Proceedings of the 6th European VLBI Network Symposium
Ros, E., Porcas, R.W., Lobanov, A.P., & Zensus, J.A. (eds.)
June 25th-28th 2002, Bonn, Germany

32 Meter Radio Telescopes in the Arabian Region

M. Shaltout

Space Research Center, Desert Environment Research Institute, Minufiya University, El-Sadat City, Egypt

Abstract. This paper presents the importance of building two new radio telescopes of diameter 32 meters to work in the frequency range from 1.4 to 43 GHz, one in the South of Egypt (Abu-Simbel), and the other in the South of the Arabian Peninsula. Both telescopes would be of great interest for the International Radio Astronomy Community from the beginning, especially for EVN.

1. Introduction

The first radio telescope in the Arabian Region was built on the top of the North Mountains of Iraq, near the border between Iraq and Turkey, with a diameter of 32 meter. It was developed under the guidance of the Max Plank Institute for Radio Astronomy, Bonn, Germany in the 1980's. Unfortunately, during the Iraq-Iran war in the 1980's, the telescope was completely destroyed by the Iranian Air Force, thinking it was a military installation.

First discussions on a possible new radio telescope in Egypt started during the fifth UN/ESA workshop on basic space science held in January 1996 in Colombo, Sri Lanka (Shaltout and Schwartz), and were continued during the sixth UN/ESA workshop held in September 1996 in Bonn, Germany.

An invited paper on "The Activities of the Max Plank Institute for Radio Astronomy (MPIfR) under the Aspect of Scientific Cooperation e.g. Very Long Baseline Interferometry", during the 14th National Radio Science Conference held in Cairo University, Egypt from 23 to 25 March, 1997 (Schwartz, 1997), led to a recommendation giving the new radio telescope project a high priority. Following this, a scientific visit from the Egyptian side (Shaltout) was made to the MPIfR for two weeks in April 1997, to complete the discussions on cooperation in building the radio telescope in Egypt.

2. The Problem

Schilizzi, in his paper "Current Developments in VLBI Astronomy on the Ground and in Space" (1995) said that considerable effort went into the optimum placing of the VLBA antennas for (u, v)-coverage. No such freedom was possible for the EVN; the telescopes are where they are. A figure, depicting the (u, v)-coverage for the EVN at 22 GHz in 1996, was included in his paper. The coverage is good at northern declinations where radio sources pass overhead at the majority of telescopes, but gaps appear at lower declinations and the coverage becomes more one-dimensional for sources close to the celestial equator. A telescope near the equator between Europe and the South African telescope at Hartebeesthoek would help solve this problem.

3. The solution to the problem

At the 15th National Radio Science Conference (March 1998), held at Helwan University, Cairo, Egypt, an invited paper on the importance of building a radio telescope of 32 meter diameter at Abu-Simbel in upper Egypt was presented by Shaltout. A revised version was published later (Shaltout, 1999).

Shaltout saw that the solution to the problem is to build a radio telescope at Abu-Simbel in upper Egypt. Why Abu-Simbel ? Abu-Simbel is a small village on the western bank of Lake Nasser in upper Egypt, with latitude 22° 20'.22 N, longitude 31° 36'.97 E, and altitude 200 meters above sea level. It is approximately mid-way between the Northernmost telescopes in the EVN and South Africa, and it completely satisfies two important requirements for modern radio observatories:

- A site far from population centers, which affords a degree of freedom from artificial interference (Ishiguro et al, 1997)
- The dry atmosphere conditions necessary for high frequency radio astronomy (Roth, 1997)

The total population of Abu Simbel is not more than 5000 people, who mostly work in the field of tourism due to the Abu Simbel temple of Pharaoh Ramses II. It is 270 km South of Aswan, with a small local electric grid. Its climatic conditions are extremely favorable for astronomical observation in general; the atmospheric transparency is excellent, and the site is almost cloudless all the year round. The annual mean value of precipitation is 1mm and evaporation per day is 20 mm. The humidity of the air in Summer is less than or equal to 13% , and in the winter 37%. The mean yearly air temperature is +26°C; in January it is +16.7°C and in July +33.7°C. Minimum and maximum values of air temperature reach +2°C and +50°C once in some dozens of years. The total sky cover per day is one oktas (cloudiness unit) as an annual mean. Abu Simbel has an international airport with a low traffic density (five or six flights per day) for tourism. This will be helpful for the fast transport of the magnetic tapes from observations to the EVN Data processor at JIVE.

