WALLABY

Newsletter No. 8
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Editor:
O. Ivy Wong

Contents

Foreword

Due to the excitement surrounding the start of ASKAP-12 observations in August 2016, we were too distracted to produce a WALLABY newsletter in time. Therefore, it is with great pleasure that I welcome you to the 2017 special edition of the Wallaby newsletter which contains 20 months of news since the last newsletter. This bonus edition will feature many articles from the different technical and science working groups. In particular, our update on ASKAP-12 engineering and early-science commissioning will be reported by Attila Popping and Karen Lee-Waddell. This newsletter will also include regular features such as the introduction of new student and ECR members; reports from recent workshops and conferences; as well as other bits of news and information relevant to the WALLABY team and project. I hope that you enjoy catching up with the 20 months of news as much as I have enjoyed putting it together this bumper edition for you.

Profiles

Tristan Reynolds (PhD Student, ICRAR/UWA)

I am excited to be joining the Wallaby project. I have joined UWA and ICRAR for my PhD studying HI in galaxies using ASKAP and Westerbork. Through stacking the HI signal from thousands of galaxies, we will be able to measure properties of complete galaxy samples,

Tristan Reynolds

such as gas mass and far-infrared luminosity, and study the evolution of the whole galaxy population, rather than only the brightest sources. I will begin by analysing new data obtained using a new MkII Phased Array Feed on the Parkes radio telescope.

I completed my Masters at Melbourne University, during which I used simulations of the 21cm signal from the epoch of reionisation (EoR) to investigate if FAST, the new Chinese radio telescope, would be capable of detecting quasar-generated HII regions during the EoR. However, we found this to not be possible due to side-lobe confusion noise. Earlier this year, I undertook research at Leiden University in the Netherlands studying the relationship between the fraction of radio-loud galaxies and stellar mass, cross-matching observations from the Low Frequency Array (LOFAR) with data from the Sloan Digital Sky Survey and using the SED fitting code MAGPHYS on the SDSS fluxes to determine the galaxies' stellar masses. Our preliminary results show agreement with previous work whereby the radio-loud fraction increases towards higher stellar masses. I have also done some research at Swinburne University studying galaxy properties, such as size and stellar mass, at optical and infrared wavelengths.

I am looking forward to becoming a member of the Wallaby team and working with ASKAP, as I have been hearing talks over the past couple years about ASKAP's progress and early science. ☉

Ahmed Elagali (PhD Student, ICRAR/UWA)

From the subatomic leptons to the vast structures of the cosmos; the science of all these discoveries forces me to marvel at the numerous wonders of our Universe. It's this fascination that has derived my pursuit of knowledge, regarding the elegant Universe and all structures contained within it.

Ahmed Elagali

At the age of 16, I attended Khartoum University, Sudan, for B.Sc. with Honours majoring in physics and mathematics. These years of undergrad did not satisfy

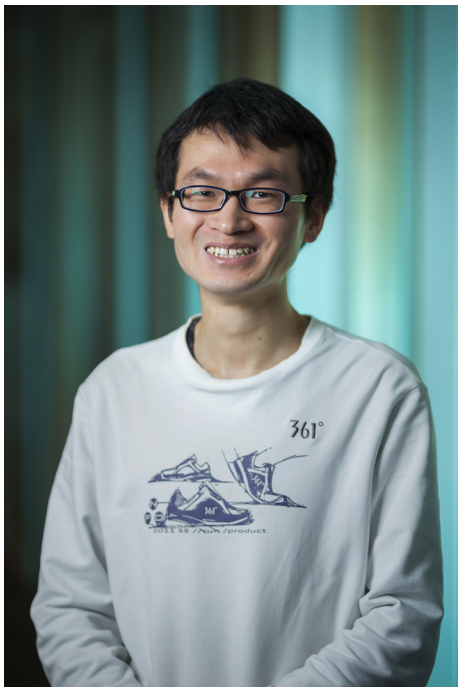
my thirst, and did not answer all the questions I had about our Universe, even though it was really very intense and fruitful. So, I decided to undertake another Honours degree in Astrophysics and Space Science at Cape Town University, South Africa. After I completed this Honours degree, I knew that Astrophysics will be the solution to my eagerness and thirstiness to understand how the Universe works, and how galaxies evolve. Thereafter at the same university, I completed a Master Degree in Astrophysics. The aim of my MSc. project was to explore a newly discovered Supercluster within the Zone of Obscuration and determine the mass of its constituent clusters, which will link to the local group motion and the cosmography of our local Universe.

