CMS-PAS-SUS 16048

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CMS PAS SUS-16-048

CMS Physics Analysis Summary

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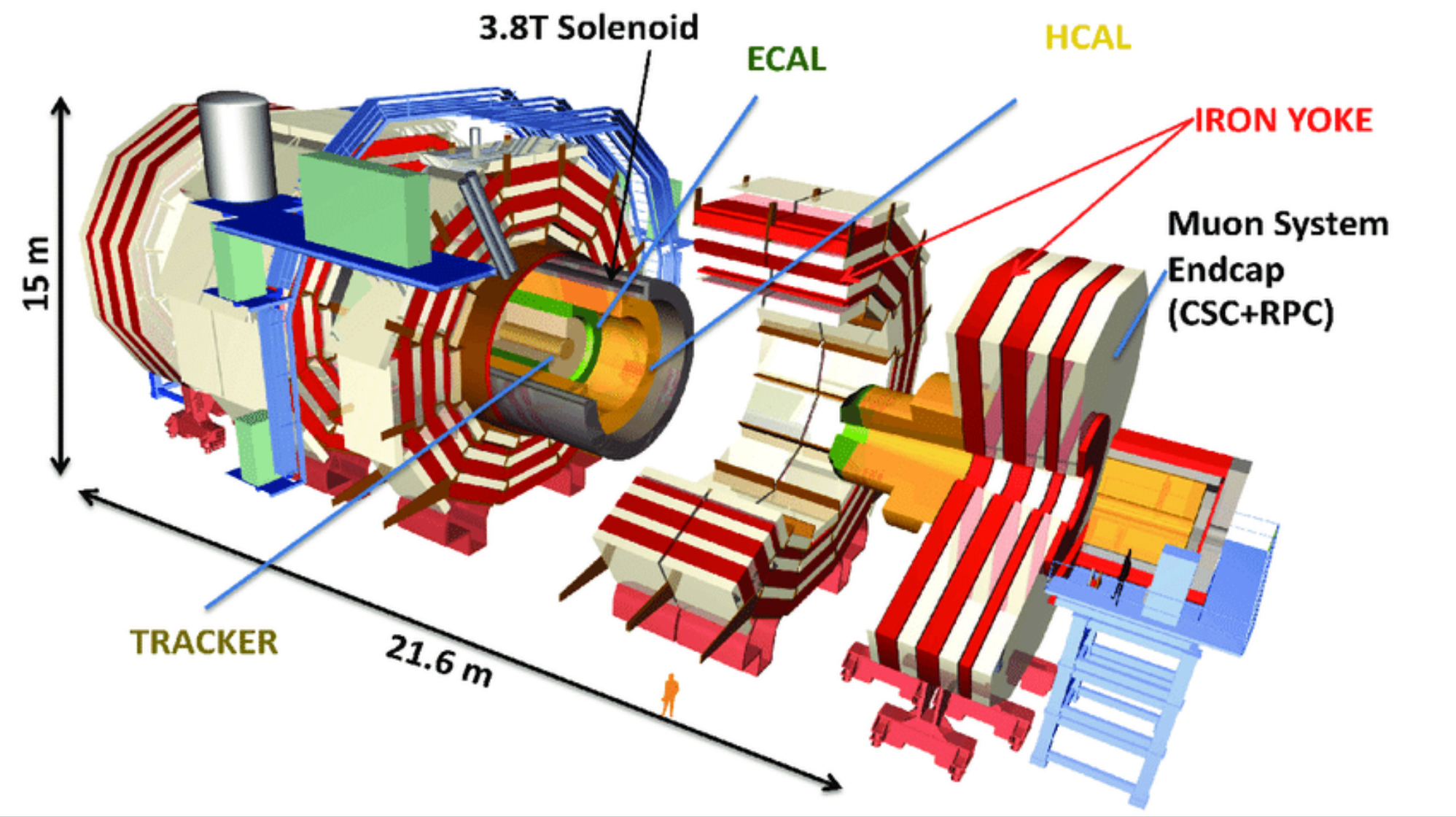
Search for new physics in events with two low momentum opposite-sign leptons and missing transverse energy at $\sqrt{s} = 13$ TeV

