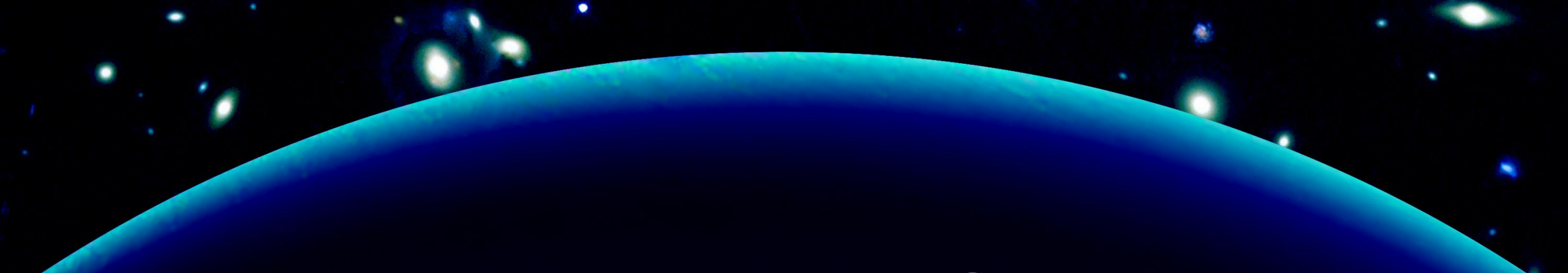


Decadal plan for Australian astronomy 2026–2035

Australian Academy of Science

NATIONAL COMMITTEE FOR ASTRONOMY

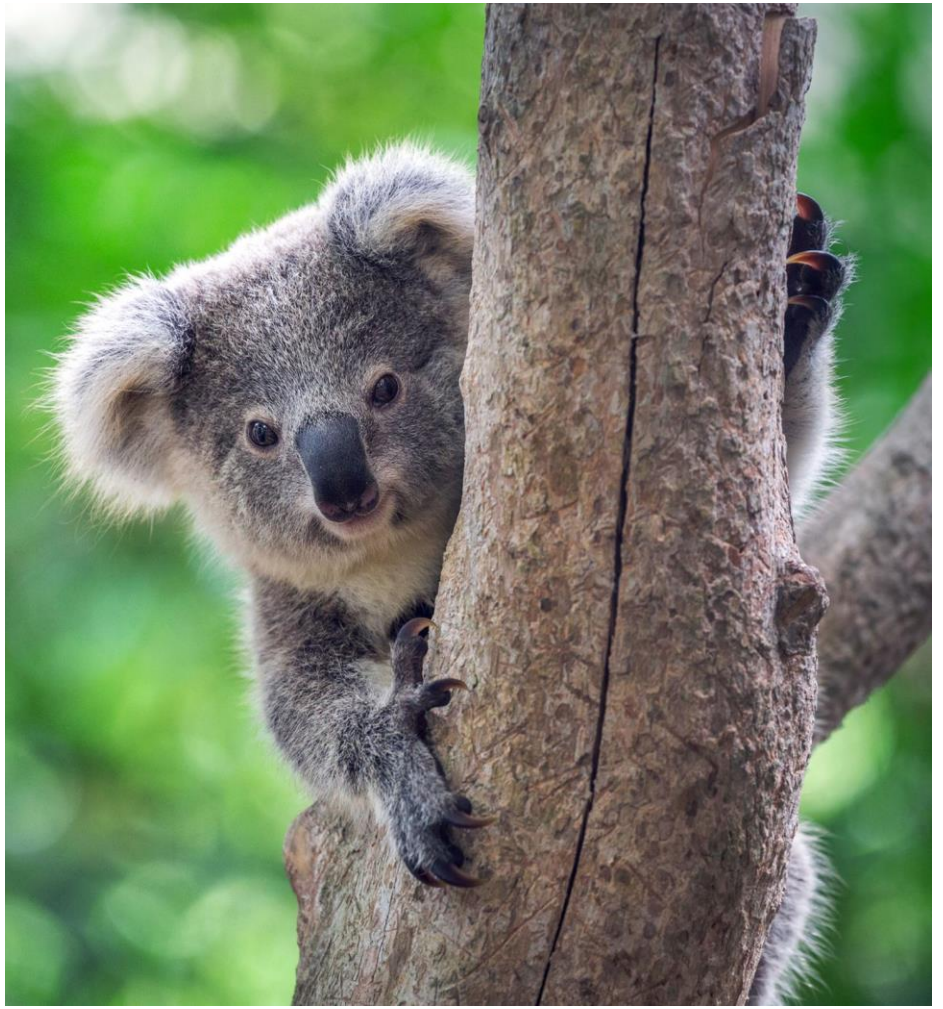
CSIRO

Acknowledgment of Country

The Australian Academy of Science acknowledges and pays respects to the Ngunnawal people, the Traditional Owners of the lands on which the Academy office is located. The Academy also acknowledges and pays respects to the Traditional Owners and the Elders past, present and emerging of all the lands on which the Academy operates, and its Fellows live and work. They hold the memories, traditions, cultures and hopes of Aboriginal and Torres Strait Islander peoples of Australia.

Thank you!

- Thank you to the local hosts for organising the room / catering / AV - this is much appreciated!!
- Thank you to all of the WG chairs and members who have provided slides and are writing reports
- Thanks to everyone both participating here today or through on of the other avenues
- And welcome and thanks to Swasti Devi who is attending all the town halls for the Academy of Science
- I would like to acknowledge the generous funding from CSIRO and academy of Science supporting the development of the astronomy Decadal Plan



Overview

- The Australian astronomical community is carrying out a formal strategic planning process on a ten-year timeframe, reviewing its goals and progress at the mid-term mark.
- This process is run by the Australian Academy of Science's National Committee for Astronomy.
- It provides the opportunity for Australian astronomy to
  - carry out a review of its current capabilities, assess its impact both nationally and internationally,
  - provide a vision for the future and set priorities and develop strategies to implement the vision
  - Astronomy Australia Limited (AAL) supports the delivery of the infrastructure goals of the Australian Astronomy Decadal Plan

Vision and impact of the decadal plan

- The Decadal Plan not only articulates a strategic vision for Australian astronomy but also sets a roadmap for addressing critical scientific questions and building the necessary infrastructure.
- It examines:
- Educational, training, and career pathways, reinforcing Australia's research leadership globally.
- Engages with governmental bodies, and industrial, and research partners worldwide, the plan secures essential funding and fosters international collaboration.
- Alignment with Government priorities:
- Provides advice and recommendations that directly benefit Government initiatives and priorities in the current Australian science system
- Support ongoing investments and identify further scientific opportunities for Australia

