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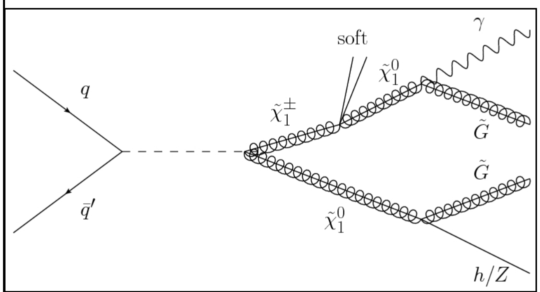
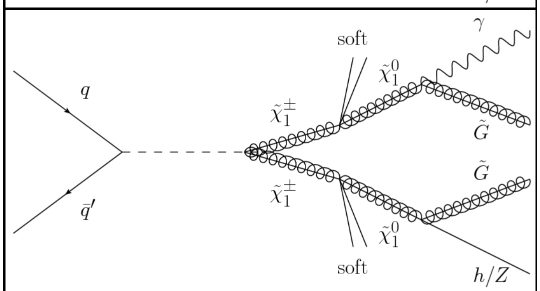
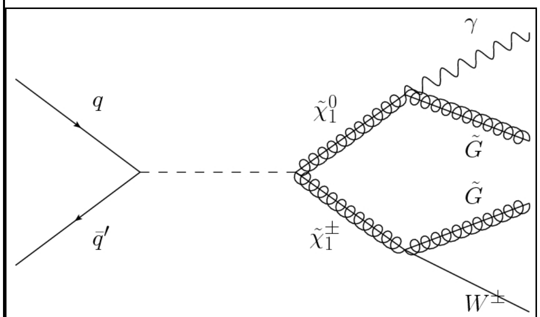
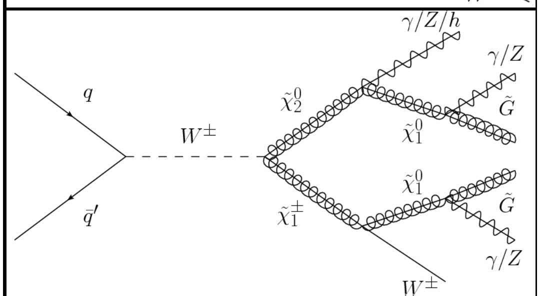
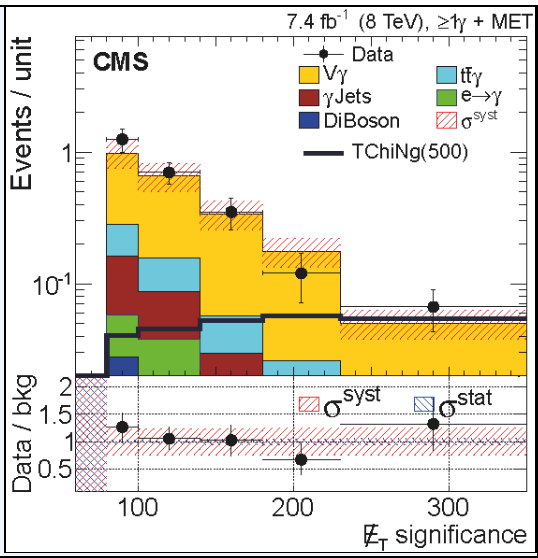
Search for electroweak production of gauge mediated supersymmetry with photons at CMS (SUS-14-016)

Abstract

In this letter a search for electroweak production of gauge mediated supersymmetry at CMS is reported. The lightest neutralino is assumed to have bino- or wino-like components, resulting in decays to photons and gravitinos, where the gravitino escapes undetected. The analysis focuses on electroweak production of low mass sparticles resulting in final states with photons and missing transverse energy. A special dataset with relaxed photon transverse momentum and missing transverse energy trigger thresholds is used to search for the signal characterized by low hadronic energy in the final state. This dataset collected in pp collisions in 2012 corresponds to 7.4 fb^{-1} at$\sqrt{s}$= 8 CMS.TeV. No significant excess over the standard model background expectation is observed. Cross section limits and exclusion contours for various scenarios of direct electroweak gaugino production are presented.