I recently joined ICRAR/UWA for a PhD in Astrophysics. I feel very delighted to be part of the WALLABY team, especially during this time as the early science data is looming on the horizon. I am mainly interestedin interacting galaxies and the influential effects of the environment on the evolution and the morphology of galaxies. I intend to study the HI content, gas morphology and kinematics in a nearby galaxy group using data from WALLABY. The high resolution of the WALLABY data will allow me to explore the diffuse intragroup medium, gas removal in the group, and any signatures of galaxy harrassments or/and ram pressure stripping. After obtaining the PhD degree, I plan to work as an astrophysicist; I am looking forward to improving on our understanding of galaxy evolution and the connection between HI galaxy content and the surrounding environment. With the SKA project on the way, it is indeed a wonderful time to be a Radio Astrophysicist! ☉

Fei Qin (PhD Student at ICRAR/UWA)

I am excited to be part of the WALLABY project. I am a current PhD candidate in ICRAR/UWA and sponsored by a UWA/China SKA Scholarship.

Before joining ICRAR, I worked on the Einstein Equation theory of general relativity and high-order cosmological perturbation theory at the University of Science and Technology of China. I changed the Einstein Equation to the extrinsic curvature form in the co-moving coordinates to obtain the energy constraint and the momentum constraint as well as the evolution equation. Finally, I obtained the high-order evolution equation for the metric of the space-time of the Universe, which can be used to study the structure growth of the density field of the Universe.



Fei Qin

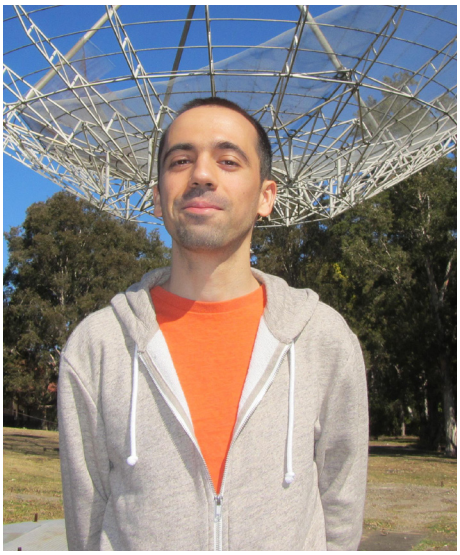
My current research focuses on the bulk flow velocity field measurement using 2MTF and 6dFGSv. The bulk flow is the weighted mean value of the peculiar velocities of galaxies in a given volume of the Universe. Peculiar velocities are believed to be caused by the mass density contrast of the Universe. So the bulk flow velocity and peculiar velocities are good indicators of the density field in the Universe and enable us to determine cosmological parameters, test the cosmological model, and test whether General Relativity accurately describes the motion of galaxies on the largest scales.

Being a new ICRAR WALLABY member provides a great opportunity for me to investigate the forthcoming early science of Wallaby. I look forward to extending my research with Wallaby data. ☉

Georgios (George) Bekiaris (CASS)

I am very excited to be part of CSIRO, and honoured to have the opportunity to work next to many bright minds and successful researchers. I recently submitted my PhD at Swinburne University of Technology, and I am now a Postdoctoral Fellow at CSIRO Astronomy and Space Science (CASS), working with Bärbel Koribalski on the WALLABY survey.

Prior to my doctoral studies, I completed a Master's degree in Computer Graphics Programming at the University of Hull in United Kingdom, and worked as a Graphics and Visualisation Research Programmer at the School of Simulation and Visualisation of the Glasgow School of Art.


Georgios Bekiaris

My research interests lie at the cross section of astronomy and scientific computing. I really enjoy developing methods and software technologies that will help scientists analyse astronomical data and make new discoveries.

