

EUROPEAN ORGANISATION FOR NUCLEAR RESEARCH (CERN)



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**Search for new resonances in mass distributions of  
jet pairs using  $139 \text{ fb}^{-1}$  of  $pp$  collisions at  
 $\sqrt{s} = 13 \text{ TeV}$  with the ATLAS detector**

The ATLAS Collaboration

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Danışman: Doç.Dr. Sertaç ÖZTÜRK

# İçerik

- Amaç
- Veri Yapısı
- Olay Seçimi
  - Sinyal ve Ardalan
- Sonuçlar

# Amaç

- Standart Model Ötesi Fizik Araştırmaları:
- Jet çiftlerinin kütle dağılımlarında yeni rezonanslar bulmak.

İncelediğimiz süreçler:

Sinyaller:

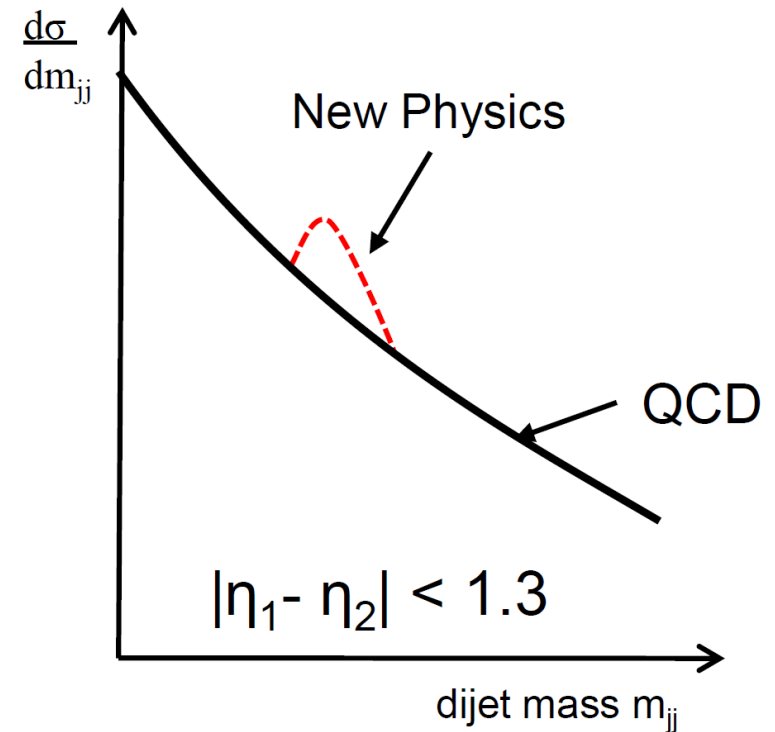
➤  $q^* \rightarrow qg$

➤  $b^* \rightarrow bg$

➤  $RSG \rightarrow b\bar{b}$

Ardalan:

