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Future perspectives for Antarctic infrared astronomy at Dome C

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Abstract. A brief presentation is done about the objectives, the justifications and the purposes of the PNRA Project entitled: "A preliminary study of a large Antarctic IR Telescope for Dome C", with a mention to the up-to-now history and the planned development for the next years. This research does not pretend to be either in competition or in opposition to any of the proposals in progress for IR Astronomical Observations from Antarctica, but wishes to be a contribution toward a full future utilization of the unique site characteristics expected from the High Plateau for IR Astronomy.

Key words. telescopes – infrared: general

1. Introduction

In addition to the project for the creation of the first observing facility in the infrared at Dome C (IRAIT Project) (Busso et al. 2002; Tosti et al. 1996), a new proposal in collaboration with N. Epchtein of the Observatoire de la Cote d'Azur, Nice, France and with J. Storey of the University of New South Wales, Sydney, Australia, has recently been presented and funded for the three-year period 1999-2001 by the PNRA, with the object of performing a preliminary study for a Large InfraRed Antarctic Telescope, as a natural projection of the undertaken activity.

The aim of this proposal is to develop, in the framework of the International community around the Concordia Project, the concepts and tendencies for the construction of a Large Antarctic Telescope, in case that this starting project (IRAIT) keeps the expected brilliant promises.

In fact even if the IRAIT Project can potentially produce important scientific results, it has the main task to define on one side the real observing limits obtainable at Dome C for IR observations and on the other side it must verify which are the real difficulties and what is the logistic organization required to perform current high tech, automatic IR observations on the Antarctic Plateau.

The measure of these two objectives will be able to open or not the way to a more stable and important development with the creation of a permanent Antarctic Observatory, capable of performing high-sensitivity and high-resolution observations

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at the highest level of competitiveness, from the site offering the best observing conditions on earth.

2. Preliminary study of a large infrared Antarctic telescope. Starting considerations

In recent years some proposals have been presented by Research Groups (i.e. in the USA and in Australia) for the construction of a medium-large aperture Telescope, to be installed on the Antarctic Plateau, (Burton et al. 2000; Chamberlain et al. 2000; Smith & Harper 1998; Storey et al. 2000).

Now, the creation of a new Antarctic French-Italian Base at Dome C, drove some Research Groups to begin a general discussion in a more realistic way, on the basis of the knowledge derived by Site Testing Campaigns and by the results of the recent observing facilities, SPIREX (Fowler et al. 1998), IRAIT. In this context it seems that some starting points can be placed:

– a) The Preliminary Study proposed must derive from an international cooperation that includes not only France and Italy but also all those Countries that declared their interest in the Antarctic Astronomy in the International context.
– b) The Telescope, more than a classical pointed Instrument, for general purpose programs, could be able to perform an agreed plan of observations consisting, for example, in limited surveys at high resolution in the range of thermal infrared of selected regions in the southern hemisphere (molecular clouds, active forming regions, complexes, obscured clouds, HII regions ect.), so as to produce a complete census in the selected regions with particular reference to the birth and formation of stars, or to investigate on the origin and evolution of planetary systems.
– c) The choice of the objectives must take into account not only the possible scientific results that can be obtained, but it must be intended also as an international facility for the set up of the observing programs on the last generation of Very Large Telescopes with their interferometric facilities (VLT, LBT), and in preparation of the future space Missions expected at the end of this decade (SIRTF, NGST).
– d) In principle we would privilege the ideas that take into account the extreme conditions of the site, that suggest the creation of non-conventional structures, at the maximum degree of simplicity and hence at the higher degree of reliability. For this purpose the involvement of the European industry in the development of the necessary technology could be of great interest.
– e) The instrument that is planned to be used continuously for long periods in the winter Antarctic season, will be robotized and will have an automatic remote control and an acquisition system allowing the remote collection of data.

The objective of such first phase will be the definition of the concepts and the general parameters of the future instrument on which the Research Groups involved will agree.

3. Optimization of the instrumentation under construction for IRAIT

As previously illustrated, the IRAIT project of the small Antarctic Telescope will provide for the construction of two advanced IR cameras in different ranges of wavelengths.

Over the years these instruments will undergo a process of optimization for observations in the IR from Antarctica to reach the maximum of efficiency and the minimum noise figure and hence the maximum sensitivity of the system. At the end of this process they will be ready to be transferred to the large Telescope. It is very important to obtain the maximum sensitivity from the cameras, so as to utilize fully the advantages offered by the site.

The observing plans should foresee the utilization of one focal plane instrument at a time for long periods (one or more years), planning its replacement in the summer season, in a way similar to that applied in space activity with HST.

4. A brief history of the project and the planned activity for the next years

In 1998 a research project entitled "A Preliminary Study of a Large IR Telescope for Antarctica" - the so called GTA Project (Grande Telescopio Antartico) - has been submitted to the PNRA, for the three year period 1999-2001, by M.F.T. and collaborators. In 1999 the program has been approved with a financial support for the 1999, but starting officially from the beginning of the year 2000. At this point we faced the administrative problems related to the transfer of funds from the ENEA to the CNR to permit the use of the financial support obtained.

In 2001 a solution to this problem has been found, with the approval of a Collaboration Agreement between the two institutions. Meanwhile, the funds for the 2000 have also been approved. At present we are waiting the end of the administrative process that will permit in a few months the utilization of the allocated funds. (The 2001 funds are still waiting for the Governmental approval of the total PNRA budget).

The consequence of this delay, is that there has been a very long preparatory introduction with some informal meeting with French and Australian partners, but without the possibility of a formal beginning of the activity.

The conclusion of this phase is that it is very difficult to discuss the future perspectives for the development of the IR Astronomy from Antarctica, when it is not clear which are the present perspectives.

Nevertheless, the fact that all the projects related to the development of the Antarctic Base of Dome C suffered some delay, allows us to consider a translation of the period assigned to this theme that will begin when the collaboration agreement becomes operative and will be developed for three years as stated.

As regards this project, the activity plan for the next years, will be devoted to a joint study in order to reach the definition of the general parameters for the "Large InfraRed Antarctic Telescope" and to define the non-conventional observing modes that could be used. We expect to organize some Test Campaigns at IR High mountain Observatories to set up methods and technologies to be adopted for the future large IR Telescope.

We will also give an evaluation of the technical choices and an estimation of costs, to manage to produce, if the results are encouraging, a real "Phase A" Study of the Telescope.

5. One tentative proposal for the Large Antarctic Telescope project

The initial proposal presented in the PNRA application is an attempt to figure one of the most simple configurations for an easy development of a highly reliable and relatively inexpensive instrument.

We repeat the general lines of the proposal, but we must underline that it represents only one working hypothesis, that can be radically transformed during the open discussion.

- The proposal is mainly directed to high resolution imaging in the 10μm and 20μm range (for this reason the request of a large aperture becomes necessary).
- The system would be formed by a large Transit telescope (without tracking), that operates in drift scan, producing elementary acquisitions (of few msec), mainly limited by the presence of the sky and telescope background while the source remains in the field of view.

– The transit time must be implemented by studying devices utilizing opto-mechanical systems at the focal plane or the control of a tip-tilt secondary together with the software for the control and reconstruction of the images acquired during the shifting of the field in drift scan. The stability of the atmosphere expected at Dome C will be in favour of this image reconstruction technique for integration times long enough to give limiting magnitudes that will be competitive, with the results produced by Large IR Telescopes of the last generation.

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