

Australia & Subaru

Subaru Users Meeting
January 2017

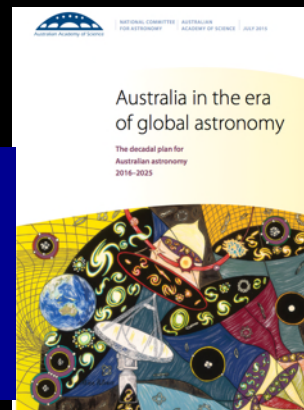
Matthew Colless
RSAA Director, ANU

Warrick Couch
Director, AAO

What Australia seeks...

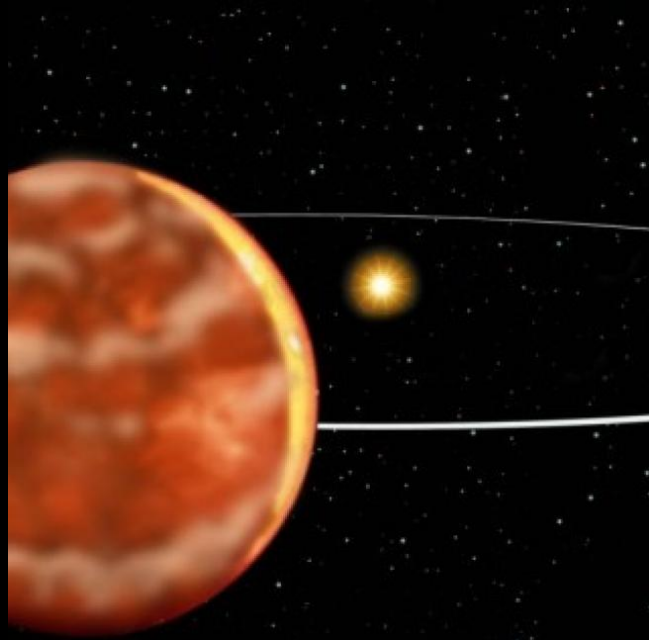
- Guaranteed long-term access to a ~30% share of a world-class 8-metre telescope
- Implement this via a partnership arrangement with involvement at a commensurate level in:
 - observatory governance (via Board or Council)
 - time allocation process (via joint TAC)
 - instrumentation (both strategy & implementation)
 - scientific collaboration opportunities

Partnership in an 8m telescope facility is one of the highest priorities of the current Australian Astronomy Decadal Plan (2016-2025)

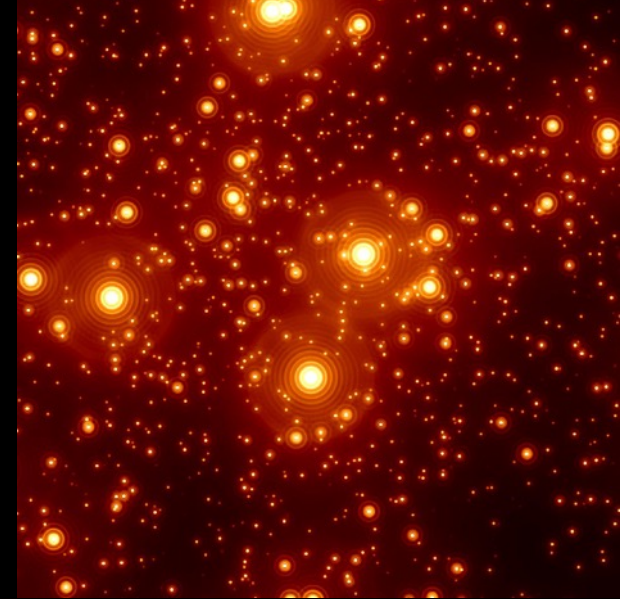


What Australia can offer...