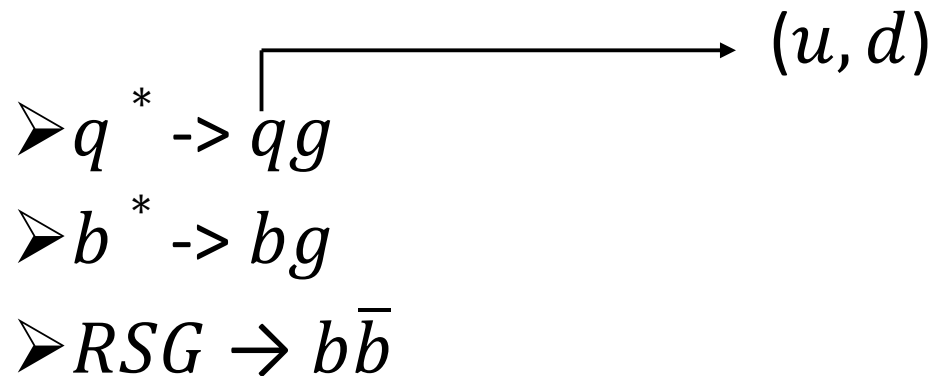
➤ KR



# Amaç

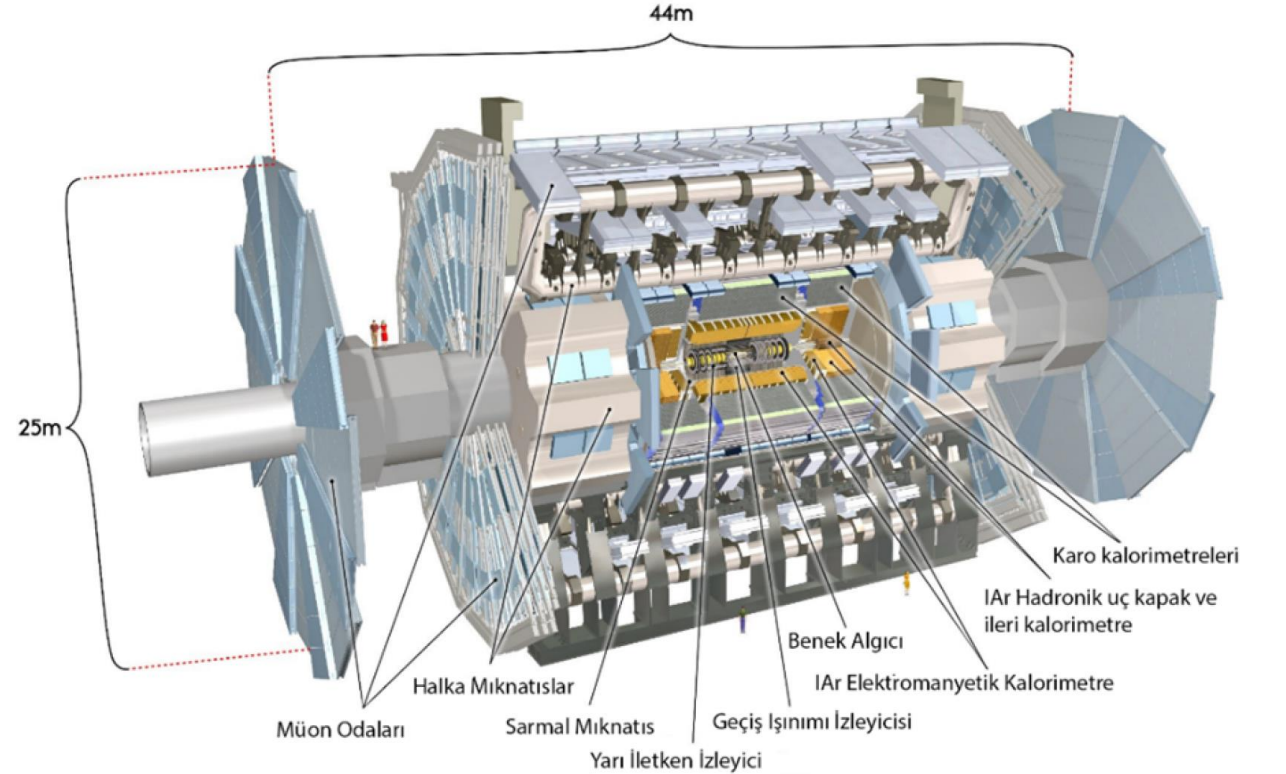
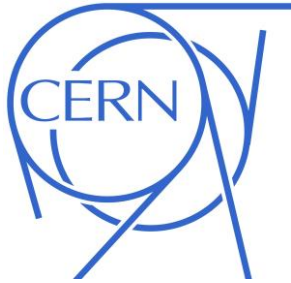
- Standart Model Ötesi Fizik Araştırmaları:
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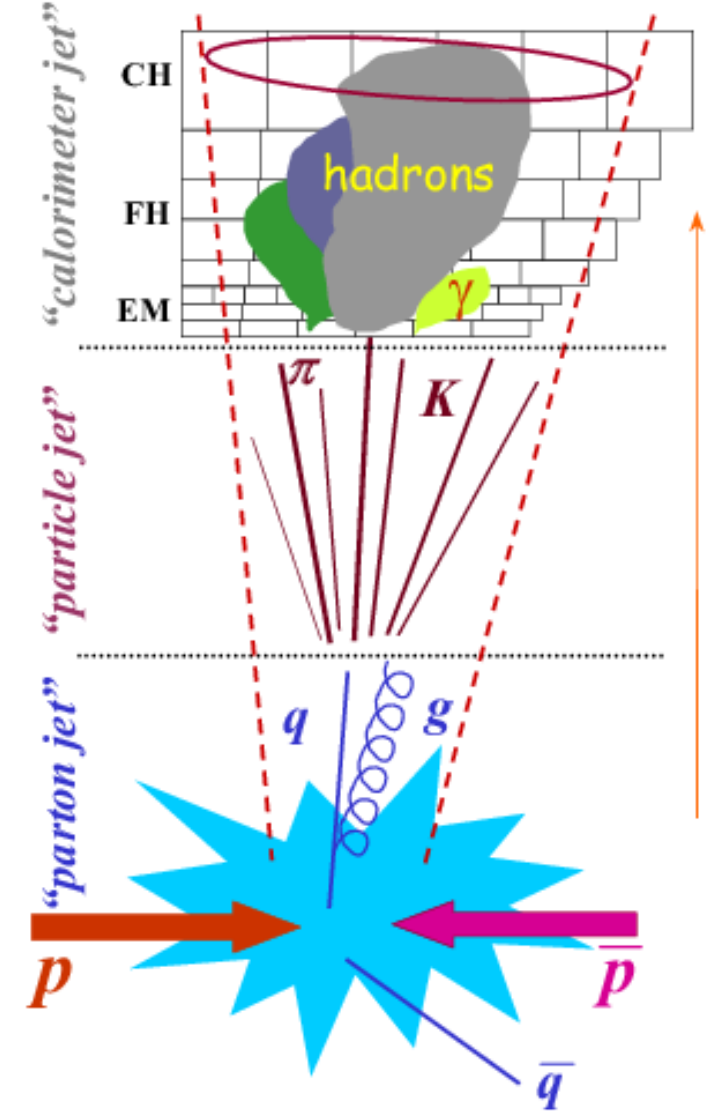
# ATLAS

- Dünya'nın en büyük parçacık hızlandırıcısı olan CERN'deki genel amaçlı araştırma yapan algıçlardan biridir.
- Kütle merkezi enerjisi: 13 TeV
- Işıklılık:  $139 \text{ fb}^{-1}$



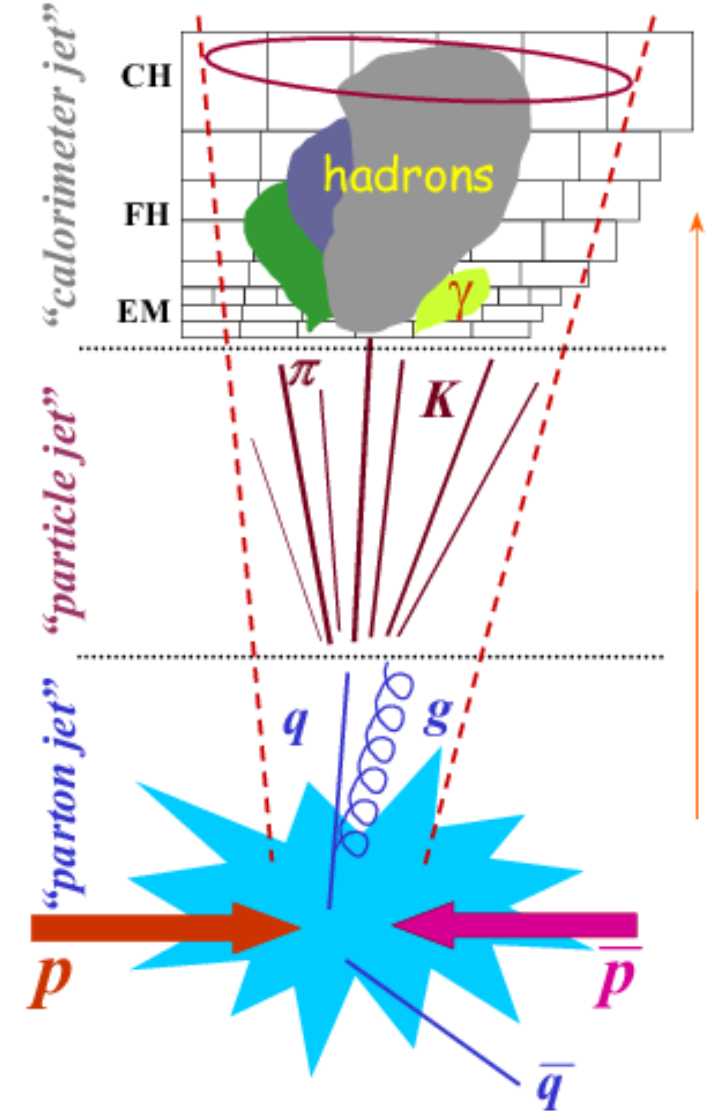
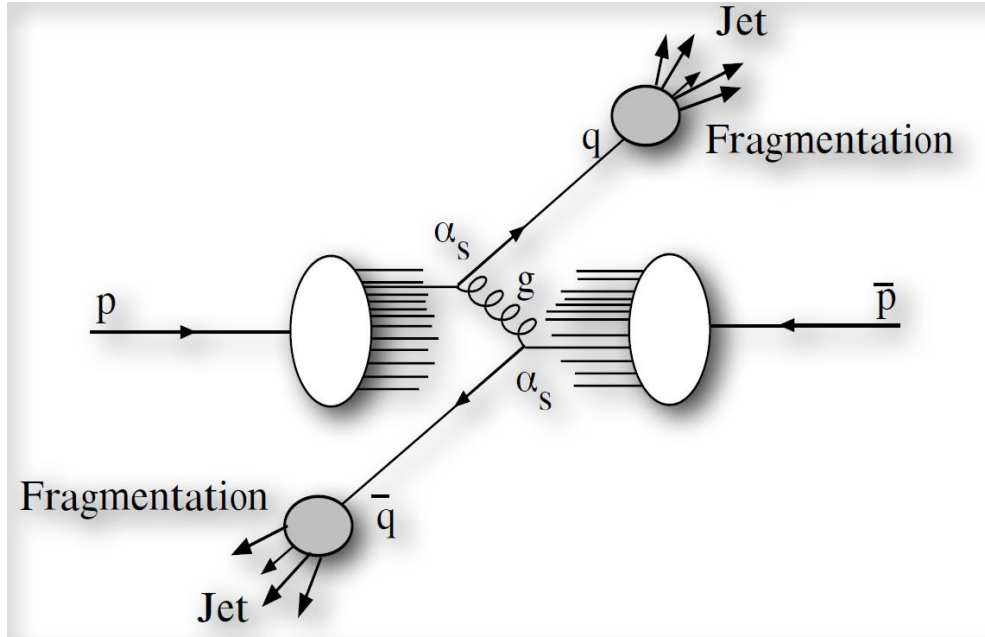
# Jet Nedir?

