

Introduction



Almost twenty years ago, scientists had a ↗ vision of a telescope so large and so powerful that it could answer some of the ↗ most fundamental questions in astronomy and physics

From that vision, the SKA project was born.

The SKA will be the world's most impressive telescope – capable of looking back to the dawn of time to observe the first stars and the most distant galaxies.

But the SKA will be more than just a huge leap forward for astronomy.

The unprecedented scale and ambition of the SKA will give it the power to deliver huge benefits ***beyond astronomy***. These include:

- ↗ supporting education and science awareness around the world;
- ↗ developing life-changing information and communication technologies;
- ↗ driving further development of 21st century renewable energy technologies.

Achieving these benefits will depend ↗ on building the best possible SKA on the best possible site.

The concept of a site that is “good enough” for the SKA is simply not good enough when one is aiming to push the boundaries of human knowledge as far as possible.

↗ We only have one opportunity to get this right.

Only the Australian and New Zealand site offers outstanding ↗ radio-quietness AND the capacity to deliver the most powerful, ↗ flexible and affordable configuration for the SKA.

Together these ↵ elements will support ‘Maximum Discovery’ - and ensure the full vision of the SKA is realised.

Optimal radio quiet

With the SKA’s unprecedented sensitivity comes an equally unprecedented need for radio quietness.

↵ Radio quietness matters.

For the world’s largest astronomical project, it is no longer acceptable to simply throw away significant amounts of RFI-contaminated data. At the cosmological distances and sensitivities to which the SKA will probe, radio frequency interference will absolutely prevent key science from being successfully carried out.

Low population

The site for the SKA must be as close to perfectly radio quiet as possible ↵ and due to an extremely low population density, the Australian-New Zealand site is unmatched in this respect. Moreover, Australia’s proposed core site for the SKA, the ↵ Murchison Radioastronomy Observatory – or MRO – is located on one of the most sparsely populated regions on the planet.

Population is the greatest enemy of radio quietness.

With population comes towns, roads, railways, farm equipment, home electrical devices, radios and mobile phones. They all make radio noise.

↵ The Shire of Murchison has an area of 50,000 square kilometres (an area just slightly larger than the Netherlands) yet only 110 inhabitants. A population density of just over ↵ two thousandths of one person per square kilometre.

↵ This low population provides the most effective protection against radio noise, both now and, most importantly, into the future.

The MRO is the home of the ↗ Australian SKA Pathfinder (ASKAP), the ↗ Murchison Widefield Array and other international radio-astronomy experiments including CORE and EDGES.

↗ Recent radio spectra taken by the US EDGES experiment at the MRO confirms the unmatched quality of the site at ↗ radio frequencies between 80Megahertz and 200 Megahertz; most notably in the FM band.

Radio-quietness protection

↗ Mining development around the MRO is limited by areas excluded from exploration (in green) and by an ↗ extensive Mineral Resource Management Area defined by the State Government of Western Australia (in red).

The MRO site is also covered by ↗ Australian Government legislation which protects it from licensed transmissions at varying levels up to 260 km from the site.

The Australian Government is absolutely committed to ensuring a radio quiet site for the SKA.

Moreover, a radio quiet site that can be protected without any significant negative impact on socio-economic development into the future.

SKA site masks

↗ The SKA Program Development Office has developed parameters to optimise the location of every dish in the SKA; ensuring the discovery potential of the telescope is not compromised.

↗ These parameters excise areas that cannot be used for siting antennas – either because of radio frequency interference, or geophysical constraints like slope or water.

The exacting requirements of the SKA mean that even a superb radio quiet site
↪ like ours has areas that will be masked out.

Within a radius of 180km ↪ from our core site, the following areas represent the places where we cannot place an array station because of:

- ↪ geographical constraints such as slope or water
- ↪ farm homesteads
- ↪ towns and mines
- ↪ roads, rail and power

As you can see, the remaining non-masked areas show there is more than enough flexibility to configure the SKA in the Australian landscape.

↪ Each of these dots represents an array station that is indicatively placed within one of the most radio quiet areas in the world.

↪ The masking map demonstrates that the SKA is **perfectly** configurable in Australia, even to its most exacting requirements.

Compromise on these requirements and you compromise on the science.

Optimal configuration

↪ Existing and planned infrastructure in both Australia and New Zealand makes the SKA both optimally configurable and affordable.

Most of the SKA costs will be globally determined. ↪ These include the cost of highly skilled labour, technical personnel, and globally sourced components.

Global prices make costs comparable between sites - but our existing continental-scale infrastructure provides Australia and New Zealand with an important advantage.

↪ This infrastructure will provide significant savings for the project and will make the SKA powerful and achievable at any scale.

Fibre Optic Infrastructure

↪ A major cost for the SKA will be the cost of data transport. In Western Australia, the Australian Government and the CSIRO are building an optic fibre link capable of supporting SKA data rates between the ↪ Australian core site and Perth by mid 2011.

HPC infrastructure

This broadband link will feed into the ↪ 80 million dollar Pawsey Centre for SKA Science, Australia's Peta-scale high performance computing facility in Perth, due to be constructed by 2012.

