RECONSTRUCTION OF SUPERPARTNER MASSES

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In the context of Minimal Supersymmetric Standard Model histograms of mass distributions for superpartners $\tilde{q}_R,\ \tilde{\chi}_1^0,\ \tilde{q}_L,\ \tilde{\chi}_2^0,\ \tilde{l}_L,\ \tilde{g}$ are constructed.

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1. INTRODUCTION

Minimal Supersymmetric Standard Model (MSSM) [1] is determined by the superpotential

$$W = h^e_{ij} L_i H_1 \overline{E}_j + h^d_{ij} Q_i H_1 \overline{D}_j + h^u_{ij} Q_i H_2 \overline{U}_j + \mu H_1 H_2$$

and by the soft supersymmetry breaking potential

$$V = m_1^2 |H_1|^2 + m_2^2 |H_2|^2 - m_{12}^2 (\epsilon_{ij} H_1^i H_2^j + \text{h.c.}) +$$
$$+ M_{\tilde{Q}}^2 \left[\tilde{t}_L^* \tilde{t}_L + \tilde{b}_L^* \tilde{b}_L \right] + M_{\tilde{U}}^2 \tilde{t}_R^* \tilde{t}_R + M_{\tilde{D}}^2 \tilde{b}_R^* \tilde{b}_R +$$
$$+ M_{\tilde{L}}^2 [\tilde{\nu}^* \tilde{\nu} + \tilde{\tau}_L^* \tilde{\tau}_L] + M_{\tilde{E}}^2 \tilde{\tau}_R^* \tilde{\tau}_R +$$
$$+ \frac{g}{\sqrt{2} m_W} \epsilon_{ij} \left[\frac{m_\tau A_\tau}{\cos\beta} H_1^i \tilde{l}_L^j \tau_R^* + \frac{m_b A_b}{\cos\beta} H_1^i \tilde{q}_L^j \tilde{b}_R^* - \right.$$
$$\left. - \frac{m_t A_t}{\sin\beta} H_2^i \tilde{q}^j t_R^* \right] + \frac{1}{2} \left[M_3 \overline{\tilde{g}} \tilde{g} + M_2 \overline{\widetilde{W}^a} \widetilde{W}^a + M_1 \overline{\widetilde{B}} \widetilde{B} \right],$$

where L_i and Q_i are slepton and squark $SU(2)_L$ doublets, $\overline{E}_j$ and $(\overline{D}_j, \overline{U}_j)$ are selectron and squark $SU(2)_L$ singlets, H_1 and H_2 are Higgs $SU(2)_L$ doublets.

The superpotential W and the potential V contain more than 100 parameters [2]. The analysis of this parameter space, based on theoretical and experimental constraints, allows to obtain the restricted parameter set [3]:

$$m_0,\ m_{1/2},\ A_0,\ \tan\beta,\ \text{sgn}(\mu), \qquad (1)$$

where m_0 and $m_{1/2}$ are respectively universal masses of scalar and spinor superpartners, A_0 is the trilinear soft supersymmetry breaking parameter, $\tan\beta$ is the ratio of vacuum expectation values of two Higgs doublets, $\text{sgn}(\mu)$ is the sign of the Higgs mixing parameter. The choice of concrete values of parameters (1) is ambiguous, to what the Table testifies [4].

2. RECONSTRUCTION OF MASSES

The purpose of this work is the construction of histograms describing mass distributions for superpartners

$$\tilde{q}_R,\ \tilde{\chi}_1^0,\ \tilde{q}_L,\ \tilde{\chi}_2^0,\ \tilde{l}_L,\ \tilde{g}\ . \qquad (2)$$

We choose the following set of parameters:

$$m_0 = 20\ \text{GeV},\ m_{1/2} = 440\ \text{GeV},\ A_0 = -25\ \text{GeV},$$
$$\tan\beta = 15,\ \text{sgn}(\mu) = +1. \qquad (3)$$

Using the parameter set (3) it is possible to construct histograms of mass distributions for superpartners (2) by application of the computer program PYTHIA [5] This histograms are shown in Fig.1 - 6.

