Российская Академия Наук
Физический Институт имени П.Н.Лебедева
Ф И А Н

THE GAMMA-400 PROJECT

Direct measurements of the primary gamma-radiation in the energy range 30 GeV – 1 TeV

GAMMA-400 COLLABORATION:

Lebedev Physical Institute (Leading organization)
Moscow Engineering Physics Institute
Institute of High-Energy Physics (Protvino)
Special Construction Office of the Space Research Institute

The problem leader is academician V.L. Ginzburg

MAIN SCIENTIFIC GOALS

1. The measurements of the gamma-ray energy spectra of the Galactic diffuse radiation and some astronomical objects.
2. Search for monoenergetic gamma-ray lines, created by the annihilation of neutralinos, supersymmetric particles, which, as supposed, form Dark Matter.
3. Long-time (about 5 years) observations of the strong gamma-ray sources.

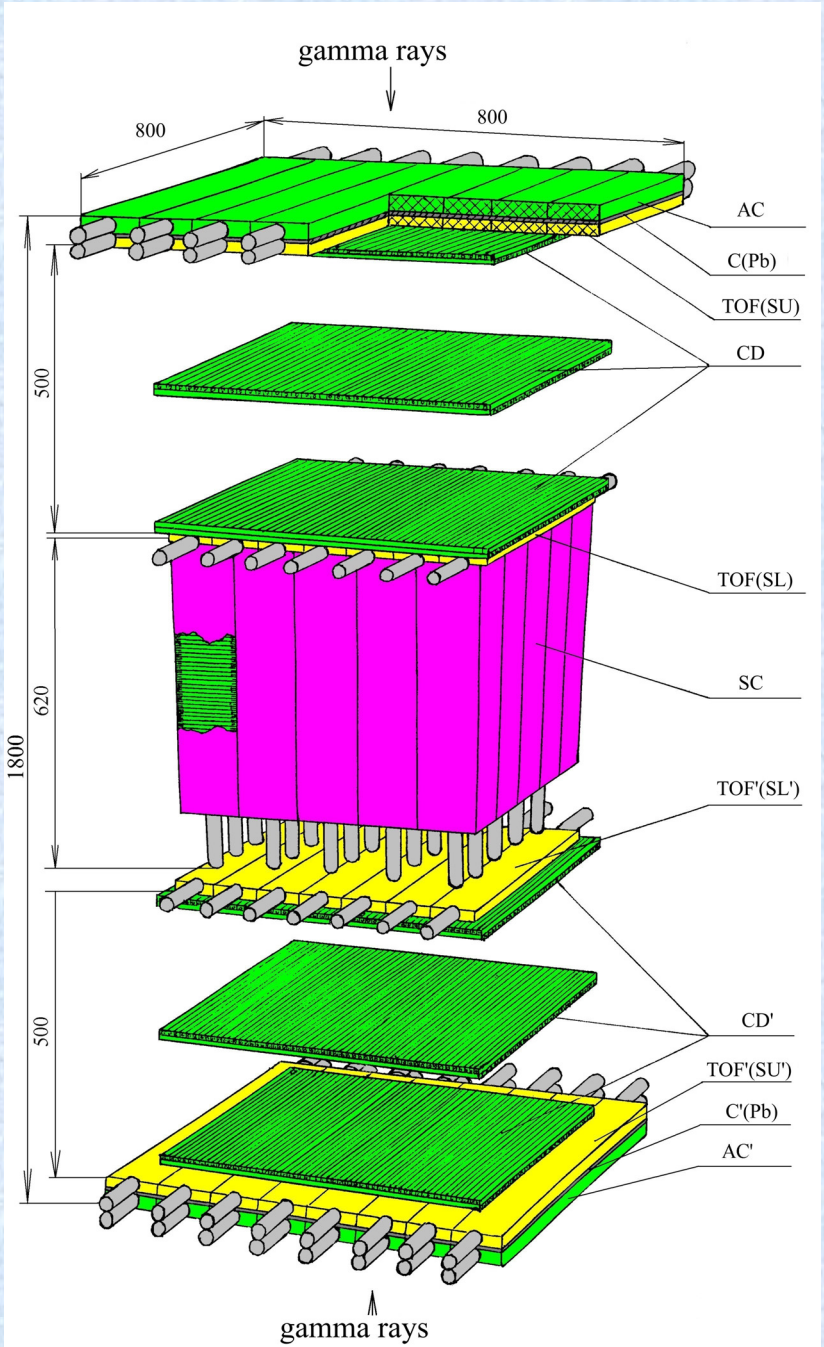

Fig. 1. The GAMMA-400 gamma-ray telescope.

