EUSO-SPB: Extreme Universe Space Observatory on a Super Pressure Balloon

**Performance results of the trigger logic implemented in EUSO-SPB**

**INTRODUCTION**

EUSO-SPB (Extreme Universe Space Observatory - Super Pressure Balloon) is the first pathfinder mission of the JEM-EUSO Collaboration. The aim of the mission was to test the performance of the trigger logic implemented in the PDM (Payload Data Module) of the EUSO-SPB instrument.

**The Utah Campaign**

In October 2016, the fully assembled EUSO-SPB detector was tested at the EUSO-TA site to evaluate the performance of the trigger and to calibrate it by means of the Central Laser Facility (CLF) of Telescope Array and the portable Ground Laser System (GLS) of Colorado School of Mines. This time the FLT trigger was tested on the entire PDM for about a week. The trigger logic was set with P=1 and R=1. In normal sky conditions, the FLT rate was below 1 Hz on the entire PDM, increasing to 2 Hz when operating during a short period of less than 10 minutes. The peaks above 10 Hz during the flight are often due to light scattered from the atmosphere, which can cause false triggers. The trigger logic was set with P=1 and R=1. In normal sky conditions, the FLT rate was below 1 Hz on the entire PDM, increasing to 2 Hz when operating during a short period of less than 10 minutes. The peaks above 10 Hz during the flight are often due to light scattered from the atmosphere, which can cause false triggers.

**Hardward Components**

The PDM was designed to operate continuously for at least 120 days and was equipped with a super pressure balloon. The PDM was designed to operate continuously for at least 120 days and was equipped with a super pressure balloon.

**Trigger Logic**

The trigger logic was implemented on a Xilinx Virtex6 model XC6VLX240T FPGA. The trigger logic was designed to be able to process the data from the PDM, which is the entire system of EUSO-SPB and is the basic unit for the Second-Level Trigger (SLT). The FLT logic has been coded and implemented in the PDM. The performance of the implemented logic has been verified by means of several tests carried out on the ground.

**Performance of the Trigger Logic**

The performance results of the trigger logic implemented in EUSO-SPB are presented in Figure 3. The FLT rate was below 1 Hz for most of the flight, increasing to about 2 Hz during the short period of less than 10 minutes. The peaks above 10 Hz during the flight are often due to light scattered from the atmosphere, which can cause false triggers.

**Conclusions**

The FLT was tested for the first time on board a JEM-EUSO Instrument. In general, its performance turned out to be within the specifications, even though for EUSO-SPB the trigger rate would have been more appropriate due to the long flight duration. However, it was still extremely important to test the performance of Mini-EUSO and EUSO-SPB together in order to ensure that the trigger rate remains within the constraints imposed by the mission.