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# The PADME calorimeter: Performance of the prototype

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**Summary.** — The aim of the PADME experiment is to search for a signal of a dark photon $A'$ in the process $e^+e^- \to \gamma A'$, using a 550 MeV positron beam from the Frascati LINAC, and measuring the missing mass of the final state. The missing mass measurements require the knowledge of the 4-momentum of the emitted photon: for this reason, the most important part of the experiment is the BGO calorimeter.

## 1. – The PADME calorimeter prototype

The PADME calorimeter is a homogeneous crystal calorimeter, composed by 616 ($21 \times 21 \times 230\,\mathrm{mm}^3$) BGO crystals, recovered from the L3 experiment at LEP. The BGO crystals are disposed in a cylindrical array ($\varnothing \sim 600\,\mathrm{mm}$) with a central square hole ($100 \times 100\,\mathrm{mm}^2$) (see fig. 1, left). In order to test the performance of the chosen components, a prototype consisting of a $5 \times 5$ matrix, composed of 25 BGO crystals ($20 \times 20 \times 220\,\mathrm{mm}^3$), has been built (fig. 1, right). The crystals were wrapped with teflon sheets and coupled to HZC Photonics XP1912 PMTs. The tests of the crystals were performed using beam energies of 250 and 450 MeV, with an average number of particles per bunch close to one (frequency $\sim$50 Hz). For each event, the individual PMT charges were obtained by integrating the recorded waveforms after pedestal subtraction. The corresponding relation between the deposited energy and the collected charge was determined up to 1.8 GeV. This relation shows good linearity ($\sim$2%) up to 1 GeV. This is satisfactory, since in the experiment photons of energy up to 550 MeV are expected.

 

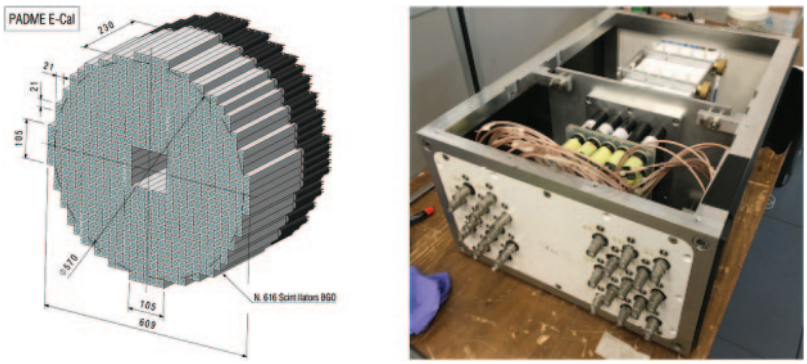


Fig. 1. – On the left, the PADME BGO crystal calorimeter; on the right, the prototype used for the tests.

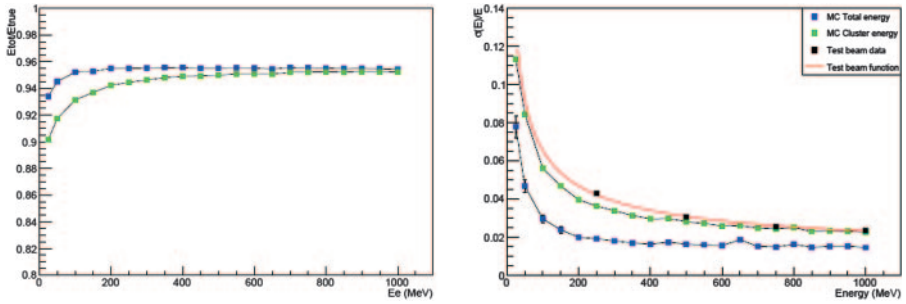


Fig. 2. – On the left, efficiency of the calorimeter prototype as a function of the energy released in the $5 \times 5$ matrix evaluated with Montecarlo simulation (blue dots) and obtained from the reconstructed cluster (green dots). On the right, energy resolution obtained analyzing the test beam data (red line) compared to the reconstructed energy resolution (green dots) and total energy resolutions (blue dots) from MC simulations. Black dots represent the resolution measured with the 250 MeV data sample.

In fig. 2, left, is represented the efficiency curve of the total energy deposited in the crystals compared to the reconstructed energy obtained with a Monte Carlo simulation, generating $3{\cdot}10^4$ electrons with energy between 50 MeV and 1 GeV. In fig. 2, right, the energy resolution measured at the beam-test (fitted with a red line) was compared with the Monte Carlo prediction obtained using the parameters measured from beam-test data (green dots). A good agreement is achieved over all the energy range, even when extrapolating the curve below the minimum measured energy point (black dots) of 250 MeV. For further information, see [1-3].

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