PROCEEDINGS OF SCIENCE

Suffa Project: Preparation for Future

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We briefly outline the Suffa large radio telescope project status and the preparation plan of local radio astronomers. The state-of-art mm-wave radio astronomy telescope having 70m main *adaptive* reflector will be completed on Suffa plateau in Uzbekistan in the near future. At the moment the steps are making also to further explore the Suffa site 'radioseeing' parameters for the atmosphere modelling at the site and to try to *forecast* the "radio-weather" for optimal planning the scientific schedule of the future telescope. The multiple step preparation and training of young local radio astronomers who will operate and make a research using this facility are also within our major aims. National University of Uzbekistan(NUU) and the State University of Information Technology(SUIT) will be basic universities for teaching students for these purposes. Naturally all above mentioned together with a broad international collaboration will facilitate for accelerating the rate of astronomical discovery.

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1.Introducing Remarks

The accelerating of astronomy development in the last decades and consequently the new fascinating discoveries have made the astronomical research very actual. Especial emphasis are making on space observatories and on more astronomically and physically informative wave ranges such as, particularly, radio and mm-wave astronomy. The projects like ALMA, SKA, VSOP are within the top science projects in the world. One of the largest telescopes for cm-mm wavelengths are completing in Uzbekistan within the frame of Russian-Uzbekistan Intergovernmental Agreement and will be the first facility for radio astronomy in the Central Asia Region in general. In the analytically over-viewing paper [1] this project was evaluated as one of the prominent scientific projects of the future which will have significant contribution for world astronomy of new millennium.

2.Radio Telescope and Radioseeing Projects

The radio astronomy telescope RT70-Suffa will have the primary reflector with diameter of 70 meters and should be completed in installation on Suffa plateau (not far from Samarqand, Republic of Uzbekistan) at 2350 m altitude (see, e.g., [1], [2], [3]). Initially this project was designed as a basic part of the Earth-Space VLBI system ([2], [3]; URL http://www.asc.rssi.ru/suffa/). Spectral bands of the telescope RT70-Suffa will cover wavelength range 0.8-60 mm.

The *adaptive optics* principle will be used for control the surface of the main mirror which consists of ~1200 trapezoid panels bonded with high precision adaptive system. These panels were made from previously surface-profiled plates using the special technology and have an rms accuracy of 50 microns (m.s.e.). The position of each panel in the parabolic coordinate system will be defined by a measuring device, data from which would be used for calculation of deformation field with consecutive correction of reflecting surface using the special drives [4].

The main purposes of RT70-Suffa will be: i) a fulfilment as ground-based facility the simultaneous observations at centimeter wavelength with space-based radio telescope Radioastron and at millimeter wavelength with space-based radio telescope Millimetron; *at angle resolution 1000 times better than groundbased VLBI existed;* ii)an independent centimeter, millimeter and sub-millimeter observations; iii) an immediate participation in ground-based interferometric campaigns.

The project's layouts have been considerably revised, modernized and updated in order to build up the state-of-art instrument.

Preliminary tests have shown the good seeing conditions of the site for cm-mm range. Averaged annual atmospheric transmission coefficients at zenith were derived as 0.90-0.98 for 3.1 mm and 5.8 mm wavelengths and about 0.60 for 1.36. [5]. Now we are further exploring the Suffa site more deep and to learn the main 'radio astro climate' parameters by means of a new technology ('radio-seeing', radio transparency in different sub-mm, mm and cm bands, PWV, their mutual correlation and correlation with meteorological parameters) for the atmosphere

modeling at the site and try to **forecast** the "radio-weather" for reliably planning the scientific schedule of the future telescope.

To the moment a few automated meteorological stations were installed on site and are measuring the main atmospheric parameters in the real time manner. We widely have discussed with foreign radio astronomers on possibilities to land used radiometers for our measurements and prospects are not so bad. What is more one radiometric facility are preparing for such measurements in Russia and should be shifted to Suffa this year. However it would be the best case if one of the 183 GHz radiometers used to check atmospheric conditions at ALMA site could be used in our measurements too since this instrument was successfully used at Chanjanator and might be as etalon for checking sites for mm-wave astronomy. The comparison of data obtained by the same instrument and processed by the same software procedure will permit us to make more correct analysis and modeling.