Yüksek enerjili çarpışmalarda ortaya çıkan parçacık püskürtüleridir. Bu jetler partonlardan oluşur. Bu jetleri kalorimetrelerde bıraktıkları izlerden gözlemleriz.



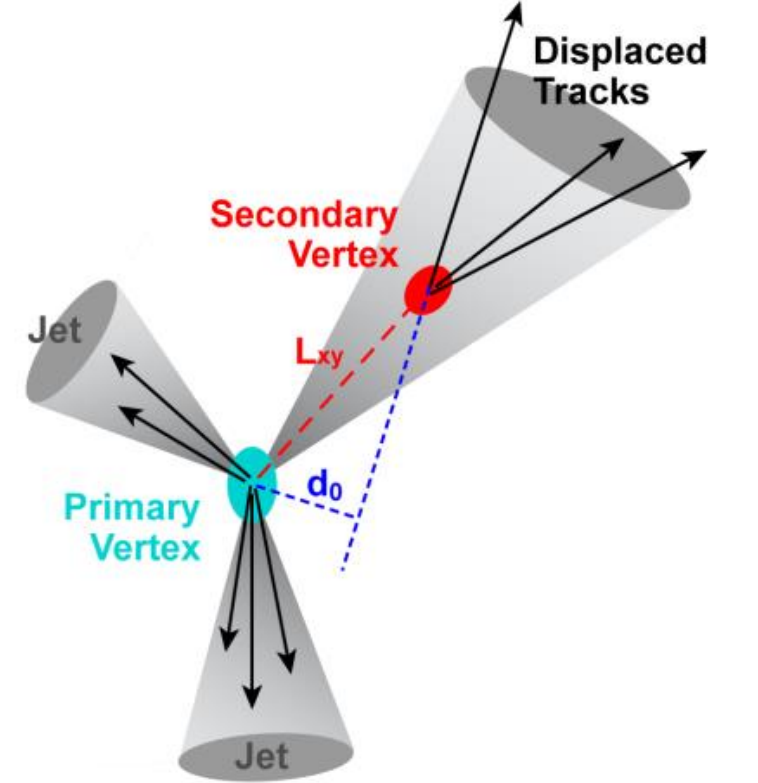
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# Jet Belirmesi

Üç çeşit belirleme vardır; b-jet, kuark/gluon, w-jet.

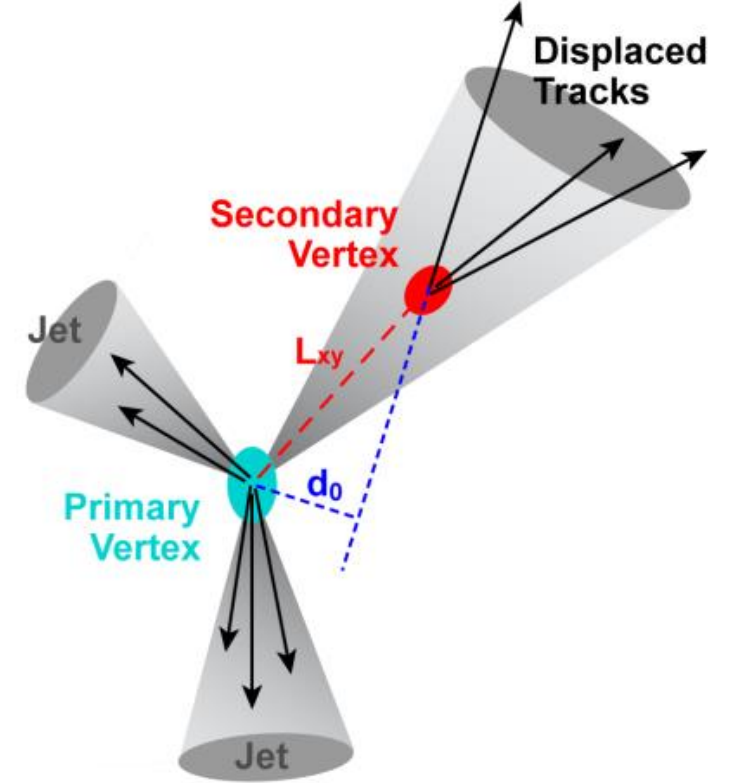




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Neden b-jet?

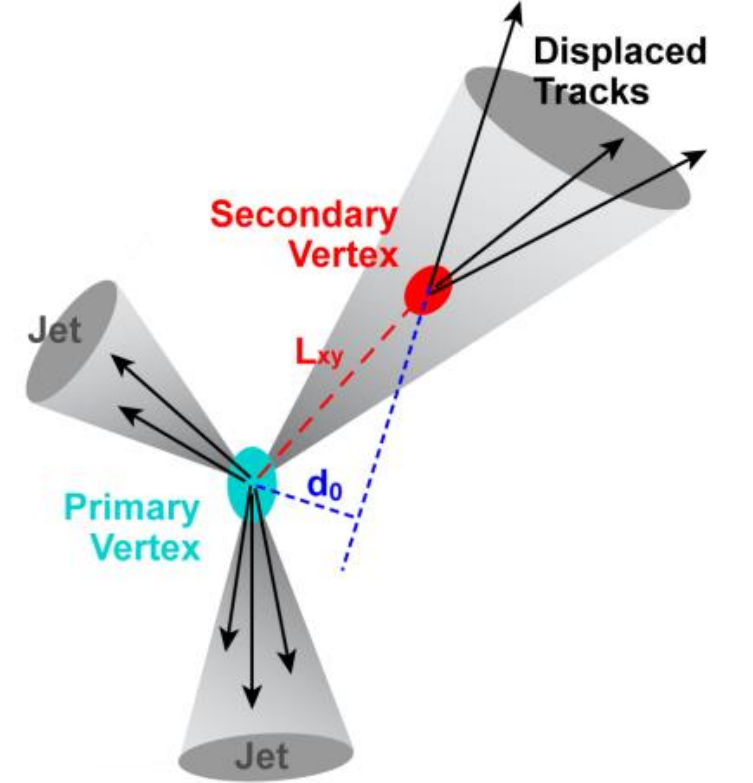


# Jet Belirmesi

Üç çeşit belirleme vardır; b-jet, kuark/gluon, w-jet.