1. Telescope GAMMA-400 has basically ordinary structure. It consists of following systems:

1.1. Primary gamma-ray selection system: veto-detector (AC), lead converter (C), scintillators (SU, SL) for detection of the conversion products.

1.2. Coordinate system (detectors CD) determining direction of charged particles.

1.3. System for measurement of electron cascade energy (sampling calorimeter SC).

2. GAMMA-400 telescope possesses some specific features:

2.1. All detectors used are plastic scintillators.

It raises device reliability and lowers cost.

2.2. There is special system for elimination backward particle scattered from calorimeter.

It gives possibility to measure the energy spectra up to several TeV.

2.3 Detectors of coordinate system are narrow scintillators with wavelength shifter (WLS) fibers collecting light. New solid-state silicon photomultipliers (SiPM) are used as light receivers.

As a result, we can decrease energy consumption and cost.

2.4. Two sets of gamma-ray selection systems are used.

In this case, geometric factor of the telescope is doubled with the slight increase of telescope weight.

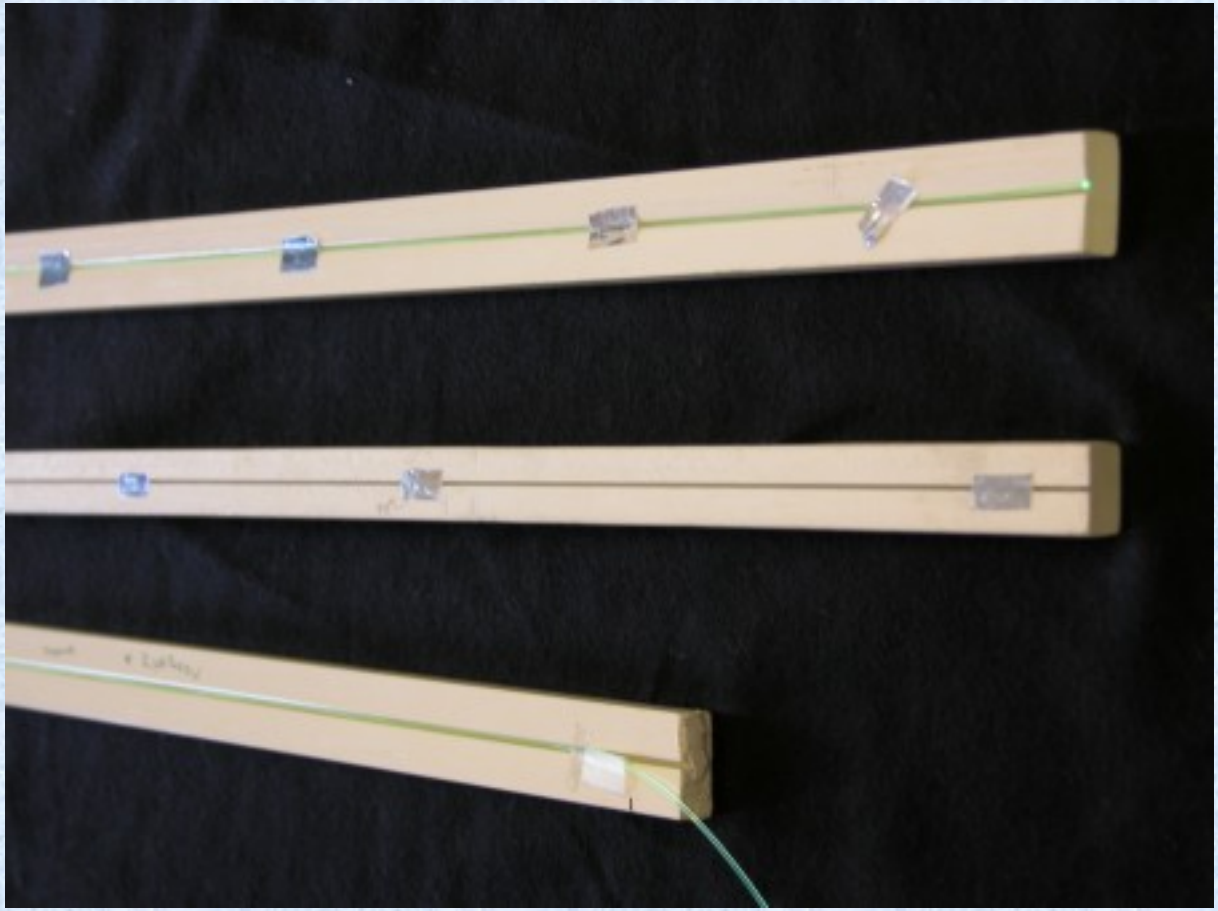

Fig. 2. Photograph of scintillation strips with wavelength shifter fibers.