3.On Preparation of Local Radio Astronomers

As we mentioned before there are no radio telescopes in the whole Central Asia area beside the creating RT-70 Suffa facility. Therefore though Uzbekistan has a great traditions and rich heritage in astronomy this experience was in the optical and a bit in the infrared astronomy only. This means we did not carry out the research in the field of radio astronomy and have not any experience in this field. It is clear that the use of such large modern telescope will require sufficiently prepared personnel. Thus the preparation and training of young local radio astronomers and the technical staff who will operate and make a research using this facility are also within our most priority aims.

Obviously the human power development should be started much earlier before the starting of telescope operation itself. For this purpose we propose and develop the multi level educational and training program which contain the teaching and training students step by step beginning from undergraduate (bachelor) level to graduate (master) one and postgraduate probation and study. All these levels should include the practice and training opportunities. National University of Uzbekistan(NUU) and the State University of Information Technology(SUIT) are considering as a basic for teaching students for these purposes.

We started to read lectures on appropriate curricula at Astronomy and Physics Departments of NUU and select students with good capacity and skills. These curricula include Common Radio Astronomy syllabus, Radio Astronomy Detectors and Methods, and will extended to mm-wave Astronomy , Radio Interferometers and other curricula. Further we will do the same at SUIT which has a good rating in IT technologies, technical education especially in radio physics and VHF techniques and engineering. In SUIT the lectures and practice will also cover the technical disciplines and engineering, such as VHF and cryogenic techniques, telescope operation instructions, software and hardware development and operation, etc.

These students will work to measure radioseeing data, take part in completing the instrument and after graduation they would be trained in the radio astronomy centers in Russia, Ukraine and abroad. It would be worse while to visit and teach students at Astro-Space Center of LPI and its bases in Puschino, Kalyazino, Medvezhie Ozera, on other facilities near Moscow, on Simeiz and Evpatoria radio telescopes, then use the possibilities of ASTRON, EVLBI and

other international facilities and institutions. Such multiple step preparation of a personnel for RT70-Suffa could allow us to permanently produce new generation of young radio astronomers and operational engineers for this exciting project.

At present stage of teaching students in radio astronomy it would be of great importance to arrange some kind of simple training educational radio telescope. Since most curricula covering radio astronomy are teaching by usual lecturing and practical exercises holding in auditorium, for more reliable preparation of practical radio astronomers they should have possibilities to use their knowledge in practice and make all operations in real observations. For example, in case of optical astronomers which are currently preparing in the Departments of Astronomy and Physics at NUU, Samarqand, Karshi, Andijan state universities in Uzbekistan, the students have chances to train on the real telescopes. For this purpose an ensemble of small-class professional and semi-professional telescopes at newly created educational observatories of some universities (for instance, in Samarqand, Andijan), Kitab latitude station and Maidanak observatory might be used. The things are quiet different in case of radio astronomy. As mentioned before the radio astronomy is novel field not only for Uzbekistan but also for whole Central Asia, so there are no experience and technical facilities. Thus the installation of any kind of educational radio telescope is one of the problems to be solve.

At present the computer and multimedia resources are using by us as wide as possible in teaching and practical exercises, including the imitators of radio telescopes and observations on them. Moreover we discussed the item with foreign colleagues, and they were willing to help with the new materials, particularly, provide us with training software on telescope operation, observation and radio data processing procedures. The radio astronomers from ASTRON, NRAO, EVLBI suggested to train students via Internet using on-line mode. Unfortunately the capacity of the Internet connections could not allow us to use on-line resources of radio astronomy training centers worldwide which even could allow to participate in the real observations on existed radio telescopes working in the on-line mode. During the IAU General Assembly in Rio we also widely and intensively discussed possibilities of the international astronomical community in assistance with the training educational radio telescope for us and some progress was made. Surely the significant progress in all these directions should be in near future as well.

4.Conlusions

We briefly described the main features and advantages of the Suffa large mm-wave radio telescope facility project hopefully should be completed in very near future in collaboration Russia with Uzbekistan. As preparation for future use of the instrument in most effective basis we are 1) re-exploring the radioseeing and other local atmosphere parameters affected on propagation and measurements of the radio ways, especially in the millimeter and sub millimeter ranges and 2) teaching the students more deeply in the field of radio astronomy in order to prepare the scientific and technical personnel of the observatory. Undoubtedly, both a new first class major mm-astronomy instrument and effective system of training of young

astronomers together with a broad international collaboration undoubtedly will facilitate for accelerating the rate of astronomical discovery.

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