



SKA CSP Consortium 3rd Technical Interchange Meeting

Place and date:

Villa il Gioiello, Arcetri, Florence, Italy

2014 July 7th-11th

Chairmen:

David Stevens MDA, Canada

Gianni Comoretto INAF, Italy

LOC:

Carlo Baffa, INAF, Italy

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Abstract. The meeting was held from 7-11 July 2014 at Villa il Gioiello in Florence, Italy.

The purpose of this meeting was to provide a common platform for discussion among the components of the SKA CSP consortium to review the progress of the project to date, analyse technical solutions and issues and establish the future plan for each activity.

Keywords. Radio Astronomy, Giant Telescopes, SKA, pulsars

The Square Kilometre Array (SKA) is a next-generation radio telescope which will constitute a vast science facility. SKA is being designed and built by a global consortium, headquartered in the UK. The consortium currently has 11 member countries but is seeking additional members and contributions.

The SKA Observatory will have two sites: in Australia and South Africa, and will build on the two precursor telescopes, ASKAP and MeerKAT, currently under construction on the two sites. The SKA is being designed as a physics understanding machine for the future and will address scientific questions such as the nature of gravity, the origins of the universe and the origins of life.

The SKA is an authentically vast-scale project and will be the largest radio telescope ever built. It will have two phases: a smaller-scale first phase, SKA1 and the final SKA2. SKA1 will consist of three networks of antennas:

- Low array, 1024 groups of 256 small antennas in phase 1, about ten times more in phase 2.
- Survey array, 96 medium-size dish antennas in both phases
- Mid frequency aperture array, groups of planar array antennas, to be implemented in phase 2
- Dish array, 256 large-dish telescopes in phase 1, about ten times more in phase 2.

The signals from these antennas will be combined in separate correlators to form wide-field images of the sky. Signals from the dish telescopes will be used to perform precise timing of known pulsars and to search for new ones. These five main instruments will be maintained in both phases, but they will be scaled up as necessary:

- Low frequency array correlator
- Mid (dish) frequency array correlator and pulsar beam-former
- Pulsar search machine
- Pulsar timing machine
- Survey array correlator

The SKA is now in the detailed design phase. Funding exceeding €120M has been committed by the partner nations to deliver that design. The design will be complete by the end of 2016 and, assuming construction funding is secured, the procurement process will begin in 2017 and construction in early 2018. The SKA will deliver early science by 2020.

To get an idea of the challenge SKA people are addressing, we will describe one of the main instruments: the pulsar search machine. One of the key scientific projects of the SKA radio telescope is an extensive survey for pulsars both in isolated and in binary systems. The data rate of the pulsar search engine is expected to reach 0.6TeraSamples/sec. For the purpose of extracting hidden pulses from these streams, complex search strategy is required to permit the exploration of a three-dimensional parameter space. Such a search, to be performed in real time, requires approximately 10PetaFlops¹ of computing power. This problem can be appropriately addressed by a massively parallel computing engine, but the dimensions of SKA bring this problem to a new level of complexity. An up-to-date study shows that this operation would require a machine which, built today, would rank among the top 10 most powerful computers in the world.

In order to simplify the management, the SKA consortium has commissioned the development of the main components of the telescope from other similar consortia. The largest of these (SKA-SDP) is in charge of developing the science data portion and the data collection and analysis. Another consortium is currently developing the central signal processor (SKA-CSP), the instrument that receives the

¹ One PetaFlops is 10¹⁵ floating point operations per second



Figure 1. *Left Panel:* an artist's view of the core of the Mid Array antenna complex. The streets portrayed give an idea of the overall dimensions. Each antenna will have an offset Gregorian design with a height of 15 metres and a width of 12 metres. *Right panel:* a proposed large-scale antenna distribution in Africa.

signals from all the individual antennas and combines them and converts them into the information needed by the SDP.

This task is complex and difficult and has been split into a number of different sub-tasks, each assigned to a group made up of numerous scientists and technologists. To synchronize the efforts and to share the new ideas and solutions developed, the SKA-CSP consortium has scheduled three technical interchange meetings. The last one, chronologically close to the delivery of the extensive documentation required for the Preliminary Design review, was held in Firenze, in the historic context of *Villa il Gioiello*.

Hosted in one of the places where modern astronomy was developed, the nearly 30 scientists participating in the 3rd Technical Interchange Meeting shared the



Figure 2. *Left Panel:* an artist's view of the core of the Mid Array antenna complex. The car portrayed gives an idea of the overall dimensions. Each white enclosure comprises 256 small antennas. *Right panel:* a proposed large-scale antenna distribution in Australia. The New Zealand locations will probably be dropped.

progress of the core SKA science design in many different areas and compared notes on more than 90 specification and development guideline documents.

This meeting was a major milestone toward the completion of the first development phase of the Central Signal Processor design. The extensive project documentation is planned to be dispatched to the SKA Project Office at the end of October 2014 and discussed in the following few months. Acceptance will take place in the spring of 2015.