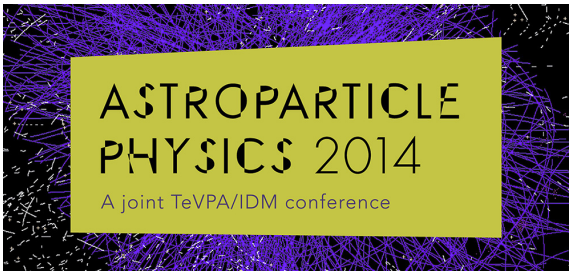

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Interpretation of AMS-02 electrons and positrons data and Dark Matter constraints.

Tuesday, June 24, 2014 4:30 PM (15 minutes)

We perform a combined analysis of the recent AMS-02 data on electrons, positrons, electrons plus positrons and positron fraction, in a self-consistent framework where we realize a theoretical modeling of all the astrophysical components that can contribute to the observed fluxes in the whole energy range. The primary electron contribution is modeled through the sum of an average flux from distant sources and the fluxes from the local supernova remnants in the Green catalog. The secondary electron and positron fluxes originate from interactions on the interstellar medium of primary cosmic rays, for which we derive a novel determination by using AMS-02 proton and helium data. Primary positrons and electrons from pulsar wind nebulae in the ATNF catalog are included and studied in terms of their most significant (while loosely known) properties and under different assumptions (average contribution from the whole catalog, single dominant pulsar, a few dominant pulsars). We obtain a remarkable agreement between our various modeling and the AMS-02 data for all types of analysis, demonstrating that the whole AMS-02 leptonic data admit a self-consistent interpretation in terms of astrophysical contributions. Other exotic emission mechanisms could produce a sizeble flux of electrons and positrons. Probably the most popular one is from the interaction of Weakly Interactive Massive particles (WIMPs) of Dark Matter (DM). Taking into account the above cited astrophysical contributions and adding also the flux from DM annihilation, we derive upper limits for the annihilation cross section of DM. We compare also the shape of high energy positrons flux from pulsars wind nebulae and DM respect to AMS-02 data trying to predict which of these two components should explain this part of the measured spectra.

Summary

Local observations of CR fluxes are among the most powerful probes of high-energy astrophysical processes in our Galaxy. These measurements can probe both the nature of particle production in energetic astrophysical systems as well as the Physics of particle propagation through the Galaxy and finally set severe constraints on DM production. Recently, results from the Advanced Thin Ionization Calorimeter (ATIC) balloon experiment, as well as from the Payload for Antimatter Matter Exploration and Light-nuclei Astrophysics (PAMELA) satellite, indicated possible anomalies in the expected flux of CR leptons.
Specifically ATIC observed a bump in the cosmic-ray electron-plus-positron spectrum at an energy of approximately 800 GeV. Moreover PAMELA first and then Fermi-LAT observed, in the positron fraction (PF) above tens of GeV, an excess compared with the standard background produced from the spallation reactions of hadronic CR species with the interstellar material (ISM).
Very recently, the Alpha Magnetic Spectrometer (AMS-02) presented measurement of the PF, electrons, positrons and electron-plus-positron fluxes with energies up to 350 GeV.
AMS-02 confirms, with significantly more statistics and precision than previous experiments, the same excess consisting in a rising of the PF.

In this talk I show our study on the emission of electrons and positrons from galactic Pulsars, Supernovae Remnants (SNRs) and from CRs spallation on ISM (secondary production).
In the case of SNRs, models explain the acceleration of CRs through non-relativistic expanding shocks waves initiated by SN explosions. We divide the SNRs electrons flux into a far away, for sources with d>3 kpc, and a near component, for sources with d<3 kpc. In order to find the near SNRs emission we use the parameters of the Green SNRs catalog while for the distant part we assume a smooth distribution of sources. On the other

hand the Pulsars flux is calculated taking into account all the sources in the ATNF Pulsar Database. Pulsars produce both electrons and positrons, from 10 GeV up to a few TeV, with the more distant (nearer) and old (young) sources contributing to lower (higher) energies. In particular we deduce that electrons and electrons-plus-positrons AMS-02 data in the energy range 1 GeV $<$E$<$ 100 GeV are due to the smooth component of distant SNRs with a spectral index of 2.2 while data with E>100 GeV are explained by near Pulsars and SNRs. Moreover the positrons and PF spectra are explained for 1 GeV $<$ E $<$ 10 GeV by positrons produced by CRs spallation on ISM and for E>10 GeV by Pulsars flux with a spectral index of 1.9. Hence the results of our analysis is the following: all the new AMS-02 data in the entire energy range (from 1 GeV up to 350 GeV) can be exlained with the positrons and electrons emission from galactic Pulsars, SNR and secondary production through CR spallation with ISM.
Other exotic emission mechanisms could produce a sizeble flux of electrons and positrons. Probably the most popular one is from the interaction of Weakly Interactive Massive particles (WIMPs) of Dark Matter (DM). Taking into account the above cited astrophysical contributions and adding also the flux from DM annihilation, we derive upper limits for the annihilation cross section of DM. We compare also the shape of high energy positrons flux from pulsars wind nebulae and DM respect to AMS-02 data trying to predict which of these two components should explain this part of the measured spectra.

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