ANTIPROTONS FROM SPALLATION OF COSMIC RAYS ON INTERSTELLAR MATTER

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Cosmic ray antiprotons provide an important probe for the study of the galactic Dark Matter, as they could be produced by neutralino annihilations, primordial black holes evaporations or other exotic sources. On the other hand, antiprotons are anyway produced by standard nuclear reactions of cosmic ray nuclei on interstellar matter (*spallations*), that are known to occur in the Galaxy. This process is responsible for a background flux that must be carefully determined to estimate the detectability of an hypothetical exotic signal. Estimates of this background suffer from potential uncertainties of various origins. First, the propagation of cosmic antiprotons depends on several physical characteristics of the Galaxy which are poorly known. Second, antiprotons are created from cosmic protons and helium nuclei (*helions*) whose fluxes were not measured with great accuracy until very recently. Third, calculations of antiproton fluxes make use of nuclear physics models with their own shortcomings and uncertainties.
The goal of this paper is to give a new evaluation of the cosmic antiproton flux along with the associated uncertainties. The propagation parameters were tightly constrained in Maurin et al. 2001 by an analysis of cosmic ray nuclei data in the framework of a two-zone diffusion model and we apply these parameters to the propagation of antiprotons. We use the recently published data on proton and helion fluxes, and we find that this particular source of uncertainty has become negligible. The Monte Carlo program DTUNUC was used to carefully examine antiproton production from proton–helium, helion-hydrogen and helion–helium reactions.
We find that all the cosmic antiproton fluxes naturally coming out of the calculation (*i.e.* without any parameter adjustment) are fully compatible with experimental data. The other strong conclusion is that the uncertainties in this flux have been strongly reduced. In particular, those related to propagation range between 10% and 25%, depending on which part of the spectrum is considered. All other possible sources of uncertainty have also been studied.