'First Light' for the Large Binocular Telescope

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The two mirrors of the Large Binocular Telescope (LBT) have produced their first scientific images of space. The event, known among astronomers as ?first light', is a major milestone in the launch of the largest and most modern single telescope in the world. The LBT will be able to see more clearly and more deeply into the universe than any of its predecessors.

Image: The Large Binocular Telescope (LBT) following its launch and the "first light" of its 8.4 meter mirrors. Image: Max Planck Institut for Astronomy

Led by the Max Planck Institute for Astronomy, five German institutes participated, garnering a total of 25 percent of the observation time. Among them were the Max Planck Institutes for Astronomy in Heidelberg, Extraterrestrial Physics in Garching, and for Radio Astronomy in Bonn, as well as the Landessternwarte (state observatory), part of the Centre for Astronomy in Heidelberg.

The Large Binocular Telescope, positioned on the 3190-meter high Mount Graham in Arizona, is one of the most prominent scientific-technical projects in modern astronomical research. Its name describes it well: it has two giant mirrors, each of them with a diameter of 8.4 metres. They are mounted onto the same surface, and focussed, like field glasses, at the same time on distant space objects. The surface of the mirrors is polished with extreme precision, down to one 20 millionth of a millimetre. If an LBT mirror were enlarged to the size of Lake Constance in the Alps - just slightly larger than the area of New York City - the ?waves' on the lake would be only one-fifth of a millimetre high. In spite of their size, each of the two mirrors ?only' weighs 16 tonnes. A classical telescope, on the other hand, at the dimensions of the LBT, would have thick mirrors weighing some 100 tonnes. It would be impossible to construct such a large classical telescope.

By combining the optical paths of the two individual mirrors, the LBT collects as much light as a telescope whose mirrors have a diameter of 11.8 meters. This is a factor of 24 larger than the 2.4 metre mirrors of the Hubble Space Telescope. Even more importantly, the LBT has the resolution of a 22.8 metre telescope, because it uses the most modern adaptive optics, superimposing pictures with an interferometric procedure. The astronomers are thus able to compensate for the blurring caused by air turbulence, and see into the universe much more clearly than Hubble.

Professor Thomas Henning, Managing Director of the Max Planck Institute for Astronomy, and Dr Tom Herbst, a scientist in the German consortium, both agree that ?The LBT will open completely new possibilities in researching planets outside the solar system and the investigation of the furthest - and thus youngest - galaxies.'

Professor Gerd Weigelt, Director of the Max Planck Institute for Radio Astronomy in Bonn, says that ?The first LBT pictures give us an idea of what kind of fascinating picture quality we can expect.'

Although in the beginning, the pictures are ?only' being collected with one of the two main mirrors, they are already showing an impressive view of the distant Milky Way. One of them is of an object in the constellation Andromeda called NGC891, a spiral galaxy 24 million light years away, which, from the earth's perspective, we can only see from the side. According to Professor Reinhard Genzel, the Managing Director of the Max Planck Institute for Extraterrestrial Physics in Garching, ?The object is of particular interest to astronomers, because it also sends out a lot of x-rays'. ?This radiation was created by a large number of massive stars whose lives come to an end with spectacular supernova explosions - a kind of cosmic fireworks.'

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The pictures were created using a high-tech Large Binocular Camera (LBC), developed by Italian partners in the project. The camera and telescope work together like a giant digital camera. Thanks to the particularly large field of view, very efficient observations are possible - for example, the creation and development of distant galaxies with weak light.

But the LBC camera is just the first of a whole line of high-tech instruments with which the LBT will be equipped in the future. ?A telescope without instruments is like an eye without a retina,' says Professor Hans-Walter Rix, Director of the Max Planck Institute for Astronomy. The scientist, a member of the LBT project for many years, adds that ?a telescope like the LBT only becomes an powerful observatory in combination with powerful measuring instruments that are equipped with sensitive detectors.'

German partners especially participated in the development and construction of the instruments, and thus were able to secure for themselves 25 percent of observation time. Scientists, technicians, and electricians from the LBT-Beteilungsgesellschaft (LBT participation group) built the control software LUCIFER 1 and 2, which makes it possible to gather infrared pictures and spectra of heavenly objects. Dr Immo Appenzeller of the Landessternwarte Heidelberg calls it ?important for detailed investigations of a great number of galaxies at different stages of development.'

Professors Matthias Steinmetz and Klaus Strassmeier, the Directors of the Astrophysics Institute in Potsdam, explain that ?the PEPSI instrument is a particularly high resolution version of what is called an Echelle spectrograph. With it, we can conduct particularly effective investigations of the structure and dynamics of the surface of stars.' At the Institute, the Acquisition, Guiding, and Wavefront sensing units are being built, which are responsible for the exact tracking of the telescope, as well as for mirror adjustments.

The LINC-NIRVANA instrument has also been built to ensure that the LBT and its instruments stay at full effectiveness. The LINC-NIRVANA, built in co-operation with Italian partners, is the heart of the LBT. It brings the light from two main mirrors to a single focal plane and corrects for picture interference due to the earth's atmosphere. The highest demands are being placed on the optical, electronic, and mechanical components, because when being used in the infrared spectrum, parts of the LINC-NIRVANA must be cooled to minus 196 degrees in order not to be ?blinded' by heat radiation around it. In this field of ?cryotechnology', scientists and technicians from the Max Planck Institute for Astronomy have shown great expertise.

Because of the impressive first pictures, the astronomers now know that more than 20 years of planning, development, and construction have paid off, and that the 120 million dollar project is on the way to offering new insights into the cosmos. This was indeed the goal of the people who initiated German participation in the project, among them Professor Günther Hasinger (Max Planck Institute for Extraterrestrial Physics, formerly of the Astrophysical Institute in Potsdam) and Professor Steven Beckwith (formerly of the Max Planck Institute for Astronomy). But it is not only the scientists who have participated in the project for such a long time that will profit from the LBT's observations. Now, students and future scientists at all the partner institutes will have the chance to analyse LBT data and initiate new observation projects.

Link: LBT information site

Source: Max Planck Institute for Astronomy