

Dear Editor, Thank you very much for sharing the referees report that we found very helpful. We appreciate their careful evaluation and valuable comments. We summarize below our response and the revision of our manuscript based on the referee's comments. We hope the revised version of our manuscript is now suitable for publication in Universe.

Yours Sincerely,

Waqas Ahmed

On behalf of the authors

Comment 1

Related past similar works on the interaction of D6-branes including the ones on the Pati-Salam model by the authors themselves are found in the literature. The differences of this work from the past similar and related ones should explicitly be explained so that the significance to describe this article can be clarified

Our Response

We are thankful for the valuable suggestions provided by the referee. The phenomenological aspect of soft Supersymmetry (SUSY) breaking terms lies in their crucial role in mediating the breaking of SUSY at low energies, thereby providing the necessary framework for reconciling theoretical predictions with experimental observations. These terms encode the dynamics of SUSY breaking and are instrumental in shaping the spectrum of particles and their interactions within SUSY extensions of the Standard Model. The gaugino masses are almost squeezed up to 50% from the previous study, which put an important contribution in evaluating the sparticle masses from the GUT to electroweak scale in SUSY GUTs. Similarly, the spectrum for $\tilde{m}_R^2$, $\tilde{m}_L^2$, $\tilde{m}_{H_{u,d}}$, and A_0 in the negative range are also squeezed up to 50% in our new study. In short, the overall mass spectrum is squeezed from 20% to 50%. Furthermore, we are unable to have the gluino coannihilation channel in our new results, and previously we were expecting to have some points that are important regarding LHC SUSY searches. We have no stop coannihilation in the previous study and in the new study, there is stop coannihilation up to 1 TeV for the Planck2018 relic density (within 5σ) satisfied points. Similarly, we have no stau coannihilation points below 1 TeV consistent with the Planck20018 relic density bounds within 5σ and in the new study, there is stau coannihilation below 1 TeV. We added the following footnote in our manuscript on page 3.

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regarding LHC SUSY searches. We have no stop coannihilation in the previous study and in the new study, there is stop coannihilation up to 1 TeV for the Planck2018 relic density (within 5σ) satisfied points. Similarly, we have no stau coannihilation points below 1 TeV consistent with the Planck20018 relic density bounds within 5σ and in the new study, there is stau coannihilation below 1 TeV.”

Comment 2

It is recognized that this study is a phenomenology to find the viable parameter space through the supersymmetry survey with LHC and dark matter candidates with the recent Planck data. What are the positive motivations to examine the specific type of the interaction of D6-branes in the Pati-Salam model with three families through the specialized soft SUSY breaking terms from the fundamental physics point of view?

Our Response

We would like to thank the referee for raising this important point. The intersecting D6-brane model building, N stacks of D6-brane gives us the $U(N)$ gauge symmetry with $U(N) \supset SU(N) \times U(1)$. The $U(1)$ might be anomalous gauge symmetry whose anomalies can be canceled by the generalized Green-Schwarz mechanism. Thus, $U(1)$ becomes a global symmetry, and the standard model (SM) Yukawa couplings might be forbidden by such kind of $U(1)$. For example, in the $SU(5)$ model, the top quark Yukawa coupling is forbidden by the $U(1) \subset U(5)$. In the flipped $SU(5)$ model, the bottom quark Yukawa coupling is forbidden by the $U(1)$ of $U(5)$. In addition, for the trinification model with gauge symmetry $U(3) \times U(3) \times U(3)$, there exist strong constraints for K-theory anomaly. Therefore, the interesting model for the interacting D6-brane model building is the Pati-salam model, where the SM Yukawa coupling can be invariant under the gauge symmetry $U(4)_C \times U(2)_L \times U(2)_R$.

Comment 3

The mass ranges of gluino, squarks, sleptons are analyzed and the relic density of the cold dark matter is studied through the A-funnel and coannihilation channels. From these analyses what properties of the candidates for the cold dark matter can be obtained?

Our Response

We are thankful to the referee for bringing this to our attention. The mentioned analysis reveals that our neutralino LSP DM is dominantly Bino-like.

Comment 4

It is argued that the results are consistent with the cross sections of the nucleon-neutralino scattering except for several ones. What physical mechanisms in the present scenario proposed can lead to this consequence?

Our Response

We thank the referee for asking this question to clarify any confusion in our draft. Except for a few points from the chargino-neutralino coannihilation, the other channels such as stop-neutralino and stau-neutralino coannihilation satisfy the nucleon-neutralino spin-independent and spin-dependent scattering cross-section.