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The Sardinia Radio Telescope and the local context

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Abstract. We describe the main development activities which are in progress in Sardinia, and which are tacking place as a result of the prospects of hosting a major European facility as the SRT. The local scientific and academic context shows an interest in the project and various collaborations are in progress, suggesting that the SRT event might have a significant role in the scientific and technological development of the island.

1. Introduction

The main financial support to the SRT project comes from one of the so-called "Cluster" projects, an ensemble of major Government actions launched several years ago, and devoted mainly to the scientific and technological development of the less-favoured regions of the country. In this respect, it is important to examine today the Sardinian context and evaluate how the local scientific and academic context is reacting to the prospect of hosting such a major European facility.

After the historical and outstanding involvement in the International Latitude Service occurred last century, astronomical research in Sardinia has never again reached such an important role. However, in the last few years significant changes took place at the Cagliari Astronomical Observatory (OAC), including the development of modern techniques in geodesy and GPS, and, more recently, the appointment of young research fellows deeply involved in the international astrophysical context. The OAC also runs a modern Time & Frequency Station, including two Cesium standards, which are involved in the definition of the Atomic International Time (TAI).

In these years of rejuvenation, the OAC has undertaken a major growth, initiating several collaboration programs at national and international levels. In this context, the involvement of the OAC in the SRT project represents a strong opportunity and an important challenge.

2. The role of the OAC in the SRT project

The OAC is in charge of the implementation of the technological infrastructure of the radioastronomical station of San Basilio. This activity includes the buildings (Fig. 1) and the antenna basement (Fig. 2), and in the future the main instrumentation necessary to run the station, such as the Time & Frequency laboratory, the RFI monitoring station, the computing facilities, the laboratories, etc.

Fig. 1. A drawing of the San Basilio radioastronomical station. The infrastructures include the control room, offices and laboratories, and a small visitor center.

Fig. 2. The SRT antenna basement. The anular structure is 40 m wide and 5 m deep, and will support the 3000-ton antenna.

3. The collaboration with the University of Cagliari

In response to the prospect of hosting in Sardinia the largest Italian radiotelescope, the University of Cagliari has activated a curriculum in Astronomy and Astrophysics at the Physics Department, and has appointed two additional astrophysics professors during the last three years. In addition, several OAC staff members are asked on a regular basis to give university courses and lectures. In this way, in the last few years, it has been possible to appoint several PhD students, and give them research projects to be carried out at the OAC, in collaboration with major international institutions where they could spend a substantial fraction of their time. The collaboration with the University of Cagliari includes also the Department of Electrical and Electronic Engineering, with particular attention to the development of new advanced instrumentation for the new antenna, including feeds, receivers and back-ends. A strong support was obtained by the University of Cagliari also during the the site evaluation and the geognostic tests, by the Department of Structural Engineering (Fig. 3).

4. The OAC upgrade period

Recently, a major upgrade occurred at the OAC site located at Punta Sa Menta, in the Poggio dei Pini suburb, 25 km South of Cagliari.

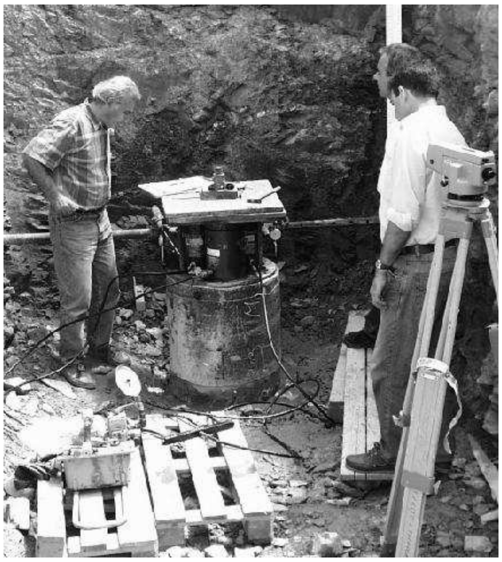

Fig. 3. Geognostic activities at San Basilio, carried out by the University of Cagliari.

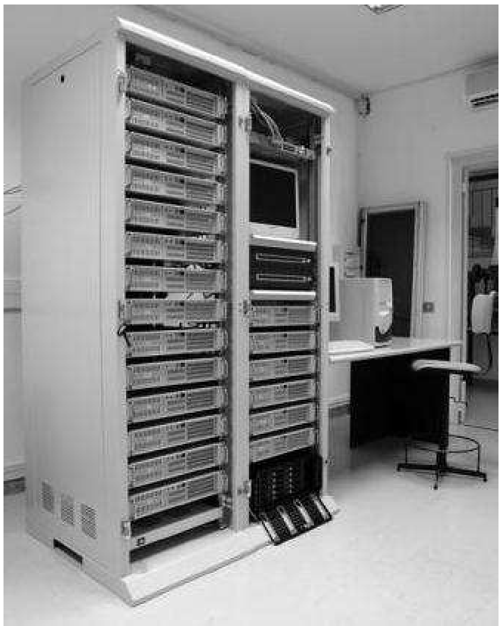

Fig. 4. MANGUSTA, the 20-node Beowulf cluster of the pulsar group.