Figures in the paper

Figures		C
 	 	Figure 1: In the (left), the charg slightly heavier leading to chargi decays accompanie One neutralino de a gravitino, wher into a Z or an h with equal probab scenario (top rig mass-degenerate a $\widetilde{\chi} $\widetilde{\chi} as shown. Within branching ratio $\widetilde{\chi} $\gamma\tilde{G}$ $\widetilde{\chi} $Z\tilde{G}$ depe neutralino-mass. for electroweak C shown in (bottom amount of hadroni one photon and $E_{\mathrm{T}}^{ common features o



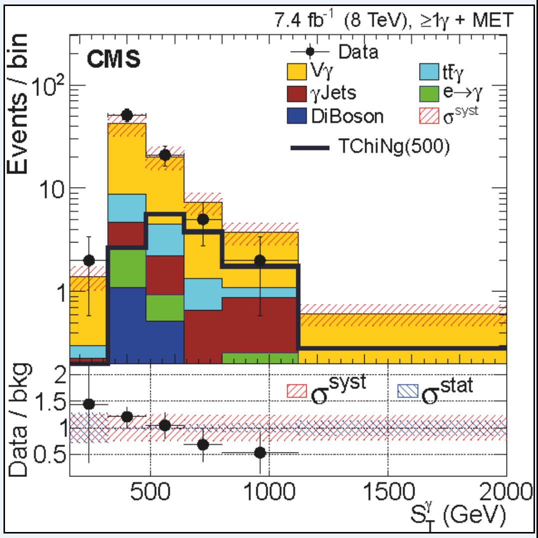


Figure 2: The $E_{\mathrm{T}}^{
(left) and $S_{\t
(right) variables
signal region. Fo
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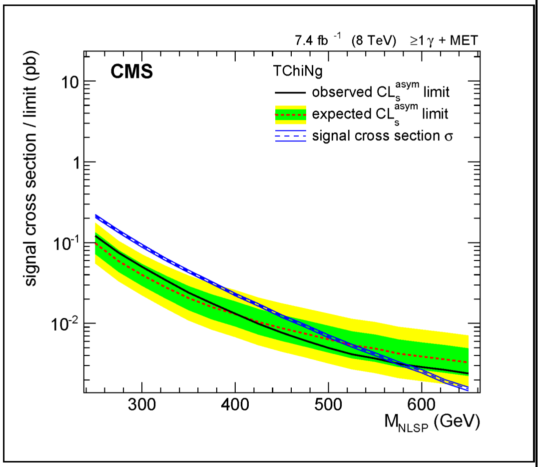
$E_{\mathrm{T}}^{
= 200 and $S_{\te
600 CMS.GeV parti
TChiNg signal poi
M$_{\text{wino}}$
shown for compari



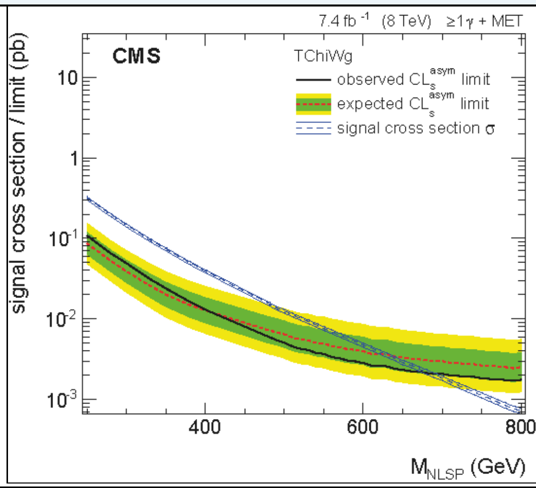
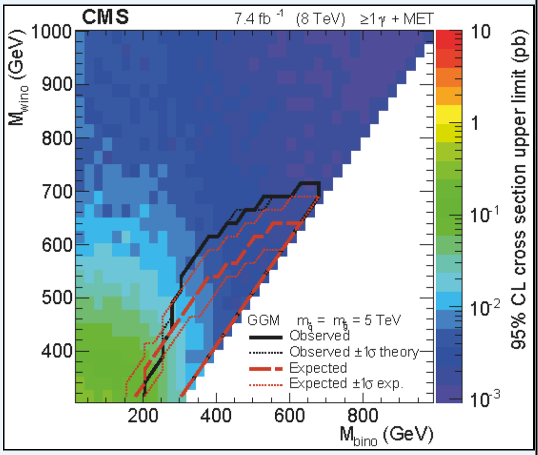