Neden b-jet?

- B-kuarklar daha uzun yarı ömre sahiptir.
- İkincil köşe oluştururlar.
- İzleri büyük etki parametrelidir.



# Sinyal Belirlenmesi

Bozunum	Enerji (TeV)
$q^* \rightarrow qg$	4, 6
$b^* \rightarrow bg$	2, 3, 5
RSG $\rightarrow b\bar{b}$	2, 3, 5

# Ardalan Belirlenmesi

Enerji (GeV)	Tesir Kesiti ( $\text{fb}^{-1}$ )
400-800	1892000
800-1200	35780
1200-2000	2640
2000-3000	43,63
3000-6500	0,4419

# ANALİZ OLAY SEÇİMİ

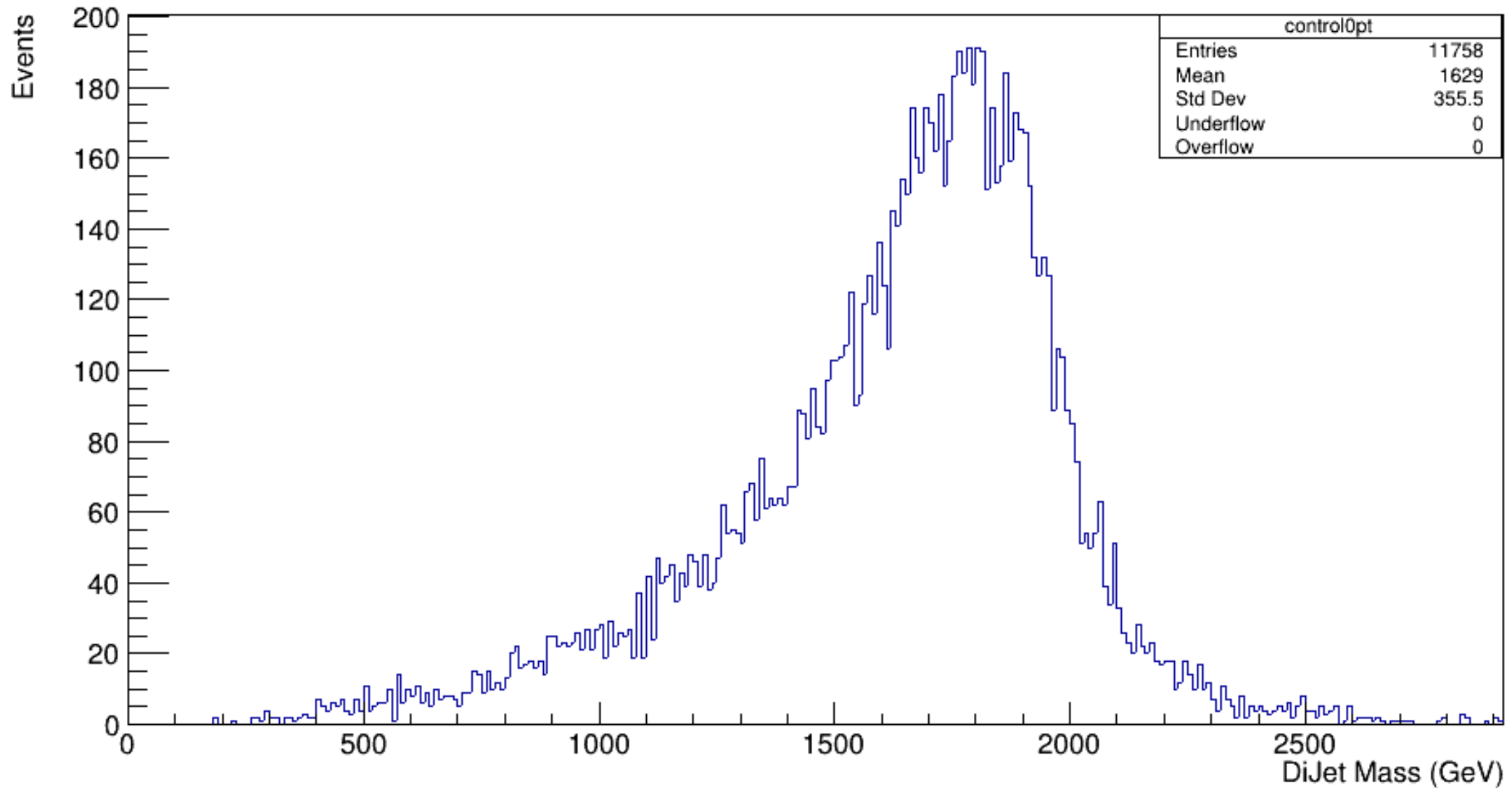
Category	Inclusive		$1b$	$2b$
Jet $p_T$	$> 150 \text{ GeV}$			
Jet $\phi$	$ \Delta\phi(jj)  > 1.0$			
Jet $ \eta $	-		$< 2.0$	
$ y^* $	$< 0.6$	$< 1.2$	$< 0.8$	
$m_{jj}$	$> 1100 \text{ GeV}$	$> 1717 \text{ GeV}$	$> 1133 \text{ GeV}$	
$b$ -tagging	no requirement		$\geq 1$ $b$ -tagged jet	2 $b$ -tagged jets
Signal	DM mediator $Z'$ $W'$ $q^*$ QBH Generic Gaussian	$W^*$	$b^*$ Generic Gaussian	DM mediator $Z'$ ( $b\bar{b}$ ) SSM $Z'$ ( $b\bar{b}$ ) graviton ( $b\bar{b}$ ) Generic Gaussian

