Summary of the Discussion Session

Workshop on "Indian Participation in the SKA"

February 16, 2015

NCRA Auditorium, Pune

- **Introduction to the SKA-India Consortium:** Yashwant Gupta presented a overview of the SKA-India Consortium (SKAIC) launched earlier in the afternoon which is expected to oversee the SKA-related activities within India. The main suggestion was that the activities be divided into three broad areas, namely (i) science activities, (ii) technical activities and (iii) training and outreach for both scientific and technical activities.

  A proposal was raised by a few members about setting up a separate working group on imaging. It was suggested that rather than taking it up as a separate activity, some other route be explored. Various possibilities were discussed in this regard, e.g., (i) join the Science Data Processor technical consortium that is looking into the design of the imaging pipeline (ii) join the relevant key science proposals, (iii) include imaging as one of the items within the SKAIC technical activities. It was also mentioned that some experiments will want to store raw u-v data, however, it was not clear whether that would be possible with the SKA.

  Some people inquired about the data holding and sharing capabilities and plans for the SKA. There are plans to build data centres for the SKA, whose details are not yet finalised. India could explore possibilities and propose to host one such data centre.

- **Proposed activities of the science working groups:** The coordinators of the SKA-India science working groups (SWGs) were requested to comment on the number of active people in the group, the field of expertise/strength within the group and resources required in the near future.

  - The *EoR/Cosmology SWG* has about 30 members from 10-12 institutions. The major area of expertise seems to be in theoretical modeling and simulations, though there are members who are doing observations too. The major resources required would be related to computing. It was also mentioned that there will be a national workshop on "Cosmology with the HI 21-cm line" during 23-26 June in RRI, Bangalore.

  - The *Continuum Surveys SWG* has about 36 people in the mailing list, however only about a dozen (from only 3 institutes) contributed to write-up prepared for the SKA-India science book. The science interests of most of the group members are in areas related to observations. The group is planning to organise a workshop soon. The nature of the resource requirement will be clear after the workshop.

  - The *Pulsars SWG* has about 25 members with a healthy combination of theorists and observers not only in radio but also in X-rays. The major resource required would be a dedicated High Performance Computing platform for pulsar astronomers. It was felt that regular meetings needed to be organised to crystallise ideas, and SKAIC should provide platform for conducting such meetings. In addition, the GMRT can help in devising strategies for pulsar processing pipeline.

  - The *Solar and Heliospheric SWG* does not have an international counterpart, and there has been very little activity in the group. The coordinator mentioned that there are about 40 people working in solar science and 10 in IPS and ionosphere within India. There are plans to approach these astronomers (e.g., in Bangalore and Udaipur) and see if they are interested in SKA science. The computing resource requirement may increase with time.

  - The *Cosmic Magnetism and Turbulence SWG* too did not have much activity over the year. They are planning to organise a workshop to kickstart group activity, possibly in May 2015. It would be helpful if SKAIC can provide a platform for funding such activities.

- The *HI and Galaxy Evolution SWG* has about 30 faculty members. Its main area of expertise is in observations. There are some theorists focussed on aspects of galaxy clustering. A workshop on "Galaxies and Cosmology" was organised in NCRA during July 2014. The group would need a large computing cluster for galaxy evolution simulations.

Overall, it was felt that almost all the groups require computing resources, both for theoretical simulations and observational data analysis. One could explore possibilities if institutions like CDAC can join the consortium and provide computing resources. There was agreement that the SWGs should try to organise group-specific meetings once a year. Such meetings, combined with an annual workshop in the sidelines of the ASI meeting, would ensure that the SWG members meet at least twice a year.

A need for a wiki page for SKAIC was suggested. It was mentioned that creating such a page is in the works. This would possibly facilitate collaborative editing of documents, as was demanded by some members. Various members inquired whether there would be a central office of the consortium, with adequate administrative and technical staff. There is a proposal to have ~0.5 person staffed in NCRA for this purpose. The possibility of creating 4 regional centres in the country could also be explored.

