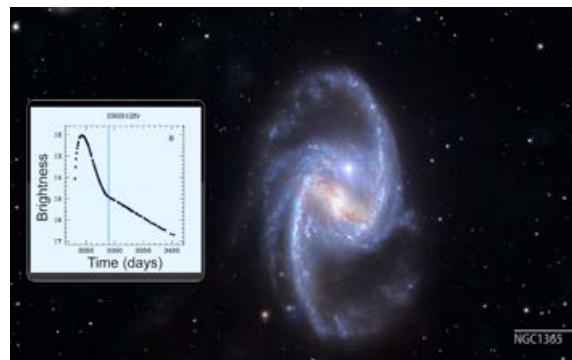
Bryan Gaensler
CAASTRO Director

Research Update

Supernova 2012fr: Key Link Found in Cosmic Distance Ladder

Supernova (SN) 2012fr was a Type Ia supernova that occurred in late 2012 in the nearby galaxy NGC 1365. [A team led by Mike Childress obtained 65 optical spectra of SN 2012fr](#) from 9 telescopes over the first two months following the SN explosion. They measured the evolution of absorption features caused by the intermediate mass elements (IMEs) Si and Ca, as well as Fe-group elements. They found that Si and Ca exhibited strong "high velocity features" at early epochs, indicating some IME-rich material outside the nominal SN photosphere. The team also detected a late phase velocity plateau for the IMEs that was not present for the Fe-group elements, indicating stratification of the ejecta. The study provides important constraints on theoretical models for the explosion of SN 2012fr and other similar Type Ia supernovae Ia, and provides a large legacy data set for future Type Ia spectroscopy modelling. This research [was published in The Astrophysical Journal](#) in June 2013.

*Lightcurve of Supernova SN2012fr,
observed in nearby host galaxy
NGC1365*

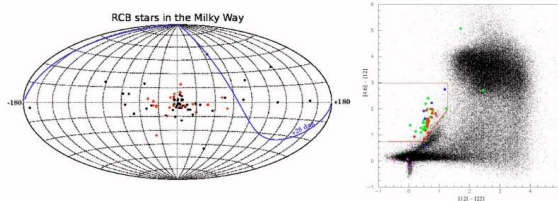


Newly Discovered R Coronae Borealis Stars

Patrick Tisserand and his colleagues [have found new members of the very rare class of R Coronae Borealis \(RCB\) stars](#). These stars are thought to be the evolved product of intermediate mass white dwarf mergers, and therefore are a potentially key missing piece in the puzzle of white dwarf merger products. Only 55 of these stars were previously known in our Galaxy, but Tisserand et al. have now boosted this number to 76 in the Milky Way, plus 22 in the Magellanic Clouds. The team used the ASAS-3 south optical dataset to identify candidate stars. The team applied independent techniques that exploited different properties of the stellar population, and then obtained follow-up spectroscopic observations of 104 RCB candidates with the Wide Field Spectrograph on the ANU 2.3-metre. The spectroscopic success rate was ~90% for bright RCBs (magnitude ~13, corresponding to distances of ~20 kiloparsec), and the team also confirmed two previously known RCB candidates. It appears as if RCBs are mainly located in the Galactic bulge. A few of the new discoveries reveal high infrared excesses which means that they have a dusty shell surrounding them. A paper reporting this work [has been published in Astronomy and Astrophysics](#).

Left: Galactic distribution of all known RCB stars in the Milky Way. The red dots represent the 23 newly discovered RCBs.

