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Confronting recent AMS-02 positron fraction and Fermi-LAT Extragalactic γ-ray Background measurements with gravitino dark matter

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The positron fraction measured by the space-based detectors PAMELA, {\it Fermi}-LAT and AMS-02 presents anomalous behaviour as energy increase. In particular AMS-02 observations provide compelling evidence for a new source of positrons and electrons. Its origin is unknown, it can be non-exotic (e.g. pulsars), be dark matter (DM) or maybe a mixture. We test the gravitino of bilinear R-parity violating supersymmetric models as this source. As the gravitino is a spin 3/2 particle, it offers particular decay channels, $W^{\pm}l_i^{\mp}$, $Z\nu_i$, and $H\nu_i$. We compute the electron, positron and γ-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 can fit AMS-02 measurements of the positron fraction, as well as the electron and positron fluxes, with a gravitino dark matter mass in the range $1-2$ TeV and lifetime of $\sim 1.0-0.8\times10^{26}$ 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 $W^{\pm}\tau^{\mp}$, unlike previous analyses. Then we study the viability of these scenarios through their implication in γ-ray observations. We set limits on the gravitino lifetime using the Extragalactic γ-ray Background recently reported by the {\it Fermi}-LAT Collaboration and a state-of-the-art model of its known contributors. These limits 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.

Collaboration

– not specified –

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