Telephone: +34 922 425400
Fax: +34 922 425401
Internet: http://www.ing.iac.es/

Apartado de Correos, 321
38700 Santa Cruz de La Palma
Canary Islands; SPAIN

Isaac Newton Group of Telescopes

The Isaac Newton Group of Telescopes is an establishment of the Particle Physics and Astronomy Research Council (PPARC) of the United Kingdom and the Netherlands Organisation for Scientific Research (NWO)

MEDIA RELEASE

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S-CAM, THE WORLD'S MOST ADVANCED OPTICAL CAMERA, CAPTURES ECLIPSE OF BINARY STAR

A totally new type of optical detector has been used on the William Herschel Telescope to directly measure intensity and colour changes in a faint, rapidly variable binary star system, UZ Fornacis, for the first time. A team from the Space Science Department of the European Space Agency's Research and Technology Centre in the Netherlands (ESA/ESTEC), who have developed the S-Cam camera, were joined by astronomers from the Mullard Space Science Laboratory (MSSL) in the UK to exploit this advanced instrument.

With conventional optical CCD detectors, very rapid changes in light intensity cannot be measured. Furthermore, the energy or wavelength of the arriving photons can only be measured by introducing a filter or spectrograph into the optical light path, degrading the efficiency. With the new instrument, advanced detector elements based on superconducting technology register the arrival of each photon individually, and measure its energy and wavelength directly.

"This cryogenic detector is very efficient, very sensitive, and very fast; and there is no dark current or readout noise", explains Dr. Anthony Peacock, who has led the development of the detector technology from ESA's Astrophysics Division. The instrument, built by an ESA technical team led by Nicola Rando, is cooled to below one degree kelvin to minimise all possible noise, resulting in an almost perfect detector performance.

Larger and larger telescopes are being built on the ground and in space to study fainter and more distant objects, but more efficient detectors are paramount to astronomers' progress in understanding.

"We have a very powerful instrument for looking at faint astronomical sources which vary rapidly, for example pulsars or binary star systems. It is of particular interest when the light changes its energy distribution, or colour, at the same time", said Dr. Michael Perryman, who has led this astronomical investigation.

In the particular binary star system studied, one of the two stars is a so-called white dwarf, a star in an advanced state of stellar evolution that collapses slowly under its own gravity. This white dwarf tears gas from the surface of its nearby companion, which is then engulfed by the white dwarf's powerful gravitational field. The material is channelled down highly intense magnetic field lines onto the surface of the white dwarf, where it emits prolific amounts of optical, ultraviolet and X-ray radiation as it cools.

Many clues are contained in the very short interval of time in which the intense light emitted by the infalling material is eclipsed by its larger but fainter companion. The results show that the diameter of the accretion spot, where material hits the white dwarf surface, is less than about 100 km.

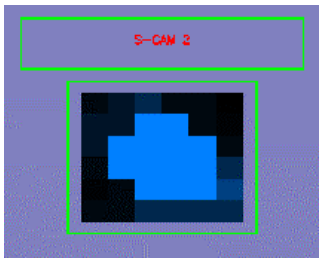
Dr. Mark Cropper, from the Mullard Space Science Laboratory, has been studying this type of binary system, known as a magnetic cataclysmic variable, for more than a decade. "This new detector allows us to look at changes in the light from the system as it changes over small fractions of a second. And this is the first time we have been able to study the rapid colour changes which occur at the same time."

The results of the observations, performed by an ESA technical team in support of the ESA/MSSL science team, were made at the William Herschel Telescope in December 1999, and are reported today in the scientific journal Monthly Notices of the Royal Astronomical Society.

ESA scientists Dr. Michael Perryman, Dr. Clare Foden and Dr. Anthony Peacock published the theoretical ideas underlying the new detector in 1993, the first instrument able to detect the energy of optical photons directly. Dr. Anthony Peacock and Dr. Peter Verhoeve at ESTEC reported the first detection of optical photons using this technology in 1996. S-Cam, the instrument making use of these principles and developed by the same research team, was commissioned at the William Herschel Telescope in February 1999 (see ING Press Release ING 0/99) and its scientific exploitation has been supported by Dr. Fabio Favata and Dr. Alastair Reynolds.

The Isaac Newton Group of Telescopes (ING) is an establishment of the Particle Physics and Astronomy Research Council (PPARC) of the United Kingdom and the Netherlands Organisation for Scientific Research (NWO). The ING operates the 4.2 metre William Herschel Telescope, the 2.5 metre Isaac Newton Telescope, and the 1.0 metre Jacobus Kapteyn Telescope. The telescopes are located in the Spanish Roque de Los Muchachos Observatory on La Palma which is operated by the Instituto de Astrofísica de Canarias (IAC).

PICTURES



Caption: In order to demonstrate the capabilities of S-Cam, the astronomers have created an animation showing an observation of an entire eclipse of UZ Fornacis. This was created by splicing together two integrations, with the join between them near the mid-point of the eclipse. Each step in the animation corresponds to 3 seconds of actual data. The lightcurve in the top of the movie shows the evolution of the total source intensity across the complete spectral range. In order to illustrate the energy sensitivity of the device, however, the 36 array pixels in the lower image are first assigned colours based on the brightness ratio obtained from two energy bands (ranging from blue to red on a spectral scale), and are then assigned intensities based on the total counts in that pixel over the 3 second time period.
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Caption: S-Cam camera at ESTEC laboratory.
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Caption: The William Herschel Telescope (WHT). The WHT is part of the Isaac Newton Group of Telescopes and it's the largest telescope of its kind in Western Europe.
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FOR FURTHER INFORMATION PLEASE CONTACT:

Dr. Michael Perryman
Astrophysics Division, ESA/ESTEC
2200AG Noordwijk
The Netherlands
E-mail: mperryma@astro.estec.esa.nl
Phone: +31 71 5653615; Fax: +31 71 5654690

Dr. Mark Cropper
Mullard Space Science Laboratory,
University College London
Holmbury St Mary
Dorking, Surrey RH5 6NT
United Kingdom
E-mail: msc@mssl.ucl.ac.uk
Phone: +44 1483 204155; Fax: +44 1483 278312

Mr. Javier Méndez
Public Relations Officer
Isaac Newton Group of Telescopes
E-mail: jma@ing.iac.es
Phone: +34 922 425464, +34 616 464111; Fax: +34 922 425401, 442