Right: Colour-colour diagram based on WISE mid-

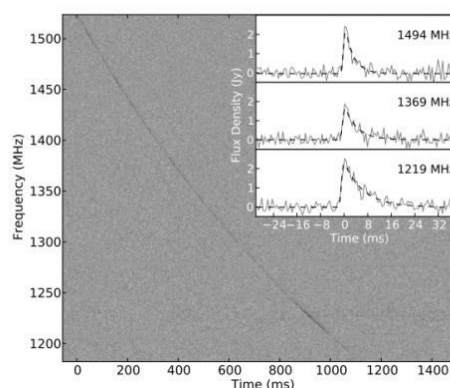


infrared bands. RCB stars are indicated with large multi-colour dots among a random sample of objects catalogued by the WISE survey. RCBs are located in a rather unpopulated area of the diagram, simplifying the selection of candidates (red lines).

New Extragalactic Radio Bursts Probe the Universe

CAASTRO scientists were involved in the discovery of four isolated bursts of radio emission of millisecond-timescale duration detected with the Parkes 64m radio telescope. The transients all lie more than 40 degrees from the Galactic plane and have dispersions consistent with cosmological origins, at redshifts of 0.5 to 1. The events have been dubbed "fast radio bursts" and have great potential to elucidate our knowledge of the baryonic content of the Universe. In the Figure below, the brightest burst is shown displaying the characteristic dispersion sweep expected for a pulse of celestial origin. The pulse shows a frequency-dependent width that is consistent with that theoretically-predicted. Extrapolation of the event rate implies that every day the Earth is struck by over 1000 similar events. The discovery was reported last month in a paper in Science.

A greyscale of the brightest burst detected with the Parkes radio telescope showing the characteristic $1/\nu^2$ delay expected. In the inset the pulse as a function of frequency is shown for various sub-bands demonstrating the increase in width expected due to scattering.



A Mid-infrared Extension of the Tully-Fisher Relation

A CAASTRO team led by David Lagattuta has recently derived a new mid-infrared Tully-Fisher (TF) relation using photometry from the 3.4-micron W1 band of the Wide-field Infrared Survey Explorer (WISE) satellite. This is the largest Tully-Fisher relation constructed at mid-IR wavelengths, and was designed to follow up the surprising preliminary results of Freedman & Madore (2010), who presented a small sample of galaxies with almost no intrinsic TF scatter at 3.6 microns. However, Instead of relying on only galaxies in cluster environments, Lagattuta et al. have utilised CAASTRO's all-sky 2MASS Tully Fisher (2MTF) galaxy sample, combining the HI line-widths of 2MTF galaxies with cleaned 3.4-micron photometry from the WISE all-sky survey. This has resulted in a very large sample of 568 galaxies living in clusters, groups, and the field.

After initially selecting the galaxies, the team applied several normalisations to the data, so as to better measure the parameters and total dispersion of the final WISE TF relation. In addition to "standard" modifications, they also accounted for variations in galaxy morphology and systematic effects of peculiar velocity to reduce the measured TF dispersion even further. Using this corrected data, Lagattuta et al. determined a final TF relation and associated dispersion ($\sigma_{\text{WISE}} = 0.686 \text{ mag}$), and found that the parameters agreed much better with the 2MTF K-band (and other, smaller mid-IR TF data sets) than those of Freedman & Madore. This suggests that the Freedman & Madore results were likely due to small number statistics a chance alignment of galaxies, rather than a true indicator of TF behaviour. This new work also shows that there is no "magic" TF behaviour in the mid-IR, improving our understanding of galaxy properties at longer wavelengths.

Peculiar Supernovae

One of the key questions for understanding supernovae is the nature of their progenitors. For very

nearby core-collapse supernovae, direct identifications of pre-explosion progenitor stars have led to the tightest constraints on their physical characteristics - but this is only possible in a handful of cases. Recently, an increasing number of unusual transients occurring far away from galaxies has been discovered by wide-field transient surveys. For these outlying events, direct observation of the local stellar population is impossible, due to low surface brightness. In a new paper, Fang Yuan and her collaborators have studied a class of peculiar sub-luminous "calcium-rich" supernovae that exhibit locations consistently well outside their host galaxies centres. They compare their distribution with globular clusters and stellar populations through the results of self-consistent cosmological simulations. A statistical analysis shows that their distribution is consistent with globular clusters or a very old metal-poor population. Because several of the objects have photometric limits which exclude an underlying globular cluster, Yuan concludes that this population represents an exotic explosion process involving the oldest most metal-poor stars in the local Universe. Recent large transient experiments indicate that there are other classes of objects that occur at atypically large distances from their host galaxies. The methods developed in this paper can be used in the future to help identify the progenitors of these unusual classes of objects as sufficient numbers become available to undertake a statistical analysis.