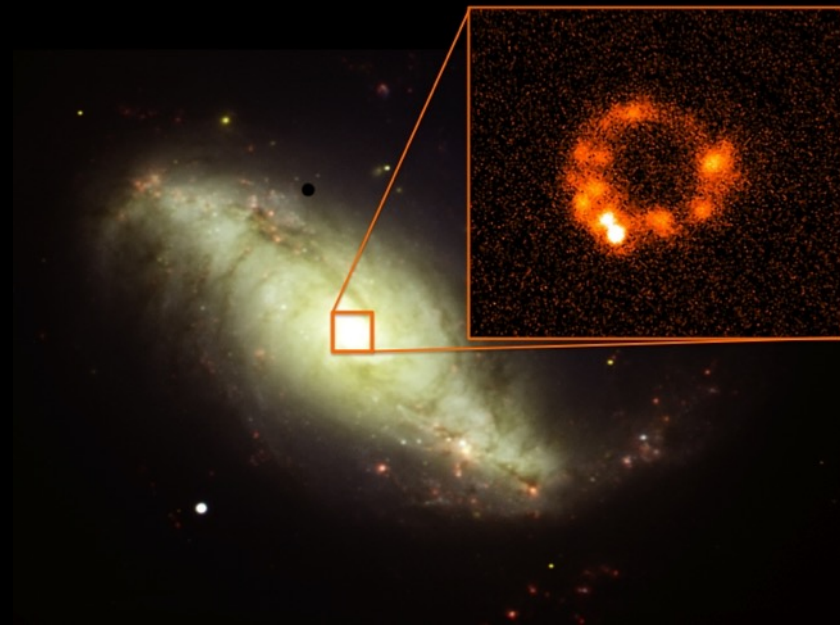
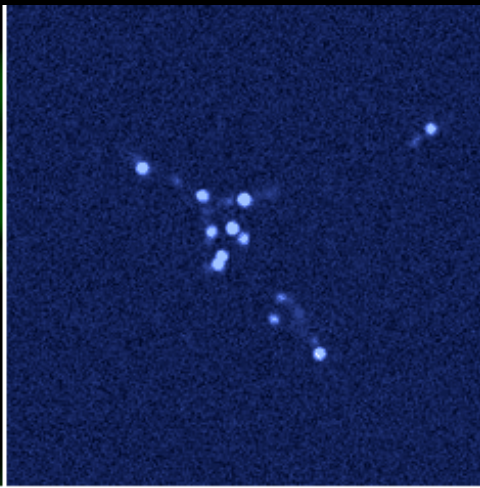
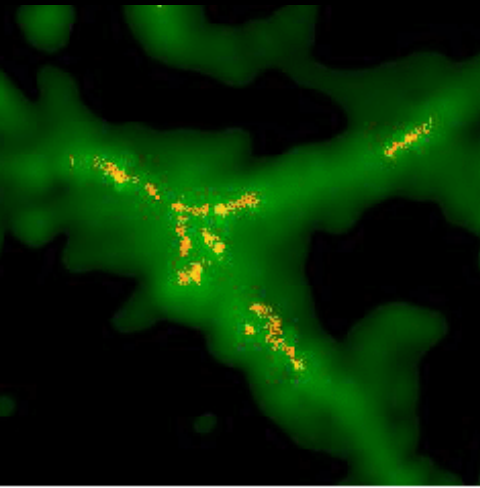
- A strong astronomical research community:
 - >500 researchers at 16 institutions over a wide range of research fields, with particular strength in Optical/IR astronomy
 - a long history of successful international collaborations and partnerships (and in a similar time zone to Japan!)
- Innovative, world-class instrumentation capability:
 - major instrumentation programs at AAO and ANU, with broad and complementary strengths
 - substantial funding capability for instrumentation (currently building major instruments for AAT, Gemini, GMT and others)
- Supportive government and reliable funding:
 - once committed, Australia has fully honoured its long-term funding commitments to international science organisations



