

Mid-term review white paper (unsolicited): An Australian Space Telescope Institute and Data Centre

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Preamble:

Astronomy from Space represents a critical and rapidly growing part of Australian Astronomy research. We argue that Australia requires a formal national entity, mandated through the mid-term review, to manage and expand our science engagements with ongoing NASA, ESA, and other space agency missions.

Introduction:

The majority of global A* Astronomy publications and citations now originate from data obtained via space platforms (see Fig 1). This trend is expected to continue with a number of ongoing and upcoming space missions (*HST*, *GAIA*, *TESS*, *eROSITA*, *EUCLID*, *WFIRST*, *LISA* etc), funded by international space agencies with budgets significantly larger than those of *SKAO*, *ESO*, or any other ground-based astronomy entities. Within Australia individual scientists are already engaged in a significant number of these space missions including: *HST* (UMelb, ANU, UWA, Swin); *GAIA* (ANU, USQ); *TESS* (UNSW, USQ); *JWST* (Swin., USyd, UWA, UMelb); *eROSITA* (UWA, Curtin); *EUCLID* (UWA, Swin); *WFIRST* (UWA, ANU) and many more. Given this current and future facility landscape, and the metrics from Fig. 1, it is clear that Astronomy from Space represents the long-term future of Astronomy research. In all likelihood, the ground-based radio, optical, and gravity-wave facilities under construction today, are likely to be the last of their generation, as the skies become brighter, more polluted, and contaminated from a crowded and noisy low earth orbit environment.

At the current time Australia has a strong radio lobby in the form of CSIRO and a strong ground-based optical lobby in the form of the AAO and ANU. Through these entities Australia has successfully established robust international representation, with major international ground-based radio, near-IR, and optical facilities (*SKAO*, *ESO*, *GMRT*), with Exec/Board/Council-level engagements. Conversely, we have no formal *science* engagement with NASA, ESA or other external space agencies, nor any capacity by which to engage. Nevertheless, through CSIRO, Australia does perform a critical *service* role by supporting NASA and ESA Deep Space Tracking operations via Tidbinbilla (ACT) and New Norcia. Collectively Tid. and New Norcia are tracking over 40 space missions including several space telescopes including *GAIA* and will shortly be supporting *JWST*, *Euclid*, *WFIRST* and *LISA*.

Current governance structures:

While CSIRO CAS would seem the obvious organisation to manage this engagement, they are conflicted by their substantial *service* contracts to NASA and ESA. In addition, as radio astronomers they lack the expertise and perhaps motivation, to engage outside the radio domain. This may be why, after several decades of engagement, Australia's NASA role remains purely service provision. The revamped AAO currently has insufficient capacity to lead in this area at the present time, and as the pursuit of Astronomy from Space is not clearly mandated in the Decadal plan, AAL has made clear that it is currently unable to act on behalf of the space community. Meanwhile the National Committee for Space and Radio Science (NCSRS) does not include astronomy in its remit. This all leads to an inability for Australian astronomy to engage nationally with the international astronomy space sector.

The advent of the Australian Space Agency (ASA) does provide an opportunity to engage more formally with international agencies at a national level, however it is also clear that the ASA priorities laid down by the Federal government, are understandably focused on jobs and economic growth within Australia, and not growing Australia's Astronomy from Space aspirations. In here lies a significant challenge, as to how to now evolve and expand Australian Astronomy research over the coming years, from a ground-based facility focus, to one which positions ourselves for a future of diminishing ground and expanding space-based facilities. The starting point is the recognition that space is important to the Australian Astronomy community, and its consideration needs to be on par with ground-based radio and optical aspirations.

We are mindful that this transition needs to occur slowly, over a significant period of time, in a manner which does not disrupt our existing radio (*SKA*) and optical (*ESO*, *GMRT*) activities, nor undermine CSIRO's

provision of services to NASA & ESA. Within the mid-term process we are therefore advocating for the recognition of the need to establish an Australia Space Telescope Institute & Data Centre, or similar entity, to start preparing Australia for the inevitable expansion of Astronomy onto space platforms.

