



## CAASTRO Newsletter Edition 10, March 2014



### INTRODUCTION FROM CAASTRO DIRECTOR

Signing contracts and negotiating agreements are not usually seen as the cutting edge of scientific research. Nevertheless, such activities have been a major focus of CAASTRO's senior management team over the last few months, and I'm excited to now be able to tell you about a whole host of new opportunities that these agreements and partnerships have made possible:

- I am delighted to announce a new partnership between CAASTRO and the German eROSITA Consortium, which will provide major new opportunities for multi-wavelength astronomy projects across the southern sky. [eROSITA](#) is an instrument on the Russian Spektrum-Röntgen-Gamma satellite, to be launched in 2015. eROSITA will perform an X-ray survey of the entire sky with unprecedented angular resolution and sensitivity. The [German eROSITA consortium \(eROSITA DE\)](#) and CAASTRO have now signed a memorandum of understanding that enables collaboration on projects requiring combined data from eROSITA and from Australian wide-field facilities such as ASKAP, MWA, SKAMP, Parkes, ATCA, SkyMapper, AAT and TAIPAN. I'm very much looking forward to the discoveries that will emerge from this exciting new partnership.
- ANU and CAASTRO are pleased to announce that ANU's [SkyMapper telescope](#) will be offered as a national facility over the period 2014-2019, with data available to the entire Australian community. Through the national facility program, astronomers at any Australian institution can join existing SkyMapper science collaborations, or can propose new SkyMapper science programs. In addition, 20% of non-survey observing time on SkyMapper will be made available to the Australian community for other programs. SkyMapper images, data products and catalogues will be accessible to all Australian astronomers as soon as they are available. The national facility capability for SkyMapper has been made possible through an ARC LIEF grant, awarded to CAASTRO, Monash University and the AAO.
- CAASTRO has begun partnering with [Voyages Indigenous Tourism](#) on astronomy outreach activities at [Uluru-Kata Tjuta National Park](#) in Australia's Northern Territory. We have commenced an "Astronomy in Residence" program at Uluru, in which a series of CAASTRO astronomers will each spend several weeks on site, engaging with guests and tourists about astronomy and training Voyages' Star Talk Team. Tara Murphy is our first CAASTRO Astronomer in Residence - you can follow the activities of Tara and our subsequent resident astronomers on Twitter via the handle [@CAASTROatUluru](#). In addition, for [National Science Week](#) this year, CAASTRO and Voyages will host a special "Astronomy Weekend" at Uluru over 22-24 August 2014, with talks, star tours and other activities.
- CAASTRO and [Museum Victoria](#) have commenced pre-production of a planetarium show, which will showcase CAASTRO discoveries and CAASTRO research. The show will be produced by [Melbourne Planetarium](#), with a release date set for late 2015.
- CAASTRO and [Swinburne Astronomy Productions](#) have formalised and expanded their joint activities, in the form of a new [CAASTRO Media Library](#). This library features custom content designed to explain the concepts behind our science programs, and to provide a visual description of our research results. Many more animations and images are in production, and all CAASTRO members are encouraged to think about additional material that they would like to develop for their talks and presentations.

I offer many thanks to all the people who've worked hard behind the scenes to help bring these new partnerships to reality. This will all greatly add to our ability to produce both world-class research and first-rate outreach content in the years to come.

Bryan Gaensler  
CAASTRO Director

## RESEARCH UPDATES

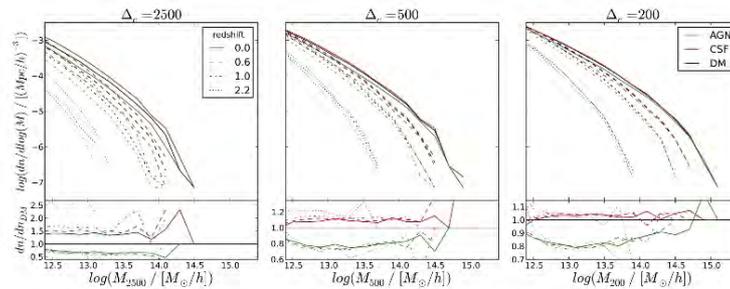
### The Effect of AGN Feedback on the Halo Mass Function

CAASTRO Affiliate Weiguang Cui and his colleagues have studied the effects of AGN feedback on halo mass functions. They simulate halo mass functions resulting from three scenarios: (1) a pure collisionless dark matter model; (2) a hydrodynamic simulation including radiative cooling, star-formation, and supernova feedback; and (3) the same hydrodynamic model with AGN feedback included.