Science

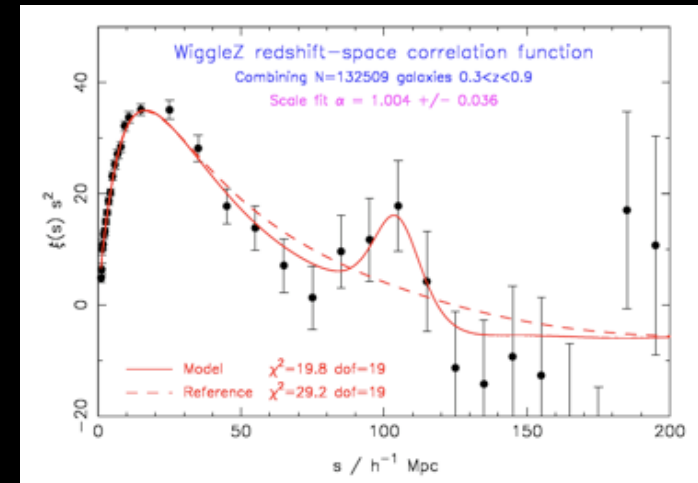


Excellence, Partnership & Collaboration



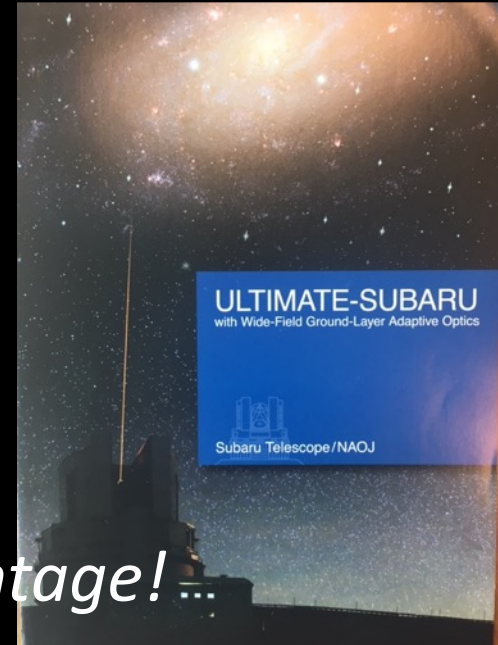
Excellence: having access to the very best instrumentation to do world-class science

- **Hyper-Suprime Cam (HSC)**
 - *Cosmology via weak lensing*
 - *Galaxy evolution and large-scale structure*
 - *Transient science*
 - *Extragalactic globular clusters*
- **Prime-Focus Spectrograph (PFS)**
 - *Cosmology (BAO & $\text{Ly}\alpha$)*
 - *Galaxy evolution*
 - *Galactic archaeology*



Partnership: working together to build world-leading instrumentation for Subaru

- **ULTIMATE**
 - *GLAO, wide-field imaging*
 - *Wide-field IFU spectroscopy*
- **Future instruments that maintain Subaru as forefront facility in ELT era**
 - *Wide-field capability a critical advantage! ...*
- **PRAXIS**
 - *Enhancing NIR-science through complete suppression of OH-line night sky emission*



Collaboration: astronomers from Japan & Australia work together on world-leading research projects

Australia-Japan Science Workshop: AAO, 15 Dec

Bringing together Australian and Japanese astronomers together to identify and discuss research areas of common interest that could be pursued on Subaru

11:10 Current and Future Instruments on the Subaru Telescope (Iwata and/or Minowa)
11:20 Current and Future Instruments on the AAT (Julia Bryant)
11:30 Jeff Cooke (Swinburne) - Fast Transients with HSC
11:40 Masayuki Akiyama (Tohoku) - Wide field spectroscopic follow-up of less-luminous quasars at $z>3$ from HSC-SSP survey
11:50 Discussion (chaired by Taddy Kodama)

12:10 Tadayuki Kodama (NAOJ): SWIMS-18 and GANBA-Subaru as precursor surveys of ULTIMATE-Subaru
12:20 Matt Owers (Macquarie/AAO) - Galaxy Clusters, HSC
12:50 Kenji Bekki - Galaxy transformations at low and high redshifts (ICRAR/UWA)
13:00 Yusei Koyama (Subaru): Unveiling the environmental effects on internal properties of galaxies across cosmic time
13:10 Discussion (chaired by Chris Lidman)