The CMS Collaboration

CMS


3.8T Solenoid
ECAL
HCAL
IRON YOKE
Muon System
Endcap
(CSC+RPC)
15 m
TRACKER
21.6 m

LSP

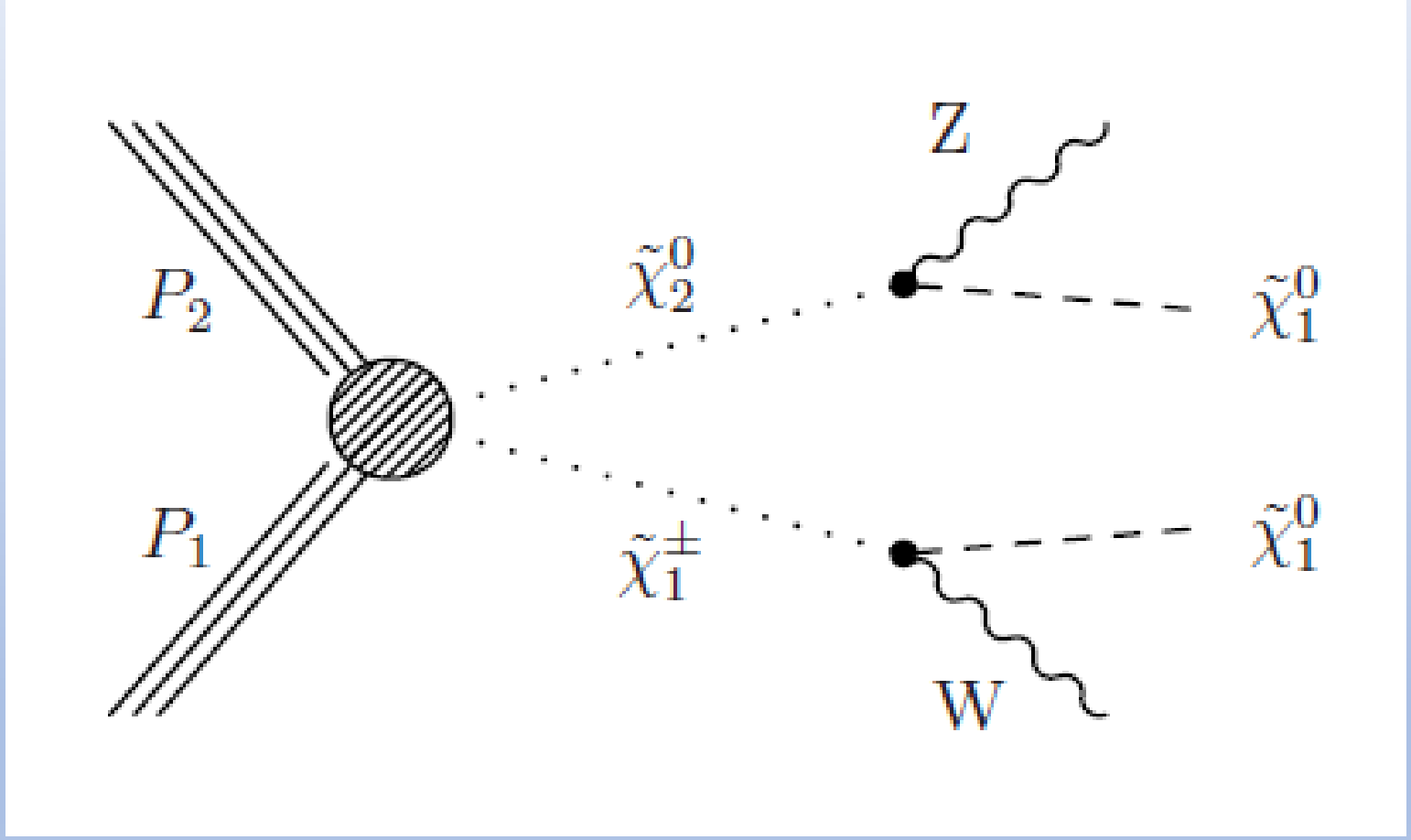
Teorik olarak öne sürülen en hafif süpersimetri parçacığıdır. Kendileri bir karanlık madde adayı. SM deki herhangi bir parçacıkla etkileşmez.