While Cui's previous work showed that a nominal hydrodynamical model (model 2 above) produces higher mass functions than a pure dark matter simulation (model 1), this new work shows that AGN feedback (model 3) suppresses the halo mass function to below the pure dark matter level. He now finds that halo mass functions with AGN feedback are 80% that of those for dark matter, almost independent of the mass scale or redshift but with a slight dependence on over-density (see Figure 1).

Cui then conducted a halo-by-halo comparison between hydrodynamic models with and without AGN feedback, and found shallower mass density profiles in the inner AGN-fed halos. This reveals that halo mass is reduced by the sudden expulsion of gas by AGN-driven feedback.

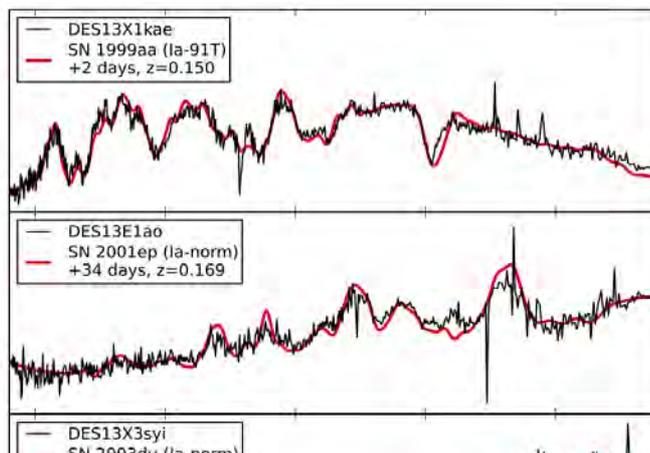
The paper reporting these results [has been submitted to MNRAS](#).

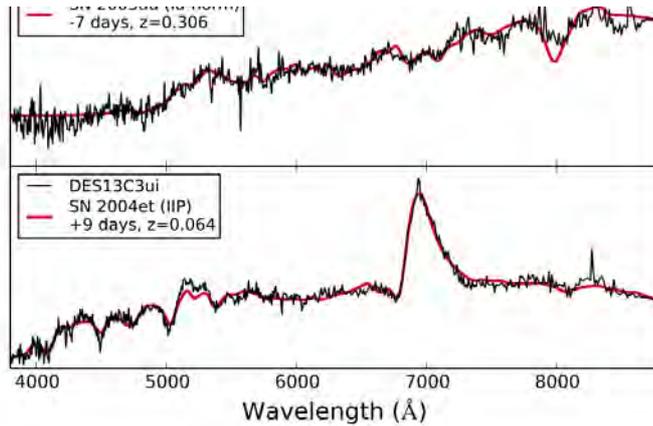


Effect of baryons on the halo mass function (HMF) for spherical overdensity (SO) halos. The meaning of the line styles and colours are shown on the legends in the left and right panels. From left to right, the SO HMFs with halo masses are computed for  $\Delta_c = 2500, 500$  and  $200$ . Lower panel: ratios between each of the HMFs from the hydrodynamic simulations and the HMF of the dark matter simulation.