Figure 3: Exclusi
TChiNg (left) and
scenario. In the
masses below 570
in the TChiWg sce
below 680 CMS.GeV
Electronic versio
TChiNg_Obs.root,
TChiWg_Obs.root,



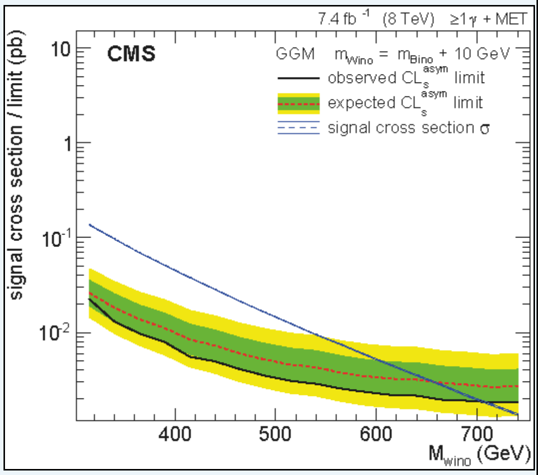


Figure 4: Observe
CLs limit at 95%
signal points for
to an integrated
fb^{-1} in theM
M$_{\text{bino}}$
shown are the exp
exclusion contour
near the diagonal
M$_{\text{wino}}$
+ 10 CMS.GeV up t
M$_{\text{wino}}$
excluded (right).
of limits: WinoBi
WinoBino_10_Obs.r
WinoBino_10_Exp.r

Tables in the paper

Tables	Caption

	$E_T^{miss,signif} > 200$, $S_T^{\gamma} > 600$ GeV	$E_T^{miss,signif} < 200$, $S_T^{\gamma} > 600$ GeV	$E_T^{miss,signif} < 200$, $S_T^{\gamma} < 600$ GeV	$E_T^{miss,signif} > 200$, $S_T^{\gamma} < 600$ GeV
$V\gamma$	4.7 ± 1.2	7.0 ± 1.8	42.3 ± 10.4	5.0 ± 1.3
γjets	0.1 ± 0.1	1.3 ± 0.3	3.4 ± 0.7	0.0 ± 0.1
$t\bar{t}\gamma$	0.3 ± 0.1	1.1 ± 0.3	5.5 ± 1.5	0.4 ± 0.1
Diboson	0.1 ± 0.1	0.2 ± 0.1	1.5 ± 0.8	0.2 ± 0.1
$e \rightarrow \gamma$	0.1 ± 0.1	0.1 ± 0.1	1.6 ± 0.2	0.2 ± 0.1
QCD-multijet	0.0	0.0	0.0	0.0
Background	5.3 ± 1.2	9.7 ± 1.8	54.3 ± 10.6	5.8 ± 1.3
Data	4	4	65	8
Signal	6.2 ± 0.2	2.1 ± 0.1	4.6 ± 0.1	3.3 ± 0.1
Acceptance [%]	12.2 ± 0.3	4.2 ± 0.1	9.0 ± 0.2	6.5 ± 0.2

Table 1: Event yields for data corresponding to 7.4 fb^{-1} and the estimated backgrounds. The signal yields correspond to the benchmark TChiNg signal point with Mwino = 500 CMS.GeV shown in Fig. 2.

