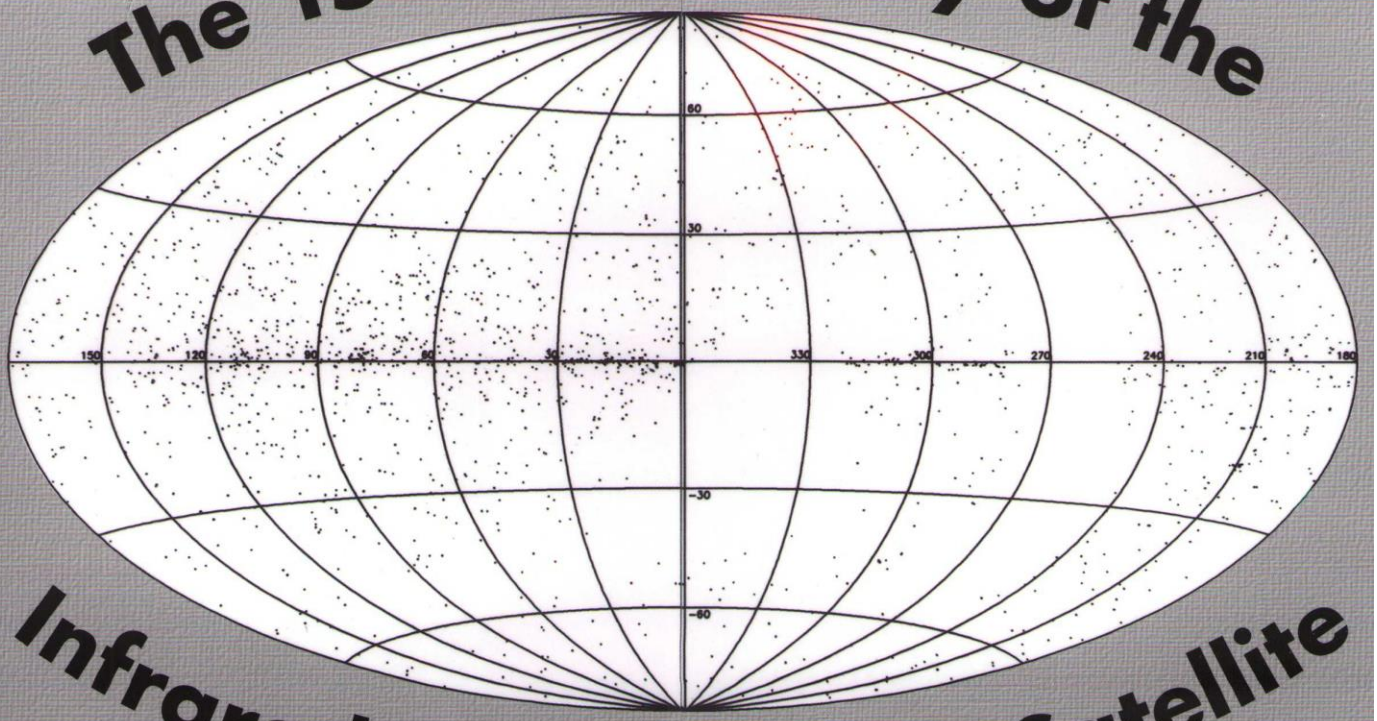
IRAS

The 15th Anniversary of the Infrared Astronomical Satellite



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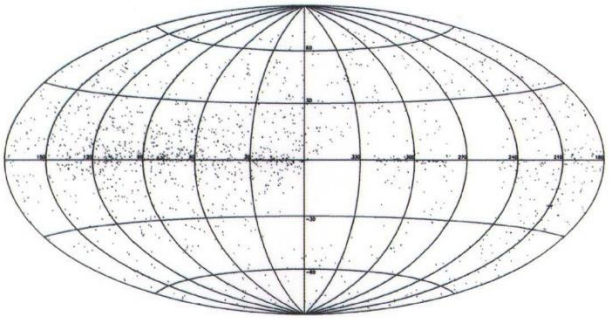
IRAS

IRAS 15 YEARS

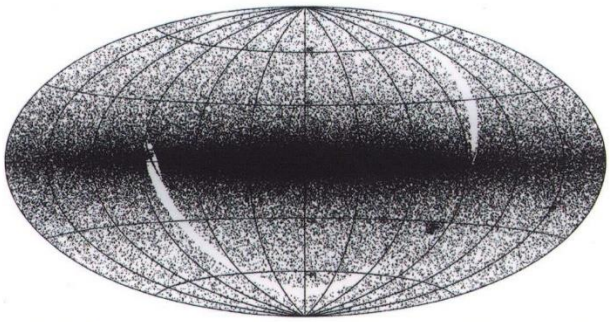
1983 1998

Before



Before IRAS: The picture shows just over 1100 objects known to infrared astronomers before the IRAS mission. These are seen at the longest wavelength accessible from the ground (using telescopes on mountains, balloons and aircraft). The Milky Way, our own galaxy, stretches along the middle of the picture.