Membership Update

CAASTRO now has 132 members. We welcome our latest team members:

- **Eromanga Adermann**, University of Sydney
 - **Joe Callingham**, University of Sydney
 - **Marcin Glowacki**, University of Sydney
 - **Jake Hughes**, Australian National University
 - **Jack Line**, University of Melbourne
 - **Danail Obreschkow**, University of Western Australia
 - **Jarrold Ramsdale**, Curtin University
 - **Tristan Reynolds**, University of Melbourne
 - **Ned Taylor**, University of Melbourne
 - **Kylie Williams**, University of Sydney
 - **Christian Wolf**, Australian National University
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CAASTRO Member Profiles



Joseph Callingham, University of Sydney, PhD Student, Evolving Universe theme

Joe is a University of Sydney PhD student, supervised by Bryan Gaensler, Sean Farrell and Randall Wayth. His thesis is on investigating the low radio frequency properties of Compact Steep Spectrum (CSS) and Gigahertz-Peaked Spectrum (GPS) sources with the Murchison Widefield Array (MWA). He is also contributing to the quality control of the MWA point source catalogue. Joe's past astronomical research experience is in X-ray astronomy and laser-guide adaptive optic systems from his work at Gemini South. When he is not getting his hands dirty with astronomical data, Joe enjoys playing soccer and rugby league, working in student politics and enjoying a good tea or beer depending on the time of day!

Ms Denise Sturgess, Australian National University, Administration Officer

Based within the beautiful surrounds of Mt Stromlo Observatory, Denise has worked for the ANU for four years and as CAASTRO ANU node administrator, since CAASTRO's inception; she is also the Assistant to

Dark theme leader Brian Schmidt. Denise has worked her entire professional life in Canberra in administration. She finds her work for CAASTRO and for Brian Schmidt rewarding and engaging.



Dr Pietro Procopio, University of Melbourne, Research Staff, Evolving Universe theme

Pietro completed his PhD in Astroparticle Physics in 2009, bouncing between Bologna and Paris. His early studies were focused on simulating spectral deviations of the cosmic microwave background from a blackbody spectrum. He moved to lower frequencies through the Simultaneous Medicina-Planck Experiment (SiMPIE), in which he led the data reduction and wrote the pipeline. He joined CAASTRO in April 2012, where he is involved in the MWA collaboration. In particular, he works on the Real Time System, developing a post-processing imaging pipeline. He has been also part of the MWA Science Commissioning Team.

CAASTRO members recognised

CAASTRO Chief Investigator **Professor Rachel Webster** has been awarded the **2013 Robert Ellery Lectureship**. The Lectureship recognises outstanding research relating to southern hemisphere astronomy. Professor Webster has been influential in astronomy for more than two decades and has been the driving force behind the HI Parkes All Sky Survey (HIPASS) and the Murchison Widefield Array (MWA).