Additional material

Figures and tables

Source	Sample	Rel. uncertainty (on total BG)
$V\gamma$ normalization	$V\gamma$	24 % (19 %)
γjets normalization	γjets	14 % (1 %)
Tag&Probe fit	$e \rightarrow \gamma$	11 % (0.3 %)
Cross-section measurement	$t\bar{t}\gamma$	26 % (3 %)
MC simulation	diboson	50 % (1 %)
MC simulation	multijet	100 % (0 %)
PDF uncertainty on acceptance	signal	<0.1–11 %
PDF and scale uncertainty	signal	4–8 %
Luminosity	diboson, multijet, and signal	2.6 %
Trigger efficiency	diboson, multijet, and signal	1.2 %
Jet energy scale	diboson, multijet, and signal	1–2 %

Table 2: Summary t
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luminosity and tri
to the backgrounds
data normalization
diboson and multij
uncertainty of the
selection are domi
$V\gamma$ backgrou

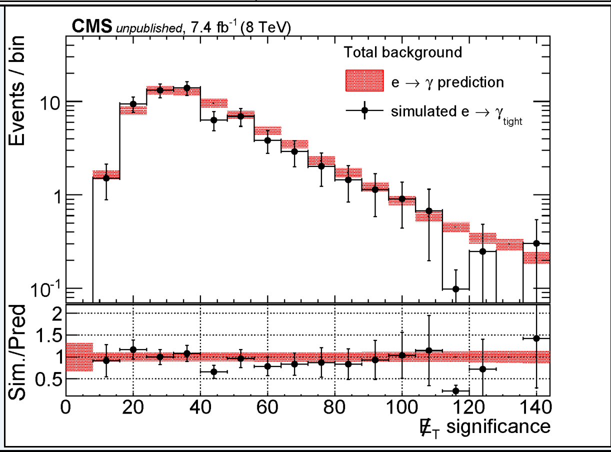
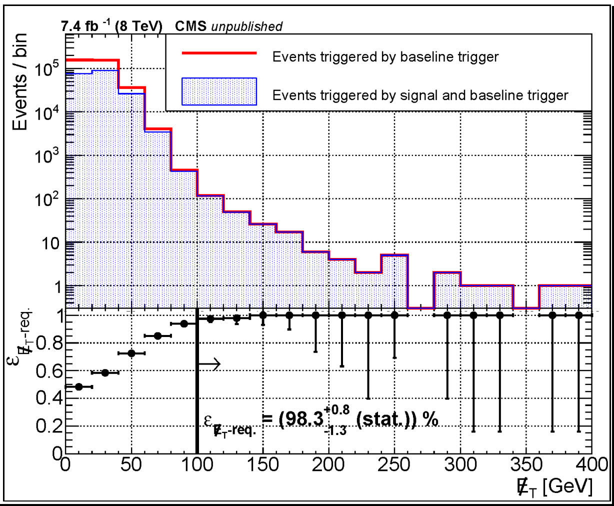


Figure 5: Validati
events arising fro
depending on the $
The prediction (re
$\gamma_{\text{tig
$\gamma_{\text{pix
distribution with
compared to the di
ΔR(sim e
using generator in
agreement is obser

Figure 6: Measurem
$E_{\mathrm{T}}^{\
missing transverse
broad turn-on due
$E_{\mathrm{T}}^{\
trigger and the of
is flat for $E_{\m
CMS.GeV and given
$\varepsilon_{\tex



= \text{(98.3 }^{+

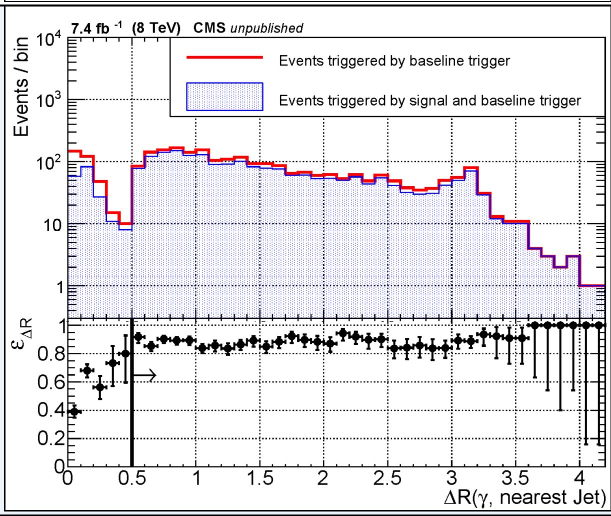


Figure 7: Measurem
photon part in dep
the photon and the
nearest jet). The
for small spherica
γ, nearest
analysis.

