Australian National University

Research School of Astronomy & Astrophysics Review

Panel Report

Site Visit Held on 11-13 November 2024

Contents

Australian National University

Panel Members

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Executive Summary

ANU's Research School of Astronomy and Astrophysics (RSAA) has been at the frontier of discovery for 100 years. The review panel was highly impressed by the breadth and depth of activity taking place at RSAA, spanning fundamental research, outstanding teaching and training, technological innovation, operation of important national facilities, impactful equity and inclusion activities, and spectacular outreach programs, all maintained at the highest quality.

In order to maintain RSAA's high national and international standing and to better position the school for the next century of astronomical exploration, the review panel makes the following five core recommendations:

1. RSAA should adopt an explicit focus on building a culture of internal and external collaboration at all levels. This will help ensure that RSAA remains scientifically competitive and impactful and will keep the school's technical competencies competitive and at the cutting edge.

2. RSAA should evolve its research profile and its approach to hiring faculty. Rebalancing of the School's research portfolio will mitigate the current strong dependency on facilities with uncertain future access, will position RSAA to capitalise on the coming flood of data in radio astronomy and time-domain astrophysics, and will ensure that the demographic profile of its faculty becomes a key component of the school's commitment to research excellence.

3. RSAA should optimise the positioning of its infrastructure and facilities for future discoveries and applications, both by continuing to pursue socially relevant and industrial invested opportunities at Siding Spring Observatory (SSO), and by enhancing the capacity of the Advanced Instrumentation and Technology Centre (AITC) for research and innovation. The latter can be realised by providing overall base recurring funding to AITC that is not project based, and by ensuring that individual AITC staff have some fraction of their time that does not need to be charged to projects.

4. RSAA should revitalise Mt Stromlo as a destination for the public by renovating the cafe and re-opening the outreach centre. This will allow RSAA to better promote its scientific, educational, and technological contributions to the community, and will provide new philanthropic investment opportunities.

5. RSAA should ensure that its astronomy major remains relevant, accessible, and integrated with other related programs, so that ANU remains the destination of choice for Australian undergraduate students who wish to major in astronomy. The curriculum should undergo continued review to ensure that it is not just a set of excellent subjects, but a well-curated, well-integrated, and coherent program of education.

It should be feasible to begin implementing all of these recommendations even in the current period of significant budget and resource constraints, while simultaneously developing ambitious plans for coming years when the financial outlook is rosier.

The members of the review panel thank RSAA and ANU for their hospitality during the site visit and congratulate Professor Wyithe on the significant vision and leadership he has offered during the early stages of his tenure. The panel looks forward to seeing this iconic institution reach even further heights in the years ahead.

Commendations

- RSAA is a clear national and international leader in frontier research areas of astronomy, astrophysics, and cosmology, with unique capabilities and facilities across observation, instrumentation, theory, and computation.

- AITC is an international leader in optical and infrared instrumentation, with highly sought services that have socially relevant applications.

- RSAA's successful translation of research technology into applications such as space situational awareness, bushfire monitoring, and laser communications is an impressive expansion of capabilities over a historical focus purely on astronomical research and instrumentation.

- Siding Spring Observatory is an important international facility, supporting numerous international partnerships and providing a highly efficient and cost-effective facility in the form of the ANU 2.3-metre telescope. The relevance of SSO is demonstrated by the extensive use of the site by international organisations (in part due to its unique longitude site). There has been strong strategic investment in transient instrumentation technology, and the site's transition to a user-pays operational model is a strength.

- RSAA has fully leveraged its investment in infrastructure, with AITC successfully self-financing and SSO well on the way to an externally funded operational model. Careful strategic choices to keep the facilities and expertise relevant and agile for both astronomical and industry needs will allow these infrastructures to remain high value, both scientifically and technologically, well into the future.

- The first-year astronomy courses that RSAA offers are extremely impressive, and the major commitment that has produced this can be deemed a significant success. Paul Francis is an internationally recognised educator, who has driven a very innovative and interesting set of first-year offerings.