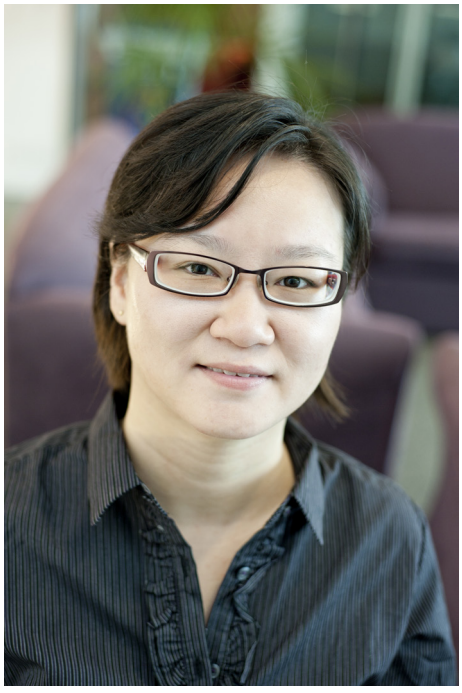
In my PhD thesis I investigated how novel software and hardware technologies can be used to enhance the process of galaxy kinematic modelling, and accelerate the pace of scientific discovery. While doing so, I worked mostly with optical, infrared, and submillimetre data from

a wide variety of galaxy surveys and instruments, and I utilised several different hardware architectures, such as multi-core CPUs, Graphics Processing Units (GPUs), Intel Xeon Phi accelerators, and supercomputer clusters.

The WALLABY survey will play a very important role in our understanding of galaxy structure and evolution in the near Universe, and form numerous scientific collaborations. Being one of the leading large-scale HI surveys, it will face many technological and scientific challenges that will arise from the vast amount of observed data. During my time at CSIRO, I will use my expertise in high-performance computing in order to tackle these Big Data challenges and open the road for exciting new discoveries. ☉

Bi-Qing For (ICRAR/UWA)

I am the ASTRO 3D WALLABY postdoc at the ICRAR/UWA. In the last few years, my research focuses on the multi-wavelength studies of the Magellanic System. The HI studies of the Magellanic System include the investigation of formation mechanism and origin of the gaseous features, the effect of interaction with the Galactic Halo and provide constraints for simulations based on the observed properties. I am also involved in the VISTA Magellanic Cloud (VMC) Survey, the Arecibo Ultra Deep Survey (AUDS) and the GaLactic Extragalactic All-sky MWA projects. My interest in the WALLABY project is to study the role of neutral atomic hydrogen clouds in the context of galaxy evolution and formation: from the formation of dark matter subhalos to the physical processes that trigger star formation, such as gas accretion and ram-pressure stripping. My current involvement within the technical working group includes testing the spectral line processing pipeline, checking the data quality and developing systematic methods for identifying intergalactic HI clouds. ☉



BiQing For

Dane Kleiner (CASS)

I'm very fortunate to be a part of the WALLABY team during early science. It's the cutting edge of radio astronomy and I can't wait to push it forward to set the standard for ASKAP.

I completed my PhD at Monash University while co-supervised at CSIRO. I concentrated on multi-wavelength studies of: the galaxy cluster Abell 1664 and galaxies in the Cosmic Web. A significant result was to define the Cosmic Web in the 6 degree Field Galaxy Survey and conduct HI stacking using the HI Parkes All Sky Survey to find that massive galaxies in the cosmic web have a higher HI fraction than other galaxies.

Over the past 6 months, I have been analysing WALLABY early science data on the NGC 7232 and M83 field. I am currently working on combining all NGC 7232 observations to create WALLABY depth spectral cubes and images of the nearby spiral galaxy IC 5201. Additional, I have been testing and providing feedback to improve the ASKAPsoft pipeline. I am also part of the Taipan Survey to ensure strong connections between large optical and radio surveys in the southern sky.

While waiting for my jobs to finish on the supercomputer, I thoroughly enjoy (outdoor and indoor) skydiving, SCUBA diving and rock climbing. I'm aiming to be a strong contender in the famous WALLABY Cupcake Challenge! ☉

Dane Kleiner

Congratulations to Karen Lee-Waddell!

