Fermi National Accelerator Laboratory

FNAL/C--96/371-E

FERMILAB-Conf-96/371-E

CDF

CONF-960812--28

Search for Charginos and Neutralinos using Trileptons

J.P. Done
For the CDF Collaboration
Department of Physics, Texas A&M University
College Station, Texas 77843-4242

Fermi National Accelerator Laboratory
P.O. Box 500, Batavia, Illinois 60510

RECEIVED
NOV 18 1996
OSTI

October 1996

Published Proceedings of the *1996 Annual Divisional Meeting (DPF 96) of the Division of Particles and Fields of the American Physical Society*, Minneapolis, Minnesota, August 10-15, 1996.

MASTER

Operated by Universities Research Association Inc. under Contract No. DE-AC02-76CH03000 with the United States Department of Energy

HH

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process or service by trade name, trademark, manufacturer or otherwise, does not necessarily constitute or imply its endorsement, recommendation or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Distribution

Approved for public release: further dissemination unlimited.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

FERMILAB-CONF-96/371-E

CDF/ANAL/EXOTIC/CDFR/3833
September 30, 1996

SEARCH FOR CHARGINOS AND NEUTRALINOS USING TRILEPTONS

JAMES P. DONE [a]
Department of Physics, Texas A&M University
College Station, TX 77843-4242, USA

We search for supersymmetry (SUSY) using trilepton events in $p\bar{p}$ collisions at $\sqrt{s} = 1.8$ TeV. In the Minimal Supersymmetric Standard Model (MSSM), trilepton events are expected from chargino-neutralino ($\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0$) pair production, with subsequent decay into leptons. In all possible combinations of electron and muon channels in 100 pb^{-1} of data, we observe no events which pass our trilepton selection criteria. Assuming the GUT hypothesis within the framework of the MSSM, our preliminary analysis excludes $M(\tilde{\chi}_1^{\pm}) < 68$ GeV/c^2.

1 Introduction to Supersymmetry

The first indication of supersymmetric grand unification arose from precision measurements of the coupling constants α_1, α_2, and α_3 at the Z^0 pole [1]. Using the Standard Model (SM) assuming grand unification (GUT), there is no clear intersection of the coupling constants. However, they converge at the GUT scale when the Minimal Supersymmetric Standard Model (MSSM) [2] is employed. Hence SUSY can be used in grand unification schemes. Thus, a direct search for SUSY phenomena is clearly important.

2 Data Analysis

In our analysis, we assume R-parity (a multiplicative quantum number distiguishing particles from superparticles) to be conserved. Charginos and neutralinos ($\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0$) can be pair produced in $p\bar{p}$ collisions via an s-channel virtual W yielding three isolated leptons and a stable LSP ($\tilde{\chi}_1^0$) (which causes missing energy [3]). Our data have been collected with the Collider Detector at

[a] Representing the CDF Collaboration.

Published Proceedings 1996 Divisional Meeting of the Division of Particles and Fields, American Physical Society, Minneapolis, MN, August 10-15, 1996.

Fermilab (CDF) [4] during the 1992-5 collider run. Our analysis begins by selecting the highest $p_T(\ell)$ >11 GeV/c electrons (muons) in the pseudorapidity range $|\eta^e| < 1.1$ ($|\eta^\mu| < 0.6$). The minimum p_T value for additional electons (muons) is 5 GeV/c (4 GeV/c); additional electrons (muons) are accepted in the pseudorapidity range $|\eta^e| < 2.4$ ($|\eta^\mu| < 1.0$). It is required that two of the three leptons are of opposite charge and same flavor. We look for events where $\not\!\!E_T$ >15 GeV. After all cuts, we are left with zero candidate events.

3 Backgrounds

The principal backgrounds to the SUSY trilepton analysis are from Drell-Yan plus fake leptons and diboson events. Events from diboson and Drell-Yan were generated by ISAJET [5] and run through our detector simulation. The rate of misidentified leptons is measured from data. The CDF measured cross-section for Drell-Yan was used[6]. The total SM background yield expected in 100 pb^{-1} of data is 0.4 ± 0.1 events, which is consistent with our observation of no events.