2.5. Calorimeter is assembled from 25 separate modules. Every module consists of alternate layers of lead (thickness 0,55 mm) and scintillation (thickness 1,5 mm). Total calorimeter thickness is 18 radiation lengths (200 layers of lead and scintillators). Scintillation light is collected by 144 WLS fibers, transpiercing all scintillation layers, and is transported to vacuum photomultiplier.

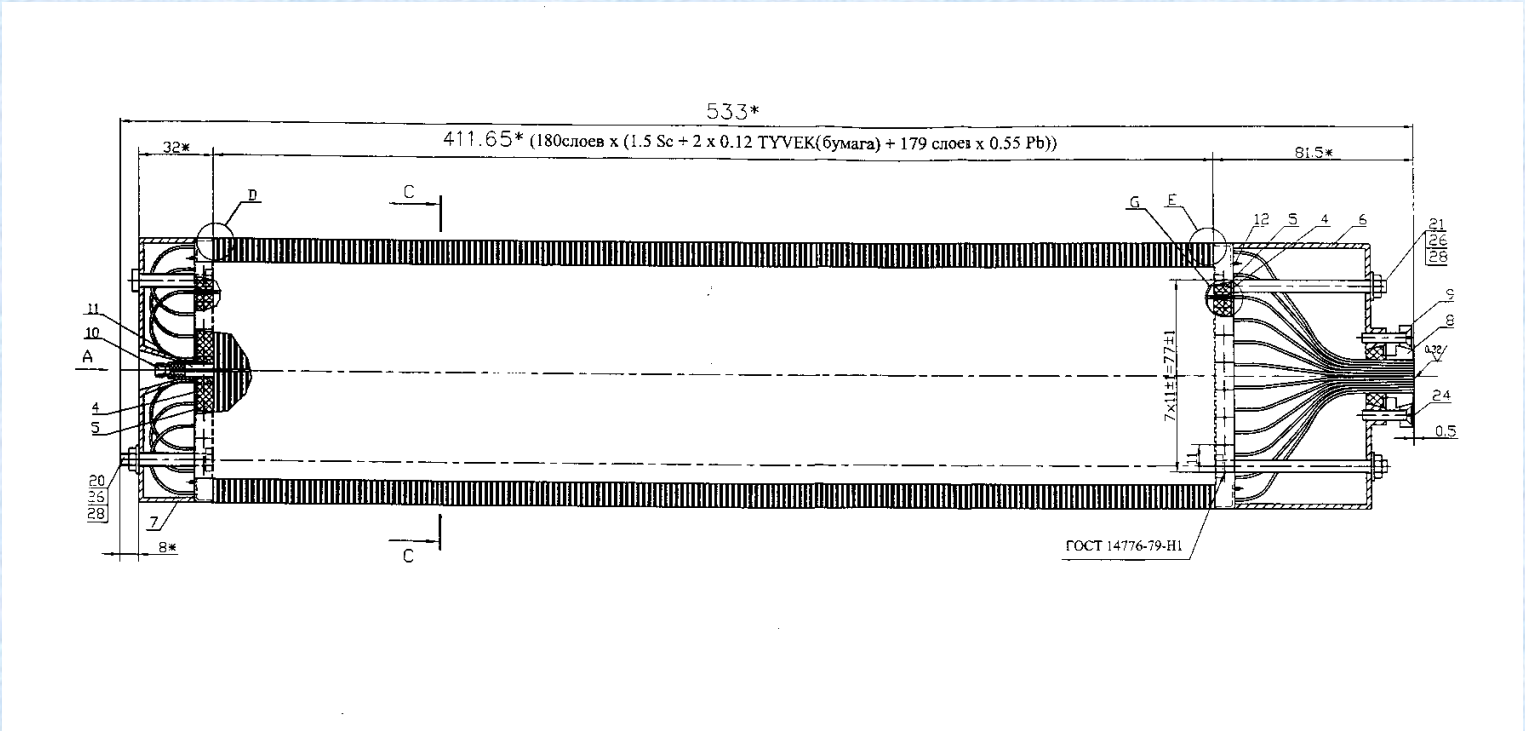

Fig. 3. Scheme of one calorimeter module.

