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CAPRICE98: a balloon-borne magnetic spectrometer equipped with a gas RICH and a silicon calorimeter to study cosmic rays

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Abstract

CAPRICE98 is a superconducting magnetic spectrometer, equipped with a gas RICH and a silicon calorimeter, launched from Ft. Sumner (USA), on the 28th of May 1998, by the WiZard collaboration. For the first time a gas RICH detector flew together with a silicon electromagnetic calorimeter, allowing mass resolved antiprotons, with $E > 18$ GeV, to be detected. The detector configuration was completed by a time of flight for particle identification, and a set of three drift chambers for rigidity measurement. The science objectives are the study of antimatter in cosmic rays and the cosmic ray composition in the atmosphere with special focus on muons.

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1. Introduction

Cosmic AntiParticle Ring Imaging Cherenkov Experiment, 1998 CAPRICE98, evoluted from the CAPRICE94 detector, is the latest balloon-borne detector built and flown by the WiZard collaboration [1]. In this apparatus, for the first time a gas RICH was used in combination with a silicon–tungsten calorimeter. Its primary scientific objective is the study of antimatter in cosmic rays and the investigation of their spectra and composition at different atmospheric depths.

2. The CAPRICE98 apparatus

The gas RICH has $\gamma th \sim 19$ and an angular resolution <2 mrad. It consisted of a 1 m tall box filled with the gas radiator: high-purity C_4F_{10}. Cherenkov photons are reflected by a spherical mirror, placed on the bottom of the box, up to a MWPC, flushed with ethane gas saturated with TMAE vapours, where they are detected [2].

The calorimeter consisted of eight silicon planes interleaved with seven tungsten absorber for a total radiation length of $7X_0$. Each plane is made of silicon sensors providing readout along two perpendicular directions. Using the event topology is possible to reconstruct longitudinal and later profiles along with the measurement of the energy deposit [3].

These detectors are stacked inside a cylindrical aluminium vessel, as shown in Fig. 1, along with a time of flight, made of two layers of plastic scintillator, located above and below a tracking system. The latter is composed of a superconducting magnet and three drift chambers for a maximum detectable rigidity of 330 GV.

3. The flight and first results

CAPRICE98 was launched on the 28th of May 1998 from Ft. Sumner, NM, USA by the NASA National Science Balloon Facility (NSBF). It floated for ≈ 20 h at ≈ 5.5 g/cm^2.

For the first time $\bar{p}$ with energy above 18 GeV have been mass resolved and the $\bar{p}/p$ ratio measured up to a kinetic energy of 50 GeV [4] as shown in Fig. 2.

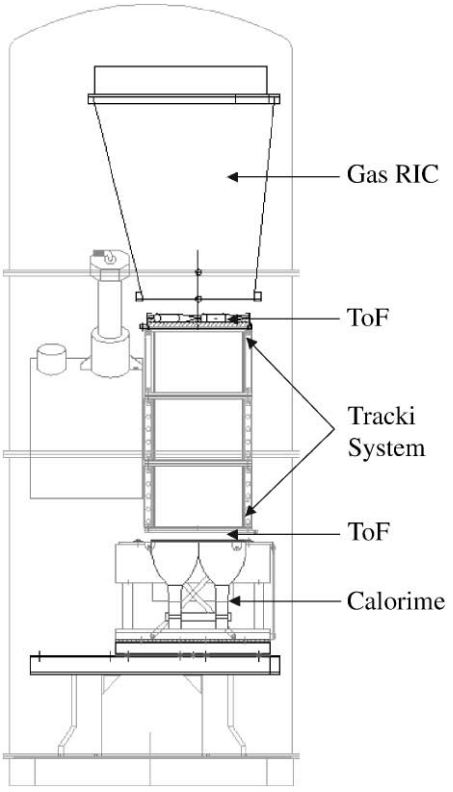

Fig. 1. The CAPRICE98 apparatus.

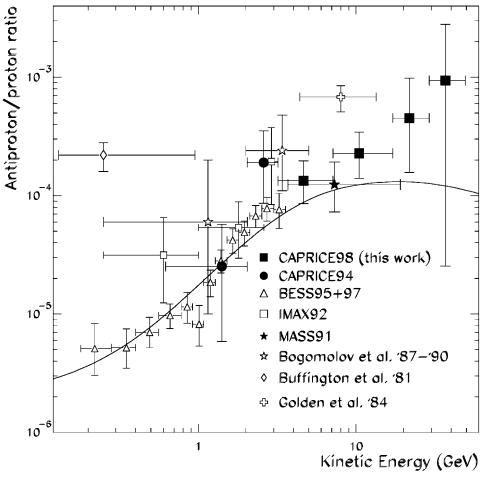

Fig. 2. $\bar{p}/p$ measured by CAPRICE98.

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