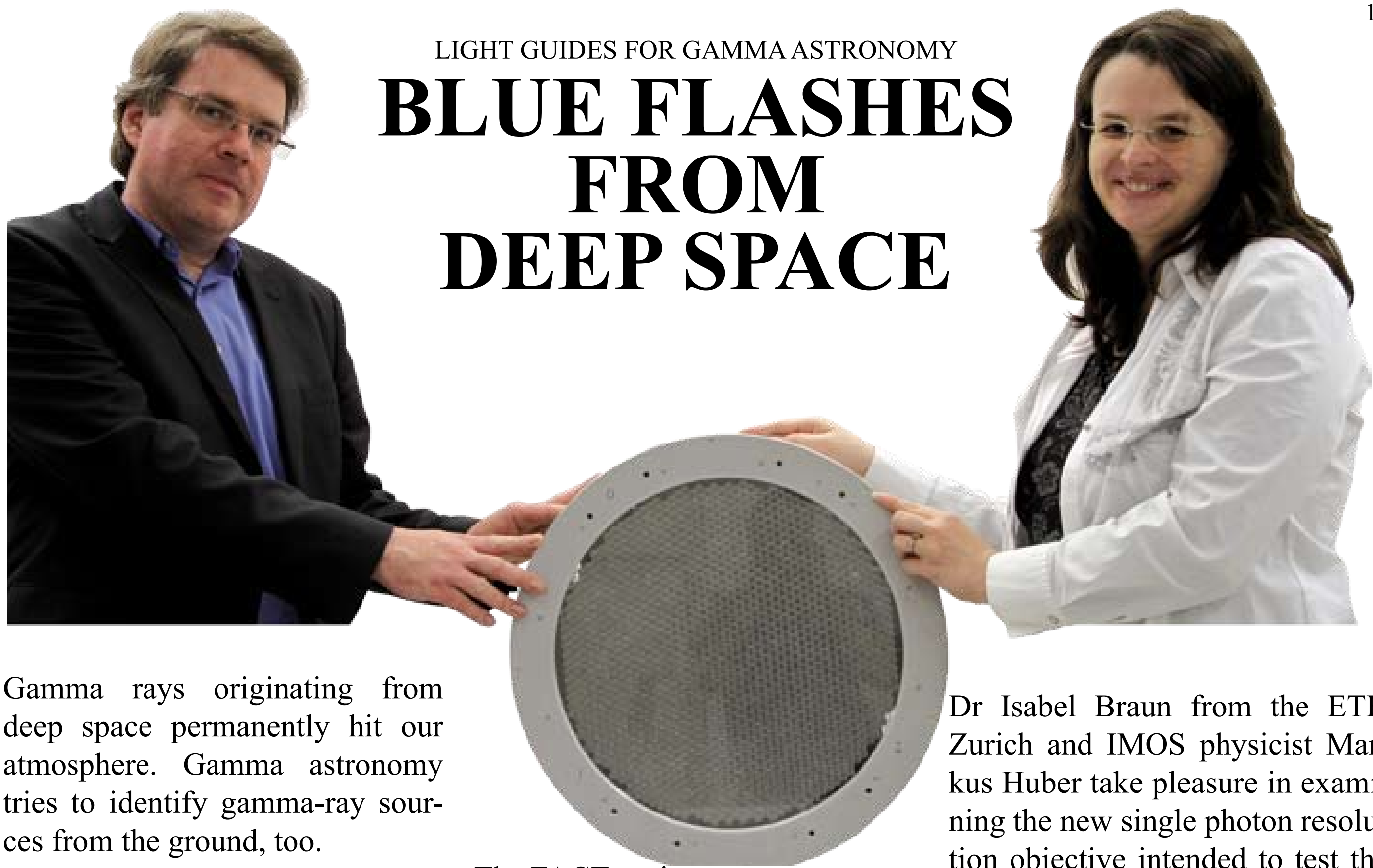
LIGHT GUIDES FOR GAMMA ASTRONOMY

BLUE FLASHES FROM DEEP SPACE



Gamma rays originating from deep space permanently hit our atmosphere. Gamma astronomy tries to identify gamma-ray sources from the ground, too.

When hitting the atmosphere gamma-rays produce extremely weak and very short flashes of Cherenkov light. A mirror of 9 m² size reflects that light towards the novel camera that takes two billion pictures a second to detect these flashes.

The FACT project – "First G-APD Cherenkov Telescope" – uses hundreds of IMOS optical elements that were made of plastic according to the design data submitted by the Swiss Federal Institute of Technology ETH, Zurich. IMOS manufactures the required light guides in a particularly reliable way at an unbeatable price.

Dr Isabel Braun from the ETH Zurich and IMOS physicist Markus Huber take pleasure in examining the new single photon resolution objective intended to test the G-APD technology developed for Cherenkov telescopes. The FACT camera will be built into such a telescope located on the beautiful isle of La Palma.

Photo: ETH

The surface of that camera objective has the structure of an insect eye. Hundreds of IMOS light guides concentrate Cherenkov light on detectors. To ensure correct photon guiding the geometry of the light guides made of high-purity plastic must be of very accurate workmanship. The back of the objective is studded with the highly sensible sensors that even allow to detect a single photon.

The back of the camera objective features quite a few photon sensors.