14:30 Yuichi Matsuda (NAOJ): Galaxy formation along the high- z cosmic web
14:40 Emma Ryan-Weber (Swinburne) - $z\sim 6$ galaxies and the IGM
15:10 Ed Taylor (Swinburne) - Weak lensing, IFU
15:20 Kentaro Motohara (Tokyo): Local Starburst Probed by Paschen-alpha Emission Line
15:30 Discussion (chaired by Julia Bryant)
16:50 Masao Hayashi (NAOJ): Emission line galaxies at $z<1.7$ selected with HSC-SSP NB data
16:00 Brent Groves (RSAA) – Galactic star formation from low- to high- z with IFU/ULTIMATE
16:10 Discussion (chair TBC)

16:30 Mike Ireland (RSAA) and Francois Rigault (RSAA) Extreme AO
16:40 Toshihiro Kawaguchi (Sapporo Medical University)
16:50 Discussion, Workshop Summary and Conclusions (chaired by Chris Lidman and Y. Koyama)

Technology

Enhancing, Complementing & Collaborating

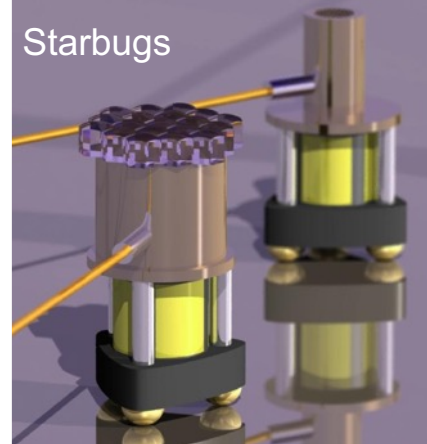
AAO: Mature Technologies

- Tilted spine “Echidna” fibre positioner
- “Starbug” fibre positioner
- Hover-bug positioning
- Fibre hexabundles
- Fibre Bragg grating “OH Suppression”
- Photonic lanterns
- Liquid atmospheric dispersion compensators
- Liquid lenses
- Integrated photonic spectrographs
- Femtosecond-laser-written single-mode reformatters
- Dual microlens array IFUs (KOALA)

Integrated photonic spectrograph



Starbugs



Hexabundle



AAO: Instrument Construction

Robotic fibre positioners

- Pick & place (2dF, 6dF, OzPos)
- Tilted spine “Echidna” (FMOS)
- Starbugs (TAIPAN)

Fibre feeds

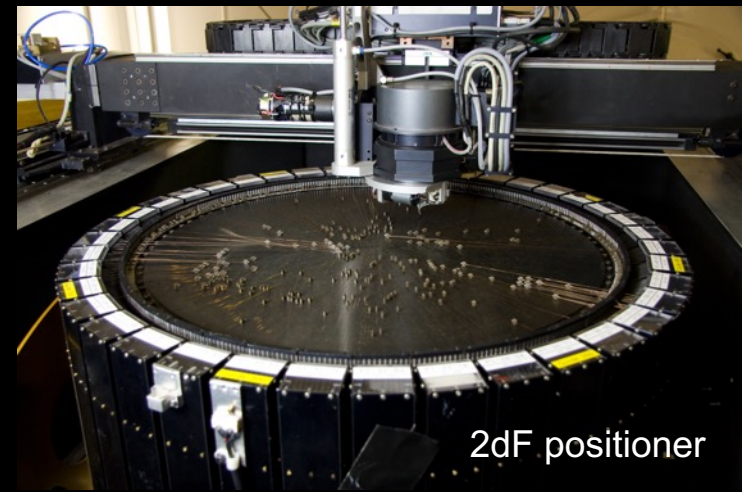
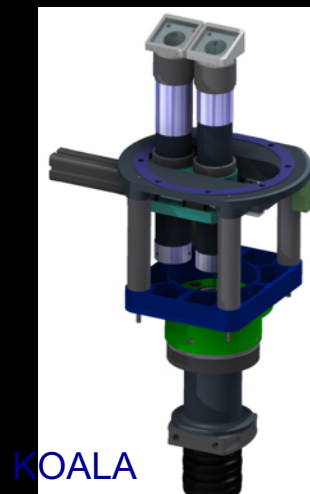
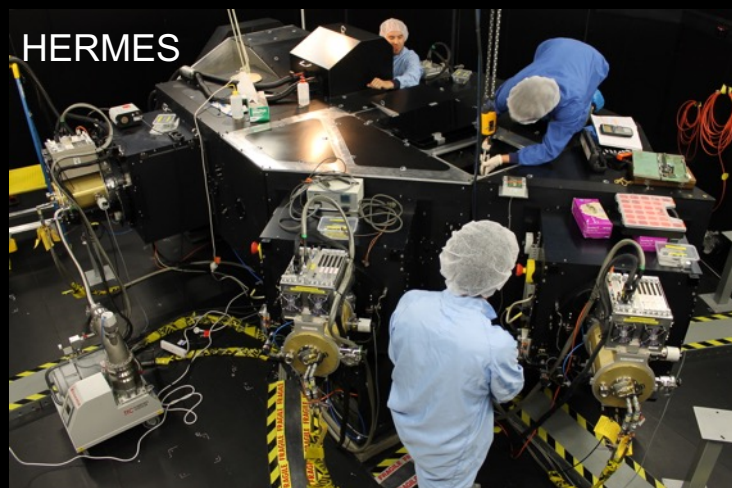
- Single (2dF, 6dF)
- IFUs (Spiral, SAMI, KOALA)
- Image slicers (Cyclops)