- **Interaction with the international SWGs:** The international SWGs for the SKA have two tiers. Tier-I is meant for taking care of day to day activities, while Tier-II is mainly for disseminating information and providing feedback. The Tier-II is open to new members interested in joining.

  It was suggested that interested scientists in India should get in touch with the coordinators of the international SWGs for joining the groups. It is important that every SWG should contain at least one representative from India. The groups have regular tele-cons and occasional workshops/conferences for discussing the science ideas, which would be beneficial for Indian scientists.

- **Contribution to the technical activities:** Various technical activities related to the SKA are being carried out in India, with NCRA leading the "Telescope Monitoring and Control" consortium. A brief summary of such activities was presented. Any person willing to contribute to such activities should get in touch with Yashwant Gupta. Anyone interested in contributing to the international groups related to technical activities can contact the SKA Office. Some possible areas were suggested where Indian scientists can make significant contribution, e.g., simulations of the EoR signal with foregrounds and instrumental effects included.

  RRI has been involved in technical activities involving one of the SKA precursors, the MWA. They have built digital receivers for the MWA. These tiles could be distributed to universities in India and use them in VLBI mode. RRI is also involved in Sky watch array of networks (SWAN) and detecting the deviations in the CMB spectra from the cosmological recombination epoch. They are also involved in making instruments for detecting the global EoR signal. RRI, along with NCRA, is also involved in upgrading the Ooty Radio Telescope.

- **Training & outreach:** A long discussion was held regarding the most effective way of reaching out to students and general public and making them aware of the SKA. The discussion can be summarised along following lines:

  - **Reaching out to students at +2 and undergraduate levels:** It was proposed that the SKAIC target students at +2 and/or undergraduate (B.Sc./B.Tech.) level and convey the excitement related to the SKA. One possibility is to make students join a research groups for 3-6 months and make them do little bits of work, as is being tried in Presidency University and SINP. NCRA too has been running a winter school for last 7 years, which is followed by live pulsar observations for students. The idea of setting up departments of A&A in universities was discussed. One should also explore publishing more books on radio astronomy. It was mentioned that not many students outside the research institutes are aware of the SKA, hence more talks/colloquia by the SWG members should be organised in IITs/IISERs/universities. Some IITs have opportunities for undergraduate students to work on radio astronomy related projects, e.g., making a working radio telescope.

  - **Advanced training schools:** It was also proposed to hold advanced training schools directed towards Ph.D. students who can be trained to do science with the SKA in the immediate future. The SWGs should

take initiative along this direction. The high energy physics community has achieved some success in this area through workshops such as WHEPP and SERC schools.

- **Outreach:** A major component of the SKAIC activities would be to reach out to public, in particular school students who can be future users of the SKA. One can explore the possibility of using the ASI public outreach committee for this purpose. In addition, The SKAIC can replicate some of the outreach activities in another mega project, i.e., the TMT. The RAD@home project too has been successful in training students, to the extent of submitting GMRT observing proposals. A web-based portal can be built for information on the SKA along with a list of possible projects.

It was suggested that the IUCAA model of training and public outreach can be used for the SKA. One should explore more active participation from the Indian universities.

- **Key science projects:** The SKA Office has recently started a process to identify key science projects (KSPs) for SKA-I. These would be projects which are resource-intensive. It has been proposed that the PI and team membership positions will be balanced among the member states in accordance with members' contributions. The Indian participation in the KSPs could be coordinated by the SKA-India SWGs.

  It was mentioned that any feedback regarding the KSPs should be conveyed to the SKA Office as soon as possible. The major concerns raised by the members were (i) the policy for partitioning data products among different groups, (ii) merging groups with similar proposals may not work, (iii) whether it is more efficient to work with target-based KSPs rather than science-based ones.