An Australian Space Telescope Institute:

The exact role and structure of any ASTI&DC should start with a formal national review of our current and future space engagements, and be driven by the recommendation of those members of the community currently invested in Astronomy from Space. An important issue is whether to include the Australian Planetary Science Community, currently outside NCA's remit and represented by NCSRS. In parallel there is a need to establish a national capacity to store, process and federate space telescope data in a robust and timely fashion - in essence a capacity comparable to that provided by AAO Data Central for optical astronomy, the SKA Regional Centre for radio astronomy, or the Gravity Data Centre for gravity-wave astronomy. In brief we envisage the entity would need to cover the following activities:

- 1) Provide visible points-of-contact to recent, ongoing, and upcoming space missions to maximise Australian access, interactions and research outcomes from ongoing and future space missions.
- 2) Lead and promote discussions around expanding Australia's NASA and ESA Deep Space Tracking roles from *service* provision to a more symbiotic *science* collaboration.
- 3) Provide science support to the Australian Astronomy community to support programs on space platforms, including hosting of local data mirrors, e.g., ESA Cosmos.
- 4) Act as a node connecting research at Universities to the broader space community including expertise in analysis of data from space platforms, e.g., Earth Observation data.
- 5) Establish a dedicated Australian Space Telescope Data Centre for the storage and processing of selected ST data with which Australian scientists are engaged.
- 6) Promote the capacity for Australia to provide time-critical processing of downlinked NASA, ESA and other agency data (e.g., Euclid, WFIRST, LISA rapid alerts) as we enter the LSST transient era.
- 7) Engage with and advise the Australian Space Agency on Astronomy related matters.
- 8) Provide ground-station support to Australian-built space telescopes, in collaboration with major agency or industry partners (e.g., NASA, ESA, GoonHilly, Inmarsat, Swedish Space Corp. etc.)
- 9) Promote internationally Australia's capacity to contribute hardware to major space missions.
- 10) Promote and communicate to the Public Australian Astronomy from Space research.

Recommendation:

The primary objective of this white paper, is to request for the MTR-panel to consider a clear top-level statement in the mid-term review, highlighting the growing importance of Astronomy from Space, and the need and recommendation to establish a national entity, within the next five years, to collate, manage and advance our Astronomy from Space aspirations.

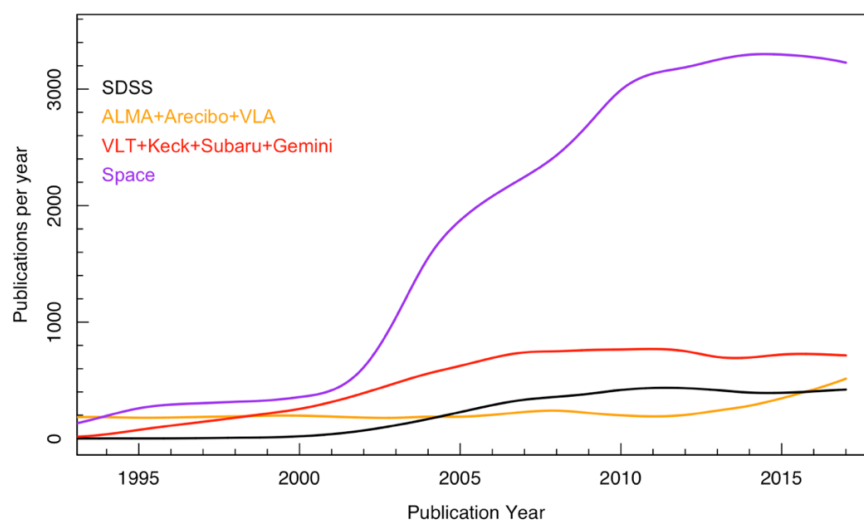


Fig. 1: Publications from combined space, radio, and 8m facilities, over the past two decades. Data obtained from NASA ADS searches on facility names cited in paper abstracts (which typically catches approximately one third of publications).