Timeframe

Date	Activity
June-December 2023	Project initiation and establishment of working groups Presentation at ASA conference Development of working group plans and white papers
February-May 2024	Establish an editorial committee Nation-wide town-hall meetings and online consultation
June-July 2024	National presentation at ASA conference Development of working group reports Series of in-person town-hall meetings
September 2024	Working group white papers provided to the NCA – September 1 Incorporation into first draft of the decadal plan by the editorial committee – September 16
September-December 2024	Editorial committee preparation of exposure draft (including feedback by NCA / Academy of Science)
January-February 2025	Exposure draft consultation
March-June 2025	Report finalisation and prepublication
July 2025	Launch of the Decadal Plan at the ASA conference

We are here

Town Hall meetings

- In-person July town halls: The findings so far
- Seven in-person with virtual option town halls scheduled for July to discuss
- initial findings to help white paper drafting
- **Locations**: Victoria, Queensland, Tasmania, Canberra, New South Wales,
- Western Australia and South Australia
- Dates between July 18th to August 2nd

Today's Town Hall

- Each working group has prepared 2 slides - we will go through these in 3 groups – research, Facilities and Impact/Engagement and then open forum for discussion
- Questions can be provided either via discussion in the room and/or slack
- Swasti will be taking notes

Working Group	Chair
1.0 Research:	
1.1 Galaxies and Cosmology	Professor Scott Croom
1.2 Stars, Planets, and the Galaxy	Associate Professor Sarah Martell
1.3 Time Domain and Multi-Messenger Astrophysics	Professor Eric Thrane Associate Professor Katie Auchettl
1.4 Theoretical Astrophysics	Professor Mark Krumholz
1.5 Aboriginal and Torres Strait Islander Astronomy	Dr Brad Tucker Ms Karlie Noon
2.0 Facilities:	
2.1 International and Space Facilities	Professor Simon Driver Associate Professor Emily Wisnioski
2.2 National and University Facilities	Professor Andrew Cole Dr Vanessa Moss
2.3 Data and Computing	Dr Minh Huynh Professor Chris Power
2.4 Instrumentation	Professor Richard McDermid
3.0 Impact and Engagement:	
3.1 Demographics, Society, and Workforce	Associate Professor Stas Shabala Professor Emma Ryan Weber
3.2 Outreach, Education and Training	Dr Brad Tucker
3.3 Industry and Translation	Associate Professor Francis Bennet
3.4 Research Funding	Professor Simon Ellingsen

Discussion

ASA #decadal plan slack channel

https://asa-comms.slack.com/#decadalplan

-feel free to use this at any time until 2 August for feedback / comments

Zoom chat

Please use this for any questions in today's session

Zoom recording

We will record the session today so we can take notes.

WG 1.1 Galaxies and Cosmology

Five white papers on the following topics:

- A – Cosmology (Christian Reichardt, Krzysztof Bolejko++)
- B – Galaxy formation theory (Aaron Ludlow, Chris Power++)
- C – the local Universe (z<1) (Luca Cortese, Katie Grasha, Jesse van de Sande++)
- D – cosmic noon (z~1-6) (Anshu Gupta, Jeff Cooke++)
- E – the epoch of reionization (z>6) (Cath Trott, Themiya Nanayakkara++)

Currently merging into a final report.

Return feedback : i) email to authors, ii) via #decadal-wg1-1-townhall on ASA Slack, iii) scott.croom@Sydney.edu.au

Link to white papers

Questions for the next decade (provisional)

1. What regulates the star formation process from parsec to megaparsec scales?
   Key capabilities: 8m and 30m class telescopes, ALMA, ASKAP, SKA-mid, JWST, multiphase high-resolution simulations
   Supporting capabilities: 4m telescopes, 4MOST

2. Understanding galactic ecosystems: what are the internal and external processes that shape galaxies and their surroundings?
   Key capabilities: 8m and 30m telescopes, 4m telescopes, ALMA, ASKAP, SKA-mid, 4MOST, Euclid, Roman, JWST, multiphase simulations.
   Supporting capabilities: SKA-low, eROSITA, LSST

3. What is the physical nature of galaxies and the IGM during the EoR?
   Key capabilities: JWST, MWA, SKA-low, ALMA, 30m telescopes, simulations
   Supporting capabilities: 8m telescopes, ATCA, ASKAP, Euclid, Roman, SKA-mid

4. What is the nature of dark matter and dark energy?
   Key capabilities: 4MOST, DESI, SKA-mid, SKA-low, Euclid, Roman, SPHEReX, LSST, LIGO, SPT/SO
   Supporting capabilities: 8m telescopes, ASKAP

Critical capabilities beyond the decade: 10m class spectroscopy survey telescope, GMT,…..++
Q: What is missing?
Q: Which capabilities are truly central to the next decade?

WG1.2: Stars, planets and the Milky Way

Goal: identify the opportunities, challenges, and enablers for world-leading Australian science in the next decade

Detailed look: separately considered survey science, radio/optical observations, theory, and exoplanets

Current activity: drafting the white paper for WG feedback in early August, updated version for community feedback after that

Major themes

- **Areas of Australian research leadership:** Milky Way/Local Group as an ecosystem, galactic archaeology more broadly, planetary habitability, high-detail observations
- **Integration:** theory-observation, multi-scale, cross-methodology tools
- **Critical resources:** Optical (incl AAT, ESO, JWST, LSST, 4MOST, GMT/ELT); radio (incl SKA, ASKAP, ALMA, LBA, MWA, Parkes, ATCA) computational/data (incl HPC, Data Central, ADACS)

WG1.2: Stars, planets and the Milky Way

Make sure your voice is represented in our white paper

- Fill out our online survey at **tinyurl.com/dpwg12**
- Join the ASA slack channel **#decadal-wg1-2-townhall** for announcements and discussion
- Send feedback on the draft white paper when it is circulated
- Send an email to WG1.2 lead Sarah Martell: **s.martell@unsw.edu.au**