Scenarios of MSSM

Model	α	β	γ	δ	ϵ	ζ	η
$m_{1/2}$	293	370	247	750	440	1000	1000
m_0	206	225	328	500	20	100	20
$\tan\beta$	10	10	20	10	15	21.5	23.7
sign(μ)	+	+	+	+	+	+	+
A_0	0	0	0	0	-25	-127	-25
Masses							
h^0	115	117	115	122	119	124	124
H^0	267	328	241	1159	626	1293	1261
A^0	265	325	240	1152	622	1285	1253
$H^\pm$	278	337	255	1162	632	1296	1264
χ_1^0	113	146	95	310	175	417	417
χ_2^0	215	282	180	600	339	805	804
χ_3^0	380	503	332	925	574	1192	1176
χ_4^0	400	518	352	935	587	1200	1184
$\chi_1^\pm$	215	283	180	601	340	807	806
$\chi_2^\pm$	399	518	352	935	587	1200	1184
$\tilde{g}$	711	880	619	1691	1026	2191	2191
e_L, μ_L	299	351	378	713	306	684	677
e_R, μ_R	216	241	328	572	171	387	374
ν_e, ν_μ	287	340	368	703	290	669	662
τ_1	213	239	315	565	153	338	319
τ_2	300	352	378	712	309	677	670
ν_τ	287	340	365	700	288	660	653
u_L, c_L	674	826	636	1604	935	1991	1998
u_R, c_R	661	808	629	1550	902	1911	1908
d_L, s_L	679	831	642	1606	938	1993	1990
d_R, s_R	652	797	621	1544	899	1903	1900
t_1	492	622	453	1219	710	1545	1553
t_2	662	800	611	1486	900	1842	1840
b_1	609	752	558	1456	852	1807	1804
b_2	641	785	603	1516	883	1851	1846

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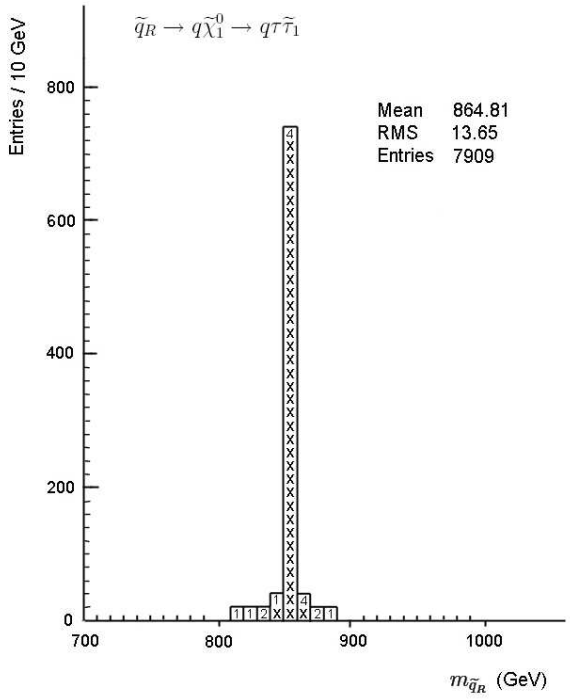

