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On the PeV knee of cosmic rays spectrum and TeV cutoff of electron spectrum

The origin of the cosmic-ray knee has remained a puzzle since its discovery over 60 years. In addition, Some latest experiments have revealed a spectral cutoff of the electron around 1 TeV. We find these two spectral breaks have a similar Lorentz factor $\sim 10^6$, and interpret this similarity with a threshold interaction. Considering the lack of photons of 1 eV in the Galaxy which may produce those breaks through $e^+ + e^-$ pair production process, we postulate the existing of a new particle X abundant in the Galaxy. The interaction process $CR + X \longrightarrow CR + X'$ can take place when the effective energy is sufficient to convert it into the mass of another unknown particle X' (as a representative to all possible threshold inelastic interactions), where the mass of X' is 10^6 higher than that of the X with respect to the above mentioned common Lorentz factor. Thus cosmic rays will loss their energy above the threshold and produce a spectral break. Under this scenario, we can reproduce the spectral break for both the nuclei and electron, and predict a flattened spectrum for electrons after the cutoff. Given that there are uncertainties of experiments in determining the actual spectra of these breaks and their components, our model allows a wide mass range of the particle X from ultra low value to around 1 eV.

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