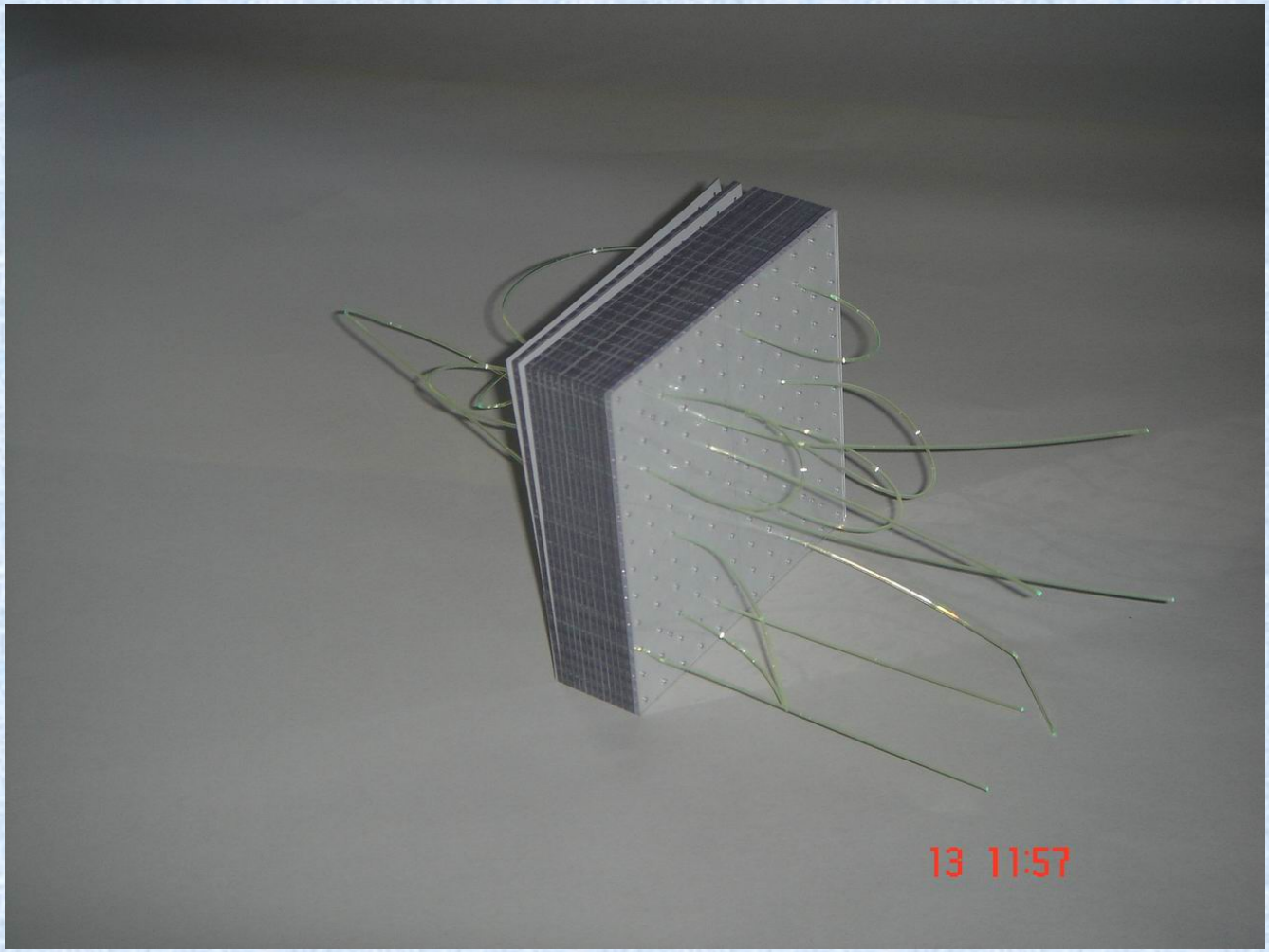

Fig. 4. Element of calorimeter.

