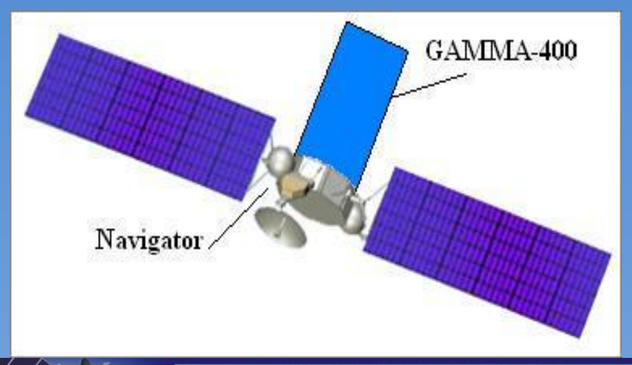


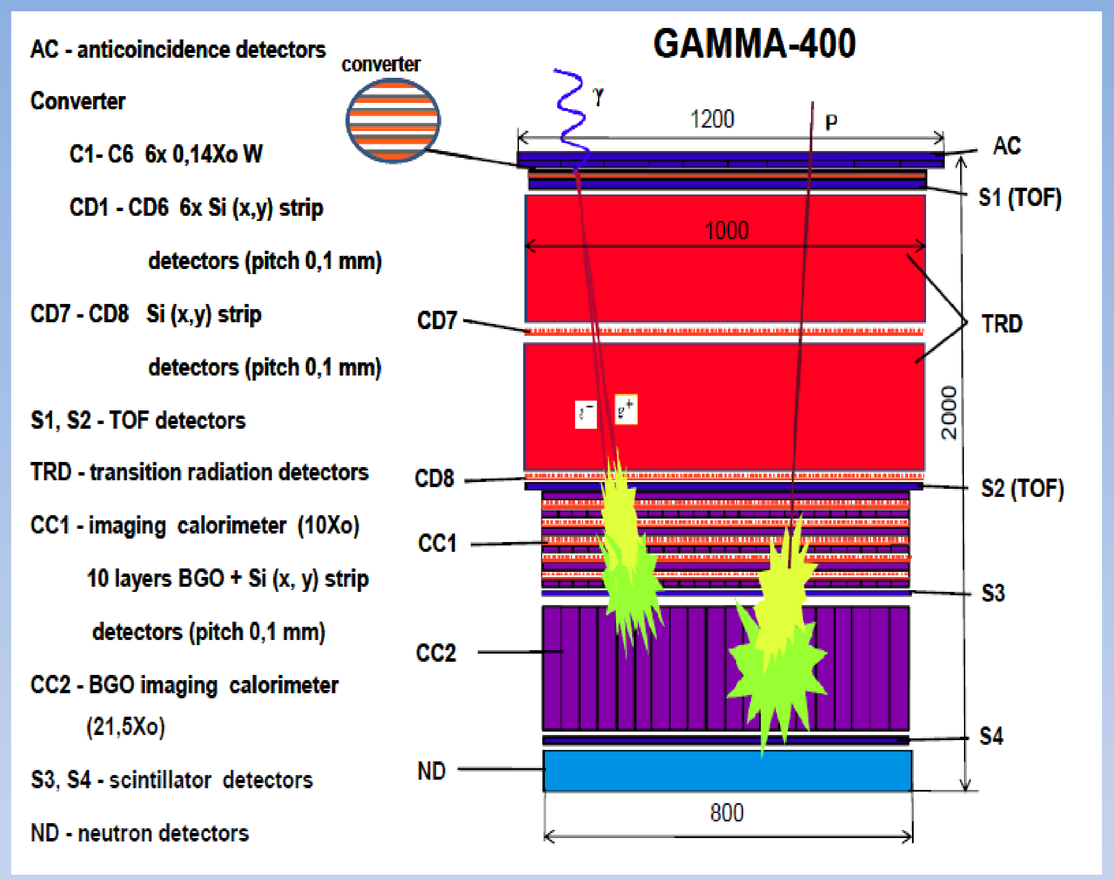
2010: STATUS OF THE GAMMA-400 PROJECT

A.M. Galper[1, 2], N.P. Topchiev[1*], M.I. Fradkin[1], S.I. Suchkov[1], Yu.T. Yurkin[2], I.V. Arkhangelskaya[2], B.A. Dolgoshein[2], M.O. Farber[2], V.A. Kaplin[2], M.F. Runtso[2], V.G. Zverev[2], V.Ya. Gecha[3], A.L. Men'shenin[3], V.A. Kachanov[4], O.F. Prilutskii[5], V.G. Rodin[5], R.L. Aptekar[6], E.P. Mazets[6], V. Bonvicini[7], M. Boezio[7], A. Vacchi[7], N. Zampa[7], P. Picozza[8], P. Spillantini[9], G. Castellini[10]

[1]Lebedev Physical Institute, Russian Academy of Sciences, Moscow, Russia;
[2]Moscow Engineering Physics Institute, Moscow, Russia;
[3]All-Russia Research Institute of Electromechanics and Iosifyan Plant, Moscow, Russia;
* tnp51@rambler.ru
[4]Institute for High Energy Physics, Protvino, Russia;
[5]Space Research Institute, Russian Academy of Sciences, Moscow, Russia;
[6]Ioffe Physical Technical Institute, Russian Academy of Sciences, St. Petersburg, Russia;
[7]Istituto Nazionale di Fisica Nucleare, Sezione di Trieste, Italy;
[8]Istituto Nazionale di Fisica Nucleare, Sezione di Roma 2 and Physics Department of University of Rome "Tor Vergata", Rome, Italy;
[9]Istituto Nazionale di Fisica Nucleare, Sezione di Firenze and Physics Department of University of Florence, Florence, Italy;
[10]Istituto di Fisica Applicata "Nello Carrara", Florence, Italy.