# Kontrol Grafikleri

- Yaptığımız tırpanlamaları kontrol etmek için grafikler oluşturduk

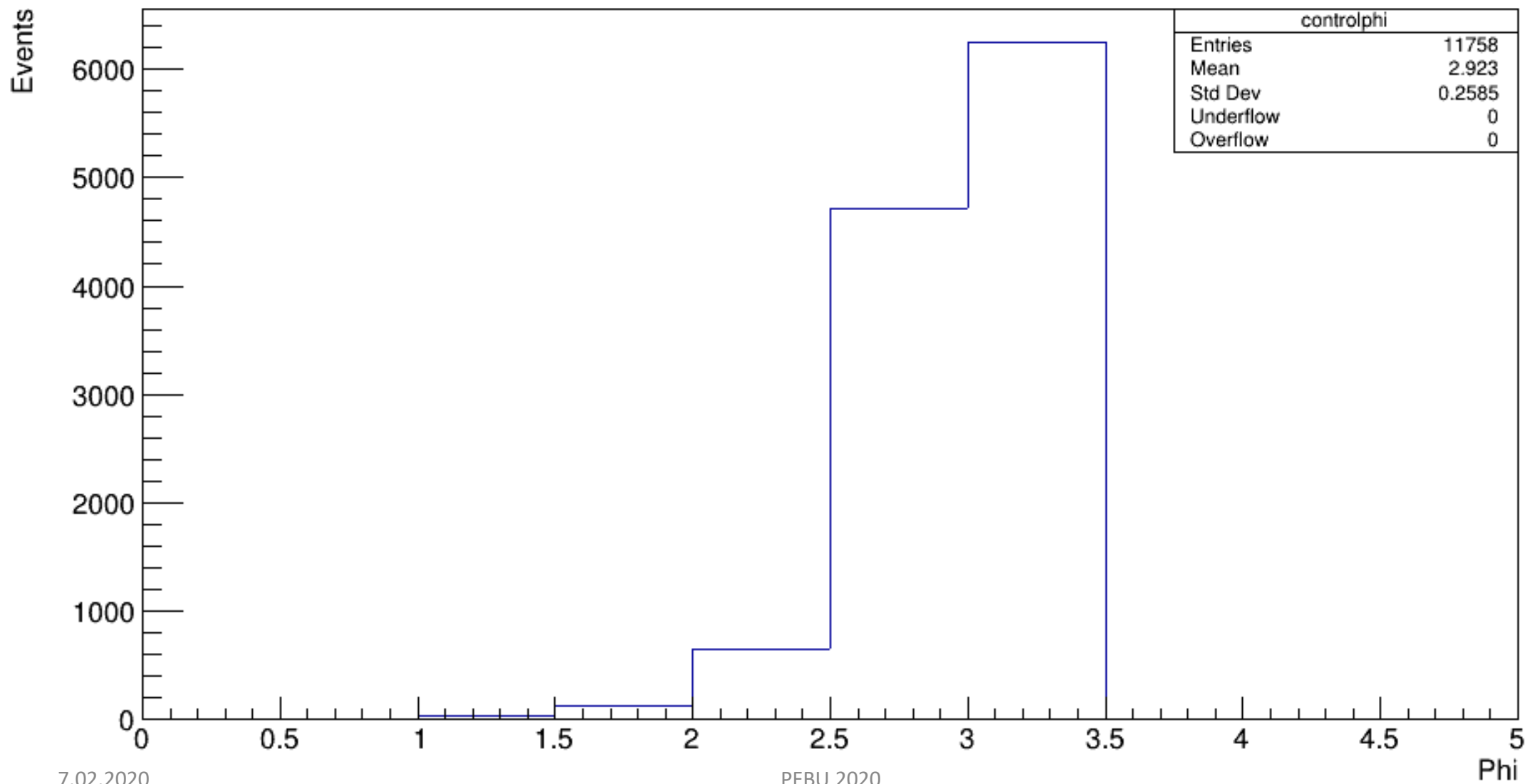
# $q^*$ 4TeV Jet0 Pt

"Jet0 Pt "



# $q^* 4\text{TeV}$

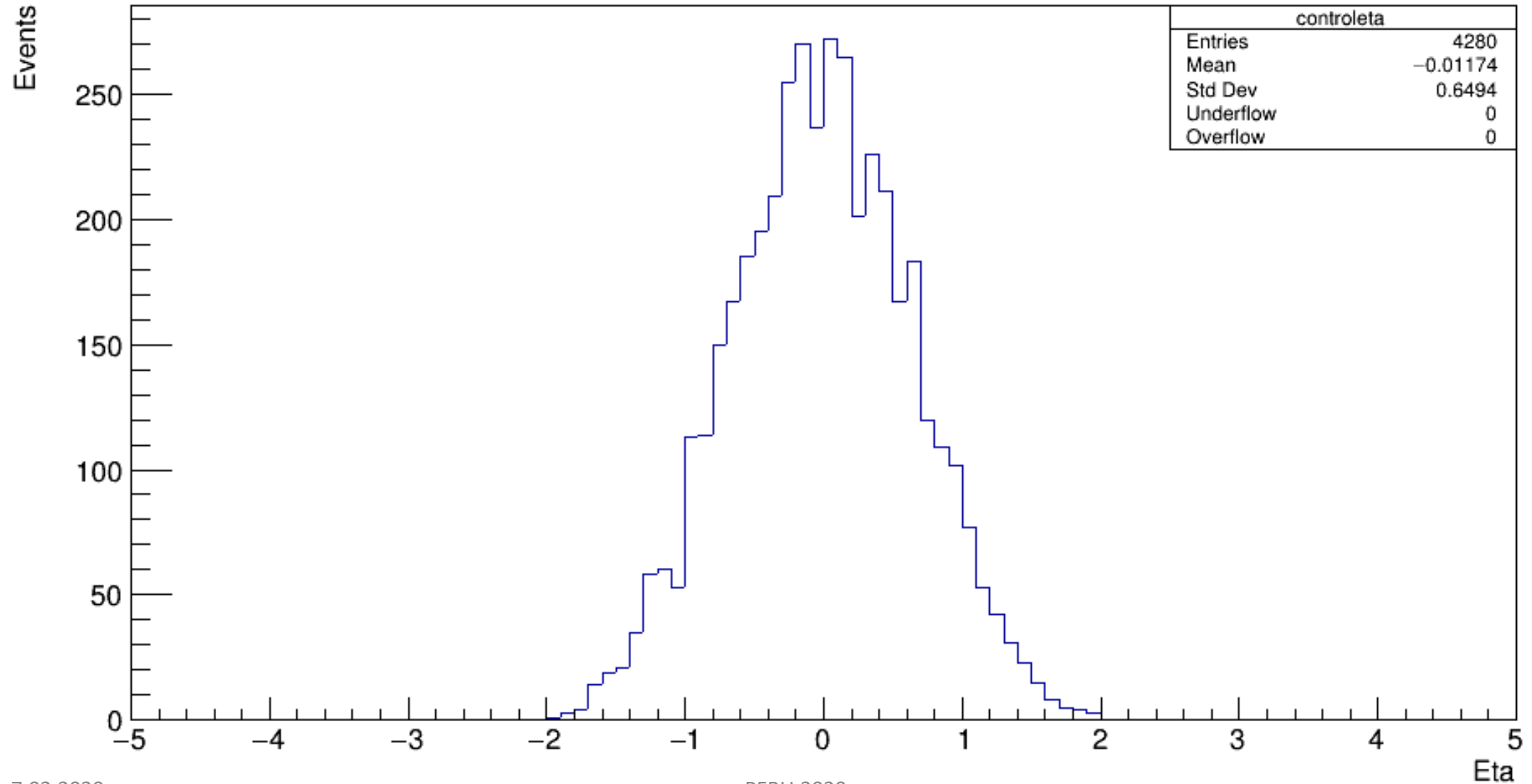
## "Phi Difference Between Jet0 and Jet1 > 1"





# $b^*$ 3TeV Jet1

"Jet1 Eta < 2.0"



# Cutlang Kodları

- Tırpanlama yaparak Dijetlerin değişmez kütlelerinin ve olay sayılarının grafiğini yaptık.