4.1. Computing facilities

A supercomputing facility, built by the pulsar group and formerly located in Bologna, was moved to Cagliari. This is a 20-node Beowulf cluster, called MANGUSTA, featuring 20x2 AMD CPUs, 40 Gb of RAM distributed among the nodes, and several Tb of mass storage (Fig. 4).

The name MANGUSTA was chosen with reference to the name of a similar, but more powerful system, called COBRA, built by the British pulsar group at Jodrell Bank. We were inspired by the fact that in nature the mangusta eats the cobra! MANGUSTA is heavily used by the pulsar group to process the Parkes survey data; indeed it led to the discovery of the first-ever double pulsar. The entire computer room has been upgraded at the OAC, and several new general purpose servers have been installed. A major upgrade is now in progress, consisting of the installation of a new 10-Gb LAN and switch devices connecting all the client machines used for scientific data analysis. This is the result of a substantial financial support obtained in reponse to the PON/MIUR Action 901.

4.2. The Time & Frequency Station

The OAC time-keeping laboratory has been moved recently to a special room underground, especially built for this purpose, and equipped with a humidity and temperature control system. A new control program has been put in operation, which makes use of high-precision probes in order to record the ambient parameters inside the clock room (Fig. 5).

Special care has been devoted to the power supply which now has three different security levels to prevent black-outs. All these facilities can be operated remotely throught the network. In the future, the OAC Time & Frequency station will be moved to the SRT site, and will be part, together with an H-Maser clock, of the main SRT time base.

4.3. The microwave laboratory and the first receiver

We have initiated a significant upgrade of the electronic laboratory and we plan to implement in Cagliari full microwave and digital elec-

Fig. 5. The renovated Time & Frequency laboratory of the OAC.

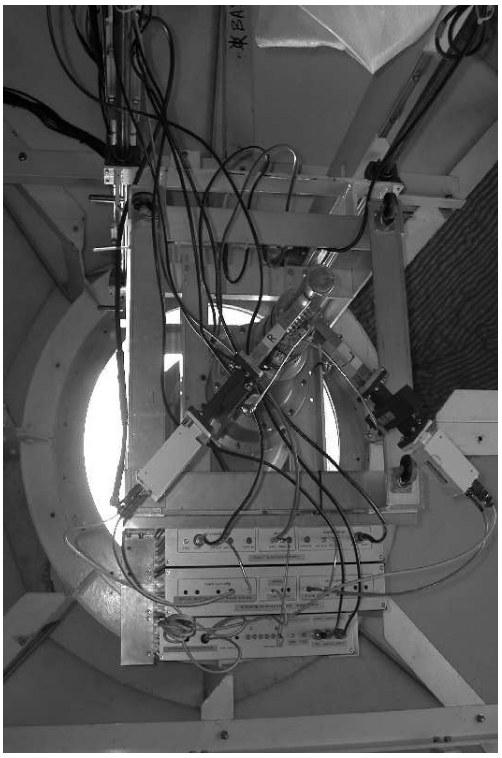

Fig. 6. The first receiver built at Cagliari tested in the Medicina 32-m dish vertex room.

tronic laboratories equipped for the development of modern state-of-the-art receivers and back-ends. Indeed, in Cagliari we have already built our first microwave receiver, a prototype 6.7-GHz receiver (Fig. 6) which was used at Medicina to work jointly with the Noto dish, performing a single Medicina-Noto baseline, and achieving good results in the accurate positioning of several methanol maser sources.

5. Current scientific activity at the OAC

Several research activities are taking place at the OAC. The study of the photophysics, chemistry and morphology of the Diffuse Interstellar Medium (DISM) is the astrophysical senario for the research activity of the AstroChemistry Group. Star forming regions are looked for and studied by means of numerous tracers. In particular, the molecular masers are used at Cagliari as tracers, performing radio observations of the H_2O maser line at 22 GHz and methanol maser lines at 6.7 and 12 GHz. Extragalactic water masers, such as the so-called megamasers and kilomasers are also the subject of an emerging research activity at Cagliari. In the context of extragalactic radioastronomy, magnetic fields and Faraday rotation studies in clusters of galaxies are also the subject of an outstanding research activity.

The Cagliari pulsar group has obtained recently at Parkes an outstanding result, the discovery of a highly relativistic binary system which also turned out to be the first-ever known double pulsar, which has reached in 2004 a peak of citations.

