PREPARATION OF THE AMBER INTEGRATIONS

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Abstract. The Astronomical Multi-Beam Recombiner (AMBER) is a near infrared/red focal interferometric instrument. Its integration takes place in Grenoble where each sub-system is tested, aligned and the AMBER requirements validated. In a preliminary phase the environment of the AMBER integration room was characterized. Several tests were made in order to determine, and when required to reduce, environmental constraints (temperature, turbulence and vibrations of the optical table).

1. The AMBER Instrument

AMBER is the near infrared/red Astronomical Multi-Beam Recombiner for the VLTI. It is a project which involves five institutes: Département Fresnel de l'Observatoire de la Côte d'Azur, Département d'Astrophysique de Nice – Sophia Antipolis, Laboratoire d'Astrophysique de Grenoble, Max-Planck Institut für Radioastronomie and Osservatorio Astrofisico di Arcetri. It is developed to combine the light from two or three telescopes of the Very Large Telescope (VLT). It can combine the light fro m the Unit Telescopes (UTs) and/or the Auxiliary Telescopes (ATs). AMBER will operate in the J, H and K bands, from 1 to 2.5 μm, with a spectral resolution up to 10000 (Petrov et al., 2002).

2. Characterizing the Environment of the AMBER Integration Room

2.1. AMBER SPECIFICATIONS

The purpose of this study is to understand how this different parameters could influence the performances of the instrument (visibility and phase stability/accuracy requirements in 5 minutes are 10^{-3}). The AMBER beam stability requirements have an accuracy and stability specifications of $\pm$ 3".

Before starting the integrations several specifications for the integration room were determined. It was decided that the heating sources would remain outside the room, that the integration room would be a clean room (with a fan ceiling, anteroom, clean clothes), that we would use the air conditioning to regulate the

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temperature and finally the use of a table pillar independent of the rest of the building to avoid vibration transmissions.

This preliminary phase consisted in a systematic study to characterize the temperature gradient and turbulence induced by the air conditioning, the turbulence generated by the fan ceiling and vibrations of the optical table inside the integration room.

2.2. TESTBENCHES

In order to measure angular fluctuations a flat mirror was put at one extremity of the AMBER table and aligned with an Electronic Autocollimator which allows to accurately measure 2-axis angular displacements. This collimator was set at the other extremity of the table. The incident and reflected light propagates under the fan ceiling whose pieces are about 1-m above the beams. To try to correlate turbulence effects to temperature variations, five temperature sensors were used.

We also used an accelerometer in order to measure and record the vertical vibrations of AMBER optical table.

2.3. RESULTS

2.3.1. *Turbulence*

We wanted to qualify a quiet level by recording X and Y angular variations when the fan ceiling was off and computing the rms fluctuations of the X and Y positions. To determine the effects of the fan ceiling for various powers of the fan, we recorded X and Y angular variations when the fan ceiling was on. One computed the amplitude of these variations as well as the time required to come back to the quiet level.

We concluded that without fan ceiling or with a 30% fan power, the X and Y angular fluctuations remained lower than $\pm$ 0.6”, which is fully acceptable as regards to the accuracy and stability specifications of $\pm$ 3”. For a fan power up to 50%, the time required to come back to the quiet level remains of the order of half an hour (see Figure 1). The results obtained clearly show that air conditioning operation obviously induces an increase of the X and Y angular fluctuations. People who entered in the hut do not clearly disturbed the X and Y angular positions in a short term.

2.3.2. *Temperature*

During the previous steps, the air conditioning remained on and servo-controlled at a temperature of 18°C. We carried out recordings with the air conditioning off. Temperature recordings show that our air conditioning controls the temperature within an accuracy of $\pm$ 3°C, which is significantly larger than the specifications at Paranal (better than 1°). To avoid thermal effects (as those observed in Figure1 in the right panel) we decided to stabilize the temperature by means of another device.

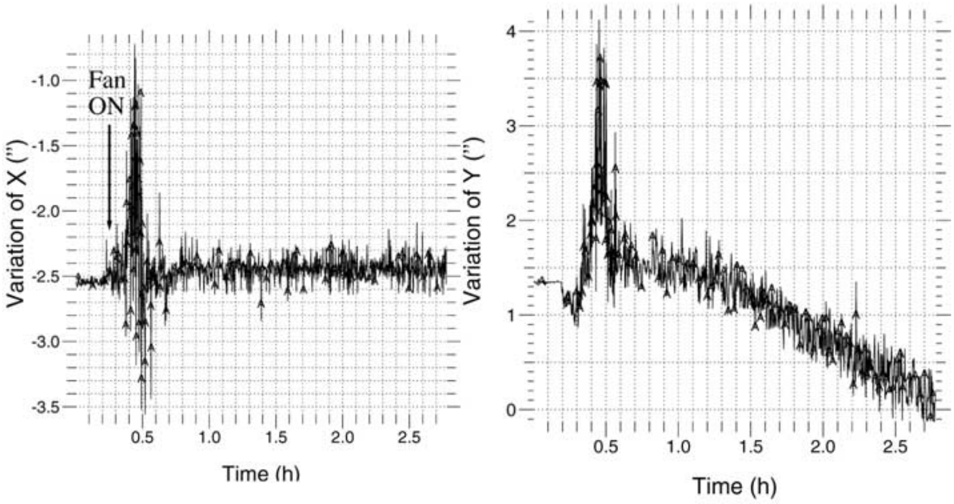

Figure 1. Angular variations (") in X (left) and Y (right) directions vs. time (hours). Fan was switched on after 1/4 h. We can see that after switching on the fan there is a period of about half an hour before coming back to a quiet level. The Y variation reveals a negative drift due to temperature variations ($\pm$ 3°C). Ordinates have arbitrary units.

2.3.3. *Vibrations*

In parallel, one determined for each hour how many times the vibration of the table exceeded 100 μV, which correspond to a vibration amplification of 100 μg.

The results of the vibrations monitoring indicate that the main vibration mode is centered around 18 Hz. Due to the proximity to a road it was shown that the traffic effects can be detected but the induced vibrations on the AMBER table remained lower than 200 μg.

3. Integration of AMBER

During a first phase all the components of the subsystem were tested by the institutes of the AMBER consortium responsible for it. Each sub-system was fully integrated and tested before delivery for its integration on the AMBER table.

Then a second phase started in LAOG: the active integrations. This phase consist in the assembly, integration and test of AMBER in Grenoble. After all subsystems were delivered in LAOG we started aligning each sub-system with the others: the spectrograph and the optomechanics are integrated and tested together. Then, the spectrograph and the detector are integrated and tested together. The proper drive and control of the opto-mechanics by the software is checked in parallel. After these steps, AMBER is tested. The software is integrated and tested with the whole instrument and the proper processing and execution of templates are checked.

4. Perspectives

Integration is under progress and has been validated by preliminary fringes. Several weeks of tests are foreseen in Spring 2003.

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