4 Excluded Regions of the MSSM

Our observation of zero trilepton events folded in with our statistical and systematic uncertainties determines an upper limit on $M(\tilde{\chi}_1^\pm)$. The total systematic uncertainty of 25% is convoluted (as a Gaussian smearing) with a Poisson distribution; we obtain a 95% C.L. upper limit of 3.35 events. The upper limit to $\sigma \cdot BR$ is:

$$\sigma \cdot BR(\tilde{\chi}_1^\pm \tilde{\chi}_2^0 \rightarrow 3\ell X) \quad < \quad \frac{3.35}{\int \mathcal{L}dt \cdot \epsilon^{tot}}$$

where $\int \mathcal{L}dt$ is the integrated luminosity for our data sample (100 pb^{-1}), ϵ^{tot} is the total detection efficiency, and $BR(\tilde{\chi}_1^\pm \tilde{\chi}_2^0 \rightarrow 3\ell X)$ is the branching ratio to three leptons (electrons or muons).

Figure 1 shows the 95% C.L. upper limit on $\sigma \cdot BR(\tilde{\chi}_1^\pm \tilde{\chi}_2^0 \rightarrow 3\ell X)$, plotted as a solid curve versus $M(\tilde{\chi}_1^\pm)$. We find that $M(\tilde{\chi}_1^\pm) < 68$ GeV/c^2 and $\sigma \cdot BR$ >0.66 pb are excluded by our analysis for the MSSM parameter values of $\mu = -600$ GeV/c^2, $\tan\beta = 2$, and $M_{\tilde{q}}/M_{\tilde{g}} = 1.0$.

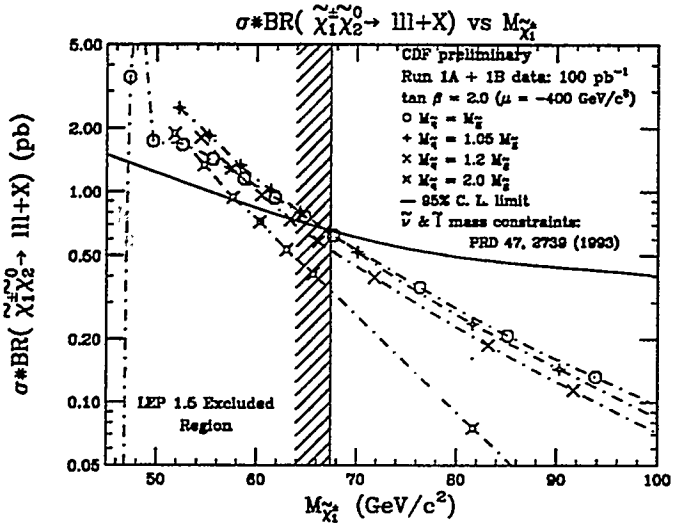

Figure 1: SUSY Mass Limits.

5 Conclusion

We searched for evidence of the production and decay of $\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0$ pairs into trilepton events in 100 pb^{-1} of $\sqrt{s} = 1.8$ TeV $p\bar{p}$ collision data at CDF. No candidates are observed. We set a preliminary limit of $M(\tilde{\chi}_1^{\pm}) > 68$ GeV/c^2 and $\sigma \cdot BR < 0.66$ pb at the 95 % C. L. for the MSSM parameters mentioned.

Acknowledgments

We thank Benn Tannenbaum for completing this analysis. This work is supported by the U.S. Department of Energy and National Science Foundation; the Italian Instituto Nazionale di Fisica Nucleare; the Ministry of Education, Science and Culture of Japan; the Natural Sciences and Engineering Research Council of Canada; the National Science Council of the Republic of China; the A. P. Sloan Foundation; and the Alexander von Humboldt-Stiftung.

References

1. P. Langacker *et al.*, *Phys. Rev.* D **44**, 817 (1991).
2. S. Dawson, E. Eichten, and C. Quigg, *Phys. Rev.* D **31** (1985) 1581.
3. P. Nath *et al.*, *Phys. Rev.* D **D48** (1993) 5175.
4. F. Abe *et al.*, *Nucl. Instrum. Methods* **A271** (1988) 387.
5. F. E. Paige and S. D. Protopopescu, (unpublished)
6. F. Abe, *et al.*, *Phys. Rev.* D **49**, 1 (1994).