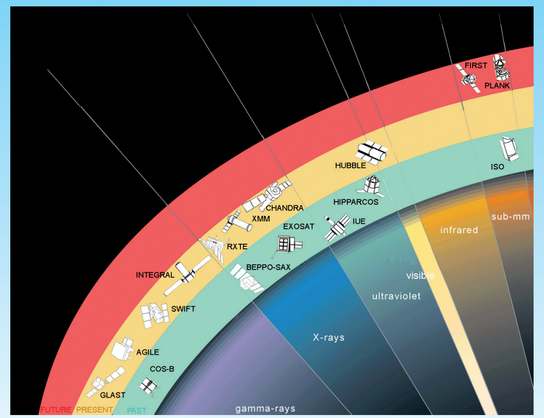
Unimaginably large explosions take place at cosmic distances. They release vast quantities of energy, mostly in forms of radiation that are invisible to our eyes.
By collecting such a radiation, the ESA's INTEGRAL mission provides a view of the Universe very different from the one we have when looking upwards on a clear night. At variance with the serene beauty of the stars, INTEGRAL is observing an ever changing, violent cosmos .

Gamma rays represent the most energetic form of radiation in nature. They carry large quantities of energy produced by extreme physical pro-cesses in astronomical objects.
There are exploding stars, colliding neutron stars and matter being swallowed by black holes.
Moreover, Gamma rays are produced by particles trapped in magnetic fields million of million time stronger that the one we experience on the Earth. All of these events release vast amounts of energy, with much of it carried by Gamma rays.

INTEGRAL collects these Gamma rays, allowing astronomers across the world a clear view of the most extreme environments in the Universe.

INTEGRAL is not alone: from November 2004 the NASA SWIFT telescope (which relies on an important Italian contribution) is operational. Other instruments, sensible to photons of slightly different energies, are complementing the observations of the Gamma missions: ESA's XMM-Newton and NASA's Chandra telescopes scrutinize the sky in soft X-rays. Taking advantage of the synergies among all these instruments, scientists around the world can study in detail the most energetic phenomena of our Universe.



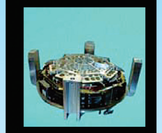
INTEGRAL spent a substantial part of his four years in orbit to collect spectra and images of very many sources in the galactic centre and on the disk of the Milky Way. A substantial fraction of the observing time has been devoted to observation of the extragalactic sky.
This observation strategy yielded the detection of more than 400 galactic sources and about 200 Active Galactic Nucleus (AGN), Clusters of galaxies, Quasars and Blazars.

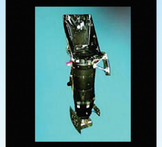
INTEGRAL showed that, contrary to what happens at lower and higher energy, the apparently diffuse emission associated to the Milky Way is due to the superposition of a lot of weak gamma sources.
Each has a position determined to better than few arcmin and, thus, can be associated with astronomical objects emitting in the optical, infrared and radio band

INTEGRAL revealed the presence of a new gamma-ray sky, extremely variable harbouring violent processes, the most energetic ever observed: a real Nuclear Laboratory .

INTEGRAL is an astrophysics Gamma-ray Observatory with extraordinary good performances. The Observatory, weighting about 4 tons, has been with a Russian Proton rochet launched into an highly elliptical orbit from Baikonur (Kazakhstan) on October 17, 2002 at 4.41 UT. The INTEGRAL principal aim is to observe the Universe in the energy range from 15 keV to 10 MeV with good X-Ray sensitivity down to 3 keV and monitoring capability in the optical V band at 550 nm. It is an international mission led by ESA with main instruments produced by Italian, French and German Institutes and Space Agencies with other EU countries and USA contributions.

