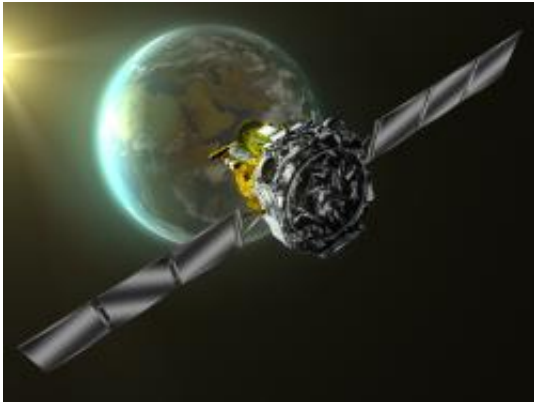


# Integral looks at Earth to seek source of cosmic radiation

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Artist's impression of Integral observing Earth

Cosmic space is filled with continuous, diffuse high-energy radiation. To find out how this energy is produced, the scientists behind ESA's Integral gamma-ray observatory have tried an unusual method: observing Earth from space.

During a four-phase observation campaign started on 24 January this year, continued until 9 February, Integral has been looking at Earth. Needing complex control operations from the ground, the satellite has been kept in a fixed orientation in space, while waiting for Earth to drift through its field of view.

Unusually, the main objective of these observations is not Earth itself,

but what can be seen in the background when Earth moves in front of the satellite. This is the origin of the diffuse high-energy radiation known as the 'cosmic X-ray background'.

Until now with Integral, this was never studied simultaneously with such a broad band of energy coverage since the 1970s, and certainly not with such advanced instruments.

Astronomers believe that the 'cosmic X-ray background' is produced by numerous supermassive and accreting black holes, distributed throughout deep space. These powerful monsters attract matter, which is then hugely accelerated and so emit high energy in the form of gamma- and X-rays.

X-ray observatories such as ESA's XMM-Newton and NASA's Chandra have been able to identify and directly count a large number of individual sources ◆ likely black holes ◆ that already account for more than 80 percent of the measured cosmic diffuse X-ray background.

However, very little is known about the origin of the highest energy band of this cosmic radiation, above the range of these two satellites. This is spread out in the form of high-energy X- and gamma-rays, within the reach of Integral.

It is believed that most of the gamma-ray background emission is produced by individual supermassive black holes too, but scientists need to couple this emission with clearly identified sources to make a definitive statement. In fact, other sources such as far-away galaxies or close weak sources could be also be responsible.

Identifying the individual sources in the gamma-ray range that make up the diffuse cosmic background is much more difficult than counting the individual X-ray sources. In fact, the powerful gamma-rays cannot be

focused with lenses or mirrors, because they simply pass straight through.

So to produce a gamma-ray image of a source, Integral uses a 'mask' technique - an indirect imaging method that consists of detecting the shadow of a mask placed on top of the telescope, as projected by a gamma-ray source.

During the observations, the scientists used Earth's disk as an 'extra mask'. Earth naturally blocks, or shades, the highest energy flux from millions of distant black holes.

Their combined flux can be accurately measured in an indirect way, that is by measuring the amplitude and the energy spectrum of the energy drop when Earth passes through Integral's field of view. Once this is known, scientists can eventually try to connect the radiation to individual sources.

All the observations were very successful, as all the gamma-ray and X-ray instruments on board Integral (IBIS, SPI and JEM-X) recorded clear and unambiguous signals in line with expectations.

The Integral scientists are already proceeding with the analysis of the data. The aim is to ultimately understand the origin of the highest energy background radiation and, possibly, provide new clues on the history of growth of super-massive black holes since the early epochs of the Universe.

Source: ESA

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