Summary of the discussion session of the Second National Workshop of SKA Science and Technology, 3-5 December 2018

The scope of this session, coordinated by the *Italian SKA Coordination Board,* was twofold: 1) to provide an opportunity for a general informal discussion of the SKA project from an Italian perspective; 2) to gather inputs from the wider community on a number of measures that the *Board* is considering in preparation of a *Roadmap* document for INAF, currently under development.

The points under discussion were presented in a number of slides, used to guide the discussion itself (see attachment). Below a summary of the main outcomes.

1. It is important to get prepared to the scientific exploitation of SKA, either by getting involved in observational projects for existing and/or forthcoming radio facilities (pathfinders and precursors), or through simulation/theoretical forecasting work. Also important is the exploration of possible synergies with existing and forthcoming facilities working in different wavebands.
2. An adequate level of funding of SKA-related activities is strategic in preparation to SKA *Science Key-Projects*. Various forms of funding were discussed: from PRINs to national calls for a number of SKA-related PhD/post-doc positions; from dedicated funding for medium/long-term exchange visits with the SKA host countries (Australia and South Africa) and the SKA Headquarters (UK). Ideally a mix of all the aforementioned opportunities should be offered, in order to satisfy different needs. Some of the discussed forms of funding (visit exchanges, dedicated PhD/post-doc positions) would fit very well in the context of SKA-focused bilateral agreements. Considering that the next 5 years will be critical for both the scientific exploitation of the SKA precursors and the preparation of SKA *Science key project,* it is of paramount importance that funding to support SKA-related science projects are made available on a regular basis and guaranteed over the years.
3. SKA precursors represent a unique opportunity to strengthen the technical expertise of Italian researchers. The current efforts to facilitate LOFAR data processing in Italy, as well as the active involvement in the development and optimization of LOFAR pipelines, will likely play an important role in view of SKA-LOW surveys. Similar efforts should be made towards the two SKA-MID precursors (ASKAP and MeerKAT). As highlighted at the workshop, several Italian groups are actively contributing to data processing and pipeline development efforts in the framework of ASKAP and MeerKAT legacy surveys. This high level of participation is encouraging, but a coordinated approach is essential to avoid duplication of efforts and to optimize the use of (the limited) resources. In addition it would guarantee data processing capability access and support to a wider community. The ASKAP and MeerKAT legacy surveys are starting now and this is the time when international teams are seeking resources (man power, storage and processing power). This is therefore a critical time for INAF to take action and better organize the Italian engagement in ASKAP and MeerKAT.

4. A number of other measures were discussed to support the involvement of the Italian community in SKA-related science. It was suggested that schools/data tutorial are organized, so as to allow a broader community to obtain real experience with radio interferometric data (specifically for LOFAR, ASKAP and MeerKAT). These initiatives should be coordinated at UTG level, and should exploit as much as possible the existing expertise and man power in INAF (e.g. LOFAR, ALMA Regional Center, IA2, ICT). Other envisaged SKA-related initiatives include a) the exploitation of the *SKA Data Challenges*[1] and b) a programme of seminars at the various INAF structures.
5. The afore-mentioned measures (see items 3 and 4) can be seen as initial steps towards an active involvement in a European SKA *Data Center*. SKA data centers are not budgeted in the SKA project, and are expected to be supported through external funding. INAF is currently involved in the EU-funded AENEAS[2] project, aimed at developing a science-driven, functional design for an SKA distributed and federated *European Science Regional Center*. Other projects will be proposed in the H2020 framework for the next future, and INAF should get there well organized. In addition it would be useful to get INAF personnel actively involved in the post-SDP[3] bridging activities.
6. There is a need to update the Italian SKA *White Book,* published in 2014*,* considering the major discoveries/advances of the last years (e.g. gravitational waves, multi-messenger science, etc.), in which the Italian community is strongly involved. The feeling is that we should not produce a new version of the White Book, but rather a short document briefly summarizing the state of the art of SKA-related science, including those science cases that are missing in the White Book. This could be an *addendum* of the Roadmap document, and should reflect Italian scientific interests. In addition it would be useful to have a section dedicated to science synergies, focusing on facilities of major interest for INAF.
7. The opportunity was also discussed of developing an Italian science case for SKA Band 5 (approximately covering the frequency range 5-15 GHz). Band 5 is of major interest for galactic science, where strong synergies with ALMA exists. In addition, Band 5 surveys with SKA would largely benefit from the deployment of *Phased Array Feeds* (PAF), and INAF is involved in the development of PAF as part of the SKA *Advanced Instrumentation Programme*. A SKA Band 5 science case will be further discussed in a dedicated workshop/meeting.
8. It may be useful to create one or more national *SKA Focus Groups,* but only if clear *Terms of Reference* can be identified. As an example such Group(s) could be responsible for (or help the Board in) the writing of the science case update and/or the development of the Band 5 science case (see previous items). One single *Focus*

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[1] For more information see https://www.skatelescope.org/news/ska-launches-science-data-challenge/

[2] AENEAS stands for *Advanced European Network of E-infrastructures for Astronomy with the SKA*

[3] SDP stands for *Science Data Processor,* and indicates the SKA *design consortium* responsible for the definition of the SKA data processing requirements

Group may facilitate the exchange of information among different scientific communities and facilitate cross-fertilization.

9. This is a critical time for the technological side of the SKA project: the SKA *design consortia* are closing their activities, and a new phase, called *Bridging*, is starting. In this new phase a different model has been adopted by SKA Office (SKAO), where international consortia are substituted by *co-located*[4] *teams* directly managed by SKAO. This means that INAF/Italian staff previously working on similar tasks (see e.g. Local Monitor and Control) in the framework of different *design consortia*, could now work together as part of the same *team*. It is strategic for the bridging phase that this process is encouraged as much as possible, so as to reach the critical mass to form national *teams*. This would maximize INAF visibility in the SKA project and its ability to successfully compete at international level.
10. The main reason behind the recently started SKA-LOW bridging activities is the need to investigate the calibratability of the station reference design of log-periodic antennas. A mitigation solution would be the deployment of dipoles (Australian design) instead of log-periodic antennas (It/UK designs). While INAF should be ready to exploit *any* final architecture adopted, this would admittably have a strong impact on the breadth of science that SKA-LOW can deliver, since dipoles can efficiently work only in the lower part of the frequency range allowed by log-periodic antennas. It is therefore strategic to have Italian experts in the calibration team, and enough man-power, to be able to fully evaluate the calibratability of log-periodic vs dipole antennas.
11. Several industrial partners have been involved in SKA-related R&D activities in the framework of SKA d*esign consortia*. In view of the establishment of the IGO and in view of SKA construction it is important to advertise SKA opportunities to industries more widely. This can be done through the organization of industrial days and/or other initiatives. Some of the industrial partners present at the workshop suggested to repeat similar workshops, encouraging as much as possible the participation of researchers and technical staff operating in industries (also as speakers). The shared feeling was that this approach would favor an early involvement of industries in engineering and system industrialization activities, in view of the forthcoming mass production. This will in turn facilitate the development of ad hoc expertise, building on past activities carried out in the framework of other related projects. To be effective, this has to be done well in advance with respect to coming tender calls. Considering that the SKA construction proposal is now planned to be ready sometimes in 2020, such initiatives should be planned very timely.

[4] In this context co-location is obtained by forming national teams whenever possible, or teams from countries located in the same time-zone.