WG 1.3 Time Domain and Multi-Messenger Astrophysics

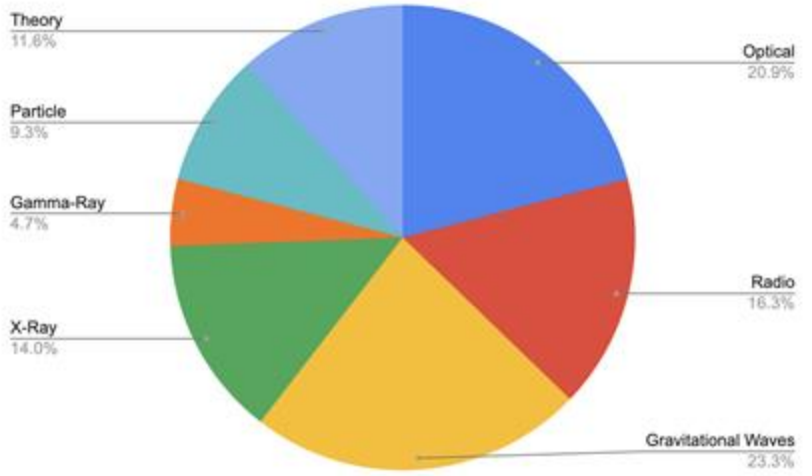
Eric Thrane | Katie Auchettl

- Broad topic that covers observations of a wide range of phenomena e.g., supernovae, FRBs, GWs, neutron stars, black holes etc.
  - Other transient like phenomena such as stellar flares etc aren't necessarily included.
- We have had 3 WG meetings and 4 in person townhalls held in April and May.
- These were very well attended and we came away from these town halls with similar takeaway messages.
- We also have a public github for transparent discussion.

https://github.com/ethrane/transients/issues

Working group members:

Wavelengths/Messengers:



WG 1.3 Time Domain and Multi-Messenger Astrophysics

Where are we now?

- We have established a Writing Team consisting of:
  - Dr. Anais Möller (Swinburne)
  - A/Prof. Chris Lidman (ANU)
  - Dr. Clancy James (Curtain)
  - Eric + Katie
- NCA report will collate the feedback, suggestions, guidance from the WG and general community in regards to the key questions and key infrastructure and priorities.
  - ~4 key questions
  - ~4-6 infrastructure and priorities
- Report is currently in the progress of being written to be sent around for feedback from the WG in the beginning of August.

Working group 1.4 (theory) — status report As of 16 July 2024

Six topical subcommittees:

- Cosmology and astroparticle physics
- Galaxies, ISM, and star formation
- Stars, planets, and supernovae
- Cosmic rays, jets, and compact objects
- High performance computing hardware and software
- Workforce, employment, and careers

- Town halls for each subcommittee in March / April, typical attendance ~30
- Subcommittees synthesised results into reports in May
- Draft report released to community on 1 July, accepting comments to 1 August
- WP will then be finalised for 1 September submission

Preliminary findings and recommendations

- Theory problems ripe for solution in next decade in all areas of astrophysics
- Areas of commonality across scientific domains identified:
  - “Flagship” simulations and codes important in many areas, but too few compute resources, too little software support for AU to be competitive
  - Recommendations for compute resources in last DP not met
  - Recommendation: investment in compute resources and software support on equal footing with telescopes and telescope software support
- Lots of emphasis on big surveys in AU, which need theory for scientific payoff, but no channel exists to fund this work
  - Risk that AU will gather data, but most science done overseas
  - Recommendation: provide support for theory work in support of surveys
- Theory community lacks critical mass and is underrepresented in decision making bodies (e.g. AAL board, NCA) relative to size of community
  - Recommendation: support a theory-focused institute analogous to CITA in Canada

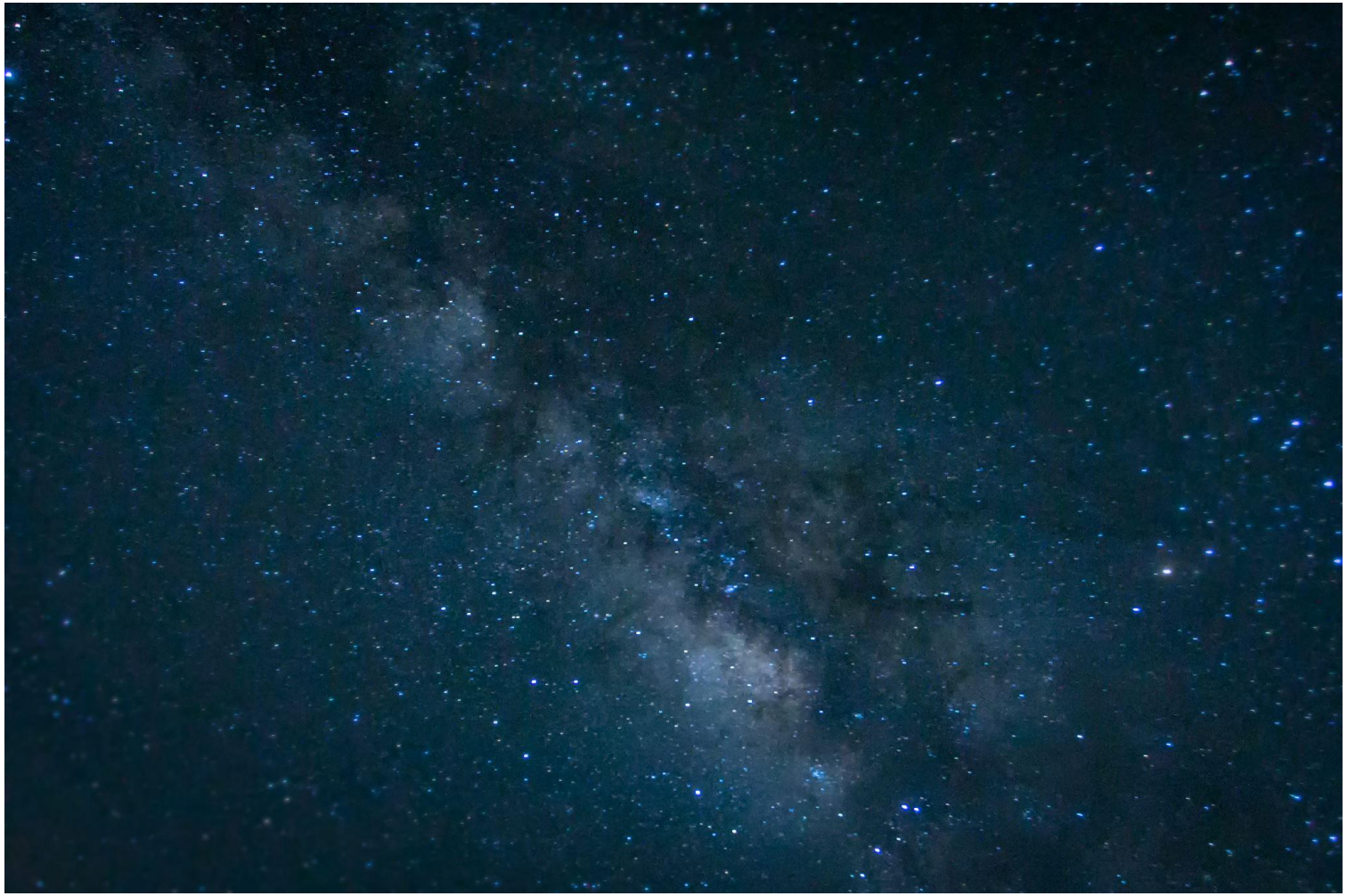
WG 1.5 - Aboriginal and Torres Strait Islander Astronomy Overview