- ANU's Astrophysics major is unique within the Group of Eight universities in Australia and serves as a significant national drawcard for high-quality talent.

- RSAA hosts an outstanding cohort of HDR students and postdoctoral researchers, who continue to have a very strong record of successful career trajectories in and beyond astronomy.

- RSAA's outreach programming is spectacular and extraordinary. Both the level of interest and the capacity to handle this demand are unparalleled in any of the panel members' experiences.

- RSAA takes its commitment to equity and inclusion seriously and has created a positive and welcoming workplace culture.

Recommendations

1. **Build a culture of collaboration at all levels**

   RSAA faculty historically have had an approach of trying to do things completely in house, or with RSAA as the clear lead.[1] There are aspects of this approach that have helped put RSAA at the forefront of global astronomy, and the associated level of ambition should be retained. However, in a time of bigger projects and constrained budgets, this can also hold RSAA back from realising its goals.

   We recommend that every effort should be made to systematically create and grow collaboration and strategic partnerships at all levels – within RSAA (including between AITC and the rest of RSAA), within ANU, and with a selected set of relevant national and international partners. It is not possible to hold all required expertise in-house in this era of highly specialised but interconnected astrophysics areas, and it was surprising to repeatedly hear during the site visit that "we can't do X because we don't have someone who's an expert in Y". However, RSAA has the potential to be a focal point that brings together the best international collaborations and drives the field through leadership.

   Building this culture of collaboration needs a pro-active faculty cohort. Co-supervision of HDR students is one keyway to begin building the needed internal and external partnerships and will naturally lead to broader collaboration. We also recommend establishing a pyramidal mentoring program for staff and students from undergraduates through to senior staff.

   A holistic culture of collaboration will help ensure that RSAA remains scientifically competitive and impactful and will keep AITC's and RSAA's technical competencies at the cutting edge.

2. **Evolve the research profile of RSAA and its approach to hiring faculty**

   RSAA has an outstanding complement of faculty, all of whom are internationally recognised researchers. However, the School has found itself in a position where a large number of its researchers have programs that depend critically on uncertain outcomes, in the form of ESO and GMT. Conversely, RSAA is not well placed to be able to significantly capitalise on relatively guaranteed programs such as ASKAP, SKA, and

[1] This made total sense at a time when RSAA had exclusive access to many facilities and data sets.

LSST, and more generally on radio astronomy and on (multi-wavelength / multi-messenger) time-domain science. RSAA recognises this, and a Centre of Excellence in SKA science would provide almost instant critical mass in new areas.

Regardless of the Centre outcome, we recommend that RSAA consider future faculty searches targeted by (broad) research topic, rather than fully open searches, in order to rebalance its research portfolio. To focus these choices, RSAA should undertake an open-minded, systematic analysis of the immediate- and mid-term future state of the national and international astronomical landscape, in terms of relevant astronomical infrastructures, technology expertise centres, and continuing and emerging groups of astronomical excellence. RSAA should review this with a mind to its self-report on current in-house interests, investments and expertise, and should evolve an agile, lean, and bold set of strategic goals that will create opportunity regardless of externally decided factors.

RSAA aspires to be one of the world's top astronomy research institutes, but the demographic profile of its faculty (~75% men, ~100% white) will become a barrier to this goal as the population of students and EMCRs continues to diversify. We recommend that RSAA seize the opportunity to capitalise on its strong record of equity, inclusion, and climate by reforming the way in which it approaches hiring and retention for continuing positions, in order to create a faculty, complement that looks like Australian society and like modern astronomy.

3. Position RSAA's infrastructure and facilities for innovation and discovery

RSAA runs two unique facilities that set it apart from all Australian astronomy institutions: SSO and AITC. We recommend that these be maintained and note that they are already almost cost-neutral to ANU as they are significant sources of revenue.

SSO is an extremely active and in-demand location for astronomical observing and space activities (such as space situational awareness and laser communications). It has achieved an almost entirely externally funded operational model. SSO is a core part of RSAA's excellence and international reputation. RSAA should continue to pursue technology and project offerings enabled by SSO, especially in socially relevant and industrial invested interest areas.

