New Zealand's Contributions to the SKA

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Past, Present and Future Mega-Science Projects

Manhattan Project

Hubble Space Telescope

Human Genome Project

International Space Station (ISS)

Large Hadron Collider (LHC)

Laser Interferometer Gravitational Wave Detector (LIGO)

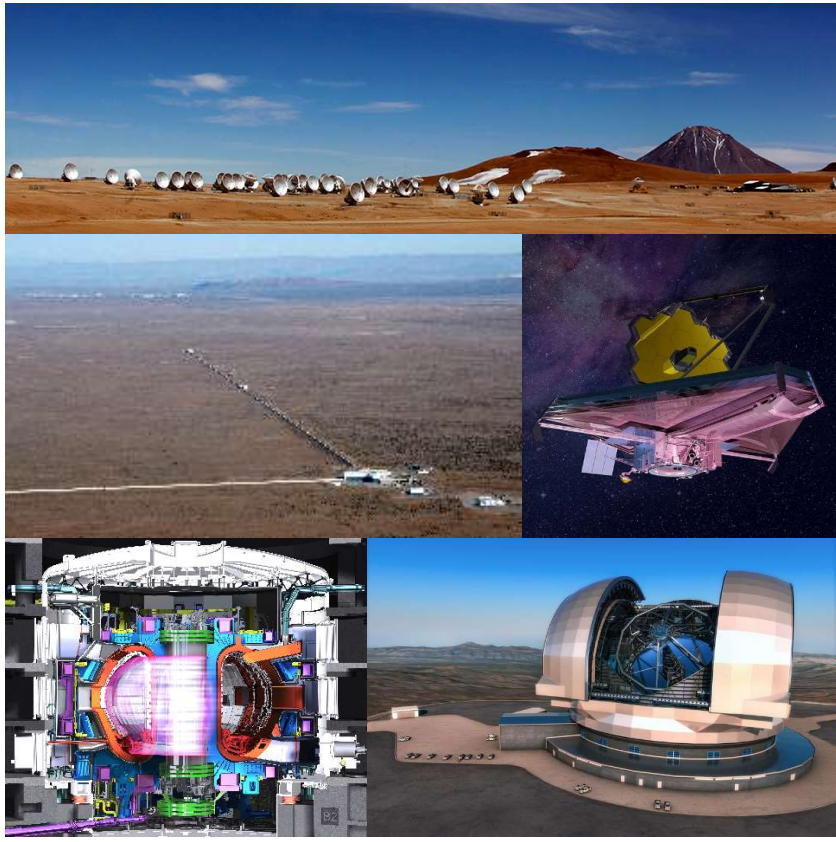
Atacama Large Millimeter Array (ALMA)

James Webb Space Telescope (JWST)

International Thermonuclear Experimental Reactor (ITER)

Extremely Large Telescope (ELT) and Thirty Meter Telescope

Square Kilometre Array (SKA)



The Square Kilometre Array Project

Will be World's largest and most powerful radio telescope with 50 year lifetime

Infrastructure distributed around world:

- Low frequency array in Murchison (Western Australia)
- Mid frequency array in Karoo (South Africa) and will grow to neighbouring countries
- World headquarters in Jodrell near Manchester (UK)

Cost €674M for SKA phase 1 construction, estimated €2-6B+ for SKA phase 2

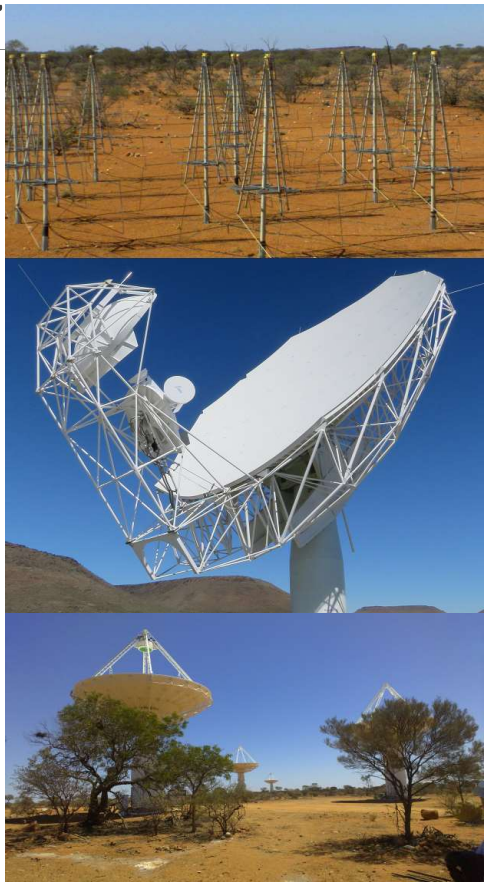
- A lot of real construction has already happened