Optical/NIR Spectrographs

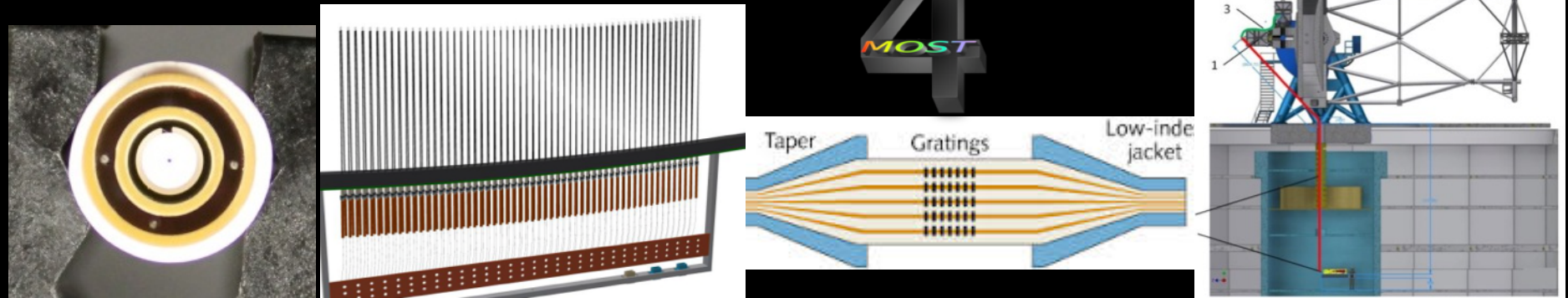
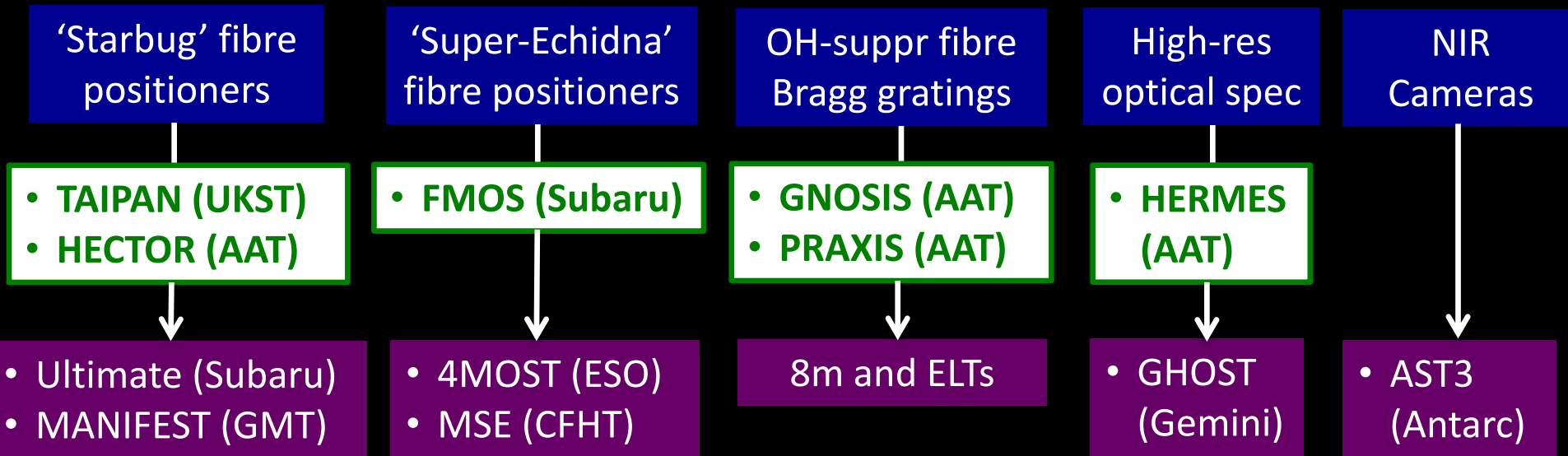
- IRIS2
- AAOmega
- HERMES
- 6dF-spec