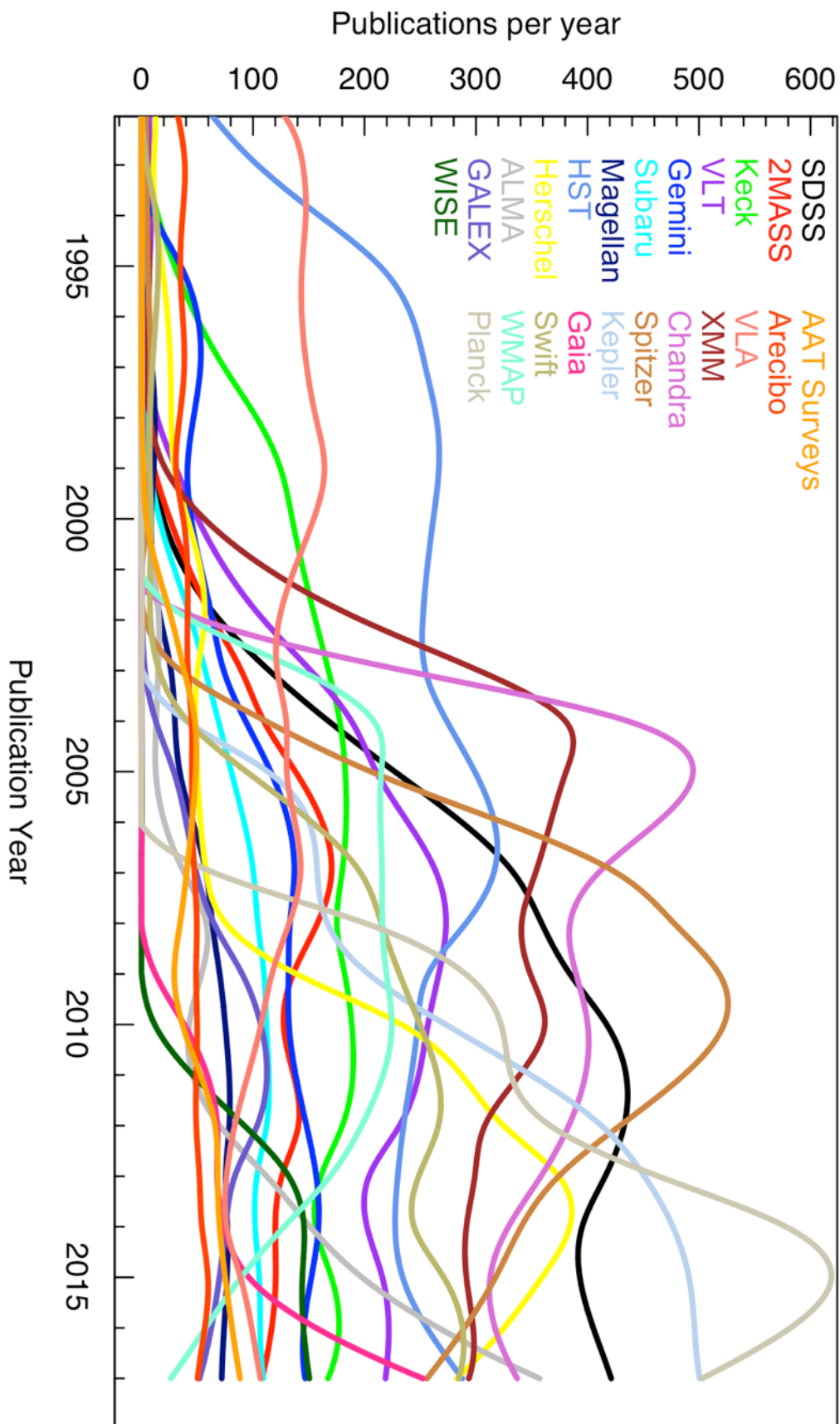


Fig 2: As for figure 1 but showing individual publications on a facility by facility basis, note the rapid rise of ALMA and GAIA representing the latest ground and space-based facilities.