INTEGRAL instruments





The Gamma Imager IBIS provides sharper images than any previous Gamma-ray instrument. It is able to locate sources to within a precision of 30 arcseconds, which is the equivalent of measuring the position of individual people in a crowd situated at a distance of 1.3 km. The instrument works in the energy range 15 keV to 10 MeV. It consists of a detector and a coded mask made of tungsten that is placed 3.2 m above it. The detector uses two layers of sensitive picture elements (pixels) located one on top of the other.
The top layer is made of 16,384 cadmium-telluride pixels to detect the low-energy Gamma rays. The second layer consists of 4,096 caesium-iodide pixels, to capture the high energy gamma rays. A Tungsten coded mask, 16 mm thick is placed at 3.2 meter from the detector unit. The principal investigating institutions for IBIS are IASF/Roma, Italy, CEA Saclay, France and IASF/Bologna, Italy.

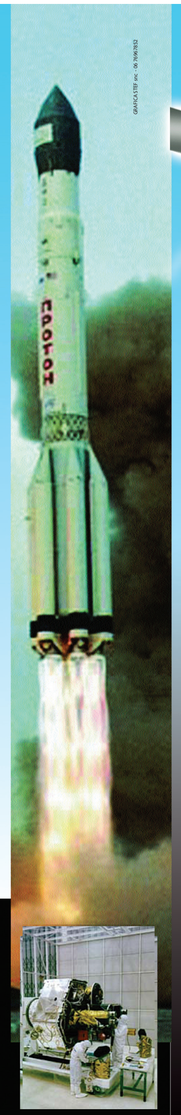
The Spectrometer SPI allows to measure Gamma ray energies with exceptional accuracy. It is more sensitive to radiation than any previous high accuracy Gamma ray instrument. SPI is used to analyse sources over an energy range between 20 keV and 8 MeV, using an array of 19 hexagonal high purity germanium detectors, cooled to -183 degree Celsius (90 Kelvin). To reduce interference, the detector is shielded by bismuth germanate oxide crystals, extending around the bottom and side of the detector almost completely up to the coded mask. As a consequence of its construction, SPI is extremely heavy, with a mass of 1,300 kg. The principal investigating institutions for SPI are CESR Toulouse, France and MPE Garching, Germany.

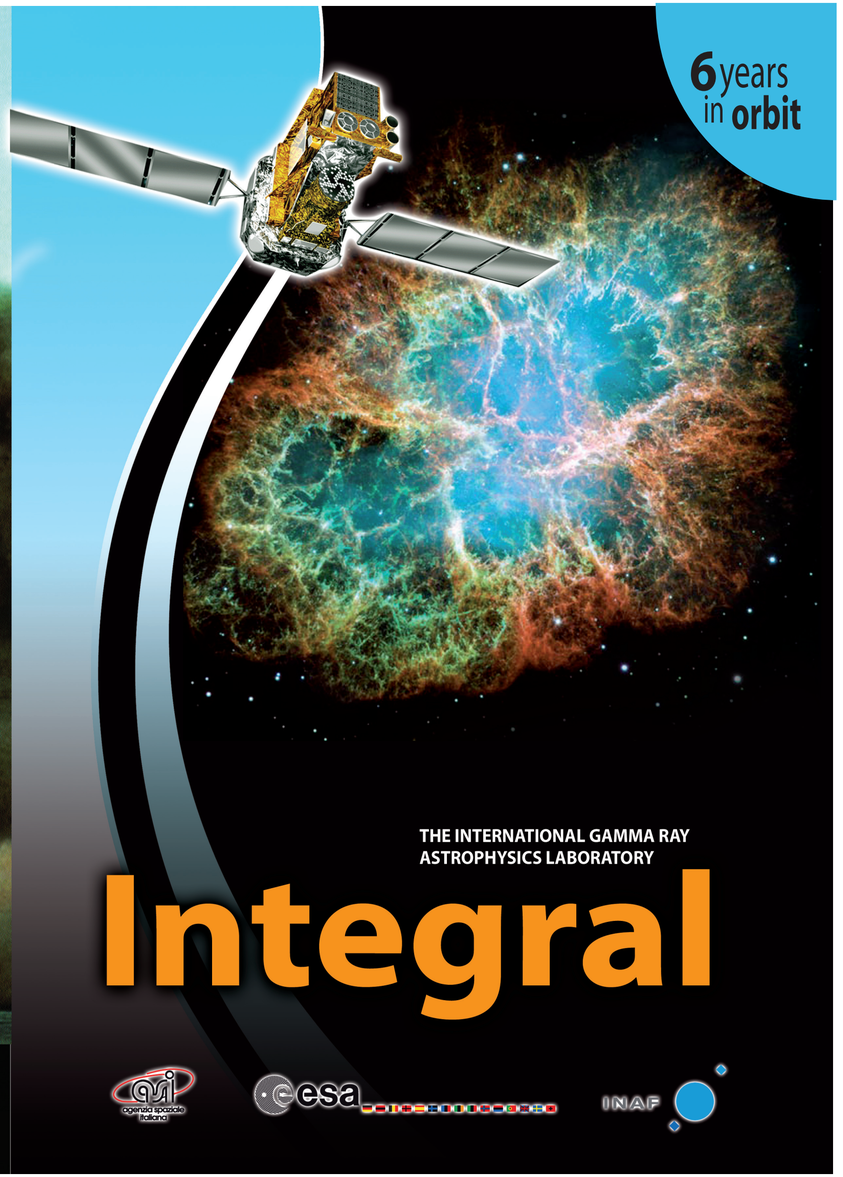
The Joint European X-Ray Monitor, JEM-X, plays a crucial role as monitor for the lower energies. JEM-X is a pair of telescopes that make observations simulaneously with the main Gamma ray instruments and provides images in the 3 to 35 keV energy range with an angular resolution comparable of that of IBIS. Like IBIS and SPI, it uses a coded mask technique. Two coded masks are located 3.2 m above the detection plane. The detector, a so-called Imaging Micro-Strip Gas Counter, consists of two identical gas chambers filled with a mixture of xenon and methane at a pressure of 1.5 bar, i.e. 1.5 times the normal atmospheric pressure at sea level. The principal investigating institution is DSRI, Denmark, with a participation, among others institutions, of IASF/Rome and University of Ferrara.