Detector controllers

Spec data reduction pipelines



AAO International Telescope Instrumentation Program

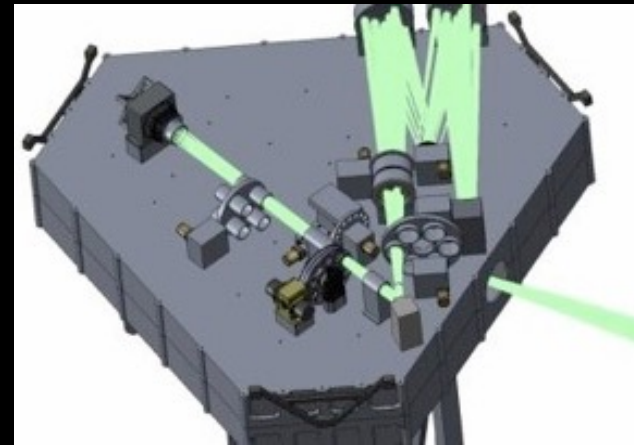


ANU Advanced Instrumentation and Technology Centre



ANU Imagers & Spectrographs

- Gemini Observatory Near-infrared Integral-field Spectrometer (**NIFS**)
- Gemini South Adaptive Optics Imager (**GSAOI**)
- Wide-Field Spectrograph (**WiFeS**) for the ANU 2.3m telescope
- **Skymapper** wide-field optical camera for the ANU SkyMapper telescope
- GMT Integral-Field Spectrograph (**GMTIFS**)
- **Veloce** high-resolution, ultra-stabilised precision velocity spectrograph for the AAT
- With AAO, the Gemini High Resolution Optical Spectrograph (**GHOST**)



ANU Adaptive Optics

- **NGS2:** sensitive tip-tilt wavefront sensor for the GeMS MCAO system on Gemini-South
- **GMT AO system:** Design and development of LGS and LTAO systems for the Giant Magellan Telescope
- **Adaptive Optics Demonstrator (AOD):** development of adaptive optics for space debris tracking
- **Space Debris Laser Tracking:** development of automated laser AO system for tracking space debris
- **Space Environment Research Centre:** over \$50M for collaborative program involving ANU, EOS, Lockheed Martin, Optus, RMIT, NASA Ames, and NICT (Japan)
- **KASI Laser Ranging Telescope:** commercial AO system for laser ranging



Operations

*An area Australia can contribute expertise,
personnel, and additional capabilities*

AAO Operations

3.9m
AAT



+ night assistant
+ *night-time tech support*
+ *support astronomer*

Remote observing (from
Nth Ryde, ANU, UWA)

7 instrument/feed combinations

- AAOmega + 2dF (400 x single fibre)
- AAOmega + KOALA (I/format IFU)
- *AAOmega + SAMI (13 x IFU)*
- HERMES + 2dF (400 x single fibre)
- IRIS2 (NIR imager + MOS)
- UCLES + CYCLOPS2 (hi-res spec)
- UHRF (ultra-hi-res spec)
- + visitor instruments