- The first time this is incorporated into the Astronomy Decadal Plan
- To date, no other Academy community or discipline has specifically looked at Indigenous Science and Knowledges
- Efforts, such as with the Australian curriculum and Chief Scientists, have stressed the importance of Indigenous knowledges
- Along with research, representation and education also need to expand
- Four pillars have been identified: Research, Education, Representation, and Service

WG 1.5 - Aboriginal and Torres Strait Islander Astronomy Key Questions

- What support needs to be in place to increase research in, using, and with Aboriginal and Torres Strait Islander Astronomy?
- How do we incorporate Indigenous Knowledges into Astronomy education – in particular at the undergraduate and postgraduate areas?
- How do we increase Aboriginal and Torres Strait Islander Representation and make these efforts sustainable?
- How does the ASA community serve and work with Indigenous communities across Australia?
- What efforts – funding, resources, and FTE can be implemented – at a realistic and sustained level?
- What are the short (10 year), medium (20 year), and long-term (30 year) goals, priorities, and initiatives?

Discussion



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WG2.1: International and Space facilities

co-chairs: Emily Wisnioski & Simon Driver

PRELIMINARY

- **Rec 1**: That Australia joins the European Southern Observatory with access to the full suite, providing value to a larger community than the Strategic Partnership (ALMA, ELT contracts, CTA, … and future programmes)
    - **Rec 1.1**: If Rec 1 is not possible Australia should seek to implement Plan B
- **Rec 2**: Australia continues to capitalise on its engagement with the SKA and the SKA precursors and ensure our share does not fall below the current level (14%)
- **Rec 3**: Resources should be allocated towards growing space engagement with a focus on home-grown capacity, ground-support and multi-wavelength synergies with existing Australian strengths
- **Rec 4**: Appropriate funds are identified/sought to ensure long-term stability for LIGO, CTA & VRO
- **Rec 5**: Sufficient computing resources (hardware and software) should exist to ensure our capacity to process and fuse data across national and key international facilities

The Above is preliminary and not yet integrated with the outputs of the science or other WGs

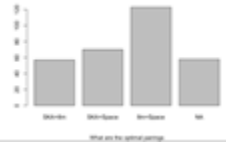
WG2.1: International and Space facilities
co-chairs: Emily Wisnioski & Simon Driver

Q 1: Plan B: What facilities are most critical for your research in the absence of ESO?

Q 2: Space: What pathways should be pursued to maximise our engagement in space access/capability growth?

Q 3: Breadth: How can we best support emerging science groups / access to intermediate facilities?

Q4: Data: What capacity is required to manage, merge, store and serve data flows from international facilities?



Co-chairs: Vanessa Moss, Andrew Cole
Image: University of Tasmania

Working Group 2.2
National and University Facilities

- **Goal:** Working to bring out the essential contributions to the science and community priorities that can *only* come from the work at and activities of university- and nationally-managed facilities

- **Note:** WG 2.1 focuses on international/space, WG 2.3 on data and computing and WG 2.4 on instrumentation (these WGs are the primary avenues for those topics, though we will link with them)

- **So far:** identification that organisations are under financial pressure. Planning, coordination, and advocacy are required – both science-driven and workforce/training-driven.

- **Current activities:** analysis of demographics survey data, outcomes from online town halls, facility input guidelines sent in early July, in-person town hall participation in July, draft version of WG 2.2 report by early/mid August, final version by 1st September

Co-chairs: Vanessa Moss, Andrew Cole
Image: Á. López-Sánchez

Working Group 2.2: How to contribute your input

- Ensure relevant national and university scale facilities are represented via our community call for facility input: **WG 2.2 Facility Input Guidelines**

- Contribute your input and perspective via our community input form: **https://forms.gle/Ks4WwTMjMupNo6M48**

- Engage with us and the broader community directly in the ASA Slack channel: **#decadal-wg2-2-townhall**

- Get in touch with co-chairs Andrew and Vanessa via Slack DM, or email:

andrew.cole@utas.edu.au
vanessa.moss@csiro.au

WG 2.3 Data and Computing: Emerging Findings

Building Capability

- Nationally coordinated **training and accreditation** scheme for **data & computing** competency, incorporate into PhDs.
- **AI/ML will be transformational** and impact day-to-day research activities - need hands-on training, propose active communities of practice
- Fund initiatives to embed **data, software, platform specialists** into projects, as part of research teams.

Based on sub-WG reports and town hall discussions

Building Infrastructure

- Facilitate **open access HPC time** in line with peer countries - 30% of a top-100 facility
- Increase **investment in mid-tier facilities** (e.g. OzSTAR) where the majority of research computing will get done
- Lock in timetable for **renewal and refresh** of computing and data infrastructure
- Expand investment in **science platforms** - co-located at computing and data centres, "**bring code to the data**"
- Ensure **all key datasets** (multi-messenger, multi-wavelength, theory and simulations) are accessible in framework that adheres to **FAIR principles**

WG 2.3 Data and Computing: Q/A

- Does this reflect your views and priorities?
- What are the emerging opportunities in this area?
- Have we missed anything?

