Confronting recent AMS-02 positron fraction and Fermi-LAT extragalactic gamma-ray background measurements with gravitino dark matter

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Abstract

Recent positron flux fraction measurements in cosmic-rays (CR) made by the AMS-02 detector confirm and extend the evidence on the existence of a new (yet unknown) source of high energy electrons and positrons. We test the gravitinodark matter of bilinear R-parity violating supersymmetric models as this electrons/positrons source. Being a long lived weak-interacting and spin 3/2 particle, it offers several particularities which makes it an attractive dark matter candidate. We compute the electron, positron and -ray fluxes produced by each gravitino decay channel as it would be detected at the Earth's position. Combining the flux from the different decay modes we are able to reproduce AMS-02 measurements of the positron fraction, as well as the electron and positron fluxes, with a gravitino dark matter mass in the range 1–3 TeV and lifetime of ~1.0–0.7×1026 s. The high statistics measurement of electron and positron fluxes, and the flattening in the behaviour of the positron fraction recently found by AMS-02 allow us to determine that the preferred gravitino decaying mode by the fit is , unlike previous analyses. Then we study the viability of these scenarios through their implication in -ray observations. For this we use the Extragalactic -ray Background recently reported by the Fermi-LAT Collaboration and a state-of-the-art model of its known contributors. Based on the -ray analysis we exclude the gravitino parameter space which provides an acceptable explanation of the AMS-02 data. Therefore, we conclude that the gravitino of bilinear R-parity violating models is ruled out as the unique primary source of electrons and positrons needed to explain the rise in the positron fraction..