Inclusive Part:

---

```
define Dijet : JET[0] JET[1]
object goodJet using JET
    select Pt(JET) > 150
define goodDijet : goodJet[0] goodJet[1]
define ystar : abs(({JET[0]}Eta - {JET[1]}Eta) / 2)

region inclusive
    select ALL
    select Size(goodJet) >= 2
    select {goodJet[0], goodJet[1]}dPhi > 1.0
    select ystar < 0.6

histo qstarmass , "Dijet Mass", 800, 0, 8000, {goodDijet}m
histo control0pt , "Jet0 Pt ", 500, 0, 5000, Pt(goodJet[0])
histo control1pt , "Jet1 Pt ", 500, 0, 5000, Pt(goodJet[1])
histo controlphi , "Phi Difference Between Jet0 and Jet1 > 1", 10, 0, 5, dPhi(goodJet[0], goodJet[1])
```

## b-tag Part:

```
region onebtag
  select ALL          # to count all events
  select Size(goodJet) >= 2
  select dPhi(goodJet[0], goodJet[1]) > 1.0
  select AbsEta(goodJet[0]) < 2.0 && AbsEta(goodJet[1]) < 2.0
  select ystar < 0.8
  select BTag(goodJet[0]) == 1 || BTag(goodJet[1]) == 1

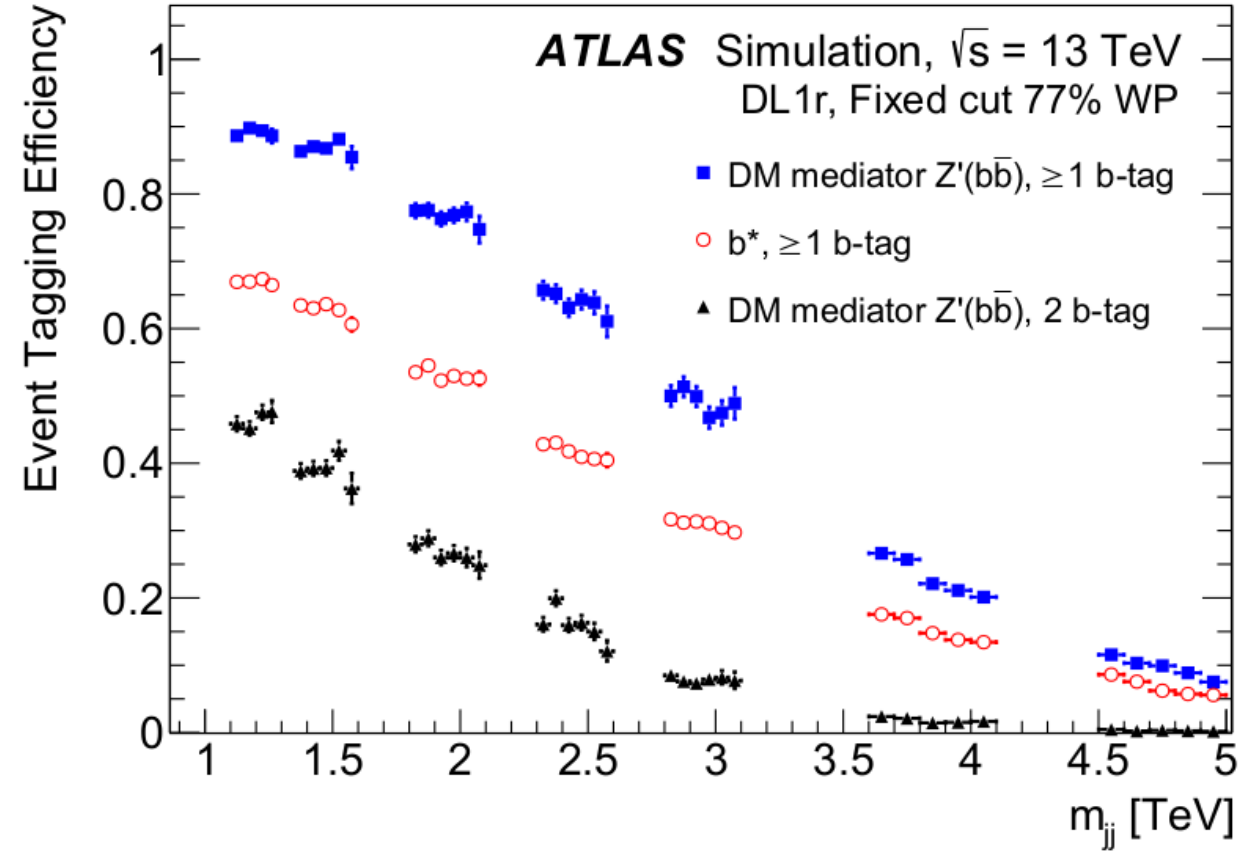
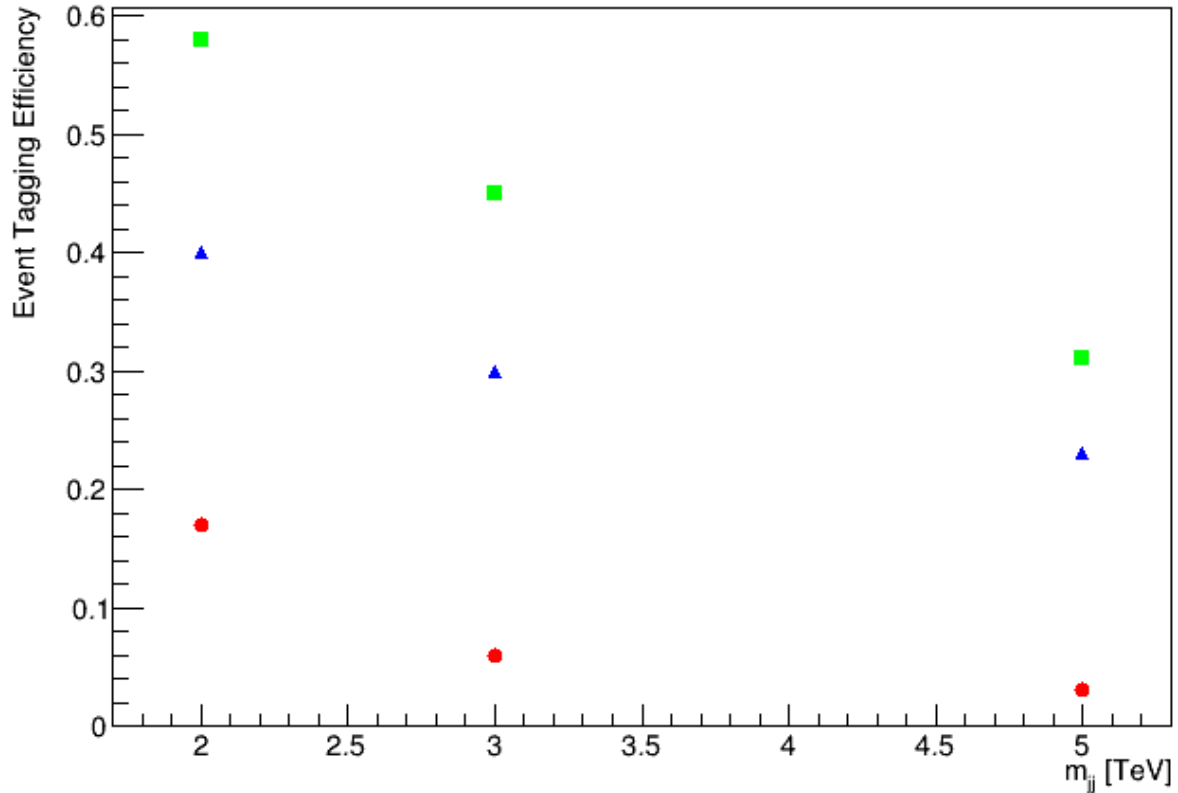
  histo onebtag      , "Dijet Mass", 800, 0, 8000, {goodDijet}m
  histo control0pt   , "Jet0 Pt", 100, 0, 500, Pt(goodJet[0])
  histo control1pt   , "Jet1 Pt", 100, 0, 500, Pt(goodJet[1])
  histo controlphi   , "Phi Difference Between Jet0 and Jet1 ", 10, 0, 5, dPhi(goodJet[0], goodJet[1])
  histo controleta   , "Jet0 Eta", 100, -5, 5, Eta(goodJet[0])
  histo controleta   , "Jet1 Eta < 2.0", 100, -5, 5, Eta(goodJet[1])
```

