

# Detection of High Energy Cosmic Ray with the Advanced Thin Ionization Calorimeter, ATIC

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**Abstract.** ATIC is a balloon-borne investigation of cosmic ray spectra, from below 50 GeV to near 100 TeV total energy, using a fully active Bismuth Germanate (BGO) calorimeter. It is equipped with the first large area mosaic of small fully depleted silicon detector pixels capable of charge identification in cosmic rays from H to Fe. As a redundancy check for the charge identification and a coarse particle tracking system, three projective layers of x-y scintillator hodoscopes were employed, above, in the center and below a Carbon interaction 'target'. Very high energy  $\gamma$ -rays and their energy spectrum may provide insight to the flux of extremely high energy neutrinos which will be investigated in detail with several proposed cubic kilometer scale neutrino observatories in the next decade.

## INTRODUCTION

The ATIC collaboration [1] is measuring the cosmic ray spectra for elemental composition from 10 GeV to 100 TeV. A Monte Carlo (MC) study of the ATIC detector indicated that ATIC is also capable of identifying neutral events such as  $\gamma$ 's.[2] The detection of  $\gamma$  could be particularly interesting because it has been suggested that in the case of photopion production models, the total source luminosity for  $\gamma$ 's is related to the overall neutrino luminosity through  $L_\gamma \approx \frac{13}{3} L_\nu$ . [3] The satellite based experiment Energetic Gamma Ray Experiment Telescope (EGRET) measured extragalactic  $\gamma$ -rays from below 100 MeV to 100 GeV [4]. The ATIC experiment, in principle, might be able to extend these measurements to higher energies, provided a  $\gamma$  detection mode can be verified and its efficiency determined. However, the flux of higher energy  $\gamma$ -rays may quickly diminish due to the interaction with the cosmic background photons.

## ATIC DETECTOR

The ATIC detector (see figure 1) is comprised of a fully active 50 cm wide BGO calorimeter, preceded by a graphite target of 1.6 radiation length, x-y scintillator hodoscopes, and a fully depleted Si matrix mosaic at the top, having an acceptance opening half angle of  $24^\circ$ . The BGO crystals of  $2.5 \times 2.5 \times 25.0 \text{ cm}^3$  are arranged in 8 layers. Each layer consists of 40 BGO crystals with the long axis aligned alternatively along the X and Y directions. The construction and commissioning of the detector, the data acquisition system and the software development for detector calibration are discussed in detail elsewhere.[5]