YÜK SINIRLANDIRMASI

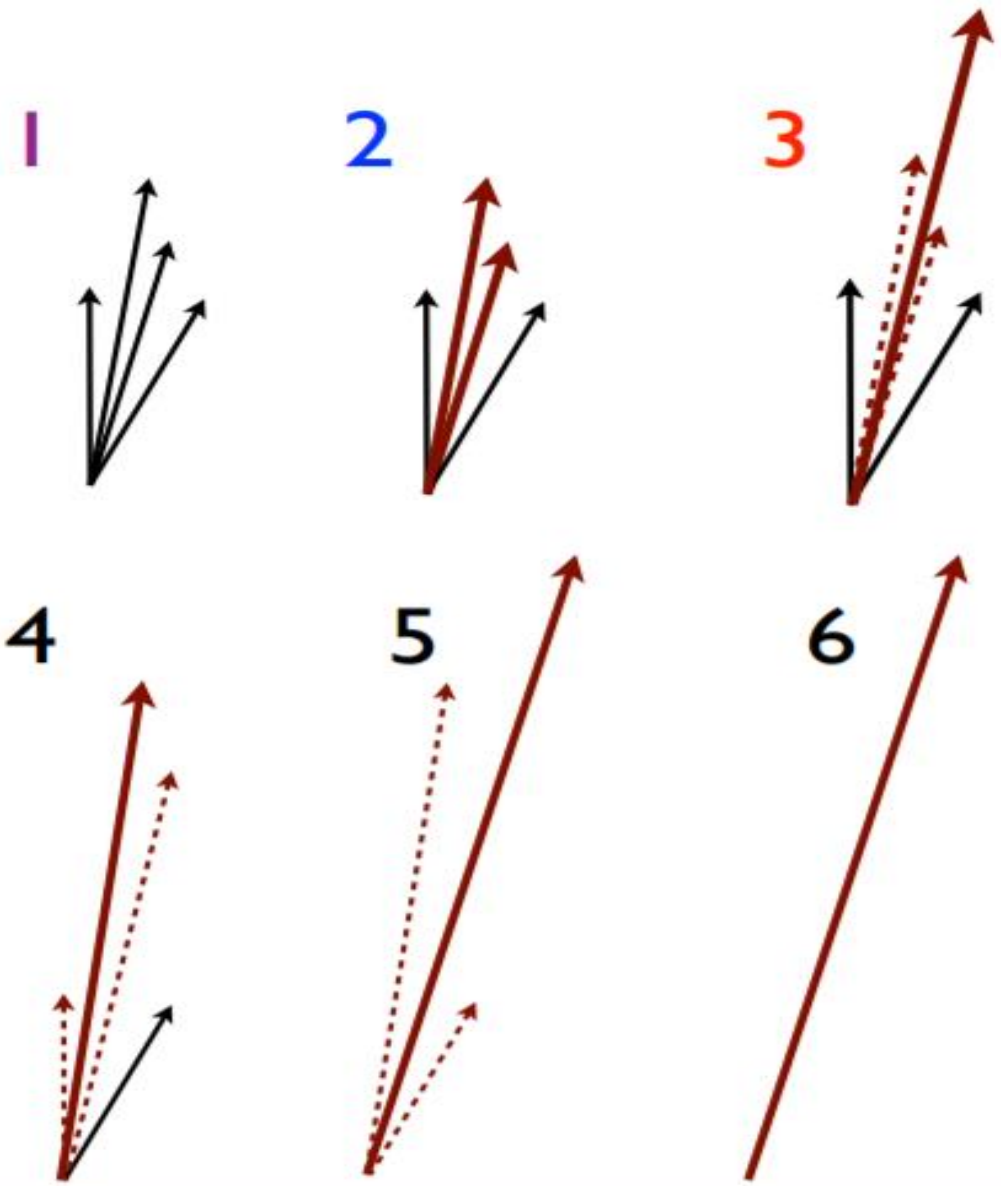
- LSP’ nin yüklü olması biraz mantıksız gibi gözüküyor. Çünkü dünyanın manyetik alanıyla etkileşip Hidrojene benzer ağır atomlar oluşturması beklenirdi.

- ???