WALLABY's ASKAP commissioning postdoctoral researcher, Karen Lee-Waddell has been awarded the Young Scientist award at the recent XXXIInd International Union of Radio Science General Assembly & Science Symposium held in Montreal, Canada. Congratulations Karen on the well-deserved accolade! ☉

Karen with her award.

ASKAP Early Science Update

A. Popping and K. Lee-Waddell

In the last months Technical Working Group 3 (TWG3) has been very busy working on reduction pipelines and processing data. Our efforts have been further ramped up with the commencement of WALLABY Early Science.

The WALLABY data processing working group is working closely together with other science teams including EMU, DINGO and FLASH to develop automated spectral line processing pipelines. Two busy weeks were organised in the last six months and there are weekly telecons between ICRAR-UWA and CASS. More details about the work of this group and the meetings are all documented on the WALLABY wiki (https://pm.atnf.csiro.au/askap/projects/sup-wallaby/wiki/WALLABY_TWG3)

Motivated by the exciting early results from ASKAP, tremendous progress has been made in the last months working on the reduction pipelines. Every step along the way, from making schedule files to calibration, flagging, imaging, HI line / continuum separation, and source-finding, we are testing, debugging and updating in close collaboration with the ASKAP computing team. Until August 2016 we could only use data from BETA, which proved to be a very exciting instrument itself. Most effort went into understanding data from IC1459 that was published by Serra et al (2015). These data contained three nights of observations using BETA with 6 telescopes and 9 beams. Initially a subset of this data was reduced by hand using MIRIAD, now all our efforts went into developing automated pipelines using ASKAPsoft and CASA. Although ASKAPsoft will be the official software package for ASKAP, it has proven useful to test two different software packages during the commissioning phase.

In August 2016 all ASKAP related work shifted to ASKAP-12, the first 12 ASKAP dishes equipped with the second generation Phased Array Feeds (PAFs). Although these MkII PAFs have a higher than expected system temperature of Tsys/η ~ 85K at 1.4 GHz, they are a very significant improvement over the BETA receivers.

The number of beams that can be processed has increased from 9 to 36 and currently the bandwidth is being expanded from 48MHz to 144MHz now and 300MHz next year. With the current data rate we are able to process the the data from one night's observations in real-time using the Galaxy supercomputer within the Pawsey Centre.

Although the processing pipeline is still under development, it has been demonstrated to produce science-worthy data on the first ASKAP-12 observations. In October 2016 the decision was made to officially commence WALLABY early science and data on a single field has been obtained to reach the proposed WALLABY depth. At the moment 180 hours of data has been collected on a field containing the NGC7232 group and nearby galaxy IC5021. These data are spread over 17 nights with typically 11-12 PAFs and 30-36 beams working. More detailed information about the Early Science observations can be found on the wiki using this link (https://pm.atnf.csiro.au/askap/projects/sup-wallaby/wiki/HI_ASKAP_observations) Individual nights have been reduced and we are now in the process of finding the optimal way of combining the data. Depending on the stability and performance of the array, we aim to complete the early science observations on the M83 and Dorado fields by the end of 2017.

