



## A model for the first SKA1 Key Science Projects

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June 2015

### Introduction

The SKA Observatory is intended to enable world-leading scientific programmes. These programmes will typically require large amounts of observing time combined with a team of scientists and other resources in *Key Science Projects*. The observatory is being optimised to conduct these programmes but it is imperative that the teams obtain sufficient resources to see them through, and important that observatory oversight accompany the allocation of large blocks of observing time. In parallel, the observatory will also accommodate PI-driven programmes that are typically shorter and less resource-intensive.

The conduct of Key Science Projects will be consistent with the access principles already agreed (SKA-BD-13-06). This paper outlines a model for KSPs for the first five years of full SKA1 operations, following the period of deployment ramp up and commissioning of the telescope resources.

### Purpose and Definition of a Key Science Project

Key Science Projects (KSPs) are central to the concept of the SKA Observatory. KSPs will fulfil several purposes:

- Allow a coordinated approach to ensure that key science objectives are addressed efficiently and effectively
- Facilitate the delivery of derived data products (catalogues etc) as resources back to the wider scientific community
- Facilitate the sharing of knowledge and expertise among the SKA Members through extensive scientific and technical collaboration
- Provide a mechanism for ongoing oversight of observing programs that consume large observatory resources (principally observing time).

It is important to stress that the KSPs should be viewed as large, but otherwise normal proposals for observing time to address very specific scientific objectives. They do not represent a special long-term status to entire categories of research.

The initial KSPs will be observing programmes that satisfy at least the first two of the following criteria:

- Substantially address the key science objectives identified for the SKA
- Require large observing time allocations (commonly > 1000 hrs) over a period longer than one year but no more than five years<sup>1</sup>
- Require substantial dedicated or customised observatory resources

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<sup>1</sup> Large projects proposed for a single observing cycle are not intrinsically KSPs unless they meet one of the other criteria.



In refining the science priority areas in the lead up to SKA1 science, the observatory will facilitate the establishment of KSPs, but in a way so as not to limit the science areas in which KSPs may be established.

### **Time Allocation**

At the beginning of full SKA1 scientific operations, it is anticipated that of order 50 – 70% of observing resources overall will be devoted to KSPs. This proportion may vary with each SKA Telescope according to proposal pressure and the needs of the key science objectives. It is foreseen that the KSP program for the first five years would be allocated as one coordinated package. The allocation of observing time to KSPs will be based on the agreed access principles. Subsequent to the first five-year KSP allocation, new KSP proposal solicitations might occur every two to three years.

Even at the beginning of full SKA1 operations a significant fraction of time will be retained for regular (non-KSP) or “PI” proposals. This will accommodate new scientific ideas and approaches, including those coming from scientists outside the SKA member states (to the extent defined in the principles of access), and provide ongoing opportunities for scientists that may not be involved in KSPs but will have reduced or no access to member countries’ national facilities once funding is redirected to the SKA.

### **KSP Selection and Team Membership**

A *notional* list of KSPs has emerged from the SKA user community via the SKA1 Science Prioritisation process [SKA-TEL-SKO-0000122-SCI-REQ-RE-01-SKA1SciencePrioritiesOutcome.pdf](#) This provides a representative package of scientific deliverables that are judged to have the highest scientific impact while being consistent with the projected telescope performance and the available observing time. The notional KSPs will be kept scientifically current: they will evolve in line with scientific knowledge and projected or measured telescope performance.

Prospective KSP teams will propose specific projects against the notional KSPs. The proposals will be reviewed using the following criteria:

- Scientific merit
- Technical feasibility
- Plans and capabilities for data analysis
- Publication and derived data product release arrangements
- Collaboration policies and management arrangements.

The observatory will support the review, which will be undertaken by a panel with broad scientific expertise representing the member states.

In selecting the projects and teams, PI and team membership positions will be balanced among the member states in accordance with members’ contributions to the observatory capital and operating costs. Membership of the teams by scientists from non-member states would be limited to non-management roles with clearly articulated benefit to the team, and to an overall fraction of order 10%, or as defined in the access policy. It is important to note that both member and non-member balance would be evaluated globally across the entire 5-year package of all allocated KSPs and not enforced on a KSP by KSP basis.

It may be more efficient to conduct the selection process in two stages, with letters of intent followed by full proposals. The observatory would use the letters of intent to ensure an



appropriate balance of members in the proposal pool, and to suggest the formation and/or merger of teams. In certain cases, pilot projects may be required to demonstrate feasibility of proposed techniques.

Prospective KSP teams will outline team membership rules such as publication policies as part of their proposals. The observatory will offer template rules and policies that teams may use to get started. The final team rules and policies will be subject to approval by the observatory, including if changes are needed during conduct of the project.

## Resourcing

KSP teams could propose for and receive dedicated observatory resources such as customised analysis pipelines. However, these resources will be limited and generally KSP teams will be expected to bring significant resources themselves, which could include contributions to the cost of customisation not already provided for in the SKA design.

## Data Rights

As with all SKA data, the Observatory will retain the *General* data rights for all observations, granting certain *Limited* data rights to users that are project-specific and exclusive only for a limited time (the proprietary period). The standard archived data products of the SKA Observatory would become publically available at the end of this proprietary period. The trend with large scientific instruments is for the proprietary period to be short or zero, and for the SKA, KSP teams would normally be required to comply with a release schedule for their value-added data products following collaborative post-processing and/or quality assurance on a timescale of one year from the date of observation. If other proprietary periods and product release schedules are deemed necessary for a project, then they must be argued for and approved in assessment of the KSP proposal.

*Limited* data rights may also be granted for commensal programs that were organised prior to, with, or even after the original proposals. The KSP teams will have the right to use data for the purposes of their proposed projects, however the observatory will retain the right to allow, following consultation with KSP teams, simultaneous use of the data for other distinct purposes, including by different KSP teams.<sup>2</sup> Serendipitous discoveries, those that are not covered by the specific objectives of any active proposal, could be published by the team that first makes those discoveries.

## Ongoing Review

KSP teams would be subject to regular review in conjunction with the allocation of additional observing time in each cycle. Satisfactory progress against the project plan would be required; in particular including timely public release of agreed data products would be a condition of further allocation of observing time. KSPs would last up to 5 years. A new proposal would be required for time extensions or materially increased observing time requests.

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<sup>2</sup> The authors note that this proposed arrangement might not be universally loved by scientists in the then extant KSPs, but propose it nevertheless to allow the broadest scientific impact from the data.



## **Discussion**

The model proposed in this paper provides a guaranteed return on investment for member states in the KSP leadership and membership with the goal of facilitating broad participation in the KSPs, and the sharing of expertise and knowledge. Over time the process should be reviewed to see if active adjustment of time allocations is still necessary or if passive monitoring is sufficient to establish that a balanced return on investment is being delivered. A fully open competition should lead to the highest scientific impact in the long term. The change may take the form of a decrease in the proportion of time devoted to KSPs coordinated by the observatory as described above.