New data from PAMELA provides better measure of positrons

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PAMELA is launched onboard a Resurs-DK1 Russian satellite by a Soyuz rocket in June 2006.

(Phys.org) —A large team made up of researchers from several European countries (Italy, Russia, Sweden and Germany) has published, in the journal *Physical Review Letters*, the latest findings from the Payload for Antimatter/Matter Exploration and Light-nuclei Astrophysics—PAMELA—satellite project. In addition to publishing raw data, the team offers an interpretation of findings as they relate to the excess of positrons (electron antiparticles) observed at high energies.

Experiments conducted over the past several years have shown that under certain conditions there are more positrons striking the Earth than theories have predicted. That has led to new theories to explain the

seeming anomaly, such as suggestions that they come from pulsars, or more exotically, from collisions between dark matter particles. More specifically, researchers have found a continuous rise in the number of positrons relative to electrons at energies of 10 GeV and above. According to everything astrophysicists know, that just shouldn't be happening. The new data from PAMELA doesn't offer any hard evidence of why the number of positrons increase or where they are coming from, rather it provides a more detailed, clear picture of what is occurring.

Up until now, measurements of positrons—taken from research balloons, planes and even from PAMELA—have used a method to count positrons called the positron-electron fraction, which is a ratio obtained by comparing the number of positrons observed over a period of time relative to the number of electrons. All have confirmed the rise in positrons at high energies. The new data from PAMELA (collected over the period 2006-2009) offers a more detailed assessment of the number of positrons, called absolute numbers—which are the actual number of positrons observed over a given length of time. The new numbers have been made possible by using new technology that not only measures positrons observed, but accurately measures the ones that are missed due to less than perfect measuring instruments. The researchers report that 24,500 positrons were observed by PAMELA over the course of the experimental run.

The research team suggests that the new data, because it is more accurate, should help to cull the various theories that have cropped up to explain what is occurring with the positrons and might perhaps quash suggestions that they come about due to dark matter events.

More information: Cosmic-Ray Positron Energy Spectrum Measured by PAMELA, *Phys. Rev. Lett.* 111, 081102 (2013) DOI: 10.1103/PhysRevLett.111.081102

Abstract

Precision measurements of the positron component in the cosmic radiation provide important information about the propagation of cosmic rays and the nature of particle sources in our Galaxy. The satellite-borne experiment PAMELA has been used to make a new measurement of the cosmic-ray positron flux and fraction that extends previously published measurements up to 300 GeV in kinetic energy. The combined measurements of the cosmic-ray positron energy spectrum and fraction provide a unique tool to constrain interpretation models. During the recent solar minimum activity period from July 2006 to December 2009, approximately 24?500 positrons were observed. The results cannot be easily reconciled with purely secondary production, and additional sources of either astrophysical or exotic origin may be required.