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The center of the Galaxy seen in X-rays
by the Chandra-NASA satellite (mosaic of 30 images)

Giant black hole

THE MOST FORMIDABLE STAR IN THE GALAXY IS A SILENT,
INVISIBLE MONSTER, HIDING IN ITS HEART ITSELF



Because of its **remoteness**, the veil of dust hiding it
and the large number of stars in-between, it is difficult to observe the exact
center of the Galaxy.

And yet, the object located at the center is the most imposing one in the Galaxy. It is a black hole,
with a **mass** that is 4 million times greater than that of the Sun. The black hole does not
produce any light itself, but the matter falling on it sometimes reaches very high temperatures.
It then produces **high-energy** radiation, in the form of X and gamma rays.

Astronomers have tried to see the black hole under this high energy light, but the
black hole has remained very inconspicuous and their research has proved to be
disappointing so far.

WHY CAN'T A BLACK HOLE BE SEEN?

A black hole cannot be seen directly because it does not radiate any light.
Its gravity is such that even light cannot escape and it therefore becomes
"invisible".

HOW CAN A BLACK HOLE BE RECOGNIZED?

A black hole can be recognized by the gravitational force it exerts and the
disturbances it creates around it.

HOW BIG IS A BLACK HOLE?

In theory, a black hole may have any mass – it may be minuscule or huge.
Astrophysicists believe that they have discovered black holes in the
Universe that are of the mass of a star but also giant black holes with
masses varying between several million and several billion times that
of the Sun.

WHAT IS THE SIZE OF A BLACK HOLE?

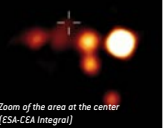
A black hole's dimension is provided by its "horizon" – the surface area
below which light is imprisoned by the black hole. The "horizon's" radius
varies in proportion to its mass. A black hole of the mass of the Sun has a
"horizon" of just 3 kilometers, while a giant black hole with a mass that is
a billion times that of the Sun has a horizon of 3 billion kilometers, i.e. 20
times the Earth-Sun distance.

THE CENTRAL REGION OF THE GALAXY SEEN BY GAMMA RAYS

The center of the Galaxy is congested with several high energy radiation sources.
The first detailed image of the region in gamma rays was obtained by the *SPACAL* satellite in 2003. At the exact
point in the center of the Galaxy where the giant black hole is located (cross), there is a very limited source of
emissions. The giant black hole currently seems dormant.



The central region of the Galaxy seen by gamma rays by the
INTEGRAL satellite (superimposed on the gas emission in orange)



Zoom of the area of the center
(ESA-ESA Integral)

"BALLET OF STARS AROUND AN INVISIBLE POINT"

HOW DOES ONE KNOW THAT THERE IS A BLACK HOLE AT THE CENTER OF THE GALAXY?

The black hole was detected by the gravitational force it exerts on the stars around it. Large telescopes and
progress in the observation of infra-red light made it possible to pierce the veil of dust and locate the closest
stars to the central point.
Observed for over ten years, these stars, which may appear to move in a disorderly fashion, actually follow
regular orbits. They seem to revolve around an invisible point. Images taken regularly show that the stars follow
elliptical orbits, like the planets around the Sun. The closest star describes a complete orbit in 15 years.
Gravitational laws allow us to calculate that the invisible object at the center has a mass that is about 4 million
times that of the Sun.
However, the object does not emit any light – it is a black hole.

Infra-red image of the stars around the black hole
(cross)



Trajectory of the stars between 1992 and 2008
(VLTI telescopes)