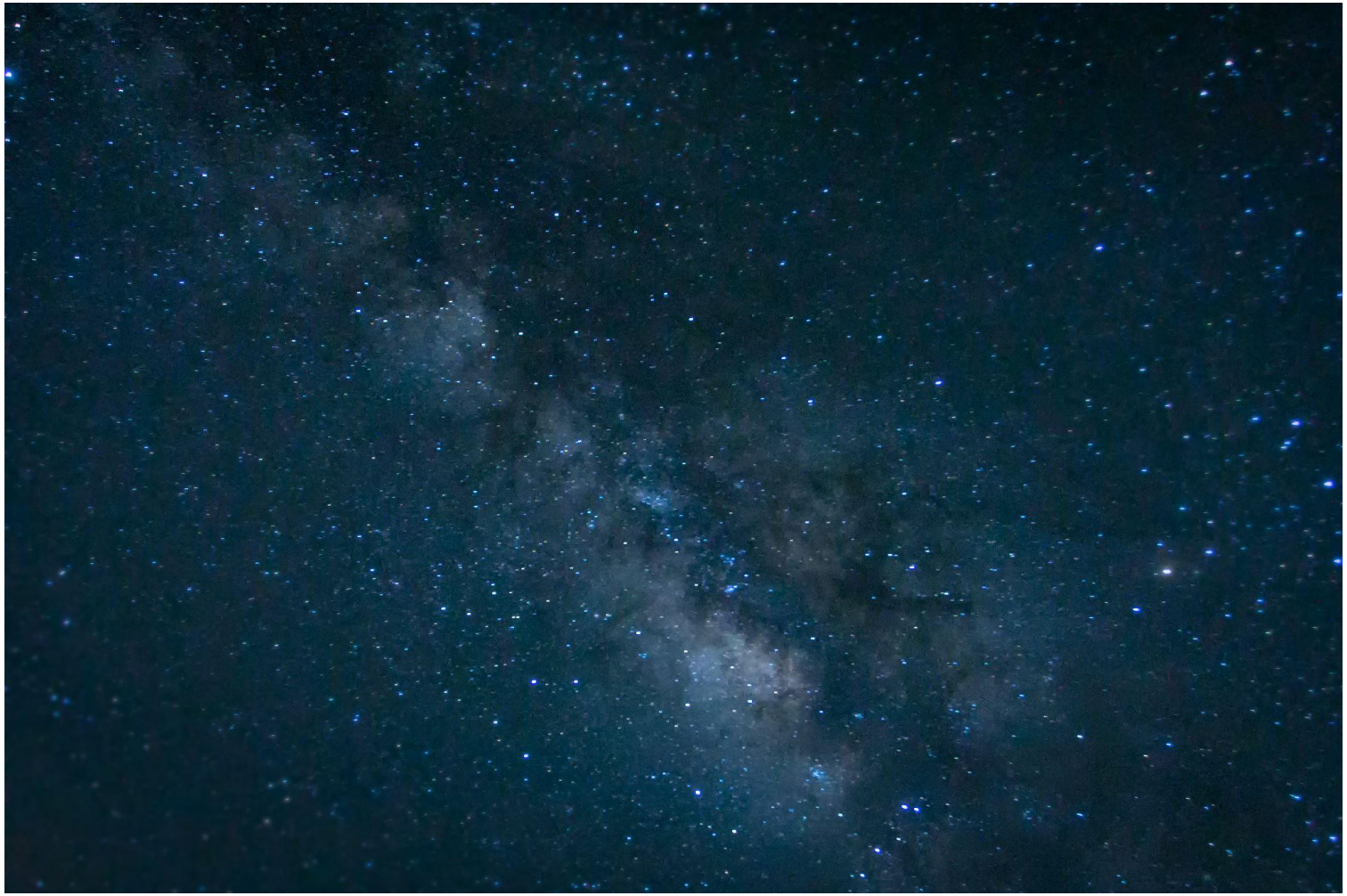
Working Group 2.4 - Instrumentation

- First dedicated Decadal Plan white paper specifically tackling instrumentation as part of the astronomy community
- Spans optical, radio, space, and gravitational wave instrumentation
- Thriving instrumentation development is key for Australian astronomy:
  - *Driving astrophysics discovery and innovation through new capabilities*
  - *Creating telescope access opportunities through in-kind guaranteed time*
  - *Developing translational technology with societal benefit*
  - *Training interdisciplinary STEM professionals for industry*
  - *Adds strategic value to major facility partnerships, and longevity to heritage facilities*

Working Group 2.4 – Decadal Outlook/Trends

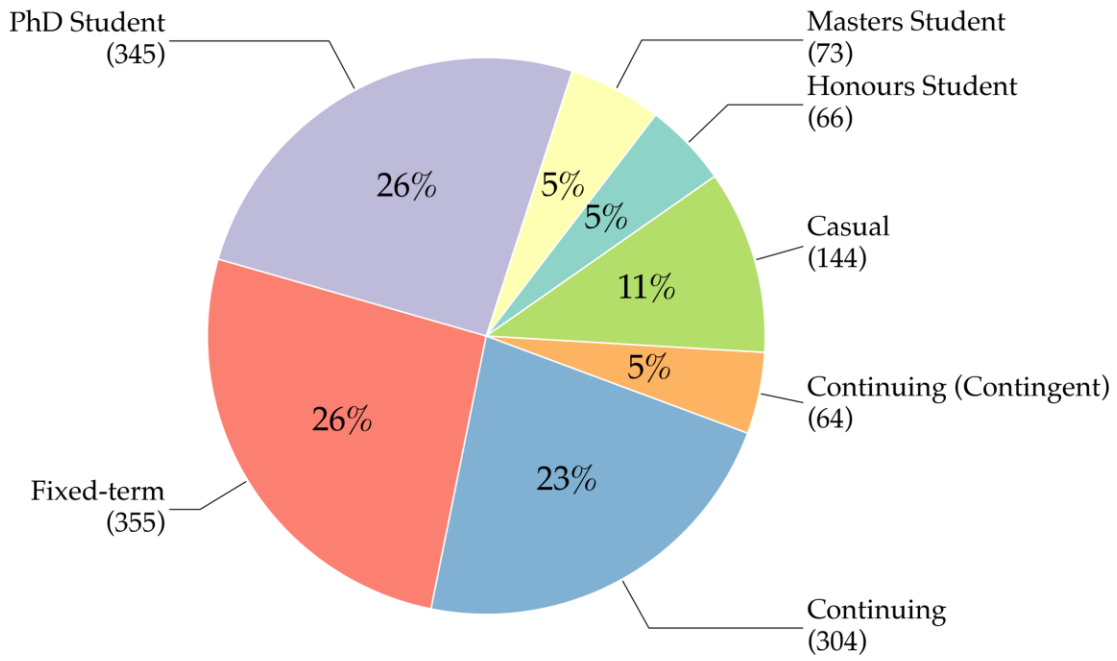
- Funding
  - International projects require large teams, sustained over long-term (typical project is ~10 years)
  - New technologies require R&D capacity, which isn't funded through instrument project contracts
  - Currently very limited long-term funding for securely engaging in major instruments or supporting strategic R&D
- Training / Career pathways
  - Astronomical instrument science straddles engineering and astrophysics/physics.
  - Traditional 'publish or perish' teaching+research academic pathways are not a good fit to developing and building world-leading instruments for cutting edge facilities
  - Need for pathways to continuing positions in instrumentation, with appropriate career progression opportunities
- Emerging Opportunities
  - ESO Membership: Australia already engaged with opportunities for ELT, WST, and potentially ALMA upgrades
  - Mature partnerships and projects with other world-leading observatories: GMT, Subaru, Gemini….
  - Space sector is an emerging area of strength and translation for astronomy instrument groups
  - Instrumentation is a key conduit for astronomy's Industry Engagement activities, but currently somewhat ad hoc

