# THE SPECTRUM OF COSMIC RAY ELECTRONS AND POSITRONS MEASURED BY THE PAMELA EXPERIMENT: A REAL PROBLEM STILL SEEKING A SOLUTION

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The Payload for Antimatter Matter Exploration and Light-nuclei Astrophysics (PAMELA) has now provided a very accurate measurement of the spectrum of cosmic-ray electrons and positrons. These results are consistent with a single power-law, but visually they suggest an excess emission from about 100 GeV to 1 TeV, which leads to the emergence of a debate about the existence and the source of this excess: Could come from nearby pulsars or dark-matter annihilation? We do not know, each one has its reasons. In this work we will try to study this controversy by clarifying this spectrum using the GALPROP code.

## 1 Introduction

Knowledge of the primary cosmic ray electron spectrum near the earth $\leq$1kpc allows us to understand several astrophysical problems. In fact, the first hint for the existence of this type of rays in our Galaxy ($MilkyWay$)came from the interpretation in 1950 of the non-thermal radio noise[1]. The first direct observation of primary cosmic ray electrons was made in 1960 [2,3], in the energy ranges of 100 MeV to several TeV. Since then, the electron spectrum has been extensively investigated.
Before 2008, the high-energy electron spectrum $E_e$ $\geq$10 GeV was measured by balloon borne experiments [4] and by a single space mission AMS-01 [5]. To date, we have at hand data from new instruments, such as Pamela [6], Fermi [7],H.E.S.S[8], and ATIC [9]. These measurements represent a unique probe for studying the origin and diffusive propagation of high energy cosmic-ray electrons in the interstellar medium within the GeVTeV energy range, as well as for constrain current models of the observed Galactic diffuse gamma-ray emission [10] such as the cosmic ray propagation package GALPROP [11].
In this work, we explore the possibility of interpreting the aforementioned data sets concerning the electrons spectrum by a model with reacceleration for the production and propagation of positrons and electrons in the Galaxy. In this framework, we start with obtaining a set of propagation parameters which reproduce the cosmic-ray B/C ratio, then we perform the calculation of the spectra of positrons and electrons using the GALPROP code. we compare

with recent observations reported by ATIC, Fermi, HESS, and other experiments.

## 2 Results and discussion

In this study, we have chosen the diffusion reacceleration model, which has been used in a number of studies utilizing the GALPROP code. This model is two dimensional (2D) with cylindrical symmetry in the Galaxy, and the basic coordinates are $(R, z, p)$ where $R$ is Galactocentric radius, $z$ the distance from the Galactic plane and $p$ the total particle momentum. The propagation region is bounded by $R_h$= 30 kpc and vertical boundaries (halo size ) $Z = z_h$. The spatial diffusion coefcient is given by [12]:

$$D_{xx} = \beta D_0 \left(\frac{\rho}{\rho_0}\right)^{\delta} \tag{1}$$

Where $D_0 = 5.5 \times 10^{28} sm^2 s^{-1}$ is a free normalization at the fixed rigidity,$\rho_0 = 4GV$ . The power-law index is $\delta = 1/3$ for Kolmogorov diffusion. The main free parameter in this relation is the Alfven speed $v_0 = 30km/s$. The injection spectrum of nucleons is assumed to be a power law in momentum, $q(p) \propto p^{\gamma_0}$ the value of $\gamma = 2.4$ can vary with species.

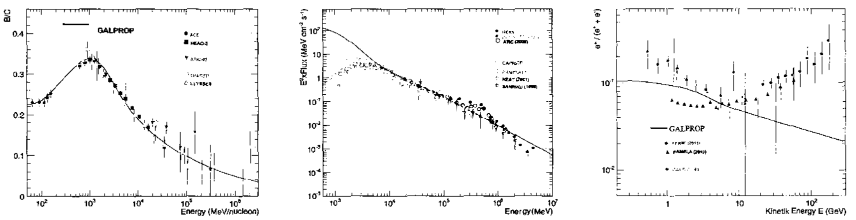


Figure 1: The *left panel* show B/C ratio which is computed by our model given above and compared with experimental data.The electron $\left(e^+ + e^-\right)$ spectrum is shown for the same model in *center panel* and the corresponding positron fraction $\left(e^+/\left(e^+ + e^-\right)\right)$ curve computed under the same conditions is shown in the *Right panel* and compared with experimental data.

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