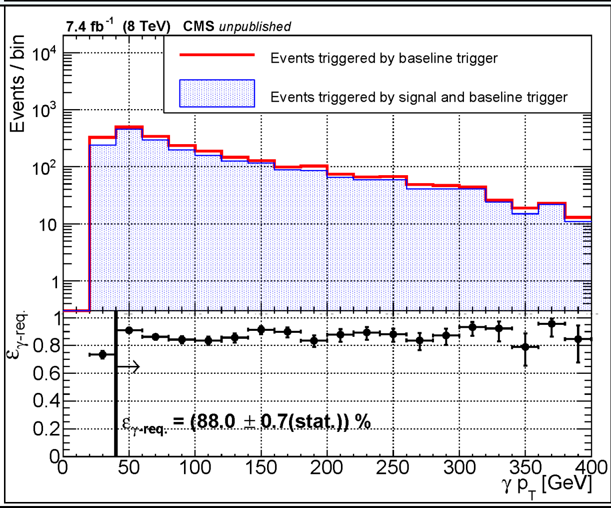
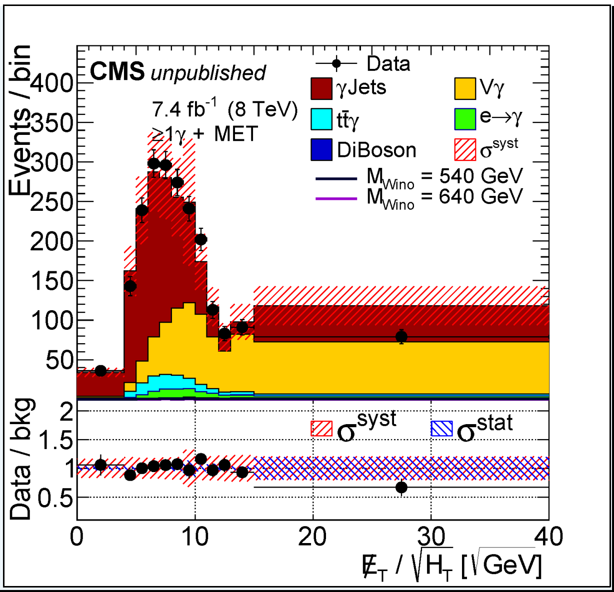


Figure 8: Measurem
photon part as a f
the photon with th
plateau region is
and the efficiency
given by $\varepsi
$\pm$ 0.7({stat.)}

Figure 9: Control
γjets backg
data using the tem
$E_{\mathrm{T}}^{\
H_{T}}}$.



Cut	TChiNg_500		TChiWg_650		GGM_640_630	
	N_{signal}	ε	N_{signal}	ε	N_{signal}	ε
generated	51.0	1.0	21.2	1.0	29.9	1.0
$\not{E}_T$ filters	50.98	1.0	21.16	1.0	29.86	1.0
$\not{E}_T > 100$ GeV	46.1	0.90	19.9	0.94	27.6	0.93
$\geq 1\gamma_{tight}$ ($p_T > 40$ GeV)	28.5	0.56	12.9	0.61	17.7	0.59
$r9(\gamma_{tight}) > 0.9$, $\lvert\eta(\gamma_{tight})\rvert < 1.44$	26.7	0.52	12.3	0.58	17.0	0.57
$\Delta R(1^{st}\gamma$, nearest jet$) > 0.5$	26.1	0.51	12.1	0.57	16.6	0.56
$H_T > 100$ GeV	21.8	0.43	10.4	0.49	14.3	0.48
control + signal region	21.4	0.42	10.2	0.48	14.1	0.47
signal region	16.3	0.32	8.7	0.41	12.0	0.40

Table 3: Number of
efficiency after e
points, each corre
scenario. The TChi
of 500 GeV, The TC
mass of 650 GeV an
a wino mass of 640