### OzDES Completes Its First Year of Observing

[OzDES \(the Australian Dark Energy Survey Collaboration\)](#) is the recently formed collaboration of Australian astronomers joining the cosmology efforts of the [Dark Energy Survey](#). OzDES has been awarded long-term project status on the Anglo-Australian Telescope, with 100 nights of observing time on 2dF+AAOmega awarded for the period 2013-2017. The OzDES team successfully completed its first year of observations in 14 nights during Spring/Summer 2013. In 10 nights of clear weather, OzDES collected 15151 spectra of 7390 unique objects, yielding a final tally of 4454 new extragalactic redshifts. OzDES also classified a dozen new supernovae, and secured redshifts of nearly 1000 supernova host galaxies, which will be used to classify their supernovae and for which a subset will be applied to the measurement of Dark Energy.

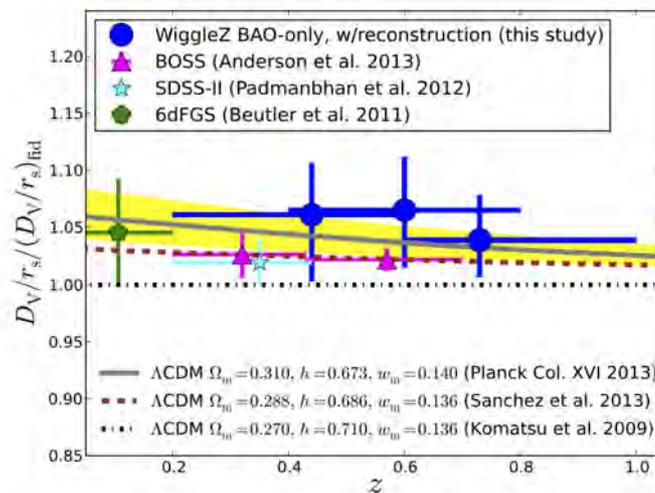




Spectra of new supernovae (black lines) classified by OzDES, along with matching template supernova spectra (red lines).

## Reconstruction Technique Sharpens Cosmic Rulers from WiggleZ

CAASTRO postdoc Eyal Kazin has used data from the WiggleZ Dark Energy Survey to construct new, more accurate measurements of the distance-redshift relation. The technique is based on the tool of baryon acoustic oscillations, a preferred separation between galaxies that was originally imprinted in the very early Universe. This feature of large-scale galaxy clustering may be used as a standard ruler to map out cosmic distances, but is blurred by the motion of galaxies over the age of the Universe. [Eyal has applied a technique called "reconstruction" to compute these motions and restore galaxies to their near-original positions](#), thereby sharpening the baryon acoustic peak and making the distance measurements from WiggleZ as good as those from rival surveys with over twice the volume.



Ratios of volume-average-distance to sound-horizon as a function of redshift, for several observational surveys. The WiggleZ reconstruction results (this work) are shown as blue circles.

## A Dark Matter Detection Experiment in Australia?

In February 2013, CAASTRO and CoEPP held [their first joint Dark Universe meeting](#) at The University of Melbourne. One of the upshots of that meeting was a decision to pursue an Australian dark matter direct detection experiment. Towards the end of 2013, the Northern Grampians Shire Council contacted CAASTRO's [Katie Mack](#), interested in her description of direct detection experiments overseas.

Last month Jeremy Mould joined Elisabetta Barberio of CoEPP in a visit to the [Stawell gold mine](#). The party was driven to 770 metres underground.

The mine is a decline, not a shaft, which makes access to container sized loads straightforward. The mine reaches 1.6 km depth. Negotiations have commenced on importing a copy of the [DAMA experiment from Italy](#), where an 8-sigma detection of the annual modulation of the dark matter flux due to the Earth's orbital velocity has been achieved. Detection is by nuclear recoil and emission of photons recorded by a NaI crystal. Sceptics have claimed the detection is actually of an annual environmental modulation. This could be confirmed or denied by detection of a 180 degree out-of-phase signal in the Southern Hemisphere.

