Under the sign of three: AMBER joins the VLTI

AMBER is the latest addition to the interferometric instrumentation on Paranal. This short note, written as the people were still travelling back from the first commissioning, reports on the successful interferometric combination of both two and three VLT Unit Telescopes.

Andrea Richichi (ESO Garching)
Romain G. Petrov (AMBER Consortium)

On the night of March 20, 2004 and 9 weeks later, in the rising sun of June 1, champagne bottles popped again in the control room of the VLT Interferometer on Paranal. This is not such an uncommon sight in that room, but please do not think of the VLTI as a centre of repeated transgressions in what is known as a (mostly) alcohol-free observatory. In fact, the good collection of empty bottles on the shelves of the VLTI control room is the result of celebrations for the success of a long series of instruments and systems in this *Mecca* of interferometric technology. *Messenger* readers may be already familiar with the news concerning systems by the names of VINCI, MIDI, Delay Lines, MACAO-VLTI, FINITO, Auxiliary Telescopes, …

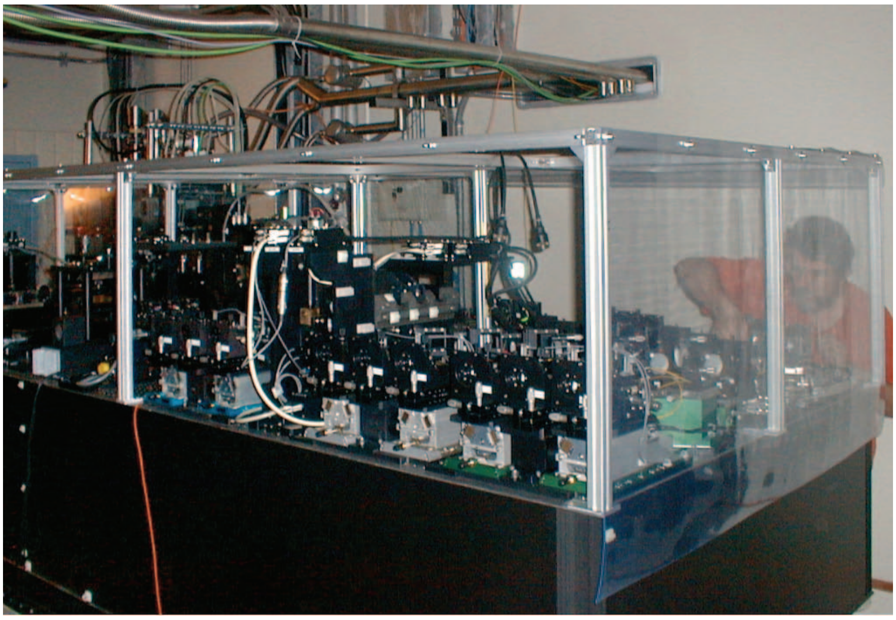

Figure 1: The AMBER instrument in the VLTI laboratory.

The most recent arrival, and the subject of the celebration on these particular nights, was AMBER. The acronym stands for *Astronomical Multiple BEam Recombiner*, and its specialty is the combination of three telescopes, yielding simultaneous measurements on three baselines at each time and therefore measuring the closure phase which is the elementary cell of image reconstruction with long baseline interferometers. For comparison, instruments like VINCI and MIDI only combine two telescopes, yielding measurements on one baseline at a time. In addition, AMBER offers operation in three bands of the near-infrared (namely *J*, *H* and *K*, from 1 to 2.4 microns), either independently or simultaneously. It can observe with three ranges of spectral resolution, the highest being $\lambda/\Delta\lambda$ = 10,000 which is unprecedented in an instrument of this kind. This higher potential of AMBER comes at the cost of complexity: a look at Figure 1 can quickly convince you of this. To put it in the words of an illustrious visitor to the VLTI laboratory during the integration of AMBER: “*Too many mirrors!*”.