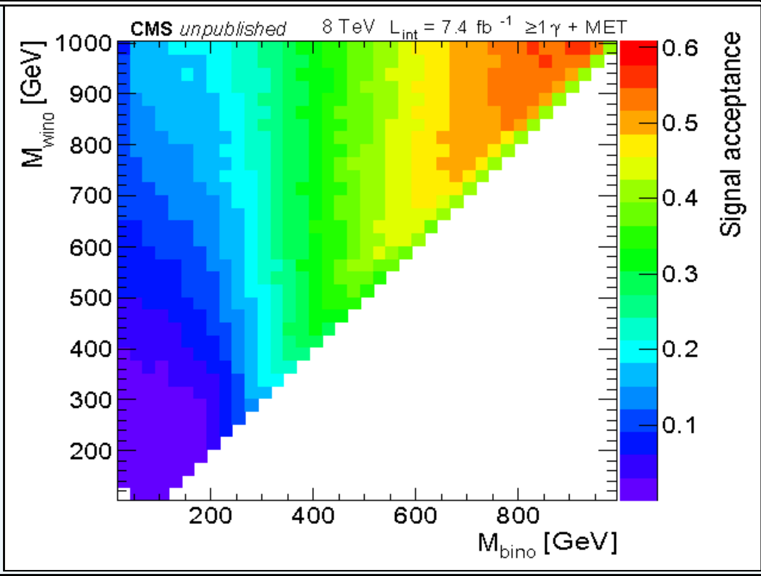
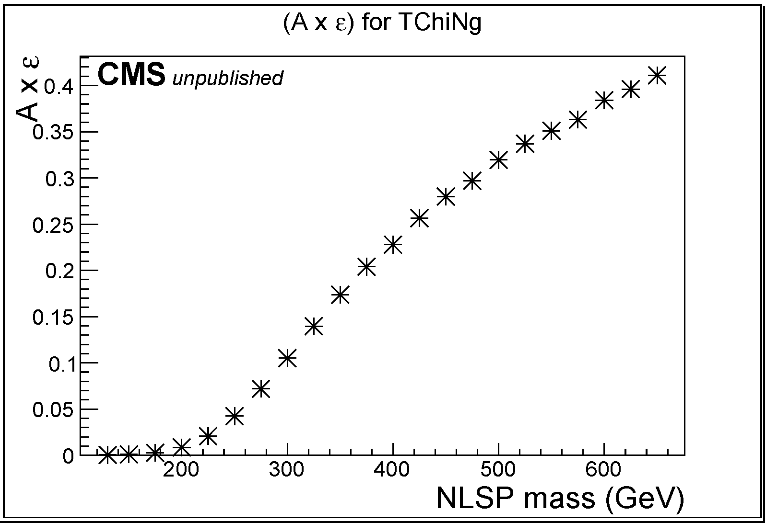
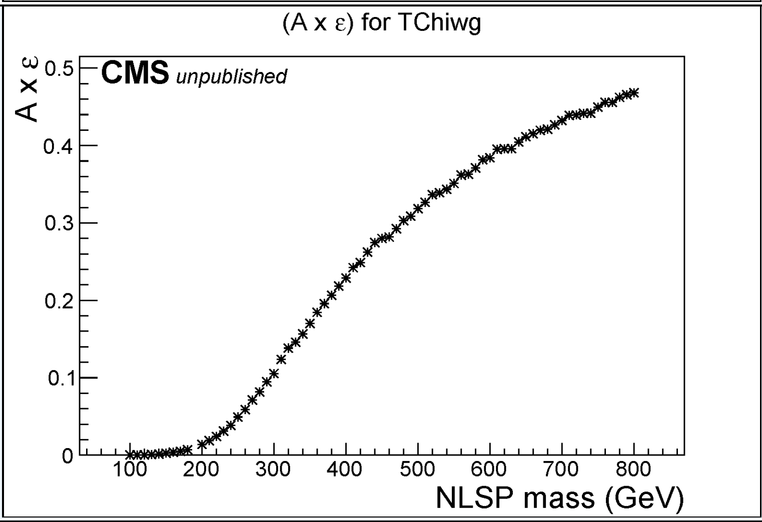


Figure 10: Efficie
plane spanned by o
version: WinoBino_

Figure 11: Effcien
depending on the m
selection. Eelectr

		
		Figure 12: Effcien depending on the n selection. The TCh compared to the TC TChiwg_acc.root

-- JohannesSchulz - 2015-07-22

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Topic revision: r13 - 2016-03-04 - FilipMortgat