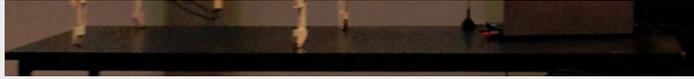


Underground in the Sawtell Mine

## CAASTRO Research on Science Communication & Education

The CAASTRO Education & Outreach team at Curtin University, Prof Steven Tingay and Dr Wiebke Ebeling, have created a new research opportunity for undergraduate and postgraduate students interested in school and public outreach. Curtin Honours student Hannah Feldman completed the first project in CAASTRO's "Science Education & Science Communication" research program in 2013. Hannah developed a hands-on "teaching tool" for High Schools that is based on the [Murchison Widefield Array \(MWA\) radio telescope](#). Using two of the MWA dipole antennas, Hannah was able to demonstrate an interference-based interpretation of the radio emission given off by a hand-held transmitter device in real-time. Curtin University summer student Seonaid Rodgers followed on from that from December 2013 to February 2014, characterising and improving this prototype "teaching tool" to allow for a classroom exercise on electromagnetic radiation and wave interference. The exercise is perfectly aligned with Year 9 Physics in the National Curriculum, and will be road-tested and rolled out in schools and science centres soon. Care was taken to produce the entire set-up at minimum cost and technical requirements to encourage schools to invest in their own set. Seonaid will remain part of CAASTRO Education & Outreach for her third year project, producing all-sky astronomy datasets for display in Curtin's [Hub for Immersive Visualisation & eResearch \(HIVE\) facility](#).





Curtin summer student Seonaid Rodgers presenting her work on the "MWA Teaching Tool"

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## CAASTRO EDUCATION AND OUTREACH

It has been a busy summer for CAASTRO's Education & Outreach program. We have released the second edition of the "[CAASTRO Reader's Digest](#)", hundreds of copies of which have been distributed to the CAASTRO nodes, to our national and international partners, and to outreach programs across Australia. We also collaborated with university media offices on [five press releases](#) to communicate CAASTRO science to the public. One of these was accompanied by a short, CAASTRO-produced explanatory video: "[Telescope to track space junk using youth radio station](#)".

For video productions like these and for new animation material, we have been collaborating with [Swinburne Astronomy Productions](#), whose 3D IMAX movie "Hidden Universe" was a great success in 2013. Their team is currently adding to our growing library of short animations for CAASTRO members to include in their conference presentations and public talks.

Our other major outreach collaboration is with [Museum Victoria – Melbourne Planetarium](#), with whom we have begun developing a new planetarium show. CAASTRO members visited the planetarium in February 2014 for a pre-production meeting at which we had many fruitful discussions. We are now looking forward to working on the science story that will become the CAASTRO planetarium show!

With the start of the new school year for 2014, "[CAASTRO in the Classroom](#)" has branched out and is offering new content closely aligned with the physics curriculum. In March 2014, we are offering to NSW high schools the special revision lecture "The World Communicates", presented by CAASTRO PhD student Aina Musaeva.



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## MEMBERSHIP UPDATE

CAASTRO now has 155 members. We welcome our latest team members:

**Ms Caitlin Adams**, University of Queensland  
**Mr Samuel Hinton**, University of Queensland  
**Ms Anthea King**, University of Queensland  
**Ms Rebecca McElroy**, University of Sydney  
**Mr Conor O'Neill**, University of Queensland  
**Dr Attila Popping**, University of Western Australia  
**Ms Dana Tabbara**, Swinburne University of Technology  
**Ms Rita Tomic**, Curtin University  
**Ms Bonnie Zhang**, Australian National University  
**Ms Candy Wu**, University of Queensland

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## CAASTRO MEMBER PROFILES



**Dr Christian Wolf (ANU)  
Associate Investigator,  
Evolving/Dark Themes**

I started work as the SkyMapper Survey Scientist in April 2013 and am responsible for commissioning of the SkyMapper telescope. I previously led the COMBO-17 optical multi-band survey, which explored the evolution of galaxies and quasars over most of the cosmic time. I am an expert in photometric redshift and statistical classification techniques and pioneered high-precision photometric redshifts and their application to quasars. My research interests include galaxy evolution and the decline of star formation in spiral galaxies as well as supernovae, GRBs and their host galaxies. My most recent work has focussed on the transformation of spiral galaxies in clusters and the effects of ram-pressure stripping.

