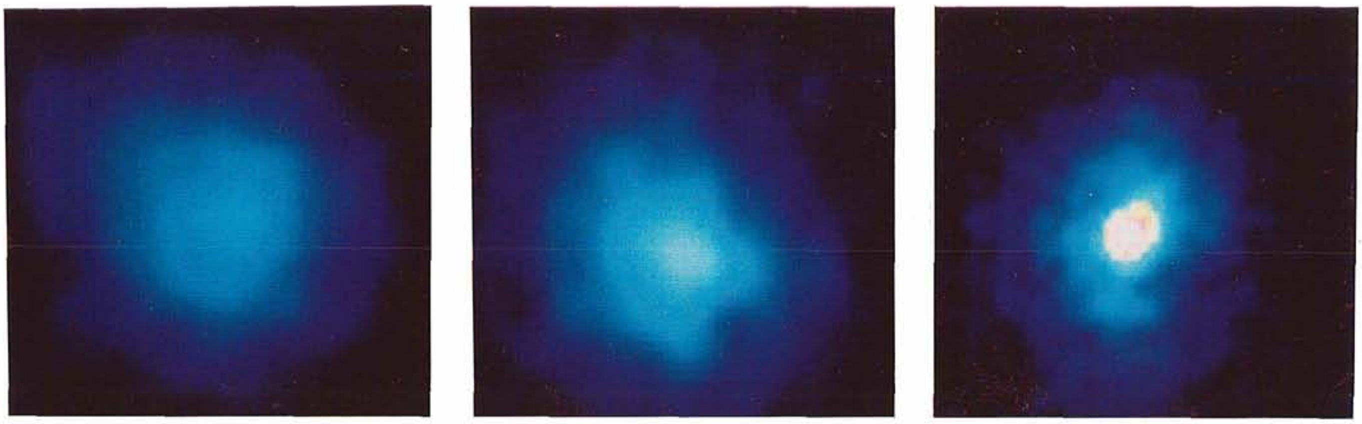

Figure 4: *This image shows an uncorrected image (left), an image corrected by the tip/tilt mirror (middle), and an image corrected by the tip/tilt and deformable mirror of the object HR 5646 (visual magnitude 3.87) in the K-Band. The object itself served as reference for the wavefront sensing. The Strehl ratio between the uncorrected and the tilt corrected image improved by a factor of 1.3, the gain to the fully corrected image is by a factor of 3.5.*

mately 0.75 arcseconds FWHM. The image improvement is dramatically evident even down to the J-Band where the system was undersampling, at least by a factor of 2.5. This corresponds to an improvement from 0.56 to 0.23 arcseconds (theoretically smallest possible value, i.e. the diffraction limit: 0.22 arcseconds) in the L-Band, from 0.58 to 0.18 arcseconds (limit: 0.13 arcseconds) in the K-Band, from 0.6 to 0.21 arcseconds (limit: 0.10 arcseconds) in the H-Band, and from 0.66 to 0.29 arcseconds (limit: 0.07 arcseconds) in the J-Band. This improvement at shorter wavelengths will be an important feature for interferometry with the VLT. The evaluation of the partially corrected images will help to build an analytical model for partial correction by adaptive optics.

Another important part of this test run was to measure the contribution of the image motion stabilization with the tip/tilt mirror in comparison to a full correction. Figure 4 shows an uncorrected image (left), an image corrected by the tip/tilt mirror (middle), and an image corrected by the tip/tilt and deformable mirror of the object HR 5646 (visual magnitude 3.87) in the K-Band. The object itself served as reference for the wavefront sensing. The seeing in the visual region varied between 0.7 and 0.85 arcseconds at the time of these measurements. The maximum intensity (Strehl ratio) between the uncorrected and the tilt corrected image improved by a factor of 1.3, the gain to the fully corrected image is by a factor of 3.5. This gain is limited due to the partial correction, since these measurements are taken in the K-Band at 2.2 micrometre.

Another important aim was the measurement of the isoplanatic angle as a function of wavelength, seeing, and order of correction. The system allowed offset angles between the object and reference source of up to 35 arcseconds.

As mentioned above, a detailed analysis of all results is now underway. This preliminary presentation of some of the most important results is only a brief introduction to the spectacular improvements which can be expected from adaptive optics at a large telescope.

What's Next in Adaptive Optics?

During the past half year it has been demonstrated that adaptive optics is a proven technique for high-resolution imaging in the near-infrared domain. The results obtained with the VLT adaptive optics prototype system give only a first impression of what will be possible in the future with systems with deformable mirrors with several tens or even hundreds of subapertures, compared to the 19 actuators the ESO system has today.

Adaptive optics devices are highly complex systems. The multichannel feedback loop requires very fast and powerful processors. Due to this complexity, adaptive optics systems are often considered as devices which are far from becoming a general user instrument of an observatory. It has frequently been assumed that only specially trained operators or the persons involved in the construction of the system can operate it and that it will therefore necessarily have quite a restricted use.

However, the observations with the VLT adaptive optics prototype system at the 3.6-m telescope have now made it quite clear that adaptive optics can become a tool which can be offered to any observer without special expertise. Although the current prototype is operated from three keybords, not including the infrared camera acquisition system (see the article by Merkle in the *Messenger* **58,** Fig. 4), the operation follows a clear procedure which could be taken over by an additional host computer. All functions can be automated without a major increase of the system's complexity. Also the optomechanical part, which at the moment still requires occasional human interaction, is now close to be completely remote controlled.

With the information and experience gained during the first test run at the 3.6-metre telescope, we are a big step closer to an "Adaptive Optics User Instrument for Infrared Wavelengths" which could be offered to any visiting astronomer. With the current plans to upgrade the prototype to approximately 50 subapertures, an adaptive system for full correction of a 4-metre-class telescope for the wavelength region above about 2 μm will become available. In the beginning it will be a bench-type instrument, but in less than three years it could be converted to a fully integrated system – as the "active optics" is already for the NTT.

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