Approximately 35-40% budget for computing hardware and software

Preconstruction design for SKA1 commenced Nov 2013

SKA phase 1 design finishing 2018/2019

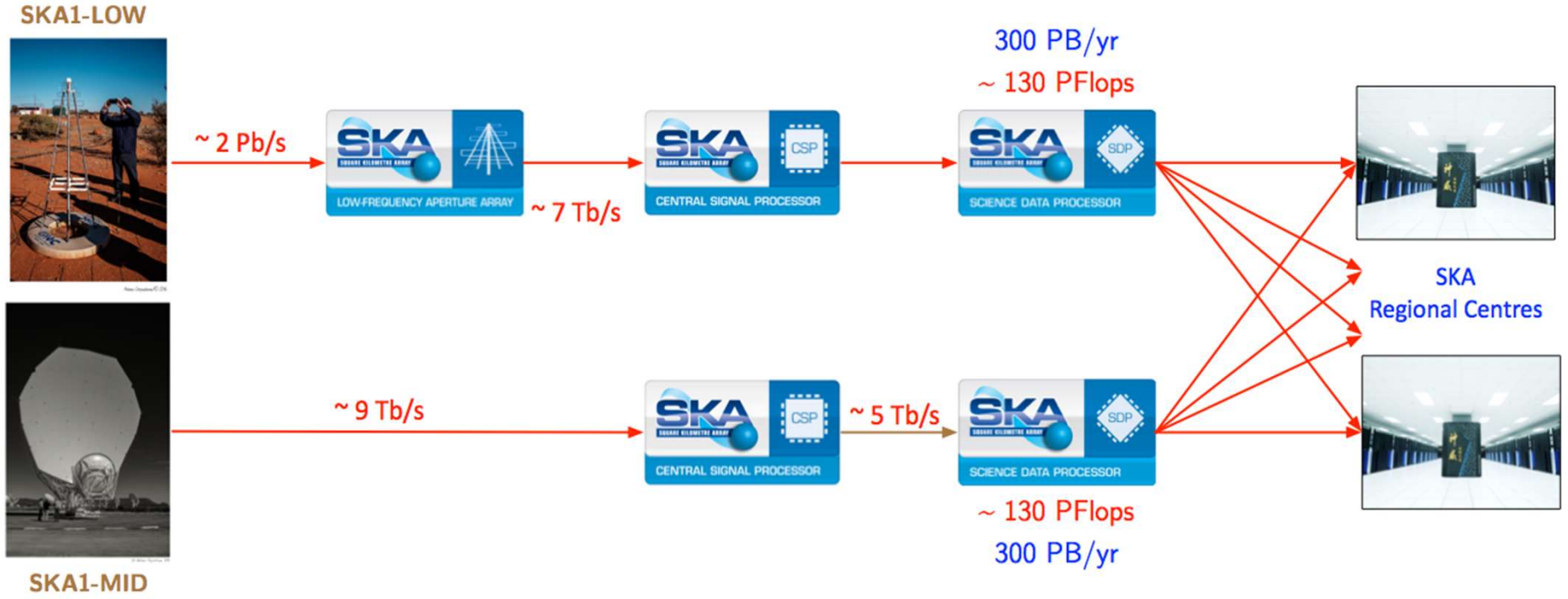
NZ was a founding full member of SKA Organisation 2012, involved 12+ years



The Square Kilometre Array


The history of the Universe
Cosmic Dawn
(First Stars and Galaxies)
Testing General Relativity
(Strong Regime, Gravitational Waves)
Galaxy Evolution
(Normal Galaxies z~2-3)
Cradle of Life
(Planets, Molecules, SETI)
Cosmology
(Dark Energy, Large Scale Structure)
Cosmic Magnetism
(Origin, Evolution)
Exploration of the Unknown
Broadest range of science of any facility, worldwide