AITC is a very impressive centre that has a good record of delivery and enormous future potential. However, a budget model in which everything is project-based will provide fundamental limits to AITC's ability to innovate, to integrate itself into RSAA's core research and training missions, to maintain cutting-edge infrastructure, to retain and grow competencies and technical excellence, and to be competitive in project bids, all of which are essential if AITC is to grow and succeed. An explicit decision should be made on whether the long-term goal for AITC is to be a place that innovates and is seen as a leader in instrumentation research, rather than focuses on delivery of projects. We note that in the current set-up, the latter approach will mean continuing to be underbid by competitors who can subsidise the cost of their staff and projects.

If RSAA and ANU wish to reposition AITC in this way, we recommend that AITC receives overall base recurring funding that is not project based, and that individual AITC staff have some fraction of their time (e.g., 20%) that does not need to be charged to projects. In this mode of operation, staff will be able to develop ideas, co-supervise students, and better interact with RSAA astronomers, while base funds can be used to improve overall workflows and facilities.

Institutionalising this might only be possible in the long term.[2] However, the review panel emphasises that international best-practice is that instrumentation institutes in university environments are not completely self-funded, because their goals need to centre on innovation, discovery, training, and on the academic mission of the university, not just on budgets, projects, and revenue.

4. **Revitalise Mt Stromlo as a destination for the public by renovating the cafe and re-opening the outreach centre**

   RSAA is situated in a highly visible place of national historical importance, with an outreach impact that is exemplary for its limited scale and resource. Fully leveraged, this program has potential to provide not just self-funding, but seed funding for broader RSAA needs.

   We recommend that the planned and sensibly scoped investments be urgently made to open the Visitor and Events Centre and associated cafe. This will allow RSAA to better promote its scientific, educational, and technological contributions to local, regional, and international visitors and students. This in turn will strengthen the social licence to operate for both the school and ANU and will provide new philanthropic investment opportunities.

5. **Ensure that the astronomy major remains coherent, relevant, accessible, and integrated with other related programs**

   ANU is the destination of choice for Australian undergraduate students who wish to major in astronomy. The astronomy undergraduate program is a significant drawcard that is almost unique to ANU and should be enhanced. We recommend that the curriculum should undergo continued review to ensure that it is not just a set of excellent subjects but a well-curated, well-integrated, and coherent program of education.

   The first-year large astronomy courses that run in non-traditional semesters are exceptionally successful and should be maintained and continually revitalised. We also recommend that succession planning should be put in place to develop the next education leaders that can take over from Paul Francis.

   Access to the courses should be ensured, potentially including more frequent transport to and from the mountain for students when necessary.

Overshadowing all the above recommendations are the current strong constraints on the RSAA and ANU budgets. As a general principle, it's important for RSAA to acknowledge, and to communicate to all its employees, that budget reductions should mean doing less with less, rather than doing more (or the same) with less. While a benefit of a tightening budget is that it forces an organisation to identify efficiencies, demanding too much of staff will result in unsustainable workloads, which will lead to people beginning to look elsewhere for employment.

[2] In a short-term environment where there is no core funding that can be used for this goal, AITC should consider using some of its strategic surplus for this purpose (~$400k can go a long way in buying out a day/week of staff time), or RSAA should try to renegotiate the indirect cost return to AITC for some fixed period.

Additional Findings and Comments

1. Strengthening our National Mission and meeting our unique responsibilities

- Siding Spring Observatory is an important national resource, and maintaining its capability for frontier research and impactful outreach should be a high priority for RSAA.

- While SSO as a whole is productive and relatively inexpensive in terms of cost to ANU, RSAA obviously needs to make a major decision around the future of SSO's largest telescope, the AAT, when the current complement of survey program ends in ~2028. The four alternatives are to identify and lead a new set of scientific programs (and to secure associated funding), to identify another institution or consortium to take over AAT operations, to convert the AAT (either fully or in part) for commercial needs such as laser communications with space, or to decommission the telescope.