6. The prospects of a new INAF headquarter in Cagliari

While we appreciate the site of Punta Sa Menta for its location on a nice hill, full of native mediterranean vegetation, we believe that we should move to a new site, close to the University campus, and possibly close to the SRT site. In this respect, there are good prospects. The Municipality of Selargius, which owns some land close to the Univerisity

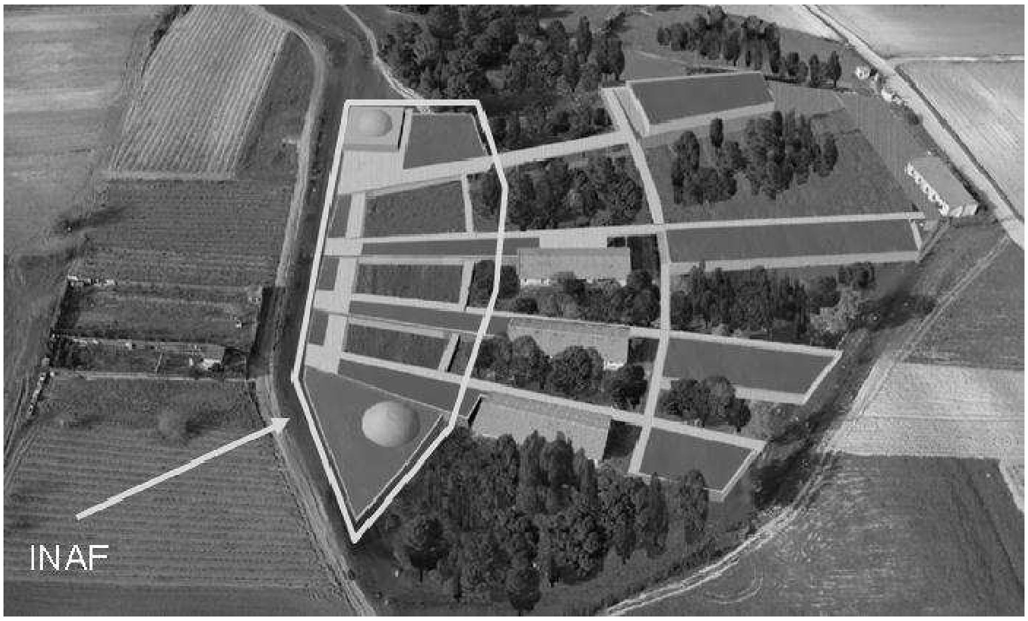

Fig. 7. A drawing of the new OAC site at Selargius.

has proposed to build a cultural campus including a new site of the OAC (Fig. 7).

So, we have applied jointly to the Regional Government in order to get financial support, and apparently the project is very well positioned on a short list of projects in the context of the POR-Sardegna financial budget.

7. The Supercomputing Regional Consortium COSMOLAB

Another interesting news item which indicates the strong attention of the local scientific and academic environment to the SRT project is represented by our participation in the CyberSar project as part of the COSMOLAB Regional Consortium. CyberSar, acronym for Sardinian Cyber Infrastructure, is a network of supercomputing facilities, mainly connected by dedicated wide-band optical fibers (Fig. 8), which has obtained a significant financial support from the PON national budget.

Two INAF nodes are foreseen in this network, one located at the OAC and one at the SRT site.

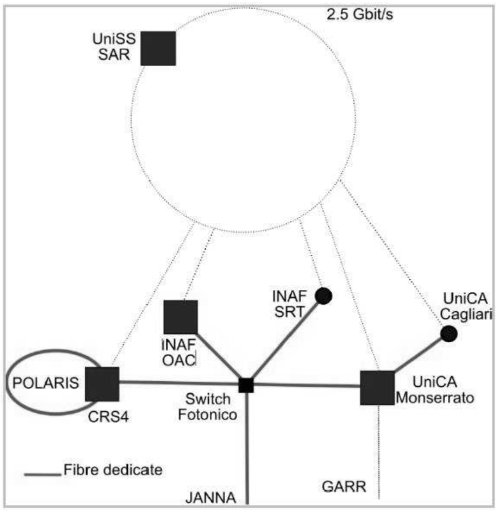

Fig. 8. The CyberSar project.

8. Outreach activity at the SRT site

The local territory around San Basilio also shows an interest in the project, which is seen as a good opportunity for attracting public and schools. In addition to the visitor center which will be available on-site, another facility will probably be available on the hill in front of the SRT site. This will be a good opportunity for the public to follow the construction of the antenna which promises to be a rather spectacular event.

9. Conclusions

The construction in Sardinia of such a major facility is creating a stimulating intellectual context, and the SRT is seen as a major opportunity to trigger a significant growth in a number of applied research fields such as ICT, microwave technology, metrology, and so on. In turn several modern research activities are now growing at the OAC. The emerging scenario suggests that the local environment is prepared to share the intellectual property of the facility.