Neutralinoları arıyoruz



Anti-kt Algoritması



- ☑ Infrared and collinear güvenilir.
- ☑ Küme algoritması.
  - ✓ Tüm parçacıkları listele.
  - ✓ d_{ij} and d_{iB} mesafelerini hesapla,
  - ✓ Eğer d_{ij} en küçük ise, i ve j parçacıklarını birleştir ve başa dön
  - ✓ Eğer d_{iB} en küçük ise, son durumu jet olarak belirle
  - ✓ Hiç bir parçacık kalmayıncaya kadar tekrarla.

Nesne Yapılandırması

```
object goodEle: ELE
  select Pt(ELE_) > 5 AND Pt(ELE_) < 30
  select {ELE_}AbsEta < 2.5

object goodMuo: MUO
  select Pt(MUO_) > 5 AND Pt(MUO_) < 30
  select {MUO_}AbsEta < 2.4

object jets : JET
  select Pt(JET) > 25
  select AbsEta(JET) < 2.4

object bjets : jets
  select BTag(jets) == 1

define WH1 : JET[0] JET[1]
define gMreco : goodMuo[0] goodMuo[1]
define gElereco : goodEle[0] goodEle[1]
```

Trigger Acceptance

- Trigger acceptance: at the trigger level the lepton pair is required to have a small boost of $p_{\mathrm{T}} > 3$ GeV together with an upper bound on the dimuon invariant mass, $M(\ell\ell) < 60$ GeV, in order to limit the trigger rate. This imposes an upper cut of 50 GeV on the invariant mass of the leptons selected offline and a lower cut on the dilepton transverse momentum $p_{\mathrm{T}}(\ell\ell) > 3$ GeV.

•EVENT SELECTİON PART OF ANALYSİS

```
region test
  select ALL
  weight randWeight 0.688
  select Size (goodMuo) >= 2
  histo h1mReco, "Invariant Mass of Muons (GeV)", 100, 0, 50, {gMreco}m
  select {gMreco}q == 0
  histo h2mReco, "After selection of neutral goodMuons", 100, 0, 40, {gM
  select Pt(gMreco) > 3
  select {gMreco}m < 50 AND {gMreco}m > 4
  select {gMreco}m ][ 9 10.5
  histo h3mReco, "Muons after mass exclusion(GeV)", 100, 0, 50, {gMreco}
  select MET > 125 AND MET < 200
  select HT(jets) > 100
  select MET/(HT(jets)) [] 0.6 1.4
  select Size(bjets) == 0
  select fMTauTau(goodMuo[0], goodMuo[1]) ][ 0 160
```

Elemenin önemli bir kısmı

```
select HT(jets) > 100
select MET/(HT(jets)) [] 0.6 1.4
select Size(bjets) == 0
select fMTauTau(goodMuo[0], goodMuo[1]) ][ 0 160
```

SİNYAL İÇİN BULDUĞUMUZ SONUÇLAR (MÜONLAR İÇİN)

```
                    test    Based on 250000 events:
                                    ALL :      1 +-          0 evt:   250000
                      randWeight 0.688 : 0.6876 +-  0.000927 evt: 171892.4531
                    Size (goodMuo) >= 2 : 0.0009006 +-  7.23e-05 evt: 154.8004456
  [Histo] Invariant Mass of Muons (GeV) :      1 +-          0 evt: 154.8004456
                      {gMreco}q == 0 : 0.8978 +-    0.0243 evt: 138.9763641
[Histo] After selection of neutral goodMuons :      1 +-          0 evt: 138.9763641
                      Pt(gMreco) > 3 : 0.9901 +-    0.0084 evt: 137.6003571
        {gMreco}m < 50 AND {gMreco}m > 4 :  0.575 +-    0.0421 evt: 79.12005615
                    {gMreco}m ][ 9 10.5 : 0.9913 +-    0.0104 evt: 78.43205261
  [Histo] Muons after mass exclusion(GeV) :      1 +-          0 evt: 78.43205261
                MET > 125 AND MET < 200 : 0.08772 +-    0.0319 evt: 6.880001068
                      HT(jets) > 100 :    0.6 +-     0.187 evt: 4.128000259
              MET/(HT(jets)) [] 0.6 1.4 : 0.8333 +-     0.183 evt: 3.440000057
                      Size(bjets) == 0 :      1 +-          0 evt: 3.440000057
 fMTauTau(goodMuo[0], goodMuo[1]) ][ 0 160 :    0.8 +-     0.216 evt: 2.752000093
              --> Overall efficiency  = 0.0011 % +- 0.000664 %
```