- RSAA has fully leveraged its investment in infrastructure at SSO and AITC by making them both self-sustaining or almost so and should not consider either program as a significant opportunity for cost-savings or cutbacks.

- As part of Recommendation 3 above that RSAA better align AITC with the academic and research missions of the School, RSAA may want to consider a re-examination of the structure of AITC-based PhDs, to reduce the risk to AITC students and to ensure they can complete on time.

- More broadly, the review panel noted that AITC does not have a formal risk register. This should be addressed, and in general we recommend that AITC adopt a disciplined approach to risk management.

- The review panel noted many outdated or inefficient administrative and approval structures in ANU overall, which inhibit RSAA's ability to do its mission. Structural improvements will address this over time, but in the meantime, RSAA and ANU leadership may want to implement a streamlined "exception to policy" process so that RSAA can move quickly on recurring situations that do not currently fall within standard operating procedures.

2. Conducting research that transforms society and creates national capability

- The ANU 2.3-metre is a powerful and exciting facility. The review panel noted that there is only a small RSAA user base for this telescope, and more generally that RSAA doesn't do a larger amount of time-domain and transient research (either theory or observations) that warrants the investment in the 2.3-metre (see Recommendation 2 above).

- To emphasize one aspect of Recommendation 2, the review panel affirms RSAA's own observation that it does not have critical mass in radio astronomy. A successful Centre of Excellence application and the new faculty positions committed to accompany it would be one way to address this, but RSAA should consider alternative options to make

strategic scientific investments in radio astronomy should this proposal not be successful.

- A school the size of RSAA will never have critical mass in all priority areas. Not only is collaboration key (as per Recommendation 1), but RSAA may want to consider establishing a strong, structured visitor, conference, or workshop program to build substantive collaborations and to establish itself as a hub of astronomical activity. The rural locale but proximity to Canberra provides the opportunity to consider an Aspen-style program of collaborations and discussions, which may make RSAA a destination of choice for visiting astronomers worldwide.

3. Delivering a student experience equal to the world's best

- The sentiment from HDR students with whom the review panel met is that RSAA could benefit from better transparency, clarity, and processes relating to central pools of funding (e.g., travel funding) available for use by these students. Part of building awareness might involve requiring short reports on the use of funds afterwards and emailing around a compilation of all successful grants and links to the associated reports every few months.

- As above, AITC and RSAA can likely benefit from better overall oversight and integration of AITC-based HDR students and postdocs, so that they are better embedded in the overall culture and mission of the school.

- RSAA may want to consider an awards and recognition program for its HDR students and ECRs, to recognize different categories of contributions (research, mentoring, IDEA work, etc), and to help people feel valued.

- The RSAA leadership have noted that it is keen to identify ways to recruit more domestic HDR students. The review panel recognises the challenges with this but can offer two suggested approaches:

  (1) Identify new approaches for encouraging more PhB students to stay at ANU for their postgraduate studies.

  (2) Target domestic undergraduate students who come from regions where there are limited options for local HDR studies, such as South Australia and New Zealand.

- Co-supervision of HDR students is a key approach for producing innovative and novel research, and for building longer-term linkages. In keeping with Recommendation 1, RSAA can likely benefit from identifying and offering co-supervision opportunities with AITC, Physics, Statistics, Computer Science, Engineering, and the Centre for Gravitational Astrophysics.

- Undergraduate students affiliated with RSAA expressed concern or confusion to the review panel over prerequisites, lack of ongoing communication to them from the school, and limited opportunities for advice on their degree pathways.

- The undergraduate cohort provided feedback to the review panel that they felt curricular reform was needed. Their perception was that many of the courses offered in the major are too difficult, that too many assessments are due at once, that more key courses need to be offered every year, and that some existing courses need overhauls or rewrites.

- To increase a sense of belonging and reduce confusion, RSAA may want to consider providing welcome packs and a series of orientation/induction sessions for new undergraduates, postgraduates, and postdocs when they join the school.