Discussion

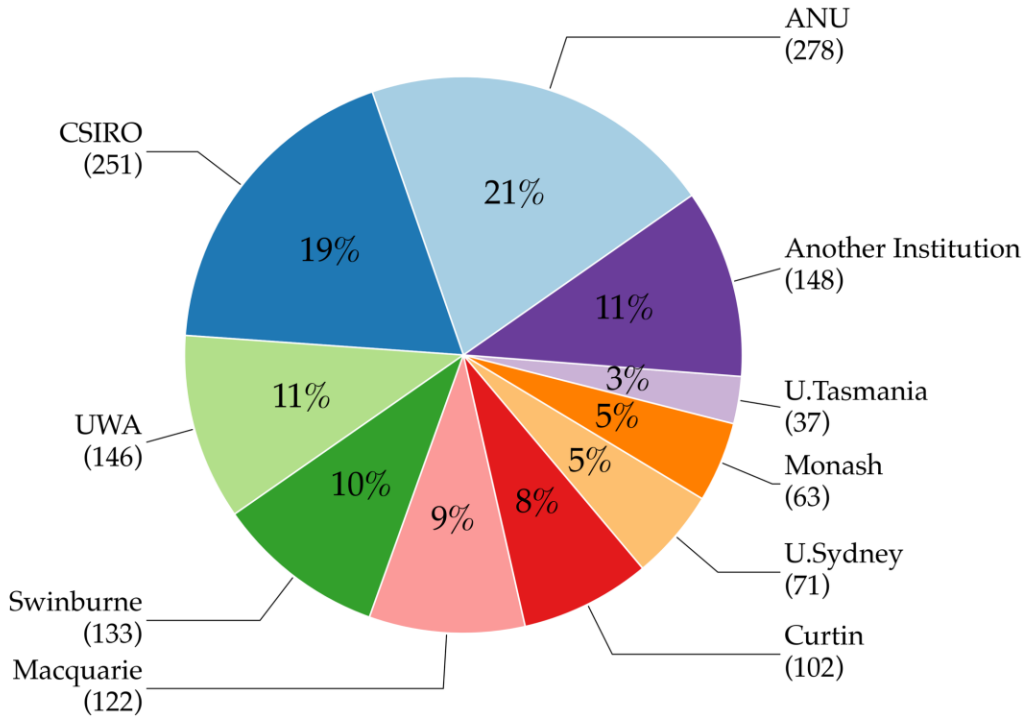


3.1 Demographics, Society, and Workforce

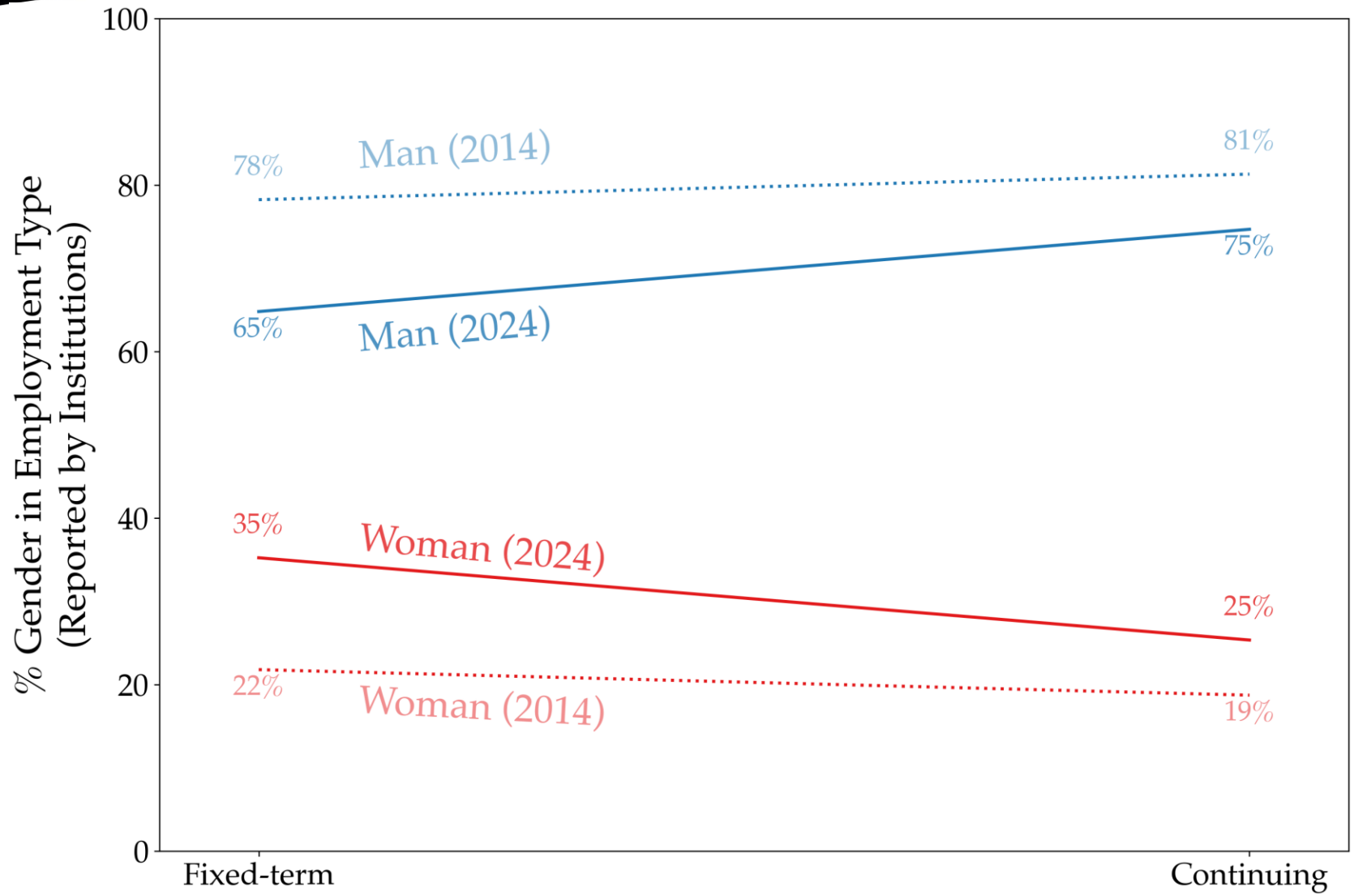
Distribution of Employment Types



Distribution of Australian Institution Affiliation



1351 people reported in the institutional survey



* Woman (2024) - Continuing increases to 26% if you include Continuing (Contingent Funding) contracts.

WG 3.2 – Outreach, Education, and Training Overview

- Of the 29 recommendations from the WG report in 2015, only 9 have been implemented – 6 of which are in careers

- The WG recommendations from 2015 and the Institutional and Individual ASA surveys show broad support for these areas, yet a lack of national and regular support and funding

- Nearly half of the WG contributors from 2015 are no longer in Astronomy or Australia = high turn-over.

- Several areas and opportunities have appeared/increased over the past 10 years (social media, space

WG 3.2 – Outreach, Education, and Training Key Questions

- How is outreach funding and prioritised – including opportunities for funding, FTE, and programs?

- A key set of recommendations in 2015 was recognition of community members who engage in outreach an education, yet this was never done. Why?

- Do we / should we focus more on national outreach and educational goals, rather than those of an individual or institute?

- How is evaluation into programs incorporated, funded, and used?

- Should astronomy work more with TAFES and technical training skills, given the need of these skills going forward? And in what ways can we?

- Townhalls and discussions are ongoing with those from outside astronomy include teachers and amateur astronomers. Who else do we need to consult?

Working Group 3.3: Industry Engagement

- **Aims of the Working Group**:
- Increase industry engagement and partnerships.
