

The regular breath of Cygnus X-3 seen by AGILE

An outstanding discovery of the Italian satellite AGILE devoted to gamma-ray astronomy: it catches a mysterious accelerator of our Galaxy while revving up particles to the highest energies and blasting powerful jets into space.

The team of the AGILE satellite (a joint collaboration of the Italian Space Agency, ASI, the Italian Institutes of Astrophysics, INAF, and Nuclear Physics, INFN) together with other American, English, and Russian researchers headed by Marco Tavani of INAF has detected for the first time high-energy gamma-rays emanating from one of the most mysterious and powerful systems of our Galaxy, the famous binary system Cygnus X-3.

The study, published by *Nature* on November 22nd 2009, reveals a surprisingly regular behavior of Cygnus X-3 according to which gamma-ray emission occurs only in particular conditions, or “states” of the source recurring over the time. Astrophysicists are very interested in these phenomena that imply the existence of a reproducible mechanism of acceleration of high-energy particles.

Although the nature of this star - either a black hole or a neutron star- is still being investigated, AGILE has definitely detected recurrent events of gamma-ray emission that always precede the onset of powerful radio jets. This discovery provides a new window on the properties of the most energetic objects of the Galaxy, and preludes further observational and theoretical studies for the understanding of these enigmatic objects and even more massive black holes.

Black holes and compact neutron stars are the most energetic and extreme objects of our Galaxy. They can throw off blobs of material at large speeds in the form of “jets” that release the energy stored in their enormous gravitational field. One of the most powerful objects in our Galaxy is the binary system Cygnus X-3 that occasionally (1-2 times per year) produces very powerful radio jets together with X-ray detected spasmodic activity. One of the envisioned phenomena, never observed before, is the gamma-ray emission stemming from high-energy accelerated charged particles associated with the production of jets. Now a group of scientists, headed by **Marco Tavani** of INAF succeeded in this task: using the AGILE satellite they have detected for the first time gamma-ray emission from Cygnus X-3, the most active galactic source producing jets.

During decades of observation, Cygnus X-3 has always shown an irregular behavior of emission. After many controversial observations at the highest energies, the breakthrough came from a special campaign of

AGILE observations of the Cygnus region that started in 2007. By monitoring the region, recurrent events of strong gamma-ray emission was finally discovered from Cygnus X-3. The gamma-ray emission and the consequent particles acceleration to very large energies are not occurring randomly, but rather take place *before* the onset of strong radio jet ejections.

“It is as if Cygnus X-3 ‘gets ready’ to hurl out the enormous jet energy by holding on for several days in a special state of ‘energy charge’ during which it accelerates particles to extremely high energies”, says **Marco Tavani**. “It is an event never detected before in its dynamics, and is very surprising. It seems that Cygnus X-3 has changed from a ‘crazy’ behavior to an unexpected clockwork pattern”.

“We are very satisfied with this discovery by AGILE because on one hand it confirms the excellent performance of the satellite and its instrument, and on the other hand it envisions the possibility of expanding its operational life” comments **Enrico Flamini**, responsible for the ASI Science Department.

“It is another important result – underlines **Piergiorgio Picozza** of the Italy’s National Institute of Nuclear Physics (INFN) and University of Rome, Tor Vergata – made possible by the use of detectors created for the physics of elementary particles that INFN has launched into the space”.

AGILE, an acronym for *Astorivelatore Gamma a Immagini Leggero*, is a mission of the Italian Space Agency (ASI), designed by the Italian Institute for Astrophysics (INAF), the Italian Institute of Nuclear Physics (INFN), the Italian Research Council (CNR), and several Italian universities. It has been developed and manufactured in Italy by several scientific institutes and a pool of industrial contractors including Carlo Gavazzi Space, Thales Alenia Space, Rheinmetall Italia, Telespazio, Mipot. It was launched on April 23, 2007 from the Sriharikota launch base in India, and since then has completed more than 13 thousands orbits around the Earth.