World's fastest and most sensitive astronomical camera

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The CCD220 detector at the core of the OCam camera has 240 x 240 pixels and has a readout noise ten times smaller than detectors in current use, making it ideal for the faint light camera systems to be used on the second generation of Very Large Telescope instruments. It was developed by the British manufacturer e2v technologies. Credit: P. Balard/INSU-CNRS/ESO

The next generation of instruments for ground-based telescopes took a leap forward with the development of a new ultra-fast camera that can take 1,500 finely exposed images per second even when observing extremely faint objects.

"The performance of this breakthrough camera is without an equivalent anywhere in the world. The camera will enable great leaps forward in many areas of the study of the Universe," says Norbert Hubin, head of

the Adaptive Optics department at ESO. OCam will be part of the second-generation VLT instrument SPHERE. To be installed in 2011, SPHERE will take images of giant exoplanets orbiting nearby stars.

A fast camera such as this is needed as an essential component for the modern adaptive optics instruments used on the largest ground-based telescopes. Telescopes on the ground suffer from the blurring effect induced by atmospheric turbulence. This turbulence causes the stars to twinkle in a way that delights poets, but frustrates astronomers, since it blurs the finest details of the images.

Adaptive optics techniques overcome this major drawback, so that ground-based telescopes can produce images that are as sharp as if taken from space. Adaptive optics is based on real-time corrections computed from images obtained by a special camera working at very high speeds. Nowadays, this means many hundreds of times each second. The new generation instruments require these corrections to be done at an even higher rate, more than one thousand times a second, and this is where OCam is essential.

"The quality of the adaptive optics correction strongly depends on the speed of the camera and on its sensitivity," says Philippe Feautrier from the LAOG, France, who coordinated the whole project. "But these are a priori contradictory requirements, as in general the faster a camera is, the less sensitive it is." This is why cameras normally used for very high frame-rate movies require extremely powerful illumination, which is of course not an option for astronomical cameras.

OCam and its CCD220 detector, developed by the British manufacturer e2v technologies, solve this dilemma, by being not only the fastest available, but also very sensitive, making a significant jump in performance for such cameras. Because of imperfect operation of any physical electronic devices, a CCD camera suffers from so-called

readout noise. OCam has a readout noise ten times smaller than the detectors currently used on the VLT, making it much more sensitive and able to take pictures of the faintest of sources.

"Thanks to this technology, all the new generation instruments of ESO's Very Large Telescope will be able to produce the best possible images, with an unequalled sharpness," declares Jean-Luc Gach, from the Laboratoire d'Astrophysique de Marseille, France, who led the team that built the camera.

"Plans are now underway to develop the adaptive optics detectors required for ESO's planned 42-metre European Extremely Large Telescope, together with our research partners and the industry," says Hubin.

Using sensitive detectors developed in the UK, with a control system developed in France, with German and Spanish participation, OCam is truly an outcome of a European collaboration that will be widely used and commercially produced.

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