- Facilitate technology transfer and commercialisation to ensure benefits of research are shared with society
- Communicate and promote the impact of research, highlighting the link between fundamental research and outcomes
- Enhance industry awareness and opportunities for engagement.
- Stimulate innovation and encourage the development of innovative solutions, fostering a culture of innovation and entrepreneurship
- Support skills development and training programs to create a pipeline of students for industry and skills in researchers to enable future industry engagement

- **Challenges**:
- Cultural differences between research organisations focused on research questions and industry focused on commercial outcomes.
- IP and commercialisation are always a challenging area to negotiate between parties who are both taking risks and providing value
- Resource constraints for both industry and research organisations means that industry engagement is often an afterthought and not a pillar of activity – this can hinder and constrain cutting edge research

Working Group 3.3: Industry and Translation

Importance: Industry engagement and research translation are vital for harnessing scientific advancements, driving technological innovation, and maximising societal impact: research funding is highly dependent on demonstrating this impact

Benefits: Working with industry and applying research accelerates progress in understanding the universe, contributes to economic growth, and fosters innovation.

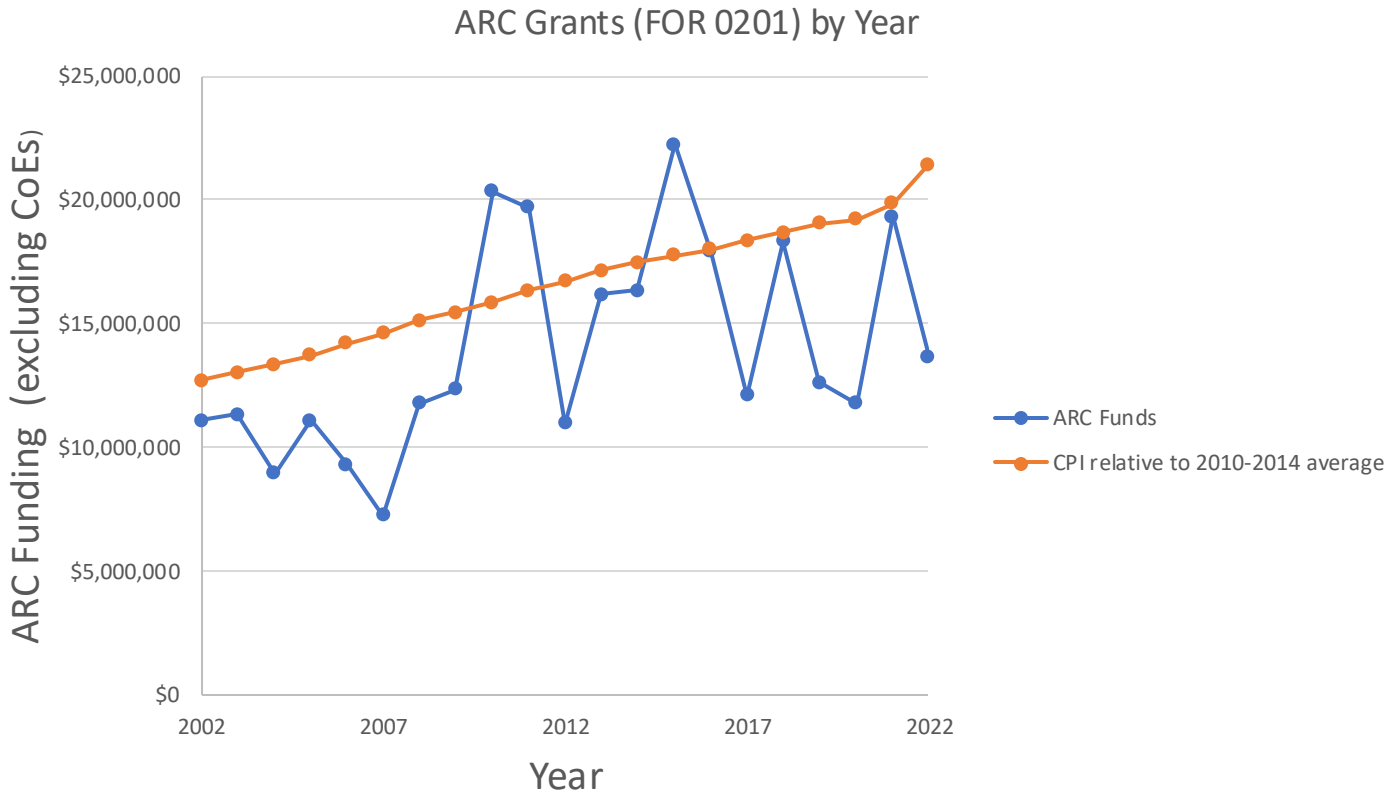
Enhanced Collaboration: Mutual benefits between academia and industry through technology transfer and economic opportunities benefit both industry and academia by opening up funding opportunities, sharing technology, and providing access to cutting edge technology