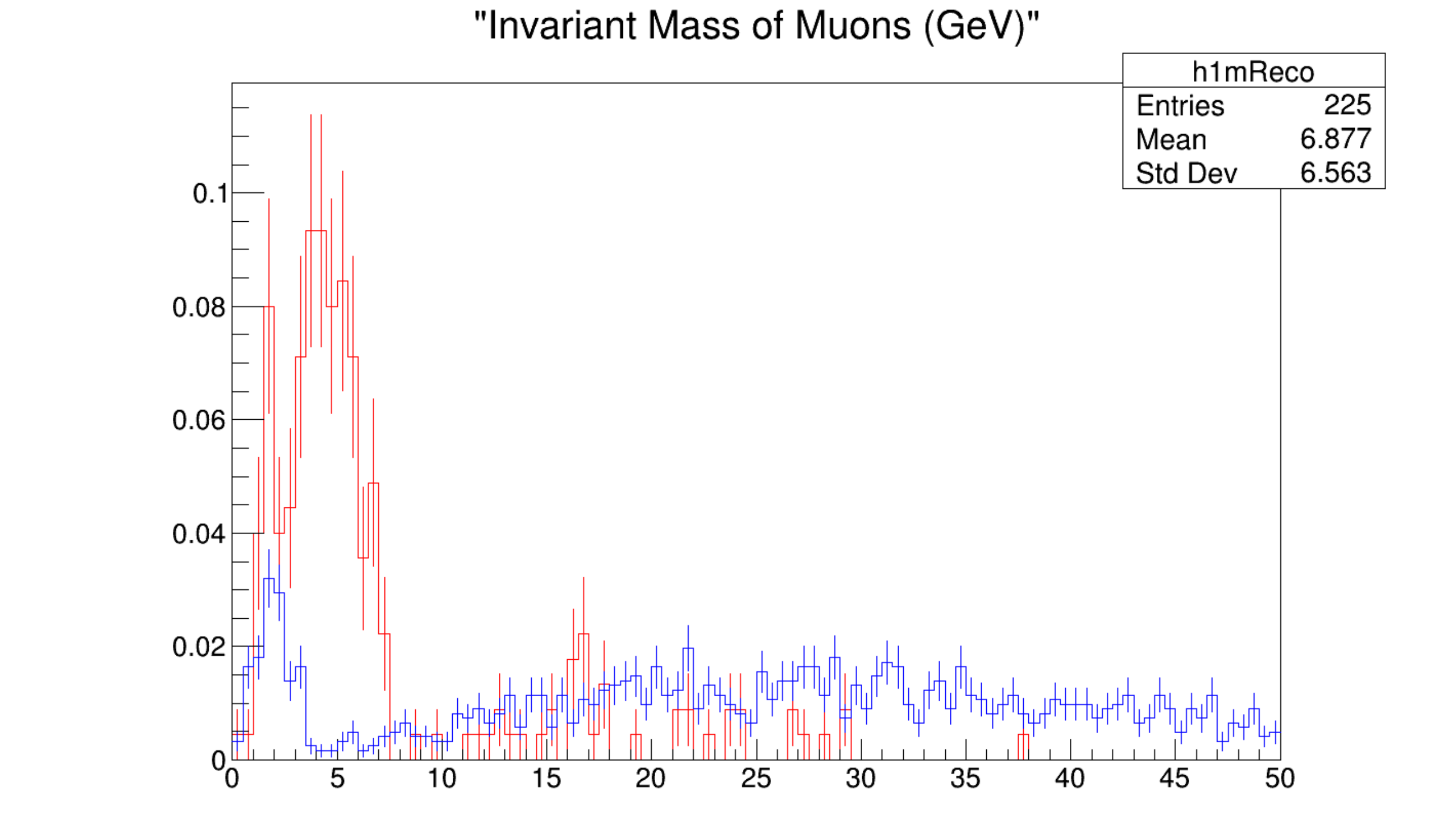
OUR MAİN BACKGROUND

6.2 The $t\bar{t}$ (2l) control region

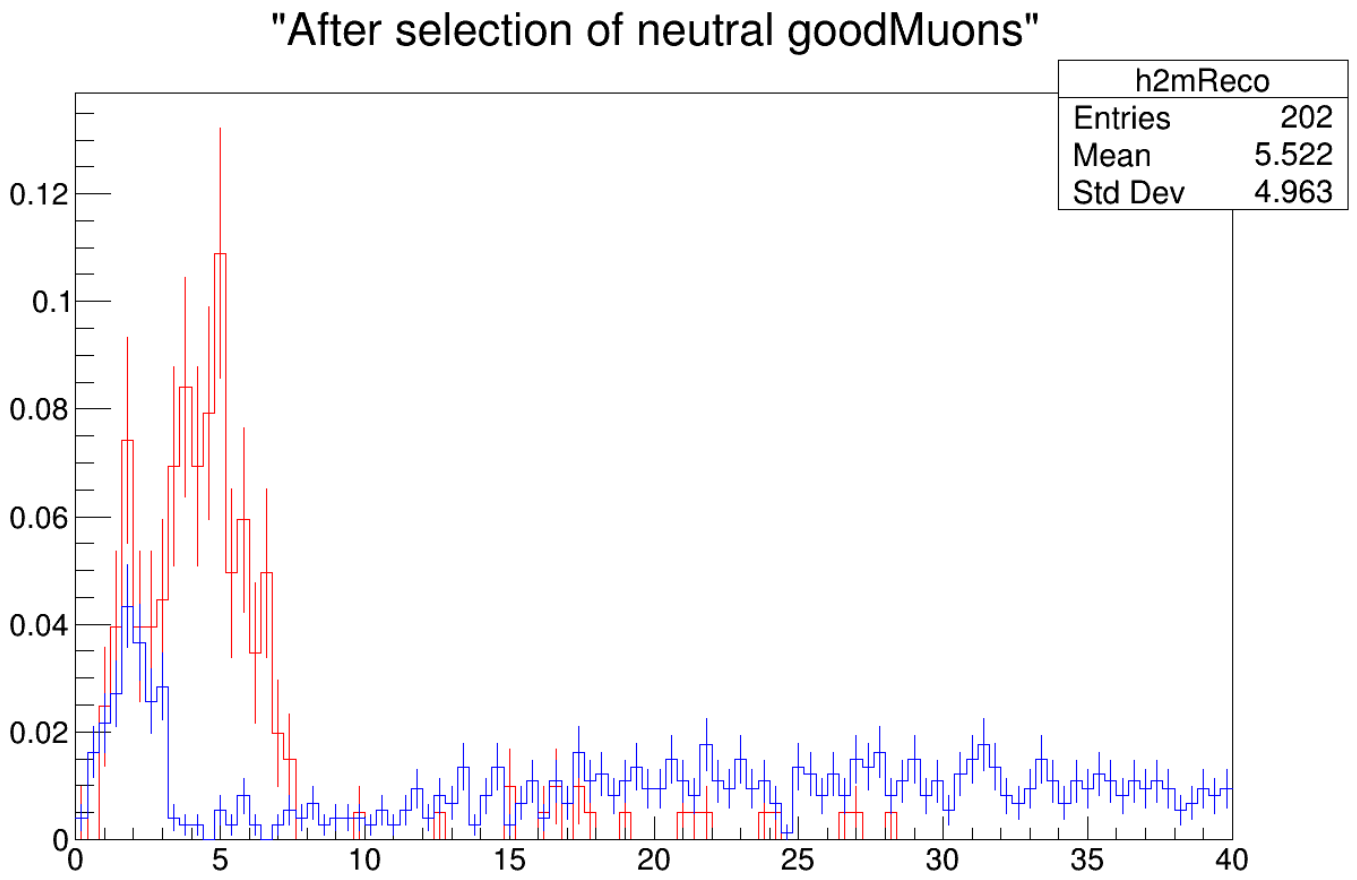
To obtain a sample enriched in $t\bar{t}$ events, one or two jets are required to be identified as originating from b quarks (b-tagged). To reduce potential signal contamination, the leading b-tagged jet is required to satisfy $p_T > 40$ GeV. To increase the number of events in the CR, while still avoiding potentially large signal contamination, the upper bound on the lepton p_T is also removed. The trigger, lepton identification and b tagging efficiencies are corrected in the simulation via the application of scale factors measured in dedicated data control samples. The event yields estimated from simulation and the observed event yields are shown in Table 3. The residual processes from standard model not classified as $t\bar{t}$ background are subtracted from data before the data to simulation ratio is evaluated for the $t\bar{t}$ prediction in the signal regions.