This facility will provide a high performance computer which will rank as one of the top 20 super computers in the world. It will be the focal point for developing the capability required for the Exa-scale challenge of the SKA.

Renewable Energy Infrastructure

↪ Last week, the Australian Prime Minister announced a further 47 million dollar investment in a massive sustainable energy program for both the ↪ Pawsey Centre and the ↪ MRO. Investment in geo-thermal and solar-thermal power, innovative energy storage solutions and energy efficient buildings reinforces the Australian government's commitment to a building an affordable and sustainable SKA.

↪ Looking beyond Western Australia, Australia has an existing fibre optic network running ↪ east/west and north/south across the continent.

The Australian Government has committed to upgrading this already extensive broadband network through a 43 billion dollar (30 billion Euro) initiative known as the National Broadband Network.

Australia and New Zealand also have an existing fibre optic cable ↪ linking them together and the ↪ KAREN research network runs through New Zealand.

Existing Infrastructure over continental baselines

↪ Between just two countries, Australia and New Zealand can provide an SKA configuration with a long ↪ 5500km east-west baseline. This is an ideal configuration which will maximise the discovery potential of the SKA.

We also have extensive ↪ existing astronomy infrastructure at ↪ Parkes, ↪ Narrabri, ↪ Tidbinbilla, ↪ Hobart, ↪ Ceduna and ↪ Warkworth in New Zealand.

Four weeks ago, telescopes at five of these sites, together with the first ↪ ASKAP antenna at the Murchison Radioastronomy Observatory were used to generate ↪ this high resolution image of the radio jet at the centre of *Centaurus A*; the most detailed image of this object at 1.4GigaHertz. This new VLBI capability is now available to scientists all over the world.

Global partnerships: Astronomy

↪ Australia and New Zealand's international connectivity enables the sharing of data around the world as part of a globally connected project.

Effective global partnerships will clearly be critical to the effective development and operation of the SKA.

Australia and New Zealand have a long history of global partnership. In astronomy, education and industry.

In the last 6 month semester at the CSIRO Australia Telescope National Facility, there were 695 individual users of the facility; almost ↪ 80% from outside Australia, drawn from 25 countries and 154 different institutions.

Australia has also developed innovative radio astronomy technology ↪ that is now in use around the world, on Arecibo, at Jodrell Bank, at the Urumqi and Shanghai radio telescopes in China, on the German Effelberg telescope and for the new radio telescope in Sardinia.

↵ Australia is a full and active partner in all work packages associated with the SKA Preparatory Study.

Global partnerships: Education

In education, Australia's Scitech and Questacon are heavily involved in ↵ international science and technology centre networks including ECSITE in Europe and ASPAC in the Asia Pacific region.

Australia and New Zealand are well placed to contribute to a global effort to extend the educational benefits of the SKA to all countries.

Global partnerships: Industry

Our global partnership also extends to our engagement with industry. ↵ Through entities such as the Australian and New Zealand SKA Industry consortia, we are leading the way in engaging with industry to maximise the potential of the SKA; drawing on industry contributions from around the world. ↵

Maximum Discovery

The radio quietness and optimal configuration offered by the Australian-New Zealand site will provide the basis for the most powerful SKA possible.

The SKA will help unlock some of the biggest mysteries of the universe – as well as make discoveries that we haven't even begun to imagine.

Many of these discoveries will not be possible with a sub-optimal SKA or a sub-optimal site.

The world cannot afford to spend in excess of 1.5 billion euros building an SKA that cannot deliver on the science that it sets out to achieve.

Make no mistake. A compromised – or even an unduly conservative – vision of the SKA, will not be interesting to the world's leading scientists.

Just as importantly, such a vision won't be interesting to the world's science funding agencies or governments.

Benchmark site choice

↪ The European Southern Observatory has set the benchmark in the choice of a Chilean site for the European Extremely Large Telescope. A choice in which the overriding driver was the scientific quality of the site.

Matching ESO's lead, we *can* keep the SKA vision.

↪ **Beyond astronomy**

By maximising the scientific discovery potential of the SKA, we will also maximise the flow-on benefits.

↪ Through big discoveries, we can educate and inspire the world.

↪ It will motivate students in every country of the world to engage with not only astronomy and physics, but ↪ computing, engineering, mathematics, energy... the list goes on.

Realising the full vision of the SKA will help produce solutions in other areas that will benefit humanity for generations.

↪ As the only mega-science program aspiring to operate 100% with renewable power, SKA will help drive green energy solutions and could provide the answer to one of this era's biggest global challenges.

The more aspirational the science, the more significant the technological breakthroughs are likely to be.

↪ Every day nearly a billion people use the wireless network technology (WiFi) that developed as a spin-off from radio astronomy's efforts to hear the faint radio whispers of exploding black holes back in the 1970's.

Will the full SKA inspire similar paradigm shifting technologies? Yes. You can guarantee it!

Conclusion

↪ In concluding -Today is all about exploring the many benefits that the SKA will bring to the world.

The full benefits will **only** be achieved through building the best possible SKA on the best possible site – by putting 'Maximum Discovery' first.

↪ There will not be another SKA in our lifetime. We must make the right decisions.

Together, let's realise MAXIMUM DISCOVERY.