SKA1 Data Rates



SKA1 Data Volumes in Perspective

SKA Firsts for NZ

First mega-science project for NZ at national level

- Founding member country and pays proportionally to NZ size
- Substantial lead roles well above NZ size
- Fostering international relationships
- Foot in door for future big science and engineering projects

Largest NZ involvement in international ICT collaboration

- Gaining experience in world's largest big data project
- Invaluable capability building
- NZ expertise on world stage

Will be longest term academic-industry collaboration

- Building enduring R&D two-way relationships outside SKA
- Accelerating research, IP generation and commercialization

SKA Partnerships

SKA SQUARE KILOMETRE ARRAY New Zealand

Domestic

AUT AUCKLAND UNIVERSITY OF TECHNOLOGY TE WĀNANGA ARONUI O TAMAKI MAKAU RAU

catalyst

COMPUCON

Massey University

NYRIAD

Open Parallel Innovation Partners

REANNZ

THE UNIVERSITY OF AUCKLAND

True Group

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI VICTORIA UNIVERSITY OF WELLINGTON

International

12 member countries, 100 organisations

CSIRO

SWINBURNE UNIVERSITY OF TECHNOLOGY

ICRAR International Centre for Radio Astronomy Research

NRC·CNRC From Discovery to Innovation / De la découverte à l'innovation

MDA

UNIVERSITY OF CAMBRIDGE

UNIVERSITY OF OXFORD

MANCHESTER 1824 The University of Manchester

ASTRON

NZ's Involvement in SKA

On site computing with tight power restrictions:

- Collaboration with CSIRO/ASTRON on the Low Correlator
- Collaboration with NRC Canada on the Mid Correlator
- Contributing to the Pulsar Search software led by Manchester
- Collaboration with Swinburne University on Pulsar Timing software

Back end supercomputing:

- Contributing to compute platform design and benchmarking
- Investigating operating system requirements for Science Data Processor
- Leading some middleware layers for the Science Data Processor (eg OpenStack, Kubernetes)
- Advancing algorithms and HPC software for compute-intensive Imaging Pipeline

Wider SKA Ecosystem

Besides the Central Signal Processor and Science Data Processor the SKA will have Regional Centres

- HPC centres distributed around the world where the “science” will be done by astronomers

SKA giving foot in door for future mega-Science projects

- ngVLA default correlator based on Canadian-NZ frequency slicing design

SKA Big Data cooperation agreement with CERN in July 2017

- Framework for collaborative projects that addresses joint challenges in approaching Exascale computing and data storage

SKA joined European Open Science Cloud Project in November 2018

- Aims to facilitate universal access to scientific data through a single online platform, allowing both professional researchers and the general public to re-use data produced by other scientists

SKA Current Status

Critical Design Reviews are completing
- NZ key member of Central Signal Processor consortium that unconditionally passed CDR (Oct 2018)
- NZ also member of Science Data Processor consortium that conditionally passed CDR (Jan 2019)

Balancing science impact versus schedule versus budget
- Key science objectives largely unchanged, about $120M over initial estimates, 1.5-2 year schedule slippage

SKA moving from phase 1 preconstruction to bridging in lead up to construction
- NZ now signed up for bridging (Feb 2019)

SKA membership is growing
- More countries joining the SKA eg France, Spain in 2018
- Currently 12 member countries (40% world's population and 35% world's GDP)
- Others signalling intention to join eg Portugal (not US)

Intergovernmental Organisation treaty will be signed by founding members in March 2019
- IGO will gradually take control of project and determine its course over next 50 years

SKA Phase 1 construction will be mostly open tenders amongst members
- Some key risk areas may be directly awarded by IGO, some contributed in-kind by countries
- Minimum 70% fair work return amongst full member countries

SKA2

Phase 2 start mid-2020s

Budget guestimate at least €2B+

Approx. 2000 dishes across 3500km of Southern Africa

Major expansion of SKA1-Low across Western Australia

10 times more data, 100 times greater compute requirements

Additional types of receivers

Questions?

Thank You

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