

## **BGO Temperature Dependence and Energy measurements in the ATIC Calorimeter**

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The Advanced Thin Ionization Calorimeter (ATIC) Balloon Experiment had a successful test flight and a science flight in 2000-01 and 2002-03 respectively from McMurdo, Antarctica, returning 16 and 19 days of flight data. ATIC is designed to measure the spectra of cosmic rays (protons to iron). The instrument is composed of a Silicon matrix detector followed by a carbon target interleaved with scintillator tracking layers and a segmented BGO calorimeter composed of 320 individual crystals totalling 18 radiation lengths to determine the particle energy. BGO (Bismuth Germanate) is an inorganic scintillation crystal and its light output depends not only on the energy deposited by particles but also on the temperature of the crystal. The temperature of balloon instruments during flight is not constant due to sun angle variations as well as differences in albedo from the ground. For this purpose the response to temperature variations of entire ATIC calorimeter was determined in a thermal chamber.

### **1. The Temperature Calibration**

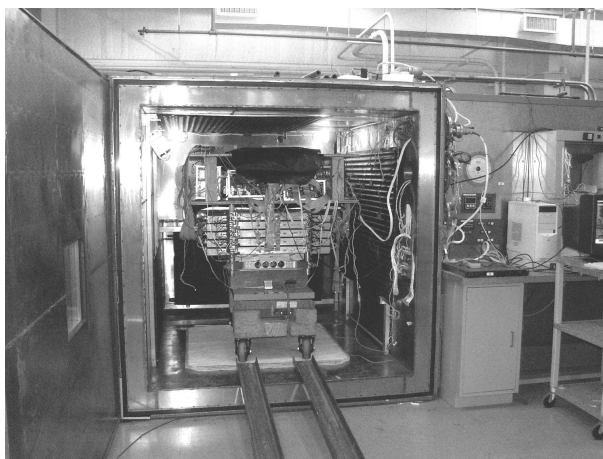
In order to determine the Temperature sensitivity of the ATIC calorimeter the ATIC instrument was taken to the NSBF in Palestine, TX and set up in their thermal vacuum chamber. Since the chamber was too small to fit the entire instrument only the BGO calorimeter, 2 scintillator panels and the readout electronics including the entire flight electronics was set up on a cart and moved into the chamber. The Calorimeter was held at various temperatures and cosmic ray muon data were taken.

### **2. Results**

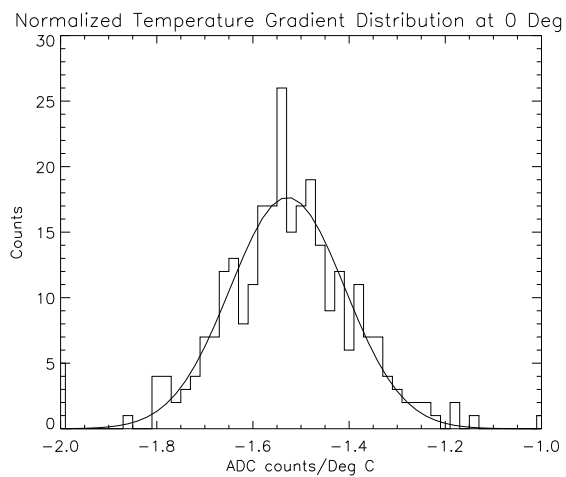
The temperature sensitivity for each individual crystal was determined. Figure 2 shows the distribution of the sensitivities normalized to 100 ADC counts at 0 Deg C.

### **3. Acknowledgements**

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**Figure 1.** The BGO calorimeter from the ATIC instrument in the Thermal-Vacuum chamber at NSBF



**Figure 2.** Normalized Sensitivities for the BGO crystals