AMBER was designed and built by a consortium of several French (Observatoires de Grenoble et de la Côte d’Azur, Université de Nice, INSU), German (Max Planck Institute für Radioastronomie in Bonn) and Italian (Osservatorio Astrofisico di Arcetri in Florence) institutes, under the leadership of R. Petrov (Nice). As in the case of MIDI, its costs are borne mainly by the consortium, which is compensated by ESO by means of guaranteed time. AMBER arrived on Paranal in February 2004, and immediately a group of consortium members and ESO staff got busy with its assembly. The main goal of the first run in March was only to assemble the instrument and verify its performance in the laboratory, already a complicated and quite intensive process. This goal was accomplished in less than five weeks, and soon the first attempts on the sky with the VLTI test siderostats took place. As for all VLT and VLTI instruments, a long period of commissioning is needed, with the goal of characterizing the performance and the reliability of AMBER before actually offering it to the community. The first fringes, obtained on the two stars θ Centauri and Sirius, were an extra bonus.

The real observations on the sky started in May 20, when an AMBER team visited Paranal again and, with the support of ESO staff, began extensive tests using the small siderostats as well as the large UT telescopes. The first fringes, i.e. the first successful interferometric combination of two Unit Telescopes (UTs) using AMBER, were obtained on May 28, observing 51 Hydrae with a spectral resolution of 1,500, only seconds after acquiring the beams sent by the UTs in the VLTI focal laboratory. Many operational and software bugs were corrected and a sample of stars with different characteristics were observed. As a very preliminary and quite conservative result, it can be said that observing at low resolution up to magnitude K=8 and in medium resolution up to magnitude K=7 is fairly straightforward, because these are the magnitudes for which fringes can be immediately detected by eye in individual frames. The evaluation of the actual limiting magnitudes will need some further analysis of the data. In the last hour of this first commissioning period, simultaneous interference between the beams coming from three UTs was obtained, which is a first for telescopes of this size and might be some day recorded as the birth date of imaging with the VLT interferometer. This was a challenge indeed, since it was necessary to use two UTs with only tip-tilt correction, and one UT without. By next July, the analysis of the recorded data should allow us to assess the immediate possibilities of AMBER and pave the way toward its fully optimized operation, to be achieved in the next commissioning runs.

Stay tuned until then for more details and... keep those bottles cool!

Figure 2: The AMBER integration team on Paranal worked over a period of five weeks, and there was a considerable changeover of personnel. In the picture, the people present in the last part of the integration: Romain Petrov, Alain Délboulbé, Fredrik Rantakyro, Etienne Le Coarer, Andrea Richichi, Pierre Kern, Stéphane Lagarde, Carla Gil, Mike Fischer, Mario Kiekebush, Florence Puech, Gérard Zins, Fabien Malbet.

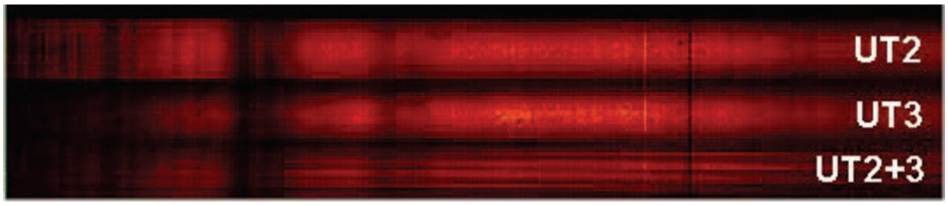

Figure 3: First fringes on the star 51 Hya, recorded with UT2 and UT3 on May 28. Top and middle: part of the light from UT2 and UT3, used for photometric monitoring. Bottom: interferometric combination. The fringes are slightly tilted due to the optical path difference between the two beams, a few tens of microns in this case. The fringes are spectrally dispersed in the horizontal direction. This raw image, recorded at medium spectral resolution of about 1200, covers the K-band from 2.0 (right) to 2.4 (left) microns