V. DISCUSSION AND CONCLUSIONS

We proposed two supersymmetric Standard Models with decaying and stable DM particles. To explain the SM fermion masses and mixings, we considered an anomalous $U(1)_X$ gauge symmetry whose anomaly is cancelled by the Green-Schwarz mechanism. Around the string scale, the $U(1)_X$ gauge symmetry is broken down to the Z_2 symmetry under which only S is odd. Thus, S is stable and can be a DM candidate. After S obtains a VEV around the TeV scale, the Z_2 symmetry is broken and then S can decay. In our models, on the one hand, the LSP neutralino has mass 101.6 GeV, and its relic density is about $\Omega_{\widetilde{N}_1^0} h^2 \approx 0.08$. Because the lightest neutralino-nucleon cross section is 5×10^{-9} pb, the CDMS II results can be explained. On the other hand, S is a decay DM particle that can three-body cascade decay into the MSSM particles. With suitable $U(1)_X$ charges, S decays dominated into the second family of the SM leptons in Model I and into the first family of the SM leptons in Model II. In Model I, if the mass of the DM particle S is 3 TeV and S has effective lifetime about $\tau_{eff} \approx 0.72 \times 10^{26} s$ (the real lifetime is about $2.2 \times 10^{26} s$), we are able to explain the PAMELA/FERMI experiments simultaneously. In Model II, if the mass of the DM particle S is 1.8 TeV and S has effective lifetime about $\tau_{eff} \approx 0.52 \times 10^{26} s$, we can explain the PAMELA/ATIC experiments as well. In addition, taking the proper astrophysics parameters that produce the minimal anti-protons, we have shown that our models are consistent with $\bar{p}/p$ measurement in the PAMELA experiment.

Finally, although the accompanied gamma-ray and neutrino fluxes are not discussed here, they deserve further study. The primary hard neutrinos, as well as the soft gammas and neutrinos during the sparticle and Higgs fragmentations are produced. They may provide the spectrum properties through the inverse Compton scattering [42] that can be tested by the ongoing FERMI experiment. In addition, the complete and systematic studies of the multi-body decays and multi-contributions are interesting since we do need them in the DM model building. Furthermore, it is interesting to study the CMSSM parameter space where the LSP neutralino relic density is smaller than the observed total DM relic desity since we may have multicomponent DM.

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