Fig.1. *Histogram of mass distribution for* $\tilde{q}_R$

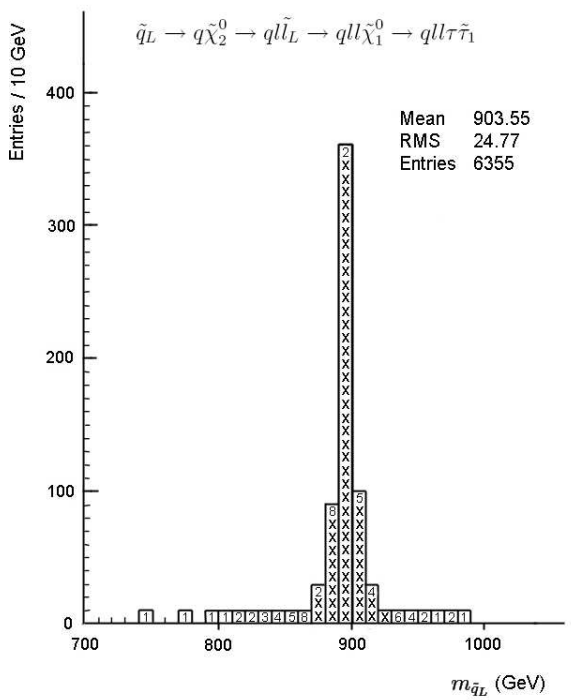

Fig.3. *Histogram of mass distribution for* $\tilde{q}_L$

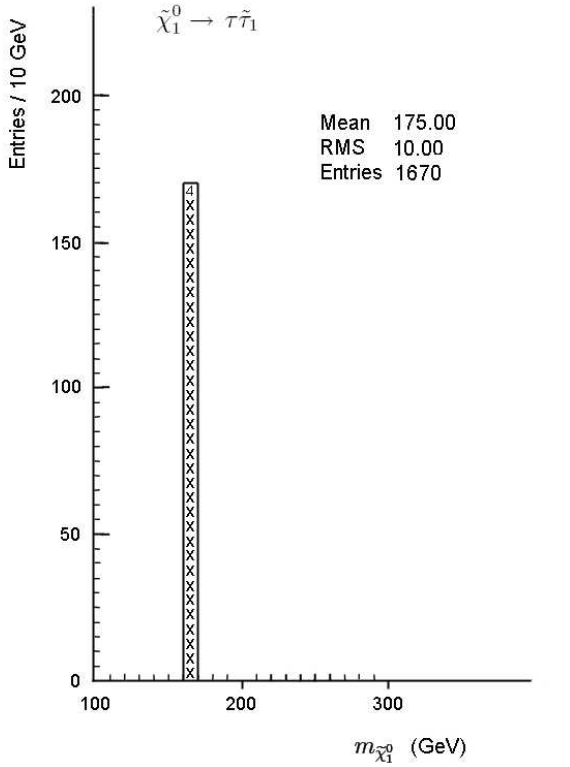

Fig.2. *Histogram of mass distribution for* $\tilde{\chi}_1^0$

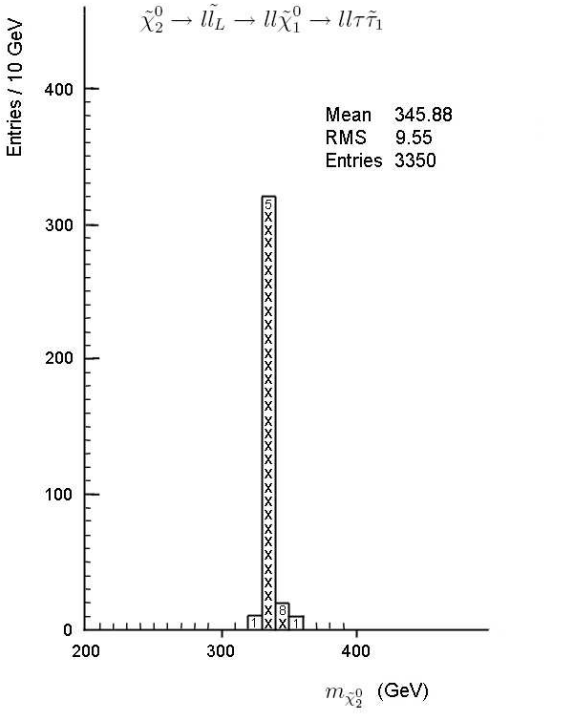

Fig.4. *Histogram of mass distribution for* $\tilde{\chi}_2^0$

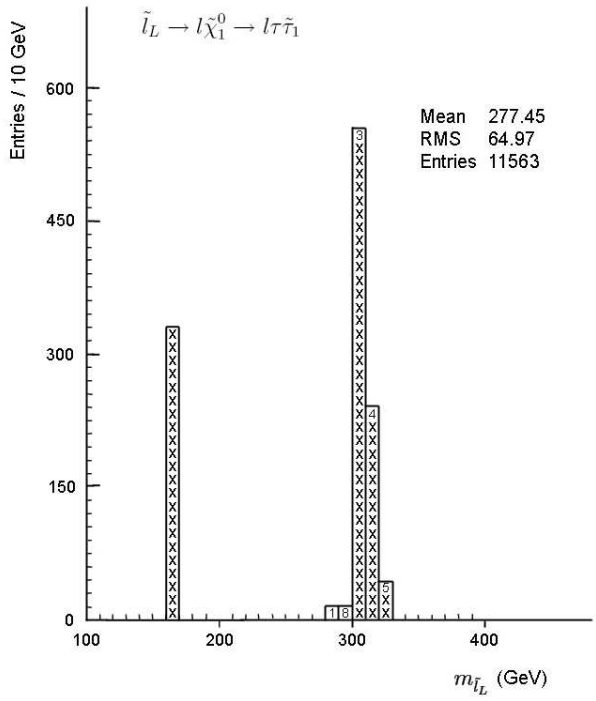

Fig.5. *Histogram of mass distribution for $\tilde{l}_L$*

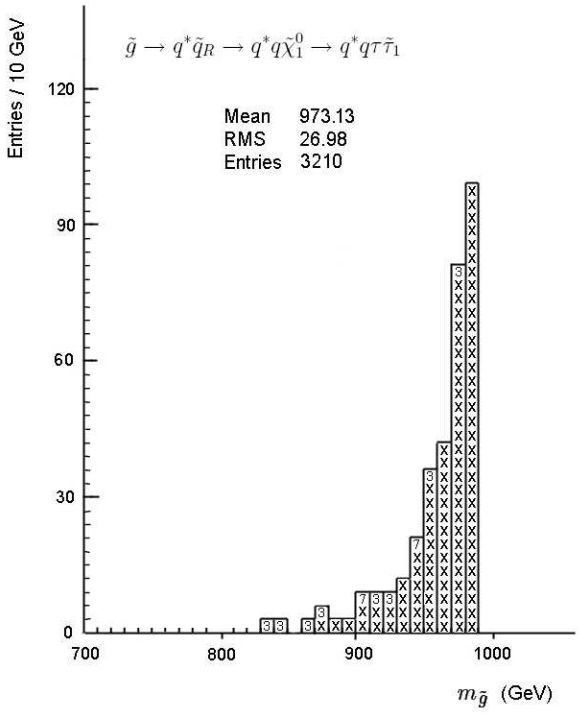

Fig.6. *Histogram of mass distribution for $\tilde{g}$*

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РЕКОНСТРУКЦИЯ МАСС СУПЕРПАРТНЕРОВ

Ю.М. Малюта, Т.В. Обиход

В контексте минимальной суперсимметричной стандартной модели построены гистограммы распределения масс для суперпартнеров: $\tilde{q}_R,\ \tilde{\chi}_1^0,\ \tilde{q}_L,\ \tilde{\chi}_2^0,\ \tilde{l}_L,\ \tilde{g}$.

РЕКОНСТРУКЦІЯ МАС СУПЕРПАРТНЕРІВ

Ю.М. Малюта, Т.В. Обіход

В контексті мінімальної суперсиметричної стандартної моделі побудовано гістограми розподілу мас для суперпартнерів: $\tilde{q}_R,\ \tilde{\chi}_1^0,\ \tilde{q}_L,\ \tilde{\chi}_2^0,\ \tilde{l}_L,\ \tilde{g}$.