Cold dust within galaxies

Dust to Dust

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How does a grain of dust affect the fate of the Universe? For starters, had there been no dust in the Universe in the first place, humankind would not exist, either...

In November 2011, the Japanese satellite AKARI, conducting observations of the Universe in infrared since 2006, was taken out of commission. Its legacy is an extensive catalogue of the entire sky, containing data on over a million objects, and a series of detailed surveys of selected sections of the sky. Although there are far more powerful infrared telescopes operating in space today - such as the Herschel Space Observatory - the data generated by AKARI remain unique since they cover almost the entire blue range at various radiation wavelengths, from close to far infrared.

Infrared dust

Why is infrared so important in astronomical research? Infrared waves - slightly longer than the visible range - are also known as heat radiation. In infrared, everything produces a glow, as long as its temperature is above absolute zero. Thermal imaging cameras take advantage of that fact.

When the American satellite IRAS first started performing a survey of the entire sky at infrared wavelengths, astronomers realized that the Universe is teeming with objects that are invisible or nearly invisible in the optical spectrum. IRAS registered over 350,000 astronomical infrared sources, increasing the number of known astronomical objects by 70%.

The sources include new comets, stars shrouded in dust disks, clouds of dust in the Milky Way, and other galaxies. The common feature of all these sources is the presence of dust: grains no larger than a few molecules, as well as significantly larger ones comprising frequently extremely complex organic and inorganic compounds.

The data revealed that there are numerous large galaxies that are virtually invisible in the optical spectrum yet glow brightly in infrared. In reality, such galaxies are filled with myriad young hot bright stars; however, these stars are still immersed in the clouds of dust that gave rise to them. The dust absorbs visible and ultraviolet light emitted by the stars, and then emits it back as infrared radiation.

What did AKARI see?

AKARI, younger than its predecessor IRAS by over 20 years, used a far higher resolution, and conducted observations at longer wavelengths. The former made it possible for the satellite to detect significantly more

The AKARI satellite was launched into orbit on 22 February 2006

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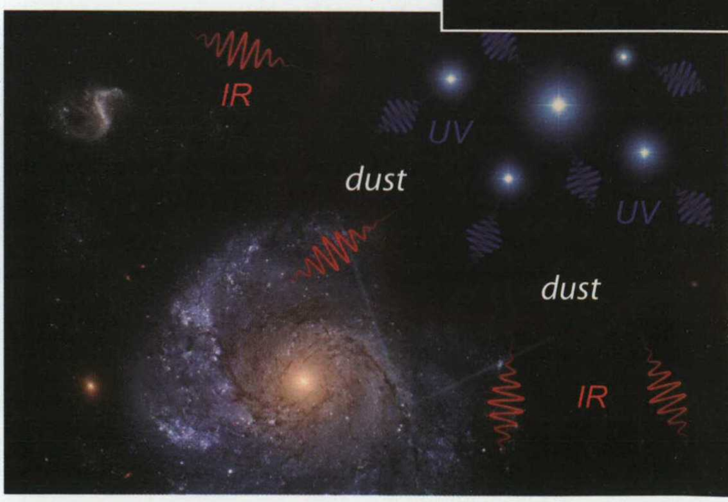