Abstract

The GAMMA-400 telescope for detecting gamma rays and electrons (positrons) in the energy range 0.1-3000 GeV is presented. Its performance (angular resolution ~0.02º, energy resolution ~1%, e/p rejection factor ~10^6) enables to detect high-energy gamma rays from galactic and extragalactic astrophysical objects, to measure energy spectra of galactic and extragalactic diffuse gamma-ray emission, to search for gamma rays and electrons (positrons) from annihilation or decay of dark matter components, to search for and investigate transient phenomena of high-energy (more than 1 GeV) gamma-ray bursts, as well as galactic electron (positron) fluxes.

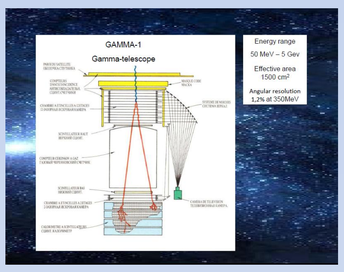


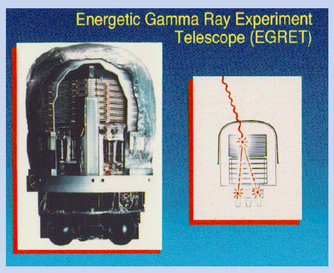
MAIN PROBLEMS OF THE HIGH-ENERGY GAMMA-RAY ASTRONOMY (Eγ > 100 MeV)

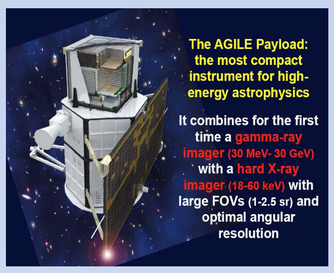
- **Generation of cosmic rays** in discrete extragalactic and galactic sources, including the Sun, connected with the appearance of high-energy gamma-ray fluxes.
- Measurement of energy spectra of galactic and extragalactic **diffuse gamma-radiation**. Search for spectral anomalies.
- Study of the nature of **dark matter** particles by their annihilation and decay, which are accompanied by the appearance of high-energy gamma-ray, electron, and positron fluxes.
- Investigation of **transient phenomena of** high-energy gamma rays.

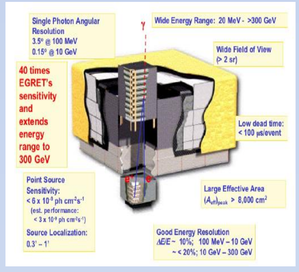
HIGH-ENERGY SPACE-BASED GAMMA-RAY TELESCOPES

GAMMA-1 | EGRET | AGILE | Fermi-LAT







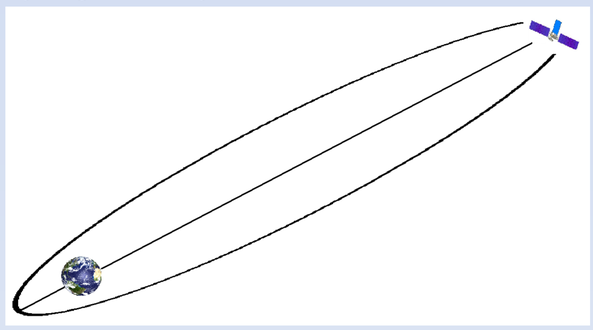


Main results (2010)

GAMMA-1 – High-energy gamma rays (> 1 GeV) from solar flares
EGRET-Third EGRET Catalog:
271 discrete sources, 170 unidentified sources
AGILE - First AGILE Catalog:
47 discrete sources, 8 unidentified sources.
FERMI-LAT – First Fermi Source Catalog:
1451 discrete sources, 630 unidentified sources

REQUIREMENTS TO NEW GAMMA-RAY TELESCOPE PROJECT

To explain many new problems occurred after the EGRET, AGILE, FERMI observation data and to improve their performances it is necessary for future gamma-ray telescopes to:
1. Extend the energy range up to 3000 GeV (to explain space-based and ground-based observation data).
2. Improve energy resolution up to ~1% (to reveal features in the energy spectra of gamma rays, electrons, and positrons, which are found to be connected with the dark matter).
3. Improve angular resolution up to ~0.02° (to identify discrete sources).
4. Increase sensitivity.
5. Increase the efficiency of gamma-ray selection.



GAMMA-400 ORBIT

The GAMMA-400 space observatory with the Navigator service module will be launched by the Zenit-2SB launch vehicle into a high-apogee orbit (apogee 300000 km, perigee 500 km, inclination 51.8).
GAMMA-400 is developed within the framework of the Russian Federal Space Program.

THE GAMMA-400 INSTRUMENT PARAMETERS AND ESTIMATED PERFORMANCE.

Parameters	*Value of range*
Energy range	0.1-3000 GeV
Converter area	100 x 100 cm^2
Converter thickness	0.84 radiation lengths
Coordinate detectors	Si strips with 0.1-mm pitch
Angular resolution (Eγ > 100 GeV)	~0.02°
Calorimeter thickness	~30 radiation lengths
Calorimeter area	800 x 800 mm^2
Field of view	± 55º
Geometrical factor	1.8 m^2sr
Energy resolution (Eγ > 10 GeV)	~1%
Weight	~ 2500 kg
Proton rejection	10^6
Point source sensitivity, ph/cm^2 s (Eγ > 100 MeV)	~5x10^{-9}
Telemetry downlink	100 GB/day
Dimensions	2×2×2.5 $м^3$
Power consumption	2000 W
Duration of experiment	More than 5 years