After



After IRAS: The picture shows over 100,000 objects found by IRAS at its shortest wavelength band (close to the longest ground-based wavelength). The Milky Way, our own galaxy, is clearly visible along the middle of the picture, and in the lower right, the two small clusters of objects are stars in the neighbouring galaxies (the Magellanic Clouds).

SERC

In 1983 the Science and Engineering Research Council was responsible for UK funding of the project.

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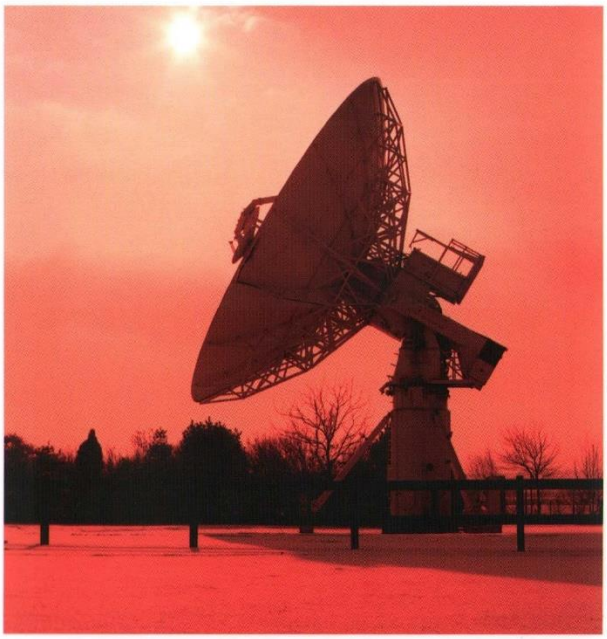
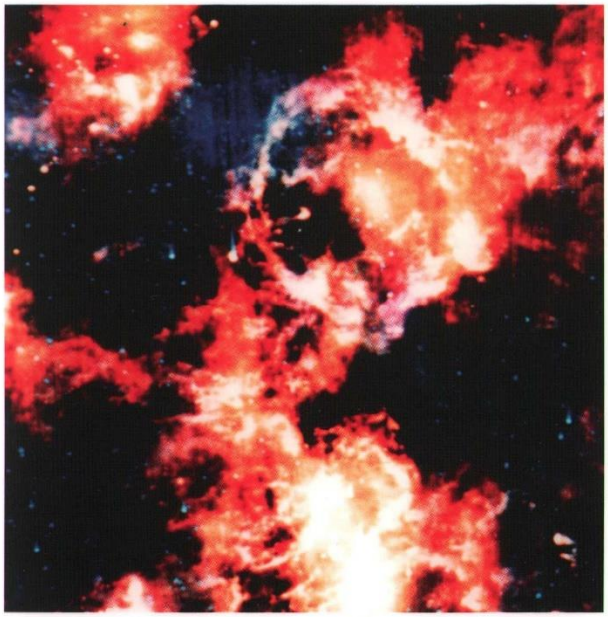


The RAL satellite ground station. The picture shows the satellite dish situated at CLRC Rutherford Appleton Laboratory which was used for the IRAS mission. It consists of a 12 metre fully steerable parabolic antenna. It is not only a feature of the RAL landscape but a source of interest to visiting schoolchildren and scientists alike.