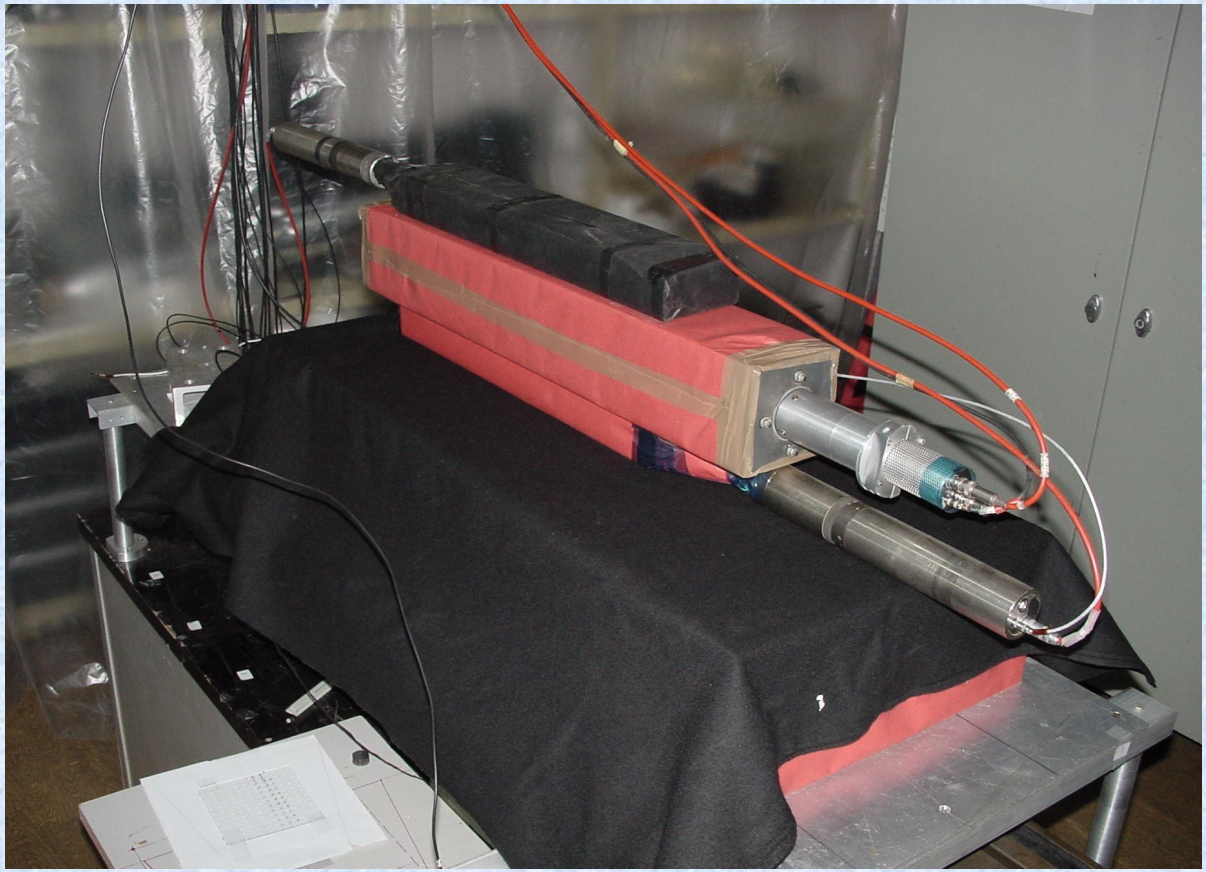

Fig. 5. Measurement of the module performances by means of cosmic rays.

GAMMA-400 PERFORMANCES

Geometrical factor	– 1 m^2sr
Conversion efficiency	– 0,7
Angular resolution ($E\gamma$ = 1 TeV)	– 1°
Energy resolution ($E\gamma$ = 1 TeV)	– 1,8%
Telescope weight	– 800 kg

SiPM PERFORMANCES

Supply voltage	- 20-50 V
Gain	- 10^6
Time resolution	- 30 ps

Present status of the GAMMA-400 project

1. Monte-Carlo simulations of the telescope performances are carried out.
2. Block-schemes of separate electronic telescope systems is developed.
3. Solid-state silicon photomultiplier performances are investigated.
4. Laboratory version of calorimeter consisting of 9 modules is manufactured and now is prepared for measurements with cosmic-ray particles.
5. Model of coordinate system is under construction and manufacture.
6. We begun consultations with Lavochkin Construction Office, which creates scientific satellites, on the realization of the GAMMA-400 experiment.