1.2m
UKST



Remote & semi-
automated observing

(from 2017)

- 150 x “Starbug” positioner feeding a new optimised low-med resolu spectrograph

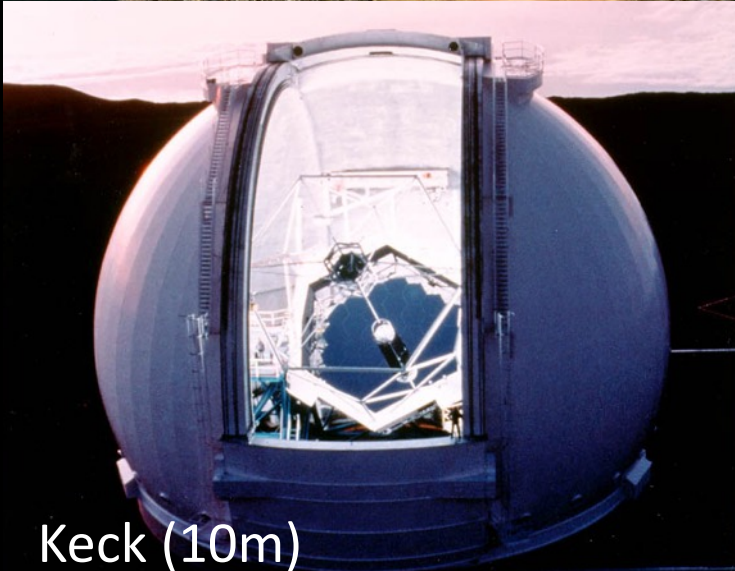
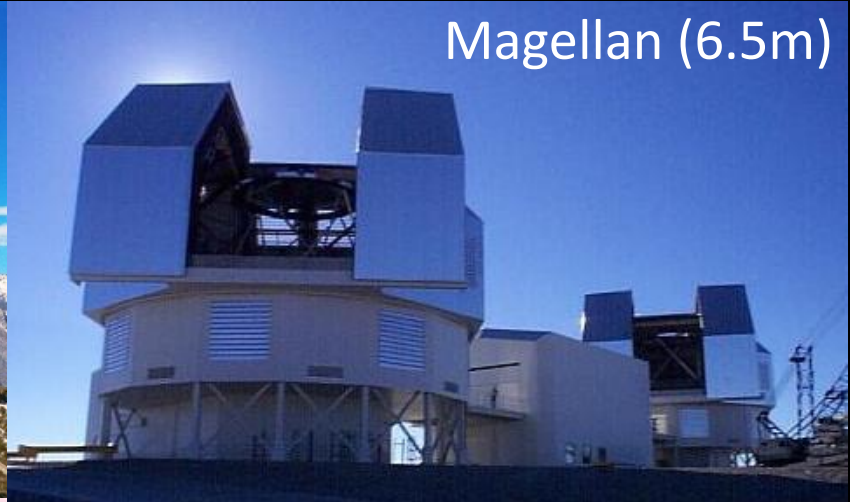
- A total of **23 FTE** required to operate, support and maintain the two telescopes
- Total cost AAT (2016): A\$3.5M p.a.
- Total cost UKST (2016): A\$170K p.a. (USER PAYS)

The international telescopes the AAO supports

Gemini (8m)



Magellan (6.5m)



Keck (10m)

Off-shore telescopes
in Chile & Hawaii

Services provided by the AAO's International Telescope Support Office

- **Expert astronomical support** for common-user instruments, covering pre-observation, observation, and post-observation stages
- **Travel support** for necessary 'classical' observing and student training purposes
- Operation and support of **peer-review time assignment process**, including detailed technical evaluation of all proposals
- **Provision of training** in the use 8m instrumentation through workshops, cookbooks, tutorials, and student intern program
- Facilitation of **Australian participation in large international-scale projects** (through, for example, the Gemini Large & Long Programs)

Thank You!