The optical monitor, OMC offers to INTEGRAL the opportunity to make automatically, simultaneous observations of the visible light coming from the Gamma and X-ray sources. Such observations are particularly important in high energy astrophysics because emission from a source can change very rapidly.
The OMC can register objects of magnitude 18.2 in a 1,000 second exposure and is basically a traditional refracting telescope (i.e. one that uses a lens to focus light). It has a 5 cm lens and a CCD (charge-coupled device) detector in the focal plane. The principal investigating institution is INTA/LAEFF, Spain.

Continuing a long tradition

The first European Gamma ray satellite was COS-B and was launched during 1975 by the European Space Agency. His successful operation enabled for a long time a leadership role to European Gamma ray Astrophysicists. COS-B was followed by the Russian-French mission GRANAT, NASA's Compton Gamma-ray Observatory and, from April 1996 the Italian+Dutch satellite BeppoSAX. From October 17, 2002 Astrophysicists have a new powerful tool in orbit: INTEGRAL, the most sensitive Gamma ray observatory ever built. From 2004 the SWIFT Telescope is also operational and during 2007 INTEGRAL has been joint in operation by the AGILE Italian Gamma -Ray satellite, successfully launched by ASI. The 11th of June, 2008, NASA launched the powerful Gamma-Ray satellite GLAST and, August the 26th, announced that GLAST has been renamed the Fermi Gamma-ray Space Telescope. The new name honors Prof. Enrico Fermi (1901-1954), a pioneer in high-energy physics.





