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The Isaac Newton Group of Telescopes

The Isaac Newton Group of Telescopes is an establishment of the Particle Physics and Astronomy Research Council of the United Kingdom and the Nederlandse Organisatie voor Wetenschappelijk Onderzoek of the Netherlands

MEDIA RELEASE

Press Release ING 1/2000
(Also at http://www.ing.iac.es/PR/press/)
Date: Thursday 29 June 2000
Embargo: For immediate release

"INVISIBLE" GALAXIES, DISTORTED ARCS AND GALACTIC RINGS REVEALED BY FIRST IMAGES FROM INGRID

The Isaac Newton Group Red Imaging Device (INGRID) saw its first light on the William Herschel Telescope on March 16. INGRID provides astronomers with the opportunity to make large field of view, deep near-infrared observations of the universe, as demonstrated by the images achieved on the first night of scientific use.

First light observations from INGRID reveal the central regions of the massive cluster of galaxies Abell 2218, at a distance of approximately 2 thousand million light years from Earth. Several arc like features are clearly visible around the brightest galaxies at the cluster center. These represent the distorted and gravitationally magnified images of very distant galaxies behind the cluster. The huge concentration of dark matter in the core of the cluster acts as a gravitational lens, bending the paths of light rays from the background galaxies and in the process magnifying their images, in accordance with Einstein's theory of relativity.

This image is being used to study the properties of a rare class of galaxies which are bright at near-infrared wavelengths but invisible in the optical, and a possibly related family of very luminous galaxies which emit most of their energy in infrared light. By exploiting the magnification by the cluster lens, astronomers can investigate the properties of these faint galaxies in much greater detail than would otherwise be possible. The new infrared camera, INGRID, facilitates the study of these very distant and faint galaxies.

INGRID was also used to image the spiral galaxy Messier 95 (NGC 3351), a galaxy at a distance of some 30 million light years from Earth. The image shows a combination of

near-infrared INGRID images in the J and K_s bands tracing the location of old stars, and an optical image, obtained with the 1m Jacobus Kapteyn Telescope, which primarily traces young stars.

Messier 95 is noteworthy because it has a prominent bar, and a number of rings outlined mainly by relatively young stars. The most obvious of these rings is the so-called inner ring, formed by a pair of tightly-wound spiral arms connecting to the end of the bar. A bright but small nuclear ring, outlined by very intense regions of star formation, can be seen surrounding the nucleus. In the outer parts of the galaxy, a third ring is present, although very faint and barely visible on the images. Rings and bars are common features of spiral galaxies, thought to be directly related to the overall dynamics of the galaxy. As such, they are powerful probes of the physical mechanisms that organise star formation in the disk, in spiral arms, and in and just around the nucleus.

INGRID saw her first light on the William Herschel Telescope (WHT), the telescope named after Sir William Herschel, a little after the 200th anniversary of the discovery of infrared radiation by this famous astronomer. INGRID makes use of a single array enabling observations between the wavelengths of 0.9 to 2.4 micrometers. Observations at these wavelengths are particularly important for a variety of reasons:

- infrared light penetrates dust which commonly surrounds galaxies and young stars far better than optical light and therefore INGRID can see into otherwise obscured regions of the universe.

- maps of our own Galaxy are most easily made at infrared wavelengths due to clouds of dust hiding the optical light.

- light from the distant galaxies is redshifted, moving the galaxy's optical light to infrared wavelengths where optical detectors no longer detect light.

- some of the key elements of the universe are best detected at infrared wavelengths, allowing astronomers new insights into the building blocks of stars, planets and even life itself.

- planets and brown dwarfs ('failed stars') shine brightest at infrared wavelengths.

- stars and galaxies used to map the universe in order to understand the big-bang model are best observed at infrared wavelengths.

Dr. Chris Packham, INGRID project scientist commented "The moment of first light was very special for all those involved with INGRID as it constituted the climax of three years of hard work. I was delighted as the first images showed the wide field capabilities of INGRID and revealed the arms of a beautiful spiral galaxy, confirming the high quality of the optics. I was particularly satisfied as INGRID made some of these images only 45 minutes after sunset on the first night of commissioning!". In fact commissioning went so smoothly that second night images from INGRID were displayed live via the internet to London during a lecture to the Royal Institution.

While it is clear that infrared observations are key to many aspects of astronomy, constructing infrared instruments is far from easy, as all the components of INGRID must be kept at less than 190 degrees C below zero and in a vacuum! The volume of INGRID is some 70 litres and holds the all-important optical components steady at temperatures

between 30 degrees C (ambient) to -190 degrees C (operating) at all orientations to better than 20 micrometers, half the width of a human hair! INGRID is the first instrument developed, assembled and commissioned by the Isaac Newton Group on La Palma, with assistance from the Royal Greenwich Observatory, Cambridge and the Astronomy Technology Center, Edinburgh, and the Spanish Instituto de Astrofísica de Canarias on the neighbouring island of Tenerife.

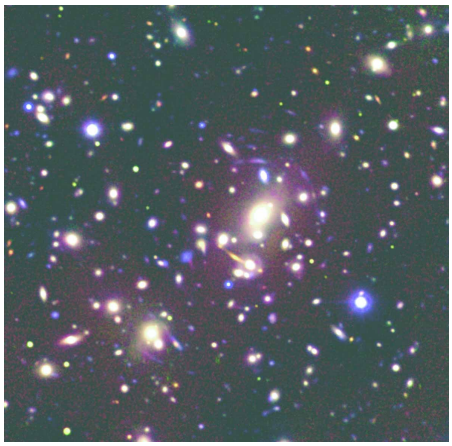
INGRID is now available for observations to the UK, Dutch and Spanish astronomical communities. For UK astronomers it represents an especially interesting addition to their astronomical facilities when combined with the instruments available at UKIRT, the UK's dedicated infrared telescope in Hawaii, as the instruments available fully compliment each other.

