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What can we really learn from positron flux ' anomalies'?

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We present a critical analysis of the observational constraints on, and of the theoretical modeling of, aspects of cosmic ray (CR) generation and propagation in the Galaxy, which are relevant for the interpretation of recent positron and anti-proton measurements. We give simple, analytic, model independent expressions for the secondary antiproton flux, and an upper limit for the secondary positron flux, obtained by neglecting positron radiative losses, e+/(e++e−) < 0.2±0.1 up to ~ 300 GeV. These expressions are completely determined by the rigidity dependent grammage, which is measured from stable CR secondaries up to ~ 150 GeV/nuc, and by nuclear cross sections measured in the laboratory. Antiproton and positron measurements, available up to ~ 100 GeV, are consistent with these estimates, implying that there is no need for new, non-secondary, antiproton or positron sources. The radiative loss suppression factor fs,e+ of the positron flux depends on the positron propagation in the Galaxy, which is not understood theoretically. A rough, model independent estimate of fs,e+ ~ 1/3 can be obtained at a single energy, E ~ 20 GeV, from unstable secondary decay and is found to be consistent with positron measurements, including the positron fraction measured by PAMELA. We show that specific detailed models, that agree with compositional CR data, agree with our simple expressions for the positron and antiproton flux, and that the claims that the positron fraction measured by PAMELA requires new primary positron sources are based on assumptions, that are not supported by observations. If PAMELA results are correct, they suggest that fs,e+(E) is slightly increasing with energy, which provides an interesting constraint on CR propagation models. We argue that measurements of the positron to antiproton ratio are more useful for challenging secondary production models
than the e+/(e+ + e−) fraction.

Auteurs principaux: M. KATZ, boaz (weizmann institute of science); Prof. WAXMAN, eli (weizmann institute of science); M. MORAG, jonathan (weizmann institute of science); M. BLUM, kfir (weizmann institute of science)

Orateur: M. BLUM, kfir (weizmann institute of science)

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