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Preparing AMICA for Antarctica: towards robotisation

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Abstract. The Antarctic Multiband Infrared Camera (AMICA, see Straniero et al. 2007) will be mounted on the IRAIT telescope (Tosti et al. 2006), to automatically perform near- and mid-infrared observations at Dome C, in Antarctica. The peculiar conditions of the site require to develop a full automatic control system. It must guarantee the correct execution of acquisition and data processing, while continuously monitoring the environmental conditions, checking the instrument status and optimising observing parameters. An essential contribution to the system complete robotisation is given by the AMICA software system (ACSW). Its architecture descends directly from the layout of the highly modular hardware. We present the current stage of the development process, focusing attention on some aspects of the hardware and software solutions. Finally, preliminary results on electronic components reliability against the Antarctic environment are discussed. The tests are performed using a small climatic chamber built within the AMICA project framework, and capable to faithfully reproduce the same extreme conditions of Dome C.

Key words. Telescopes – Site Testing – Instrumentation: miscellaneous

1. Introduction

AMICA instrumentation (Di Rico et al. 2006) will be placed inside two insulated racks mounted at the fork of IRAIT (Fig. 1), while the cryostat will be installed outdoors, at the Nasmyth focus. Only temperature-sensitive components will be maintained in a conditioned environment. As result of several thermal studies, a 3cm insulation (plastazote) will be applied to the Alucore surfaces of the cabinets. The upper rack will contain the LCU (cPCI), part of the read-out electronics, camera, environment controllers and all auxiliary devices. They will be thermally monitored by an reliable environmental control, ensured by a Programmable Logic Controller (PLC), also devoted to the whole system start-up and shutdown. The camera status, mainly concerning vacuum level and temperatures inside the cryostat, is monitored by a dedicated device directly interacting with the PLC. Moreover, in order to perform immediate and simple maintenance operations, all hardware components have been designed to be easy acces-

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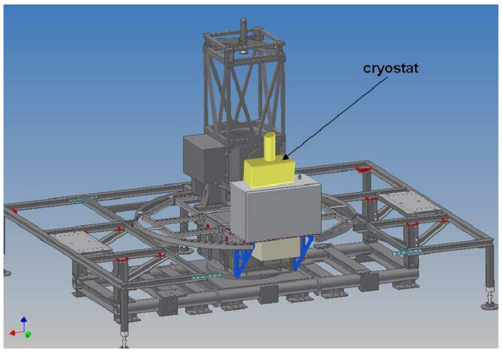

Fig. 1. AMICA cryostat (yellow) and the two underlying boxes containing the electronic subsystems mounted at the IRAIT fork.

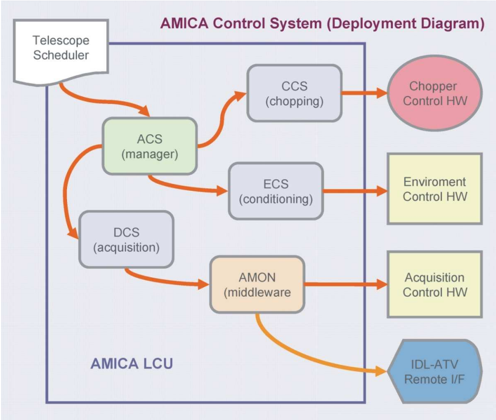

Fig. 2. Deployment diagram (hardware and software components) of the AMICA control system.

sible and fast replaceable. A high-performing acquisition electronics has been developed for the two detectors read-out, and for the sampling and real-time processing of collected data (Bortoletto et al. 2006). It has been designed as a compact and modular sub-system, focusing attention to the efficiency of the heat dissipation, the stability of bias voltage, the cables wiring, the connectors selection and the reliability of open-air components (pre-amplifiers, bias and clock boards).

The ACSW consists of four stand-alone applications to allow the correct execution of system main tasks (Fig. 2): telescope interfacing, observation management, environmental control, events handling and data storing. A top level manager is devoted to the coordination of the other three software packages, which in turn are responsible for the control of the corresponding hardware sub-systems, while the acquisition sub-system has been interfaced with a further independent application (STS).

2. Environmental testing

ANTARES (ANTARctic Environment Simulator) is a small climatic chamber built up to perform accurate tests on the AMICA instrumentation. Samples placed inside ANTARES can be cooled down to $-90°C$, with pressure down to 350 mbar and 2% of relative humidity. The cooling effect is obtained by circulating liquid nitrogen through a pipe attached below the upper cover, which is connected via copper straps to the radiative screen. The following tests have been already performed with ANTARES: i) passive electronic devices operation vs temperature (bias, preamp and clock boards) down to $-68°C$; ii) mechanical resistance and performance of critical components (O-rings, electrical cables and storage devices) down to $-90°C$.

Preliminary test results have shown a meaningful difference between nominal and measured bias voltages of tested electronics. Moreover, it has been definitively established that Buna O-rings fails at $-43°C$, thus requiring the maintenance of a higher temperature for the vacuum pipe. To avoid malfunction of the cryo-cooler head (work at the open air), ceramic bearings are currently used to perform detailed tests of a prototype.

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