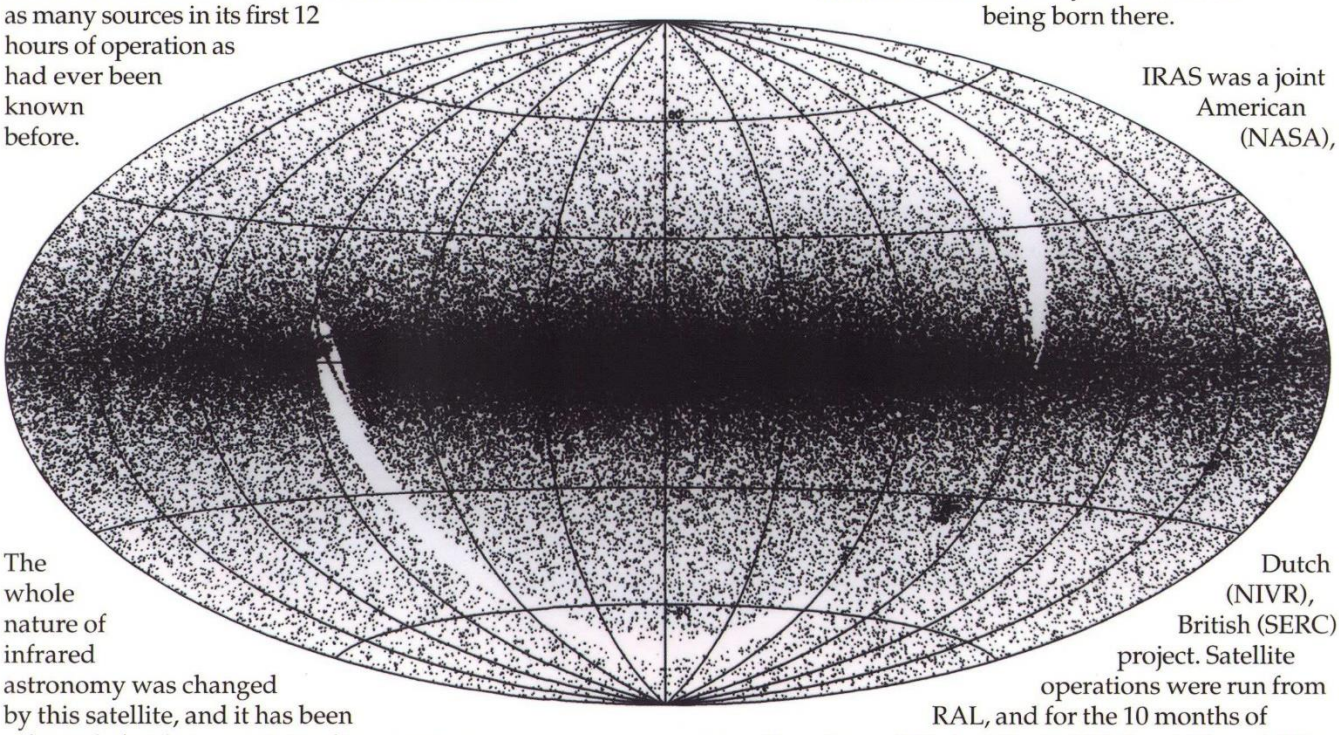


This picture shows the whole constellation of Orion, with Betelgeuse (the shoulder) in the top left and Rigel (the knee) near the bottom right. The Orion nebula is near the middle, but it is much larger in the infrared than in the visible. Another conspicuous feature is the large dust ring around the star Lambda Orionis, near the middle of the upper part of the picture, where many new stars are being born.

IRAS

Fifteen years ago, on 26 January 1983 (at 2:17 am GMT), the Infrared Astronomical Satellite (IRAS) was launched on its mission to survey the whole sky in the infrared region of the spectrum.

This type of survey had never been done before, and astronomers were stunned as IRAS discovered as many sources in its first 12 hours of operation as had ever been known before.



The whole nature of infrared astronomy was changed by this satellite, and it has been acknowledged as an outstanding success.

In the visible, the dust between the stars obscures the view of our own galaxy and the universe. In the infrared, we can see through the dust, and when the dust is heated (usually by stars buried inside the dust clouds), the dust glows brightly in the infrared, and is very easy to find across the enormous distances of inter-galactic space. The IRAS catalogues contain almost a quarter of a million objects. Among its landmark discoveries were:

- bands of dust in the solar system, where asteroids beyond the orbit of Mars had collided in past times
- six comets, including IRAS-Araki-Alcock, and the trails of dust left in space by the passing of the comets
- rings of dust around nearby stars like Vega, where planets failed to form
- galaxies which shine only in the infrared, due to millions of new stars being born in them
- Orion, where the whole constellation is filled with dust clouds warmed by the new stars being born there.