Discussion Points: Where are the challenges academics face that we can address with the decadal plan?

How do we make a positive culture change to enable research translation and industry engagement while maintaining the world leading fundamental research?

Working Group 3.4: Research Funding

Undertaking a detailed comparison of ARC funding for Astronomy compared to Physics overall, other physical sciences and compared to number of professional astronomers.



Other significant funding sources?

Direct:

- Infrastructure/NCRIS funds distributed by AAL $12M annually 2019-2023
- Department of Industry: ESO Strategic partnership ~$13M annually 2017 onwards
- Department of Industry: SKA Construction and support (including AusSRC) $387M over 10 years

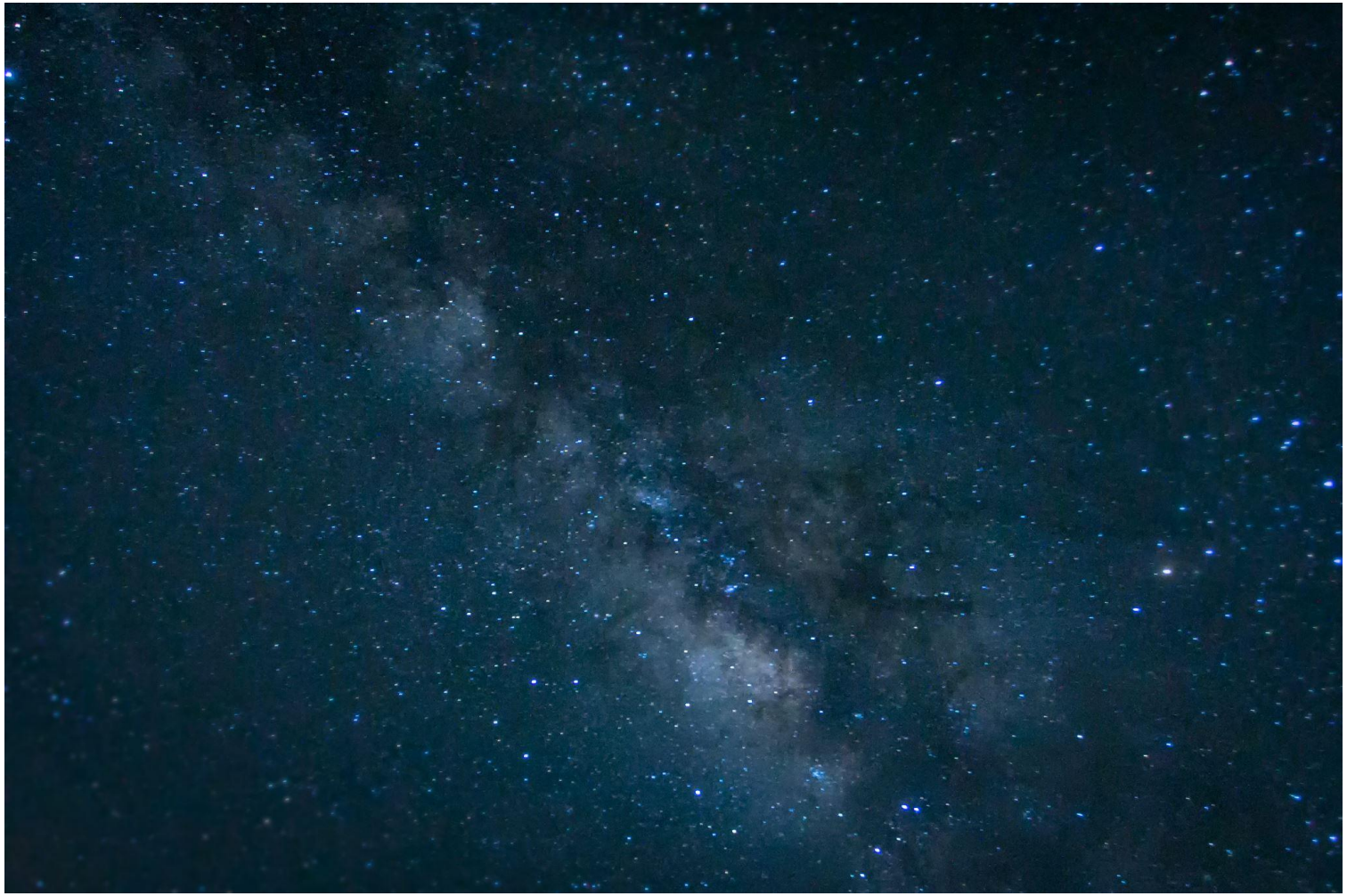
Indirect:

- Salaries of staff at Universities, CSIRO + PhD and Masters stipends
- CSIRO Space and Astronomy

Conclusion:

- Overall government funding to astronomy has (probably) increased in real terms (we're checking the figures) because of the SKA and ESO investments.
- ARC Funding per eligible astronomer has (probably) declined in real terms (again, we're still checking)

Discussion



Next steps

- Feedback will be compiled and sent back to the working groups, and/or editorial board for consideration
- Working groups will consider feedback when finalising their white papers
- Editorial board meets mid-sept to draft the plan, followed by several months of working with NCA and Academy of Science to incorporate feedback
- Exposure draft of decadal plan will be released early 2025 followed by more town halls before it is finalised

Thank you for your participation today!!