XXIII Simposio Chileno de Física
Chile,22-24 noviembre 2022 Física de Partículas, Campos y Altas Energías

Searching for light neutralinos with a displaced vertex at the LHC[1]

Fabián Hernández-Pinto [1*], Juan Carlos Helo[2†], Giovanna Cottin[1,2], Nicolás Neill, Zeren Simon Wang
[1]Departamento de Física, Facultad de Ciencias, Universidad de La Serena, Chile
[2]Millennium Institute for Subatomic Physics at the High Energy Frontier (SAPHIR), Santiago, Chile
∗fabian.hernandez@userena.cl, † jchelo@userena.cl, giovanna.cottin@uai.cl

13 de octubre de 2022

Introducción

We study a bino-like light neutralino ($\tilde{\chi}_1^0$) produced at the LHC from the decay of a scalar lepton ($\tilde{e}_L$) through the process $pp \to \tilde{e}_L \to e\tilde{\chi}_1^0$ in the context of R-parity-violating (RPV) supersymmetry [2] where $\tilde{\chi}_1^0$ is the lightest supersymmetric particle. For small masses and RPV couplings, the neutralino is naturally long-lived and its decay products can be identified as displaced tracks. Following existing searches [3], we propose a displaced-vertex search strategy for such a light neutralino with a single RPV coupling switched on [5], λ'_{111}, in the mass range $10\,\text{GeV} \lesssim m_{\tilde{\chi}_1^0} \lesssim 230\,\text{GeV}$. We perform Monte Carlo simulations [4] and conclude that at the high-luminosity LHC, the proposed search can probe values of λ'_{111} down to two orders of magnitude smaller than current bounds and up to 40 times smaller than projected limits from monolepton searches.

Desarrollo

The number of expected events to calculate the exclusion limit for λ'_{111} in function of the production cross section σ, the DV efficiency ϵ of the analysis and $\mathcal{L}$ is the future luminosity of LHC equals to 3000 [fb^{-1}]

$$S = \epsilon \times \sigma(pp \to \tilde{e}_L \to e\tilde{\chi}_1^0) \times \mathcal{L} \tag{1}$$

Figure 1 shows part of the results obtained for sensitivity in 2 benchmarks.

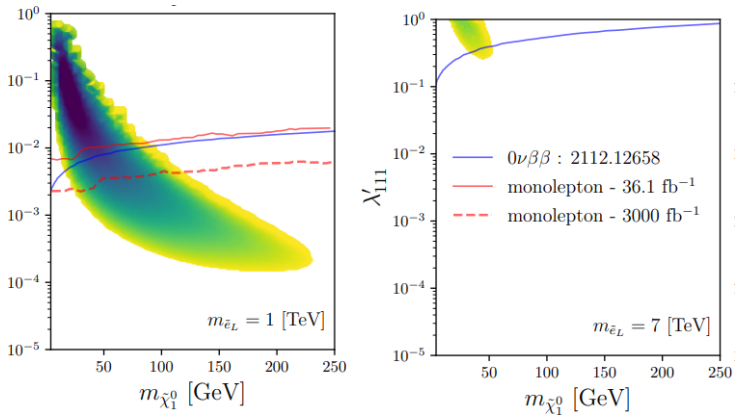

Figura 1: *Sensitivity of λ'_{111} for the process $pp \to \tilde{e}_L \to e\tilde{\chi}_1^0$. Color map shows the number of expected events S (from eq 1, begining from 3 (yellow). Blue curve is the limit for the double beta decay limit [6] and red lines are from reinterpretation of the monolepton serch [7].*

Agradecimientos:
We thank Benjamin Fuks and Torbjorn Sjostrand for useful discussions on the UFO implementation and Pythia 8, respectively. G.C. acknowledges support from ANID FONDECYT grant No. 11220237. G.C., J.C.H. and F.H.P. also acknowledge support from grants ANID FONDECYT No. 1201673 and ANID – Millennium Science Initiative Program ICN2019 044. J.C.H. acknowledges the financial support of DIDULS/ULS, through the project PTE202135. Z.S.W. is supported by the Ministry of Science and Technology (MoST) of Taiwan with grant number MoST-110-2811-M-007-542-MY3. N.A.N. was supported by ANID (Chile) under the grant ANID REC Convocatoria Nacional Subvenci´on a Instalaci´on en la Academia Convocatoria A˜no 2020, PAI77200092.

Referencias

[1] G. Cottin, J. C. Helo, N. A. Neill, F. Hern´andez-Pinto, and Z. S. Wang (2022), 2208.12818.

S. Weinberg, Phys. Rev. D 26, 287 (1982)

M. Aaboud et al. (ATLAS), Phys. Rev. D 97, 052012 (2018), 1710.04901

J. Alwall, M. Herquet, F. Maltoni, O. Mattelaer, and T. Stelzer, JHEP 1106, 128 (2011), 1106.0522.

G. Cottin, J. C. Helo, M. Hirsch, and D. Silva, Phys. Rev. D99, 115013 (2019), 1902.05673

P. D. Bolton, F. F. Deppisch, and P. S. B. Dev (2021), 2112.12658.

M. Aaboud et al. (ATLAS), Eur. Phys. J. C 78, 401 (2018), 1706.04786.