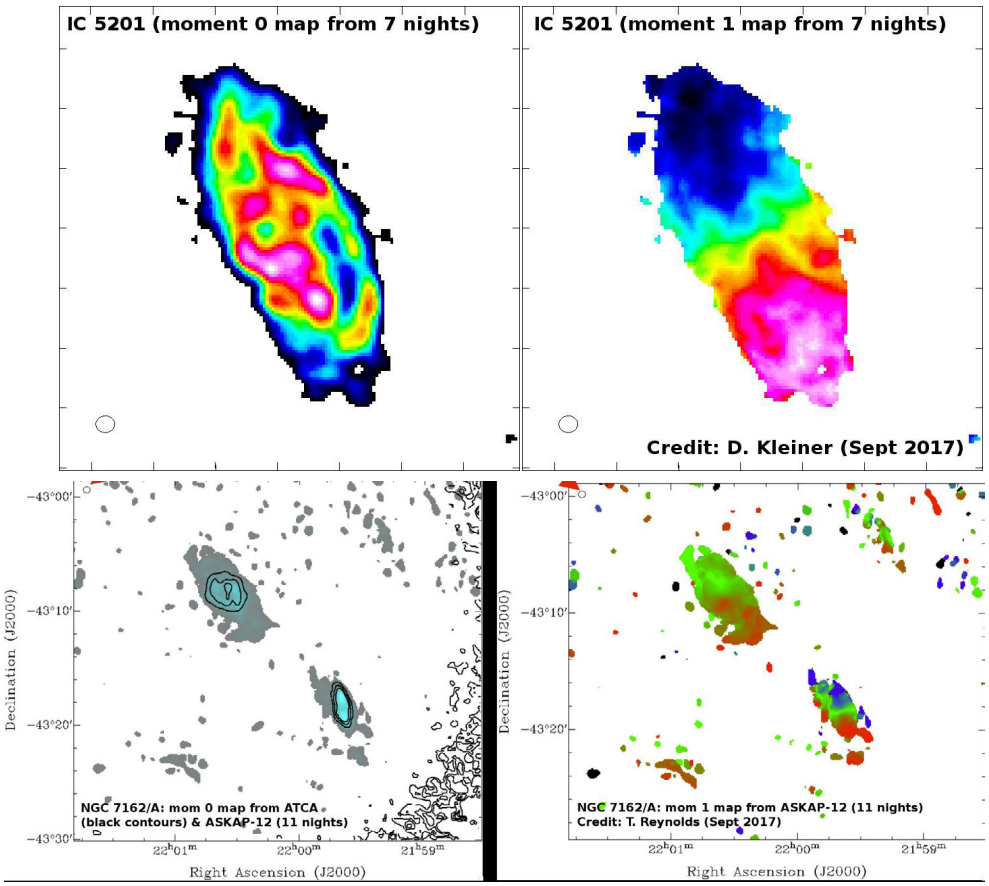
From October 2016 to January 2017, ASKAP-12 observations were collected on four WALLABY early science fields: the NGC 7232 group (48 MHz bandwidth, 140 hours), Fornax cluster (192 MHz, 160 hr), Dorado group (192 MHz, 70 hr), and M83 field (192 MHz, 80 hr). These observations amount to well over 100 TB of raw data that are currently being processed and imaged using ASKAPsoft. While ASKAPsoft is still in its commissioning and testing phases, there has been significant progress as the pipeline can now produce continuum images with default pipeline parameters and minimal human interaction. The continuum data products of the NGC 7232 group have been uploaded onto the CSIRO ASKAP Science Data Archive (CASDA; https://data.csiro.au/dap/public/casda/casdaSearch.zul) and released to the public.

The ASKAP spectral line data processing and imaging working group is enthusiastically testing (and debugging) each iteration of ASKAPsoft as there is still much work to be done for the pipeline to produce science-ready spectral line cubes. The current "cupcake challenge" (closely related to the "muffin challenge" that was orchestrated by the continuum data processing working group) will award the person who produces the "best" spectral line cube of the M83 field (using observations taken on 31 Dec 2016) with homemade cupcakes. The aim of the challenge is not only to determine appropriate ASKAPsoft default parameters for spectral line imaging, but also to establish validation tools to assess the quality of the final data products. Other processing challenges include continuum subtraction and multi-epoch data combination, which are feasible with currently available ASKAPsoft tools; however, these tasks require more testing and fine tuning.

Recent efforts by D. Kleiner and B. Koribalski (using ASKAPsoft calibrated visibilities that were then continuum subtracted, combined, channel averaged, and imaged using Miriad) have established that we are reaching full WALLABY depth with 16 nights of ASKAP-12 observations on the NGC 7232 group (~0.8 mJy/beam per 10 km/s channel for the Miriad processed cube). With the ASKAP correlator back online (after an 8-month hiatus due to firmware and other issues), spectral line observations are starting to trickle in again. Over the next few month we plan to finish the observations (i.e. reach full WALLABY depths) on the aforementioned early science fields and hopefully move on to new fields. It is definitely an exciting time to be a

part of WALLABY!