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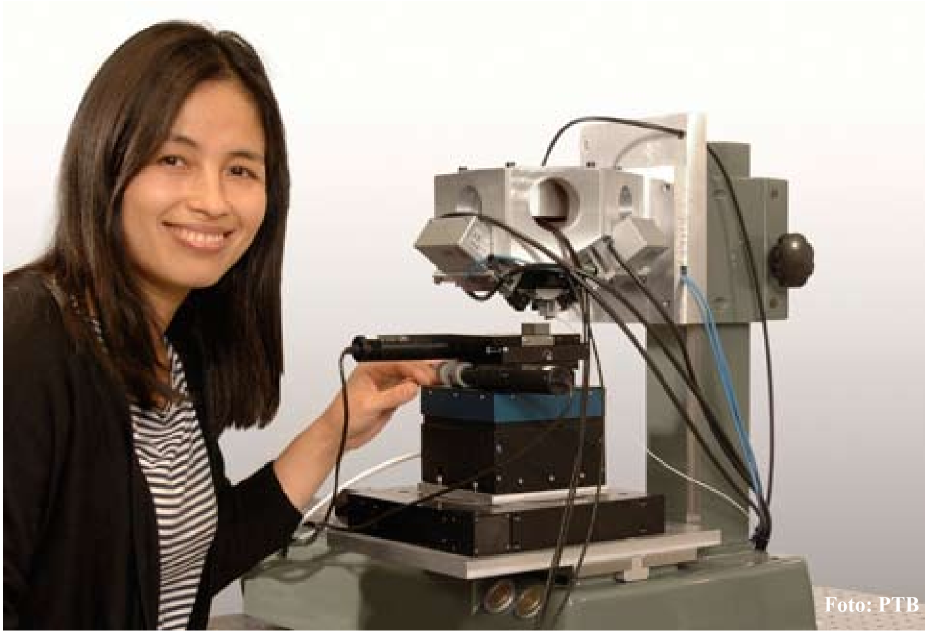
NANO-MEASURING TECHNOLOGY

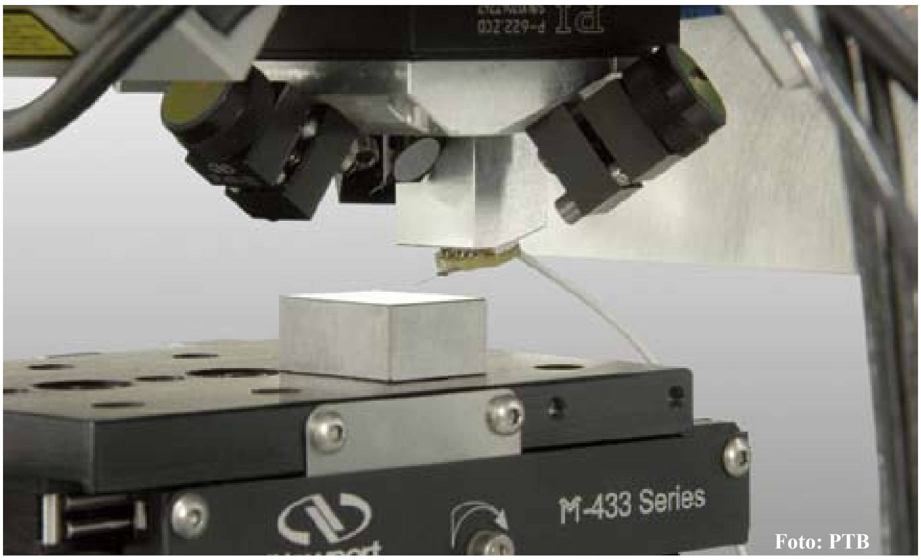
Dr. Min Xu's needle

Ever since IMOS has to manufacture complete assembly groups for novel optical sensors, the requirements put on quality assurance have never ceased to increase in all areas of production. Along with the optical measuring methods engineers require nondestructive measurement of large-area replicated plastic parts bearing microstructures. However, such microstructures are huge compared with the minute profile deviations to be measured in the nanometre range. The aspect ratio to master approximately corresponds to having to scan full-scale mountains while determining the size of a goat standing on them. The success of IMOS's miniaturized optical profiles is indeed only due to the highest possible precision obtained for the angle formed by the side faces, measured in angular seconds. However, what is readily feasible with long-sided angles, means deviations in the nanometre range for optical microprofiles.



Dr. Min Xu may justly be proud of her development work. Under the supervision of Dr. Uwe Brand at the Physikalisch-Technische Bundesanstalt (PTB), she successfully engineered a measuring device for the scanning of microstructures with high aspect ratio (resolution of the order of 6 nm for a bandwith of 20 kHz).

Since the market did not have any solution to offer, IMOS developed a suitable measuring method together with the National Metrology Institute of Germany (PTB) and funded by the BMWi.



The cantilever sensor of the PTB profile scanner is well suited for probing the contour of miniaturized diesel injection nozzles and IMOS soft microstructure optical systems.

The new PTB profile scanner features several linear slides and a rotary table. The bending beam sensor (cantilever) is separately fastened to a three-axis precision piezo-table. The sensor's position is determined using three plane-mirror interferometers. The interferometers' three measuring beams cross at the sensing point. This allows a position measurement free of any Abbe error. The output signal delivered by the cantilever is analysed using a programmed control algorithm. That algorithm makes sure that the sensing force applied by the probe on the object automatically remains constant. The critical point of that extremely high nano-resolution will always be getting rid of the major part of the noise caused by the support of the sensor in the measuring signal.