BACKGROUND İÇİN BULDUĞUMUZ SONUÇLAR (MÜONLAR İÇİN)

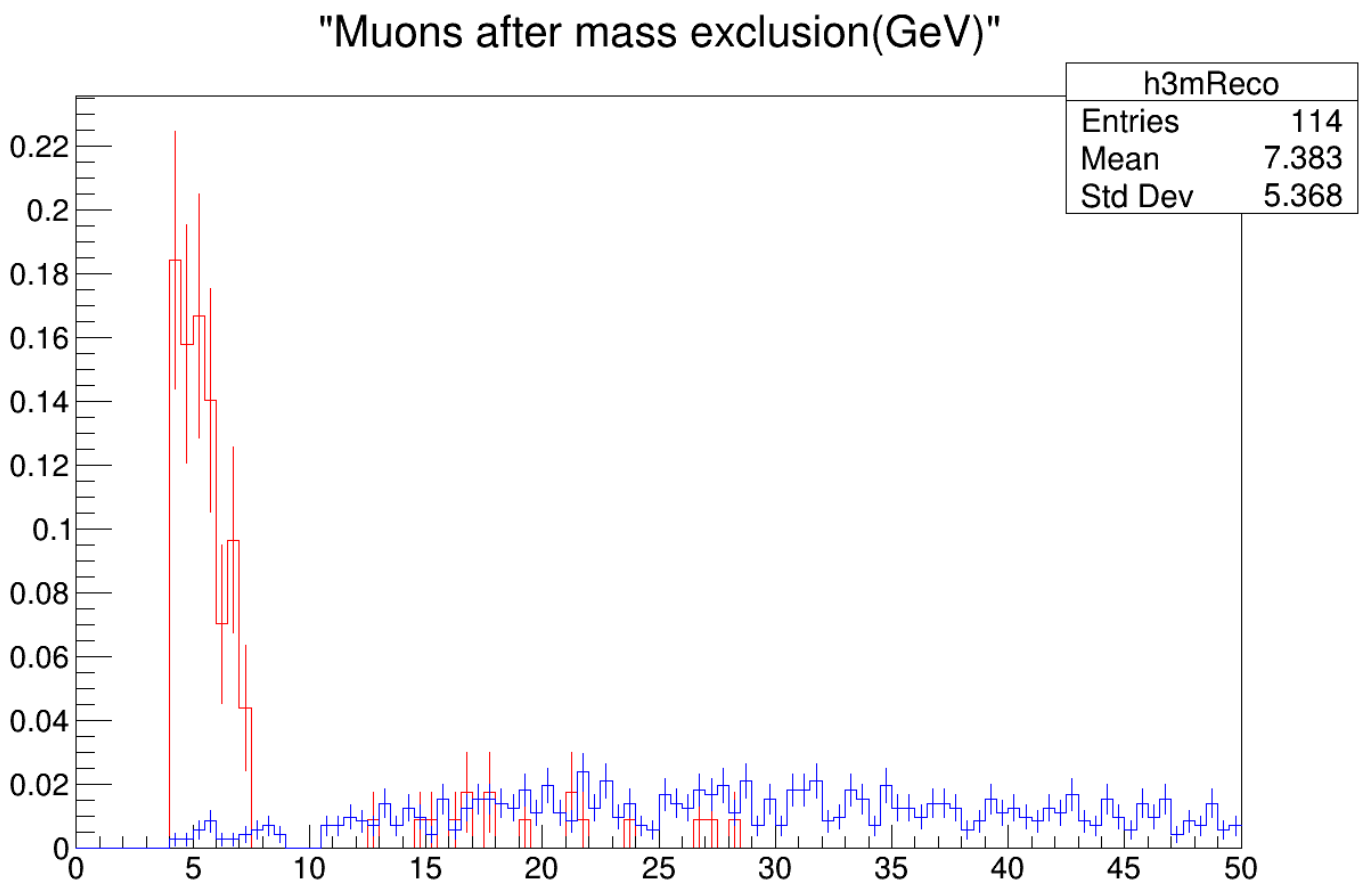
```
                    test    Based on 250000 events:
                                    ALL :      1 +-          0 evt:   250000
                      randWeight 0.688 : 0.6876 +-  0.000927 evt: 171892.4531
                    Size (goodMuo) >= 2 : 0.006052 +-  0.000187 evt: 1040.243652
  [Histo] Invariant Mass of Muons (GeV) :      1 +-          0 evt: 1040.243652
                       {gMreco}q == 0 : 0.7341 +-    0.0137 evt: 763.6723633
[Histo] After selection of neutral goodMuons :      1 +-          0 evt: 763.6723633
                       Pt(gMreco) > 3 : 0.9946 +-   0.00265 evt: 759.5444336
      {gMreco}m < 50 AND {gMreco}m > 4 : 0.6567 +-    0.0172 evt: 498.7968445
                    {gMreco}m ][ 9 10.5 : 0.9862 +-   0.00522 evt: 491.9169617
 [Histo] Muons after mass exclusion(GeV) :      1 +-          0 evt: 491.9169617
              MET > 125 AND MET < 200 : 0.1287 +-    0.0151 evt: 63.29598236
                    HT(jets) > 100 : 0.8696 +-    0.0423 evt: 55.03998566
           MET/(HT(jets)) [] 0.6 1.4 :  0.725 +-    0.0602 evt: 39.9039917
                    Size(bjets) == 0 :      1 +-          0 evt: 39.9039917
fMTauTau(goodMuo[0], goodMuo[1]) ][ 0 160 : 0.8966 +-    0.0482 evt: 35.77599335
           --> Overall efficiency  = 0.0143 % +- 0.00239 %
```