Recent and Upcoming Visitors to CAASTRO

- Ariel Sanchez, MPE, Germany. Visiting Swinburne, Sep 2013, to work on BOSS and WiggleZ
- Karen Masters, University of Portsmouth, UK. Visiting UWA, Sep 2013, to work on 2MTF
- Greg Hallinan, Cal Tech, USA. Visiting Curtin/Swinburne/USYD, Sep 2013 to work on transients
- Jason Hessels, ASTRON, Netherlands. Visiting Curtin, Nov 2013 to work on transients
- Claudia Lagos, ESO, Germany. Visiting UWA/UMelb, Jan-Mar 2014 to work on galaxy evolution

CAASTRO members interested in contacting the above visitors during their visits, should email coo@caastro.org



CAASTRO Public Outreach & School Engagement

May 2013 saw a flurry of astronomy outreach activity from our members. In the beginning of the month, we partnered with the Mount Burnett Observatory in the eastern fringes of Melbourne to deliver a **2-day Astro Schools Festival** to 530 kids at six schools. Members from our University of Melbourne (Alan Duffy, Akila Jeesson-Daniel) and Swinburne University (Eyal Kazin, Syed Uddin) nodes gave presentations and answered the kids' questions. Our Director Bryan Gaensler appeared in Episode 9 of the Television Sydney (TVS) series "**Enquiring Minds**". In

Melbourne, the community forum “Are We Alone?” was held with talks by [Alan Duffy about “Habitable Worlds”](#) and [Katie Mack about “Alien Lifeforms”](#). Alan and Katie also added two more episodes to their “[Pint in the Sky](#)” video series, answering questions astronomers often hear: What is the Universe expanding into? Are there aliens? What is your favourite planet? What came before the Big Bang? Why do comets have tails?

Two recent CAASTRO papers had press releases issued on their day of publication: in mid-June, Michael Childress (ANU) published his paper and accompanying video on [Supernova 2012fr](#); In early July, the HiTRUn team (High Time Resolution Universe Survey), including CAASTRO members Matthew Bailes, Ramesh Bhat, Andrew Jameson, and Willem van Straten, published their paper on fast radio bursts in [Science](#). The [press release](#) and accompanying [video](#) received excellent media attention.

Events and Workshops

Recent Workshops

- The [6th International PHISCC Workshop](#) took place in Sydney during the week of 17-21 June 2013, sponsored by the ARC Centre of Excellence for All-Sky Astrophysics (CAASTRO), CSIRO Astronomy and Space Science (CASS) and the Australian Astronomical Observatory (AAO). The workshop attracted 54 participants from 7 countries and there were almost [40 scientific presentations](#). An associated workshop on radio frequency interference was held prior.



Attendees of the 2013 PHISCC workshop at CAASTRO HQ in Sydney

- [Reionisation in the Red Centre](#), held over 15-19 July 2013, was the first in the annual series of CAASTRO conferences in wide-field astronomy, and took place at the Ayers Rock Resort in the shadow of outback Australia's iconic Uluru. The meeting was very successful, attracting a total of 74 participants from 9 countries, and featured [11 invited and 28 contributed talks](#). A key goal of the meeting was to provide a multi-wavelength and multi-technique discussion of the outstanding questions in reionisation research. The attendees included representatives from optical/IR telescopes including the Hubble Space Telescope and James Webb Space Telescope; radio telescopes including ALMA, the Murchison Widefield Array, PAPER, LOFAR, and CORE; as well as major instruments and surveys including MOSFIRE, COS, IRAC, HETDEX, and CANDELS.



The delegates at the base of Uluru, 2013

Upcoming Events

- Women in Astronomy Workshop 2013, Perth 11-12 Sep 2013
- Evolutionary Paths in Galaxy Morphology, Sydney, 23-26 Sep 2013
- The Ephemeral Universe with Widefield Low-Frequency Arrays, Perth 12-14 Nov 2013
- CAASTRO Annual Retreat, Torquay, 20-22 Nov 2013
- Astroinformatics 2013, Sydney 9-13 Dec 2013
- Supernovae in the Local Universe, Coffs Harbour, 11-15 Aug 2014
- ADASS XV, Sydney, 26-30 Oct 2015

*Contributions from CAASTRO members are welcomed for future editions, please contact
Kylie Williams if you have stories or suggestions.
Past editions of the CAASTRO newsletter are available at www.caastro.org/newsletters*