The WHT has now enhanced its capabilities with INGRID, as with the touch of a button astronomers can image the cosmos at wavelengths from ultraviolet to infrared by using INGRID and an optical camera already on the WHT. Later this year, INGRID will be used with the WHT's new adaptive optics instrument NAOMI. This will allow the finest details possible with the WHT to be seen with INGRID by the use of special optics which can change its shape to remove the 'twinkling' from the stars.

The Isaac Newton Group of Telescopes (ING) consists of the 4.2 meter William Herschel Telescope, the 2.5 meter Isaac Newton Telescope and the 1.0 meter Jacobus Kapteyn Telescope. The telescopes are owned and operated jointly by the Particle Physics and Astronomy Research Council (PPARC) of the United Kingdom and the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO) of the Netherlands. The telescopes are located in the Spanish Observatorio del Roque de Los Muchachos on La Palma which is operated on behalf of Spain by the Instituto de Astrofísica de Canarias (IAC).

PICTURES

Gravitational Arcs in Abell 2218



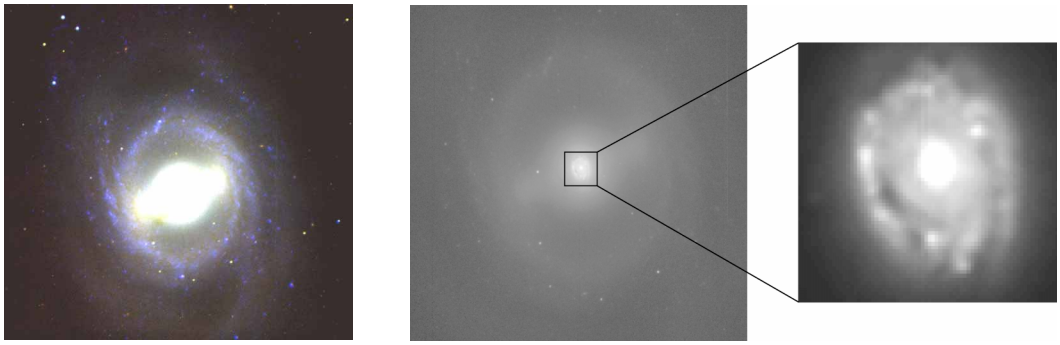
Location: `http://www.ing.iac.es/PR/press/ing100.html`

Picture credit: Ian Smail (University of Durham) and Chris Packham (ING).

Caption: The image is a combination of a blue (B-band) frame acquired using a CCD on the WHT Cassegrain focus with two near-infrared exposures in the J- and K-bands obtained with INGRID with the B (0.4µm), J (1.2µm), and K (2.2µm) images coded as

blue, green and red. The field of view of this image is 3 arcminutes, corresponding to 2 million light years across at the distance of the cluster. The INGRID exposure times totalled 4 hours in J and 2.5 hours in K under good sky conditions (better than 0.8 arcsecond seeing).

Rings and Bars in Messier 95

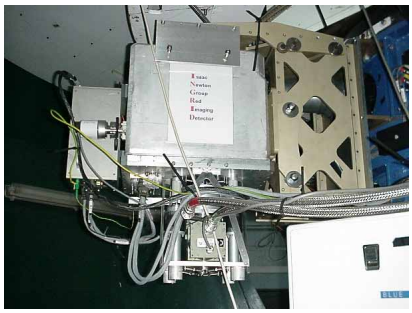


Location: `http://www.ing.iac.es/PR/press/ing100.html`

Picture credit: Johan Knapen (ING and University of Hertfordshire)

Caption: The false colour image on the left shows the morphology of the barred spiral galaxy Messier 95. Young stars and sites of current star formation show up as blue regions, with the inner ring featuring prominently. The red light, measured with INGRID, traces dustlanes in the galaxy, and the older stellar populations. The dust lanes, lacking blue emission, are seen as brownish red in the image; the bar is made up of old stars and shows up as white. The composition on the right is a J-band image and the inset shows the nuclear ring of enhanced star formation.

INGRID on the William Herschel Telescope



Location: `http://www.ing.iac.es/PR/press/ing100.html`

Picture credit: Isaac Newton Group of Telescopes.

Caption: INGRID mounted on the Acquisition and Guidance box of the 4.2m William Herschel Telescope (folded Cassegrain focus). It is held in alignment by the purpose built support bracket (coloured gold in the picture). The array's controller and the instrument's closed cycle cooler can also be seen mounted directly onto the main vacuum jacket. The collimating optics assembly is just visible through the spaces in the support bracket.

4.2m William Herschel Telescope

Location: http://www.ing.iac.es/PR/press/ing100.html

Picture credit: Isaac Newton Group of Telescopes.

Caption: The 4.2m William Herschel Telescope.

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More information on the 200th anniversary of the discovery of infrared rays by Sir William Herschel can be found in this Royal Astronomical Society press release:

http://www.ras.org.uk/press/pn00-02.htm

INGRID home page:

`http://www.ing.iac.es/Astronomy/IR/INGRID`
`http://www.ast.cam.ac.uk/ING/Astronomy/IR/INGRID (UK mirror)`

More information on ING:

`http://www.ing.iac.es/PR/`
`http://www.ast.cam.ac.uk/ING/PR/`

Other web sites:

PPARC: `http://www.pparc.ac.uk`
NWO: `http://www.nwo.nl`