The suggested radio telescope in Abu Simbel will be similar to three radio telescopes in EVN: two in

Italy at Bologna and Noto, operated by Istituto di Radioastronomia, the third in the United Kingdom at Cambridge, and operated by Jodrell Bank Observatory. The diameter of the telescope will be 32 m, and it will work in the frequency range from 1.4 to 43 GHz. The climatic conditions in Abu Simbel are ideal for centimeter and millimeter radio observations. The cooperation of interested international institutions and organizations is being explored.

Schilizzi, in his invited paper entitled "The European VLBI Network, its new data processor at JIVE, and opportunities for expansion" (1999), given during the 16th National Radio Science Conference, held in Ain-Shams University, Cairo, spoke about the importance of the Abu-Simbel Radio telescope to link EVN with Asia Pacific telescopes.

In June, 1998 a scientific visit was made to MPIfR for two weeks by Shaltout concerning associated research with the new telescope at Abu-Simbel in Egypt.

4. What can we expect from a new radio telescope in upper Egypt?

In their paper with the same title as this section, Schwartz and Shaltout (2000) noted that the participation of the new telescope in the EVN would be an advantage in two respects:

- On the one hand, the telescope would be of great interest for the international radio astronomy community from the beginning. The project would have access to scientific sponsoring programs and would have partners in the developed countries.
- On the other hand, the new telescope would improved the observational quality of the EVN by giving a significantly better (u, v)-coverage. The (u, v)-coverage is one of the fundamental features of an interferometer and indicates the degree of aperture filling of the simulated telescope.

The sites of the EVN telescopes were not chosen for the creation of the best filled array. Most of the Network telescopes already existed before the VLBI technique was adopted. Therefore the EVN is very weak in coverage in the North-South direction.

A simulation of the (u, v)- coverage for the source 3C273 when observed with the existing EVN at 5 GHz shows that the coverage is not ideal. The (u, v)-coverage can be significantly improved by adding a telescope located in upper Egypt.

There are a lot of research programs for a new radio telescope within the National scientific interest, as well as studies involving international cooperation. The main advantage is given by adopting the VLBI technique and participating in the EVN, in space VLBI, as well as in mm-VLBI. The adoption of the VLBI technique will also open the use of the telescope for research in Geodesy and Geodynamics. The cooperation of interested international institutions is being explored; the Minufiya University offers encouragement for building this telescope through international collaboration, specially with the EVN.

5. A new radio telescope in the Arabian Peninsula (The Gulf Observatory)

The author was invited as a consultant to an astronomical meeting for building the Associated Gulf Observatory, which was held in Kuwait from 16 to 18 April 2002. A similar 32 meter radio telescope was suggested by the author for the Gulf observatory (Shaltout, 2002) for six countries: Saudi Arabia, Kuwait, Qatar, Bahrain, Emirates, and Oman. The south western region of Saudi Arabia and the Eastern region of Oman contain mountains of heights more than 3000 meters above sea level, and are very, dry with latitude about $20^\circ \pm 3^\circ$ North. The suggested telescope was included in the recommendation of the meeting, for consideration by the technical committee of the Supreme Council of the Gulf of Kings and Princes, to confirm it, and consider financing it. To achieve this goal, we hope for EVN support to clarify the importance of this new radio telescope for the Gulf countries and the European countries (EVN) to the Scientific Club of Kuwait, and King Abd AlAziz City for Science and Technology in Riyadh, Saudi Arabia.

6. Conclusion

Two new radio telescopes of diameter 32 meters, working in the frequency range from 1.4 to 43 GHz, one in Abu-Simbel in Egypt, and the other in the South of the Arabian Peninsula, would be of great interest for the international radio astronomy community from the beginning, specially for EVN.

References

Ishiguro, M. and Radio Protection Groups in NRO, 1997, "Radio Interference at Nobeyama Radio Observatory", 23rd General Assembly of the IAU, August 17-30, 1997, Kyoto, Japan.

Roth, J., 1997, "Will the sun set on Radio Astronomy ?", Sky and Telescope, April 1997, pp. 40-43

Schilizzi, R.T., 1995, The Radio Science Bulletin No. 273, pp. 14-28

Schilizzi, R.T., 1999, Invited paper No. 1, Proc. 16th National Radio Science Conference, Cairo.

Schwartz, R., 1997, Invited Paper No. 2, Proc. 14th National Radio Science Conference, Cairo, pub. Egyptian National Radio Science Committee, Academy of Scientific Research and Technology, and IEEE, Cairo, Egypt.

Schwartz, R. & Shaltout, M., 2000, Astrophysics and Space Science, 273, pp. 273-288

Shaltout, M., 1999, The Radio Science Bulletin No. 288, pp. 8-12

Shaltout, M., 2002, in "Scenario for the Gulf Observatory", The Astronomical Meeting for the Gulf Observatory, 16-18 April 2002, organized by the Scientific Club of Kuwait, Kuwait. (In Arabic).