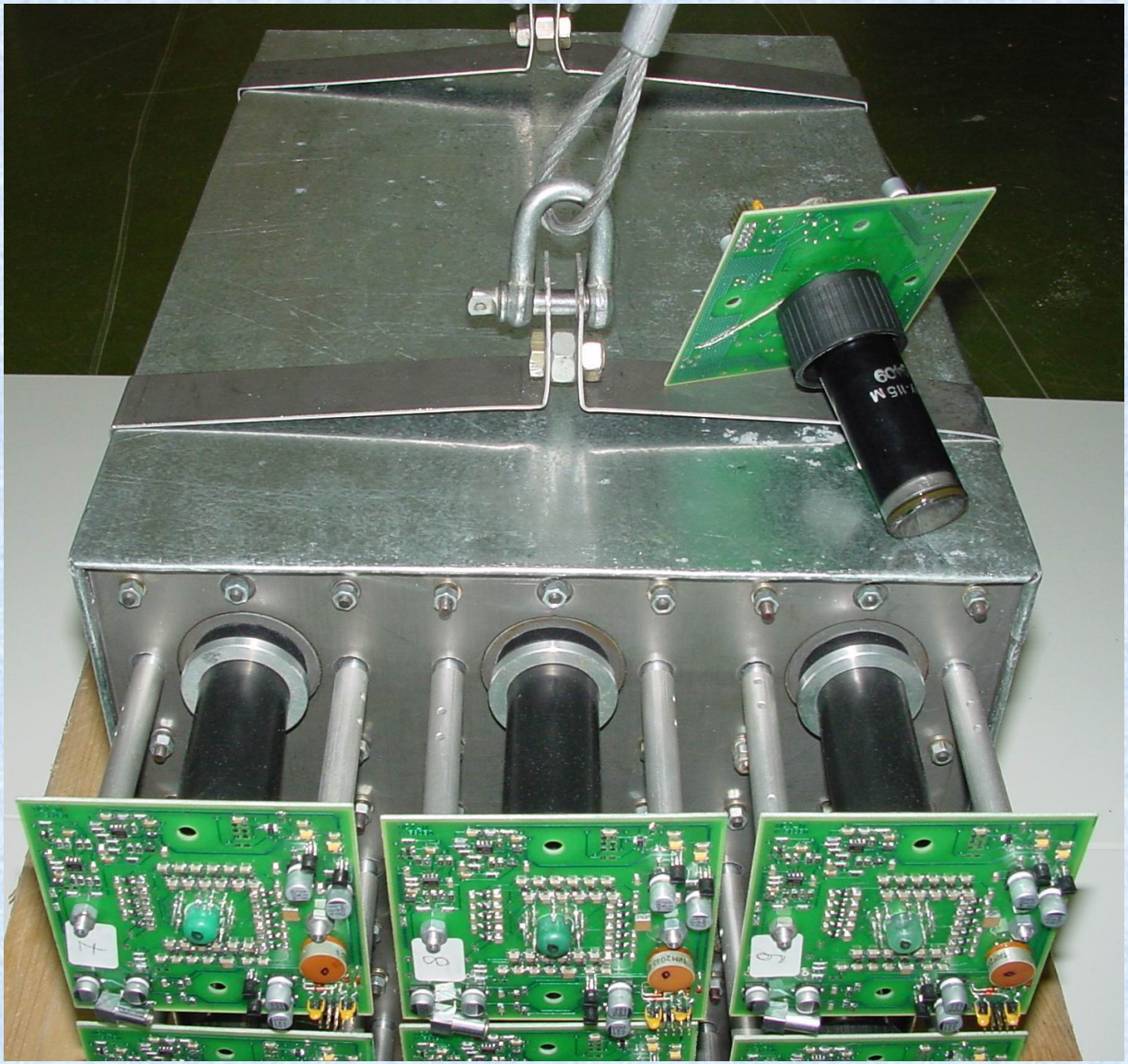

Fig. 6. Laboratory version of calorimeter.

We would like to inform members of this Workshop that the GAMMA-400 Project is open for participation on different stages of its realization.

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