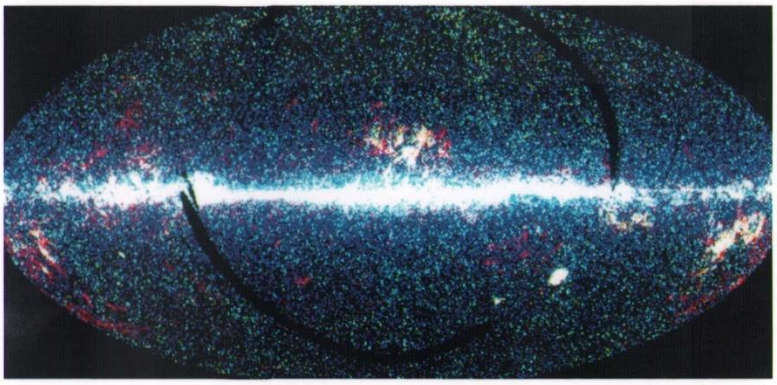
IRAS was a joint American (NASA), Dutch (NIVR), British (SERC) project. Satellite operations were run from RAL, and for the 10 months of operation, it was 'Mission Control Chilton'. The satellite was cooled by 1000 litres of liquid helium, to stop it being blinded by its own heat as it measured the very faint signals from distant objects. Once the helium had boiled away, the satellite warmed up and the mission was over.

Twice a day, seven days a week, for the full 10 months, commands were sent to the satellite, and data received using the 12m antenna provided by NASA. Alan Smith recalls the antenna being very hard to move one day, after a heavy snowfall the previous night. Visual inspection revealed the dish had filled with snow, so several people made specially shaped scrapers and climbed into the dish to clear it. He commented "after that, if there was snow forecast, we moved the dish and parked it on its side facing out of the wind".

After RAL received the data, they were checked then sent to America for processing. One day the control room was suddenly filled with very loud martial music. It transpired that this was used to wake the astronauts on the Shuttle, except they had been warned and turned down the volume, staff at RAL had not!

There was no way of measuring the amount of helium coolant left in the satellite, and so the end was a surprise to everyone. Helen Walker remembers she had been working late one evening, and so arrived late the next morning to find a very funereal atmosphere, instantly noticeable as she came through the door, and she was told the satellite had 'died'. "It was a sad moment for all of us," she mused, "but we had several great parties that week, as each and every group held a 'wake' for the satellite".

Following the IRAS mission, a small industry has developed in trying to find out what the IRAS objects are. Many students have produced theses based on IRAS data. In 1996 alone, almost 300 scientific papers were published which referred to IRAS, including around 450 objects known by their IRAS catalogue designation. Recently the IRAS catalogues have been used as the reference guide for the European Space Agency mission to study further the infrared sky with the Infrared Space Observatory (ISO). If the proposed target was not seen by IRAS, a very good excuse had to be presented to explain the omission.



The picture shows the 245,839 entries in the IRAS catalogue. The broad band across the middle (and the blue points) are objects in our own galaxy. The yellow/green points towards the top and bottom are generally other galaxies.

Scientific highlights

Solar system dust

Astronomers have known that there is a ring of dust in our solar system for centuries, it is called the zodiacal light. What they did not know, until IRAS, was that there were two extra rings of dust, one above and one below the main ring. Calculations suggest that asteroid collisions could produce dust for these extra rings. Many more 'rings' have been found within the three major rings, each ring associated with a family of asteroids.

Comets

One of the first discoveries made by IRAS was a bright comet, the discovery being shared with two amateur astronomers, hence the name IRAS-Araki-Alcock. Comets proved to have more dust associated with them than had been previously thought, which made it easy for IRAS to detect them. During the 10 months IRAS found six comets, of which three were only seen by IRAS, suggesting that the numbers of comets in our solar system have been underestimated. IRAS also detected the dust left behind a comet as it moves along its orbit, which can be seen as a faint straight line in IRAS data (like the trail of an aeroplane in the sky).

Dust rings

IRAS discovered a ring of dust around a normal nearby star, Vega. This was a great surprise because stars have dust rings when they are young, but they vanish later. It was thought the dust ring was a failed attempt to make planets. Three other nearby stars were found to have similar dust rings, and for one of them, Beta Pictoris, the ring was found, edge-on, optically. Several searches of the IRAS data have been made for similar objects, and some of these will be studied by ISO.

Infrared galaxies

Around 50,000 galaxies were found by IRAS, many of them previously unknown. When galaxies collide or merge, the event often triggers a burst of new stars being born, millions of stars at the same time. This burst heats the dust that forms them, so that the galaxies shine very brightly at IRAS wavelengths.

Orion

The constellation of Orion is very prominent in the winter night sky. When IRAS looked at this region, a very large number of warm dust clouds were found, each one being the site of new stars being born. The Orion nebula we see is only a very small part of the whole complex which stretches across the complete constellation.

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For more information contact:

Dr Helen Walker
CLRC Rutherford Appleton Laboratory
Telephone (01235) 446490
Facsimile (01235) 446667

More details of ISO and IRAS are available from CLRC's World Wide Web page, http://ast.star.rl.ac.uk/isouk/isouk.html