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EIGHT YEARS OF GAMMA-RAY ASTROPHYSICS: THE AGILE MISSION

Abstract

AGILE (Astrorilevatore Gamma a Immagini LEggero) is an Italian high-energy astrophysics space program funded by the Italian Space Agency (ASI). The satellite was launched from India on April 23rd 2007 in a LEO equatorial orbit. The scientific payload includes: an X-ray imaging detector (sensitive in the range 20-60 keV), a gamma-ray imaging detector (100 MeV – 30 GeV), and a Mini-calorimeter (0.4 – 100 MeV). As of the end of February 2015, more than 40,600 orbits have been accumulated by the satellite after almost eight years of nominal operations in space, well beyond the expected life of two years.

AGILE contributed to high-energy astrophysics and terrestrial physics with many discoveries and detections. The instrument has a unique detection capability in the range 100 MeV – 1 GeV, an optimal point spread function, and reached large exposures by dedicated pointings. It combines, for the first time, simultaneous imaging capability in the hard X-ray and gamma-ray energy ranges. AGILE detected hundreds of gamma-ray sources: a special focus was devoted to neutron star and black hole systems in the Galaxy and to the properties of supermassive black holes in remote quasars. A special data processing system leads to the fast detection of gamma-ray transients on a 2-3 hr timescale.

Major achievements include: the discovery of variable gamma-ray emission from the Galactic micro-quasar Cygnus X-3 in coincidence with ejections of relativistic jets; the search for Galactic sources of cosmic-ray acceleration, and the first direct evidence of hadronic cosmic rays in Supernova Remnant W44; the detection of gamma-ray flares from several quasars hosting rotating supermassive black holes including the very intense transient episodes from 3C 454.3 in 2010; the detection of hundreds of terrestrial

gamma-ray flashes (TGFs) up to 100 MeV demonstrating the existence of efficient and unexpected particle acceleration in thunderstorms and lightning; the discovery in September 2010 of transient gamma-ray emission from the Crab Nebula demonstrating the existence of a novel mechanism of particle acceleration (“super-acceleration”); the detection of several gamma-ray transients in the Galaxy including AGL J2241+4454 that led to the discovery of the first black hole in a binary with a Be-star companion.

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