6 years in orbit

THE INTERNATIONAL GAMMA RAY ASTROPHYSICS LABORATORY

Integral

asi agenzia spaziale italiana

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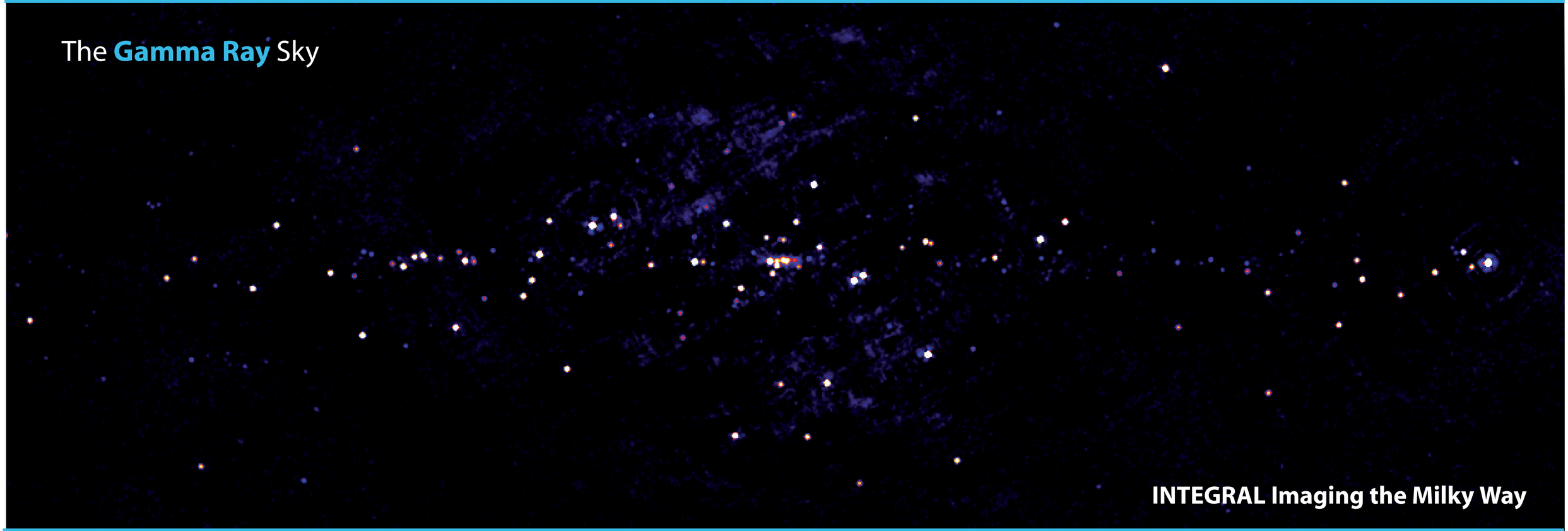
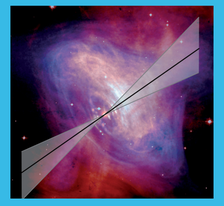
INAF

The **Gamma Ray** Sky

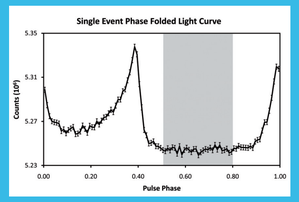


INTEGRAL Imaging the Milky Way

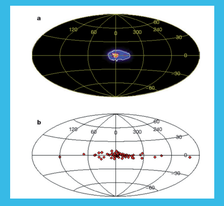
Polarised Gamma Rays from the Crab



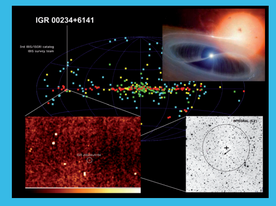
INTEGRAL light curve of the Crab Pulsar



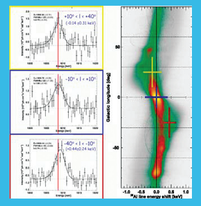
A new view of the Galactic positrons nature from INTEGRAL



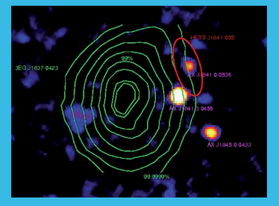
Accreting white dwarfs, a growing number of new high energy sources



Evidence of the Galaxy Rotation from Fossil Aluminium

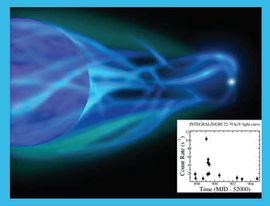


Cosmic Accelerators from keV to TeV



Milky Way central region view in Gamma-Ray

Gamma Ray Transients with Supergiant Companions



Extragalactic Giant Black Holes