**Ms Sue Lester (Swinburne)  
Administrator**

I have worked in Tertiary Education since 1990 and have seen many changes to the university sector in that time. Prior to Swinburne I had a number of EA roles in banking and private companies, both in Melbourne and in Johannesburg where I lived from 1976-1985. In 1998, I commenced working at Swinburne's new Lilydale campus which was close to my home. A restructure in 2006 saw me having to move to the Hawthorn campus and whilst exploring the area on a lunch-break, I came across a vacant shop near the campus. My husband had trained as a jeweller in South Africa and we decided to set up our own jewellery business. I resigned from Swinburne in 2010 due to another restructure but commenced 'temp' work for an agency the following year and was given a number of assignments back at Swinburne – the CAASTRO position was one of these. The position was advertised last year and I was successful in being appointed to the role so here I am! I formalised my EA experience by undertaking a Grad Cert in Business in 2003 and obtained a Diploma in Sustainability in 2008. I believe 'lifelong learning' is not a glib term to be bandied about but that we are learning constantly, throughout our life, whether in formal or informal study. I have an eight year old grandson and wonder what lies ahead for him, what amazing technology will be around when he is an adult – it is why the work that our researchers do, in all fields, is so important and why I feel privileged to work in a support role to enable that research to happen.



**Mr Scott Meyer (UWA)  
PhD Student,  
Evolving/Dark Themes**

I am a PhD student at ICRAR UWA. I was born in Wollongong, NSW which is where I also completed my undergraduate degree in physics. I have since moved to Western Australia to complete honours and my PhD. I am studying the Tully-Fisher relation using neutral Hydrogen stacking techniques with Martin Meyer, Danail Obreschkow and Lister Staveley-Smith.



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## CAASTRO STUDENT RECOGNISED

Ms Aina Musaeva has received a 2014 Australia Day Award from the National Council of Women (NSW). Aina was one of eleven young women from across NSW (in fields as diverse as history, graphic design, science and law) chosen to receive a cash award to assist with her PhD studies. Aina received her award at an Australia Day reception and lunch held at NSW Parliament House.



**Top:** Aina Musaeva (third from left in back row) with the other recipients of similar awards and including from left to right the honoured speakers: third in the first row is Nola Barkl, President, NCW NSW; Her Excellence Prof Marie Bashir, Governor of NSW, and Verity Firth, CEO, Public Education Foundation.

**Left:** left to right: Anne Sheehan, President, Soroptimist Region of NSW; Doreen Todd, Awards Committee member, NCW NSW; Aina Musaeva and Prof Elaine Sadler

**Right:** left to right Anne Sheehan, President, Soroptimist Region of NSW; Aina Musaeva and Verity Firth, CEO, Public Education Foundation.

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## CAASTRO VISITORS

Some recent and upcoming visitors to CAASTRO:

- Dr Tom Landecker, DRAO, Canada, Jan-Apr 2014 - radio polarimetry
- Prof Tim de Zeeuw, ESO Director-General, Germany, Feb 2014 - strategic astronomy partnerships
- Prof David Kaplan, University of Wisconsin, USA, Mar 2014 - MWA transients
- Dr Julius Donnert, Istituto di Radioastronomia, Italy, Mar 2014 - radio emission from the cosmic web
- Dr Amrita Purkayastha, Istituto di Radioastronomia, Italy, Mar 2014 - radio emission from dwarf galaxies
- Prof Roger Davies, University of Oxford, UK, Mar 2014 - CAASTRO PI
- Dr Ravi Subrahmanyan, Raman Research Institute, India, March-April 2014 - CAASTRO PI

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## UPCOMING EVENTS

- [SkyMapper: Everything you Need to Know](#), Canberra ACT, 7-9 April 2014
- [Supernovae in the Local Universe](#), Coffs Harbour NSW, 10-15 August 2014
- [CAASTRO Annual Retreat](#), Twin Waters QLD, 19-21 November 2014
- ADASS XV, Sydney NSW, 25-29 October 2015

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*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.caaastro.org/newsletters](http://www.caaastro.org/newsletters).*