"Invariant Mass of Muons (GeV)"
h1mReco
Entries 225
Mean 6.877
Std Dev 6.563
0.1
0.08
0.06
0.04
0.02
0
0
5
10
15
20
25
30
35
40
45
50

2. KESİMDEN SONRA KALAN MÜONLAR



EN SONA KALAN MÜONLAR



SİSTEMATİK BELİRSİZLİKLER

Systematic uncertainty source	typical uncertainty
Non-prompt background normalization	4-20%
DY+ jets background normalization	4-20%
$t\bar{t}$ background normalization	2-8%
$t\bar{t}$ modeling	$\lesssim 1$ %
VV background normalization	3-25%
Rare background normalization	1-3 %
Jet energy scale	2-12 %
b tagging	2-6 %
Lepton selection	1-4 %
Trigger	1-2 %

SİSTEMATİC BELİRSİZLİKLERE BİR ÖRNEK

Specifically for the $t\bar{t}$ background, a set of systematics uncertainties, mainly affecting the modelling of the shapes in the simulation of this physics process, have been computed. The spin correlation of the top quarks has been varied by 20%, following the measurement of CMS and ATLAS [48, 49] and also from the comparison with different generators (MADGRAPH versus

10 Summary

A search for new physics in events with two low momentum opposite-sign leptons and missing transverse energy is presented using the data collected by CMS at a a center-of-mass energy of 13 TeV and corresponding to an integrated luminosity of up to 35.9 fb^{-1}. The data are found to be consistent with the standard model expectations. The results are interpreted in the framework of supersymmetric simplified models targeting electroweakino mass-degenerate spectra and $\tilde{\text{t}}$-$\tilde{\chi}_1^0$ mass-degenerate benchmark scenarios. The search probes the $\tilde{\chi}_2^0\tilde{\chi}_1^\pm \to \tilde{\chi}_1^0\tilde{\chi}_1^0 Z^* W^*$ process for mass differences (Δm) between $\tilde{\chi}_2^0$ and $\tilde{\chi}_1^0$ of less than 20 GeV. Assuming Wino production cross sections, $\tilde{\chi}_2^0$ masses up to 230 GeV are excluded for Δm of 20 GeV. For the $\tilde{\text{t}}$ chargino-mediated decay into $\tilde{\chi}_1^0 W^*$, $\tilde{\text{t}}$ masses of up to 450 GeV are excluded for a $\Delta\text{m}(\tilde{\text{t}}, \tilde{\chi}_1^0) = 40$ GeV assuming a simplified description of the model.