Here are 2 examples of the processed ASKAP-12 data: from Dane Kleiner and Tristan Reynolds. While still a work in progress, the sensitivity and fidelity of the observations is clear.



TWG 4 – Source Finding and Cataloguing

T. Westmeier on behalf of TWG 4

The WALLABY source finding and cataloguing working group has had another busy and productive year with regular, weekly telecons and another busy week held in Perth from February 8–12, 2016. I would like to use this opportunity to thank the core team members, Nadine Giese, Thijs van der Hulst, Russell Jurek, Attila Popping and Paolo Serra, for their hard work to improve and enhance our existing HI source finding pipeline, **SoFiA**. As a result of these activities, the source finding team is proud to announce the official release of version 1.0 of SoFiA. The increase in version number reflects the fact that the pipeline is now considered feature-complete according to our initial plan. The latest version of SoFiA can be downloaded from our GitHub site: https://github.com/SoFiA-Admin/SoFiA/.

New features in SoFiA since version 0.5 include the generation of IAU-compliant source names, better configuration options for the graphical user interface, improvements in the calculation of the reliability of detections, measurement of the kinematic major axis of sources, a new image viewer integrated into the user interface, and the option of generating source catalogues in SQL format. In addition, numerous bugs have been fixed (and probably a few new ones introduced) during our dedicated "spring clean-up" campaign in early 2017.

With the first HI pilot data from ASKAP–12 coming in, our current focus is on getting SoFiA ready for the processing of WALLABY data. The two main areas of activity are parallelisation of the SoFiA pipeline and testing of SoFiA's accuracy and reliability on actual ASKAP data.

For the purpose of **testing** SoFiA's performance on ASKAP data and establishing optimal parameter settings for SoFiA, we intend to inject artificial galaxies into an actual ASKAP–12 data cube and then run SoFiA multiple times with different parameter settings to determine the set of parameters that provides us with the best overall completeness and reliability. Scripts that automatically generate galaxy models (using GIPSY's galmod task) and inject them into a FITS data cube have already been developed, and we are in the process of applying these scripts to HI data cubes from ASKAP–12 commissioning observations. Once the optimal parameter settings for SoFiA have been established, these can then be used on all WALLABY early science data.

Our **parallelisation** work is progressing well. Having successfully installed and run SoFiA 1.0 at the Pawsey Supercomputing Centre in Perth, we are currently in the process of developing a wrapper around SoFiA that automatically splits up the processing of large data cubes onto multiple computing nodes and merges the resulting output into a single source catalogue. This approach will allow us to continue to provide SoFiA as a stand-alone software for desktop computers while being able to use it for the processing of large data cubes on multi-core machines at the same time. We are planning to test this approach on an ASKAP-size data cube using theSkyNet (http://www.theskynet.org/), a citizen science project coordinated at ICRAR.

Lastly, if you would like to be notified about future SoFiA developments and updates, please feel free to sign up to the SoFiA mailing list by sending an e-mail to sofia-request@atnf.csiro.au with the word "subscribe" in the e-mail body (the e-mail subject will be ignored). Further information about SoFiA, including help with installation issues as well as a detailed tutorial for first-time users, is available on the SoFiA wiki at https://github.com/SoFiA-Admin/SoFiA/wiki. ☉

Reports from recent meetings

Annual PHISCC meeting in Pune, 6-11 February 2017: "10th International PHISCC Workshop – Exploring First Light"

A. Popping

In February 2017 the 10th PHISCC meeting was being held at the National Centre for Radio Astrophysics in Pune, India. During this meeting the HI-21 cm science projects discussed are the ones that are being planned or conducted on the various SKA Pathfinder telescopes and instruments. Apart from being the 10th meeting, this meeting marked a milestone because many of the pathfinders have achieved first light and some have already achieved exciting scientific results. The meeting was attended by about 65 people from many different countries. Apart from the regular telescope updates, the meeting was dominated by science talks. Following the regular meeting two mini workshops were being organised on source finding with SoFiA and kinematic modelling which were both well attended.