- As noted in Recommendation 1, RSAA could potentially benefit from a formal mentoring program, perhaps based on that offered by Astro3D. Key components could include the opportunity for participants to simultaneously be both mentees and mentors, and for the mentoring chain to extend all the way from undergraduate students through to senior academics.

- The review panel agrees with the sentiment from RSAA academics that the master's program could be simplified or streamlined. This may involve retiring the coursework Masters option and/or exerting more control over which students are accepted.

4. Being a standard-bearer for equity and inclusion

- A recurrent theme from students and ECRs during the review panel's meetings was that the faculty complement did not look like them, and that they doubted whether there might one day be a place for them as astronomers at ANU (or elsewhere in Australian astronomy). RSAA leadership may want to consider the perception produced by the strong institutional messaging on gender parity, and the signal this may be sending to people of colour and those from other under-represented identities.[3] The review panel also notes that if representation along other axes of identity besides gender are not meaningfully addressed until gender parity is reached, then RSAA may at that point find itself far behind other institutions on its representation efforts.

- The most crucial part of diverse hiring is building a diverse application pool, and then helping those applicants write strong applications. Conversations with RSAA faculty suggest that efforts on this front could be massively increased.

- Spousal hiring is key to hiring people from under-represented groups. The review panel were surprised to learn of an anecdotal potential aversion to such hires on the basis that it slows down the path to gender parity.

- The postdocs shared with the review panel a view that there is inconsistency in the relocation allowances offered to them. RSAA may want to consider standardising the benefits offered to ECRs (and students), so that everyone is treated equitably.

[3] The review committee notes that the focus on gender parity does not seem to be working as well as hoped at the faculty level. It's also been well established that gender parity efforts have a disproportionate benefit for white women, while providing minimal benefit, or even detriment, for women of colour.

Attachment

Terms of Reference

Review of the Research School of Astronomy and Astrophysics, College of Science

The purpose of the Review is (a) to assess the performance, the activities, and the plans of the Research School of Astronomy and Astrophysics and (b) to provide recommendations on its future directions and priorities in line with the strategic vision of the University.

1. STRENGTHENING OUR NATIONAL MISSION AND MEETING OUR UNIQUE RESPONSIBILITIES

- Our research impact and strength of future strategic directions
- Our provision of high-quality outreach and education for diverse audiences
- Our role in building Australia's capacity in research, education and training including the Siding Springs Observatory
- Our pursuit of opportunities for engagement with First Nations Peoples and integration of resonant themes and approaches into research and teaching.

2. CONDUCTING RESEARCH THAT TRANSFORMS SOCIETY AND CREATES NATIONAL CAPABILITY

- Our collaboration with global partners on research that addresses forefront astronomical questions, and the broader impact of our technology
- Our competitiveness and position in the field of instrumentation and space technology within the Advanced Instrumentation and Technology Centre (AITC)
- The relative scale of astronomy and instrumentation research streams, and opportunities for internal collaboration
- Our ability to attract external funding, and to expand sources of funding.

3. DELIVERING A STUDENT EXPERIENCE EQUAL TO THE WORLD'S BEST

- The quality of our undergraduate and postgraduate education programs compared to the top astronomical institutions in the World
- The quality of our HDR program and ability to maintain and enhance this quality
- Our proposed development of non-degree offerings such as short courses
- The quality of our cross-disciplinary teaching and opportunity for expansion
- The impact of our graduates within and beyond the academy.

4. BEING A STANDARD-BEARER FOR EQUITY AND INCLUSION

- Our success in creating an inclusive and supportive environment in which to learn and work, especially given the challenges of gender equity in astronomy and astrophysics
- Our adoption of recruitment practices which drive equity and diversity goals

- Our success in supporting international students and promoting their integration into ANU and the national astronomical community.

5. LEADERSHIP, GOVERNANCE, ORGANISATION AND FINANCIAL SUSTAINABILITY

- Our governance structure and whether it is consistent with our mission
- Our management of staff including career progression and opportunities
- Our financial sustainability and capacity to attract endowments and philanthropy.