## 2b-tag Part:

```
region twobtag
  select ALL          # to count all events
  select Size(goodJet) >= 2
  select dPhi(goodJet[0], goodJet[1]) > 1.0
  select AbsEta(goodJet[0]) < 2.0 && AbsEta(goodJet[1]) < 2.0
  select ystar < 0.8
  select BTag(goodJet[0]) == 1 && BTag(goodJet[1]) == 1

  histo twobtag     , "Dijet Mass", 800, 0, 8000, {goodDijet}m
```

# b-etiketlemede Sinyal Seçme Verimliliği



## B-Etiketleme Root Kodu

```
void Yeni_graph(){
    gStyle -> SetOptStat();
    gStyle -> SetOptFit(1111);

    TCanvas *c1 = new TCanvas("c1", "", 200, 10, 700, 500);

    double m[3] = {2, 3, 5};
    double eff_rsg_1b[3] = {0.58, 0.45, 0.31};
    double eff_rsg_2b[3] = {0.17, 0.06, 0.03};
    double eff_b_1b[3] = {0.40, 0.30, 0.23};

    TGraph *g1=new TGraph(3,m,eff_rsg_1b);
    TGraph *g2=new TGraph(3,m,eff_rsg_2b);
    TGraph *g3=new TGraph(3,m,eff_b_1b);

    g1->SetMarkerColor(4);
    g1->SetMarkerSize(1);
    g1->SetMarkerStyle(21);
    g1->GetXaxis()->SetTitle("m_{jj} [TeV]");
    g1->GetYaxis()->SetTitle("Event Tagging Efficiency");
    g1->SetMinimum(0);

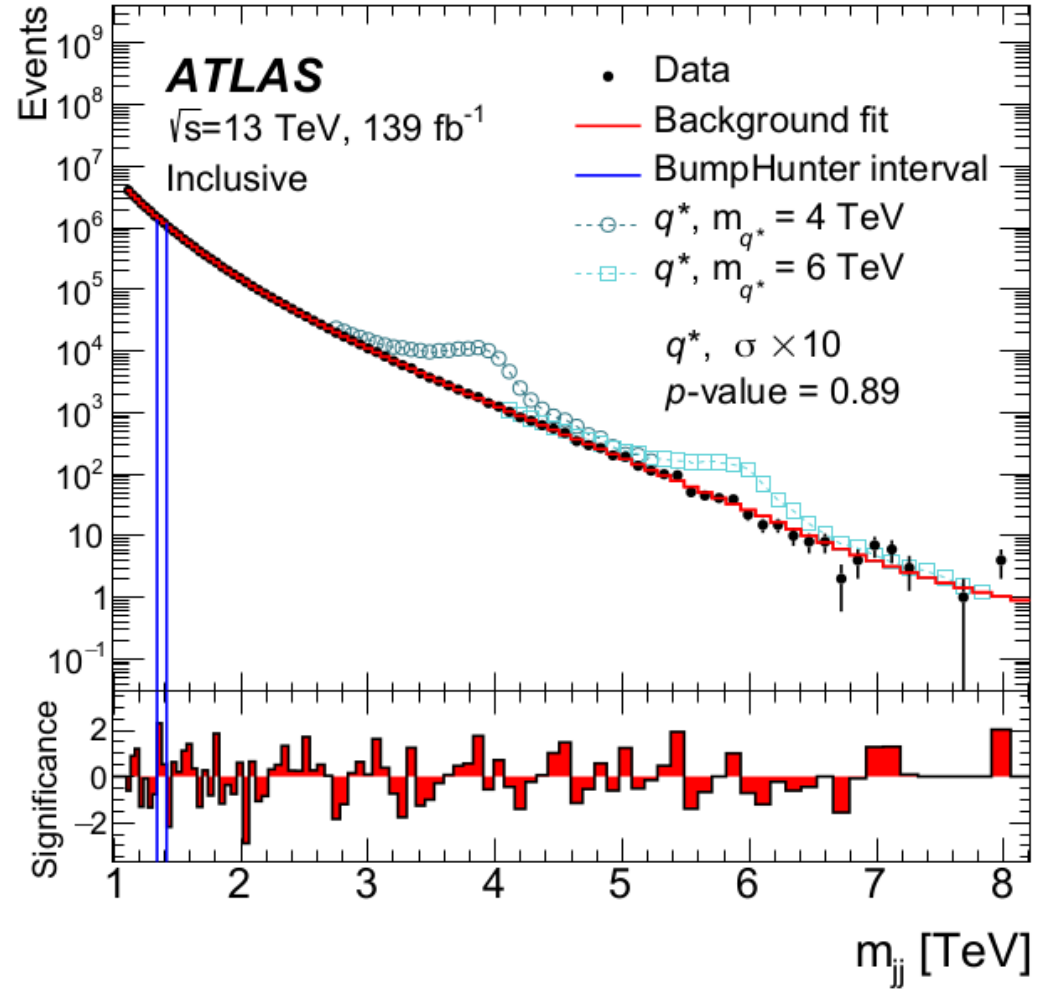
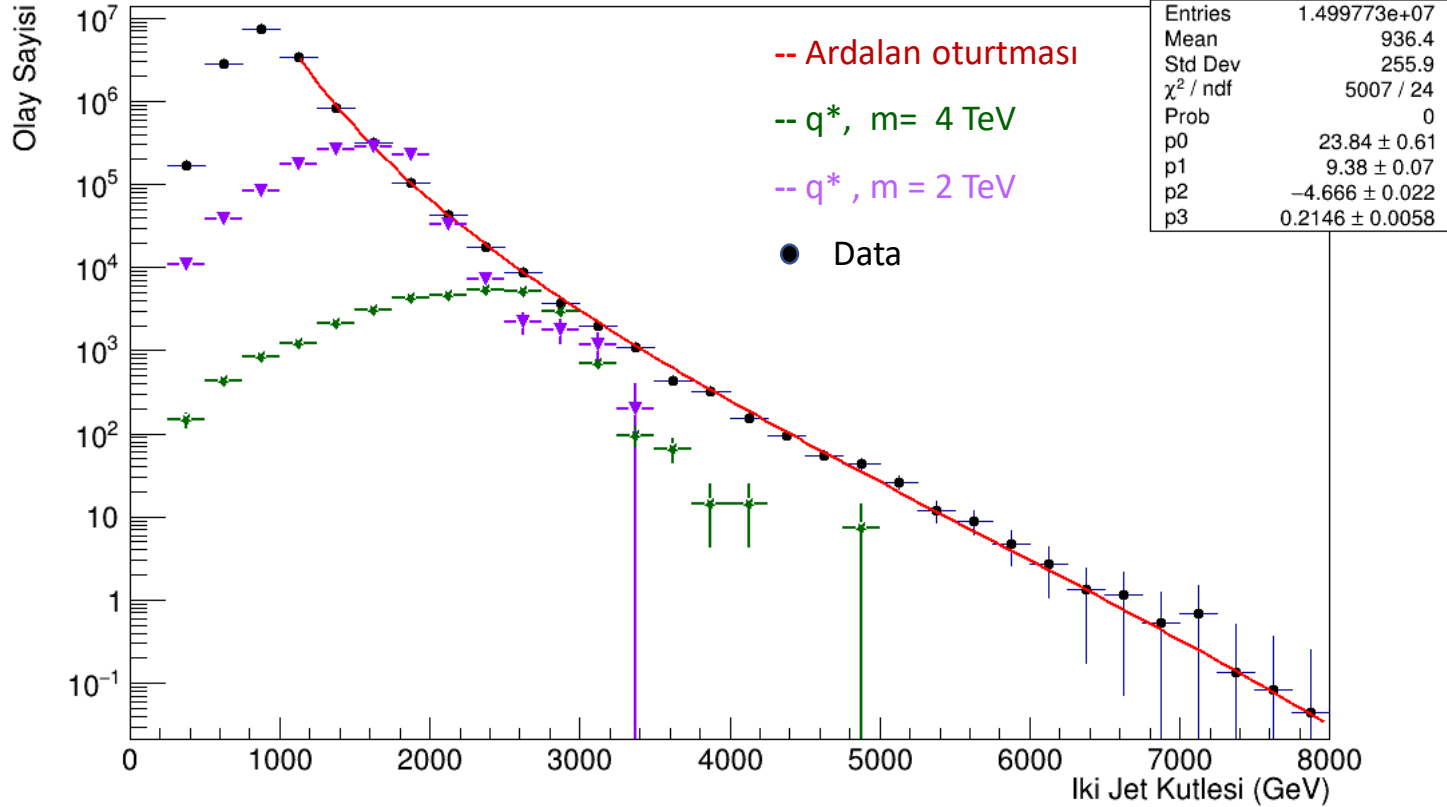
    g1->SetMarkerColor(kGreen);
    g1->SetMarkerSize(1);
    g1->SetMarkerStyle(21);
    g2->SetMarkerColor(kRed);
    g2->SetMarkerSize(1);
    g2->SetMarkerStyle(20);
    g3->SetMarkerColor(kBlue);
    g3->SetMarkerSize(1);
    g3->SetMarkerStyle(22);

    g1->Draw("AP");
    g2->Draw("P same");
    g3->Draw("P same");

    c1->SaveAs("sekil.png");
}
```