Swinburne 8-10 March 2017 "From the Field to Clusters: HI as a tracer for galaxy evolution"

I. Wong

The first WALLABY workshop for Science Working Group 3 (Galaxy Environments) brings together HI scientists to discuss new results and plans for ASKAP early science in this area. It has been ~7 years since the project proposals was written. Therefore, the purpose of this workshop is 3-day workshop was to provide an updated roadmap and plan for this group as we progress from ASKAP-12 to the eventual ASKAP-36. As a result of this workshop, Virginia Kilborn and myself have written the updated SWG3 summary which can be found on this workshop's website (https://sites.google.com/site/swg3workshop/home). In addition the workshop presentations are also available for download via the "Speakers" page on the website. ⊙

Upcoming Meetings

WALLABY busy-week

CASS, Marsfield

3 – 6 October 2017

GAMA synergy workshop

ICRAR, Perth

6 – 10 November 2017

https://www.icrar.org/conferences/gamaworkshop/

Annual PHISCC meeting

FAST, Guiyang

~11 – 13 June 2018

WALLABY Publications

2017 articles which mention WALLABY (according to ADS Beta)

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Kim, H.-S., Wyithe, J. S. B., Baugh, C. M., Lagos, C. d. P., Power, C., Park, J., 2016, "The spatial distribution of neutral hydrogen as traced by low HI mass galaxies", ArXiv e-prints, arXiv:1603.02383

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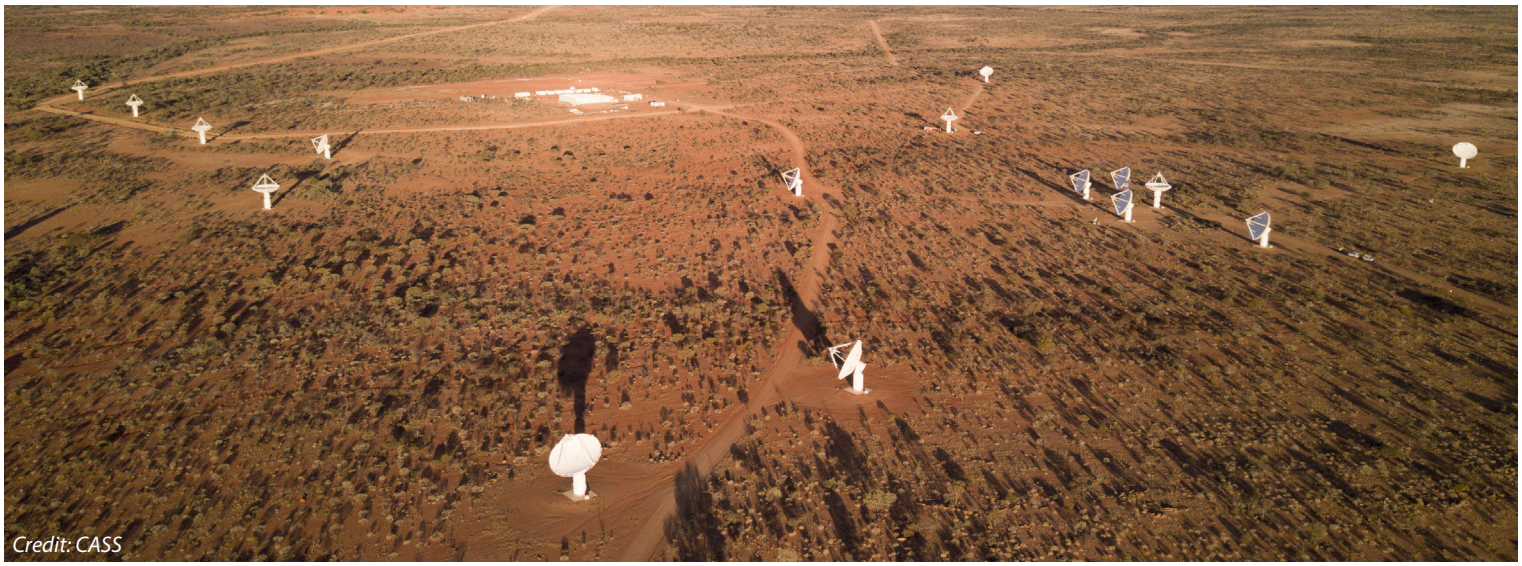

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