Adaptive optics shown on French telescope

- Theoretical image quality approached
- Development on schedule for VLT Telescope

Garching, near Munich

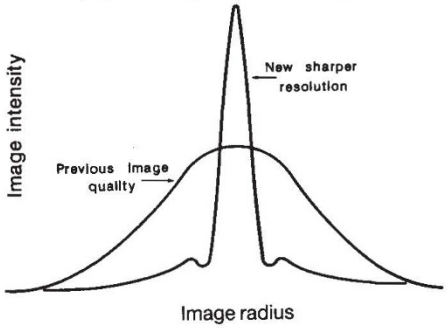
ON THE night of 12 October, astronomers at the European Southern Observatory (ESO) took a big step towards realizing the dream of effectively stripping away the distorting effects of the Earth's atmosphere. In a successful test of a technique called 'adaptive optics', developed by ESO with French colleagues from the Observatoire de Meudon, the Laboratoire de Marcoussis and the research centre ONERA, a dancing, bobbing image was reduced to an almost stable spot. The test also bodes well for the European Very Large Telescope (VLT), an innovative linked array of four 8-metre telescopes to be built in Chile.

The advance is a first step towards making adaptive optics — in which secondary mirrors are physically moved to compensate for atmospheric motions that disturb a star's image — a routine feature on future optical telescopes. It has yet to be shown that the ESO system will work on any optical telescope, or that it will be as successful at visible wavelengths as it is in the near infrared. But if development goes as quickly as the ESO staff expects, adaptive optics could transform not only future telescopes but existing ones as well. ESO director Harry van der Laan said that a telescope 4 metres in diameter with adaptive optics would produce images as good as an 8-m telescope without the system.

Fritz Merkle of ESO and collaborators performed the test on a 1.52-m telescope at the Observatoire de Haute-Provence in southern France, where light pollution and low altitude translate into mediocre image quality. The new system not only took care of atmospheric distortions but also corrected for an inherent aberration in the optics of the telescope. Image quality improved slightly at visible wave-lengths and dramatically in the infrared. The best results, which came at a wave-length of 3.5 to 5 micrometres, clearly showed a diffraction ring around the star image, meaning that the image quality approached the theoretical limit for a ground-based telescope.

Adaptive optics is analogous to active optics, another technology developed at ESO and installed on the ESO 3.58-m New Technology Telescope in Chile. In both cases, a feedback loop using an electronic image analyser improves the sharpness of the images by bending a mirror. But active optics operates on a timescale of seconds or minutes, whereas adaptive optics responds in milliseconds, fast enough to correct for the fluttering of images caused by the atmosphere. Active optics moves the telescope's primary mirror, whereas adaptive optics shunts the light from the primary mirror to a smaller mirror that can be adjusted more rapidly by small motor-driven supports.

The key to the system is a computer that processes a digital form of the distorted images and adjusts a deformable silicon mirror 1 mm thick. The adjustment improves the image before it is recorded by an electronic camera or a spectrograph. Developing special algorithms and dedicated hardware for the computer was the greatest technical problem, said Merkle.



Sketch of the improved resolution achieved in the infrared using adaptive optics. The two satellite peaks correspond to the diffraction ring around theimage.

The gamble taken by ESO in 1985 when it decided to rely on adaptive optics for the VLT seems to have paid off. Although considerable improvement is still needed, van der Laan is confident that they will be ready for installation on the VLT.

By collaborating with ESO, the French hope to add to their expertise and their reputation in the adaptive optics field. By contrast, the US military is thought to have been working for years on adaptive optics technology for the purpose of satellite tracking and laser weaponry without sharing any of its knowledge with astronomers. The most ambitious civilian programme was dropped recently by the National Optical Astronomy Observatories in Tucson, Arizona, because of lack of money and personnel.

Merkle estimates that the mirror and computer technology could be constructed from available components for as little as DM500,000 ($270,000) per system, excluding the huge cost of software development. This is a relatively small amount in the context of ground-based telescope projects; by contrast, space-based telescopes would be "hundreds of times" more as expensive. **Steven Dickman**

AIDS RESEARCH

Sex survey gets Wellcome support

London

A NATIONAL survey of British sexual behaviour, intended to provide data that will shed light on the transmission of the human immunodeficiency virus (HIV) and the spread of AIDS, will now go ahead, despite being vetoed by Prime Minister Margaret Thatcher (see *Nature* 341, 181; 1989), on the strength of a £900,000 grant from the Wellcome Trust, Britain's largest medical charity. Peter Williams, director of the Wellcome Trust, said the trustees agreed to support the study because "the results will be of great importance and of the highest scientific quality". Thatcher had refused to fund the survey because she felt it was "too intrusive", although the Economic and Social Research Council (ESRC), the Health Education Authority (HEA) and the Department of Health had supported the project.

Roy Anderson, a professor at Imperial College who helped to organize the survey, expressed great delight at the news and said the trust had acted both generously and swiftly. The survey will start in January. The research will be carried out by the department of genito-urinary Medicine at University College and Middlesex School of Medicine, the department of public health and biology at St Mary's Hospital and Imperial College, and the independent organization Social and Community Planning Research.

Detailed information on people's sexual behaviour and their attitudes to sex will, said Anderson, help to estimate the two main parameters that determine how fast, and among what part of the population, HIV spreads: these are the rate of infection and the rate of acquiring new partners. The survey will also yield valuable information about the incidence and transmission of other sexual diseases and cervical cancer.

Ben Webb

SPACE

Galileo takes off at last

Washington

ON Wednesday, 18 October, the spacecraft Galileo finally began its six-year journey to Jupiter. The space shuttle Atlantis took off after one more day of delay, due to weather, at 12.53 p.m. About seven hours later Galileo, released from the shuttle cargo bay, was steered by its own booster onto a path towards Venus. Rounding Venus and skirting Earth twice, Galileo will pick up enough velocity to reach Jupiter towards the end of 1995.

David Lindley

Erratum: THE amount of plutonium on board Galileo is not 100 kg as reported in *Nature* (**341**, 374; 1989). The correct amount is 50 lbs, which should be divided, not multiplied, by two, to give approximately 25 kg. □