

Measuring Antimatter over Antarctica: Results from the BESS-Polar Program

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The US-Japan BESS-Polar Collaboration (Balloon-borne Experiment with a Superconducting Spectrometer – Polar) has finalized its core program of elementary particle measurements. The measured antiproton spectrum probes possible exotic sources, such as dark-matter candidates. The search for antihelium or heavier antinuclei examines the possibility that antimatter domains remain in the cosmological neighborhood from symmetry breaking processes in the early Universe. Since 1993, BESS has carried out eleven high-latitude balloon flights, including two long-duration Antarctic flights, that together have defined the study of antiprotons below 4 GeV, provided standard references for light element and isotope spectra, and set the most sensitive reported limits on the existence of antideuterons and antihelium. BESS-Polar II recorded over 4.7 billion cosmic-ray events in 24.5 days of flight over Antarctica during the 2007–2008 Austral Summer, identifying about 8000 antiprotons. These data more than doubled all earlier BESS flights combined and were obtained at very low, near minimum, Solar activity when the low-energy antiproton measurements are most sensitive to a primary source. Depending on energy range, the BESS-Polar II antiproton measurements have 10-20 times the statistics of BESS95+97 data from the previous Solar minimum. Here, we give an overview the scientific results of the long-duration flights of BESS-Polar I (2004) and BESS-Polar II, including antiproton and proton spectra, the energy-dependent ratios of antiprotons to protons, light isotope measurements, and the limits on the relative abundance of antihelium. We also discuss the future of the BESS-Polar program.

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