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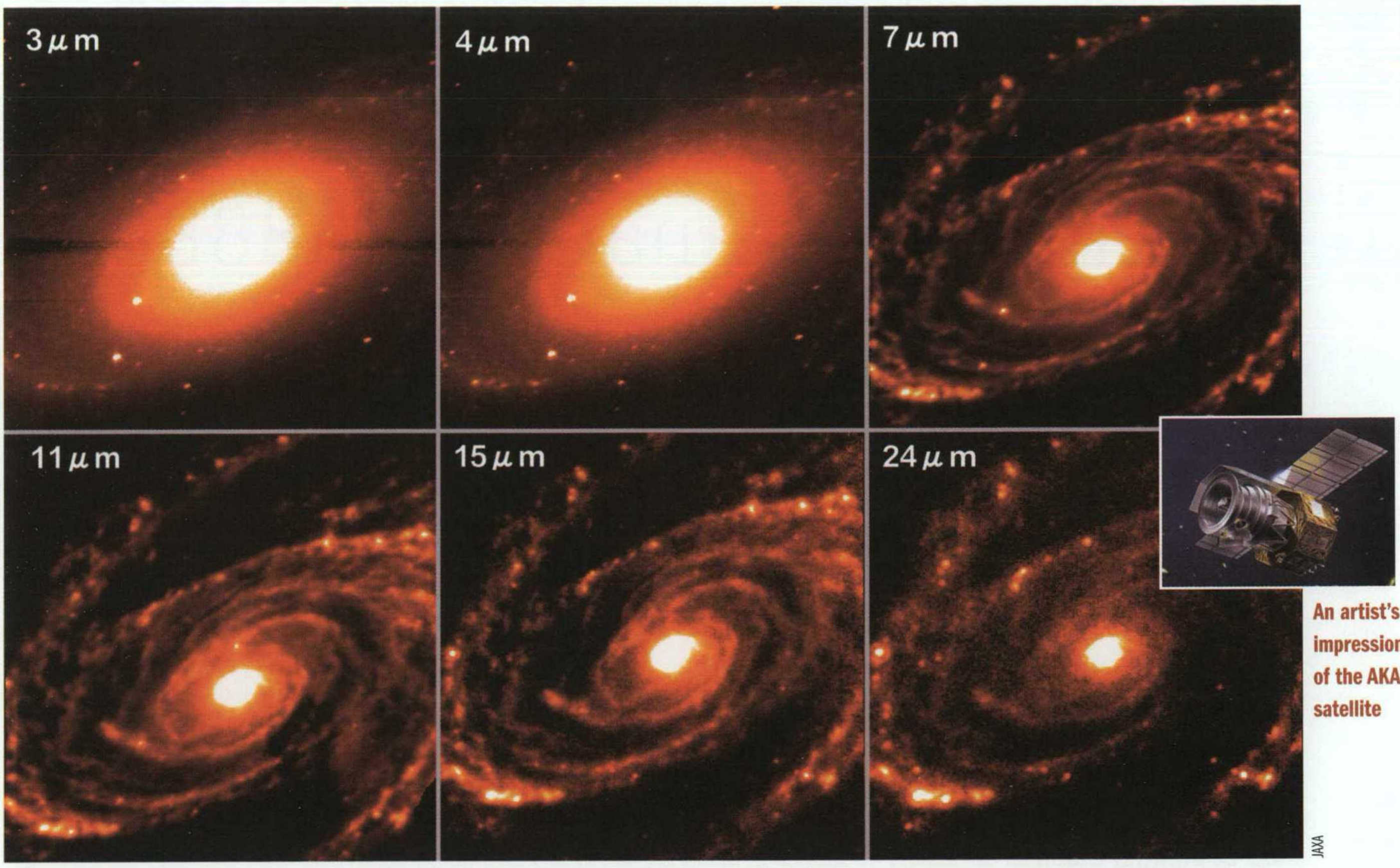
Processes of star formation within galaxies can be initiated by collisions or interactions between galaxies



An artist's impression of the AKARI satellite

The Andromeda Galaxy (M81) as viewed by AKARI in six ranges of near and mid-wavelength infrared. Shorter wavelengths (3 and 4 microns) reveal the distribution of stars in the inner part of the galaxy; at these wavelengths, dust clouds that conceal stars in the optical spectrum become transparent. The 7 and 11 micron ranges allows us to detect interstellar gas, while at the 15 and 24 micron ranges we can see radiation emitted by gas heated by young stars being formed in the spiral arms of the galaxy

sources, while the latter allowed it to detect objects filled with cold dust.

One of the sectors of the sky studied in more depth by the Japanese satellite is AKARI Deep Field South (ADF-S), covering a 12 square degree region near the South Ecliptic Pole. The region is sometimes described as an infrared "window onto the Universe" beyond the Milky Way due to the exceptionally low density of dust from our own galaxy.

AKARI detected over 2000 sources of radiation in the far infrared in the ADF-S region. The first obstacle was trying to determine whether the observed sources are faraway galaxies, or rather nearby galaxies containing high levels of cold dust, cool stars, or even entirely different objects. It was discovered that sources appearing bright in the far infrared are mostly nearby galaxies, in many ways very similar to "normal" galaxies that can be observed in visible light. Some emit significantly more energy in the infrared range than in the optical spectrum. This is undoubtedly caused by intensive star-forming processes taking place in these galaxies behind thick dust clouds.

Why is it that these galaxies emit so strongly in the infrared range, while others that appear to be similar do not? It turns out that many of the galaxies in ADF-S are currently passing or have recently passed near other galaxies; galaxies deformed by the close interaction are over ten times more common here than those visible in the optical spectrum. We know that interactions between galaxies interfere with their structure, increasing the density of dust within them and leading to violent star-forming processes. However, the importance of intergalactic interactions in the initiation of star formation remains unclear.

Remember man that you are dust...

It is no exaggeration to say that dust is one of the key players in the circulation of matter in space. Young stars form in its clouds; it is what planets emerge out of. Without dust and the chemical compounds within it, there would be no life on Earth, and - as such - no humankind. On the other hand, without it the Universe observed through optical telescopes would appear quite different - assuming, naturally, that any telescopes could exist in such a Universe.

Fyrther reading:

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