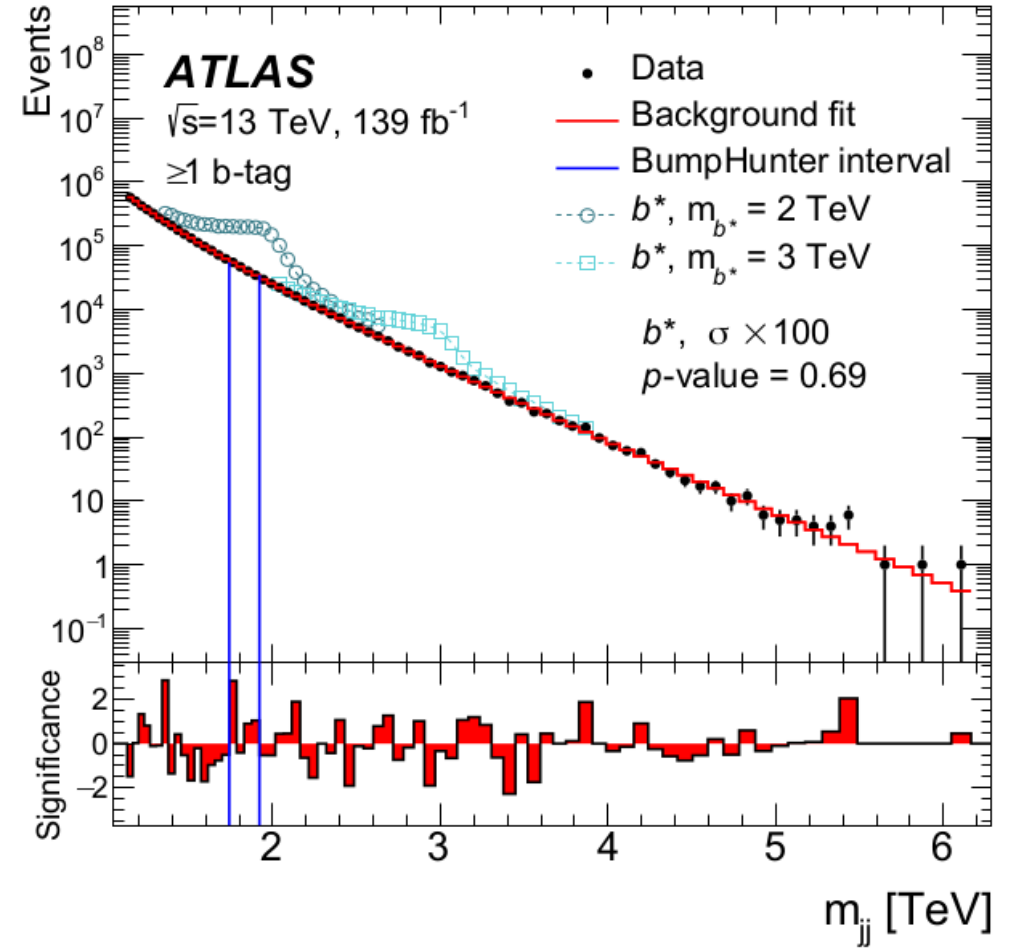
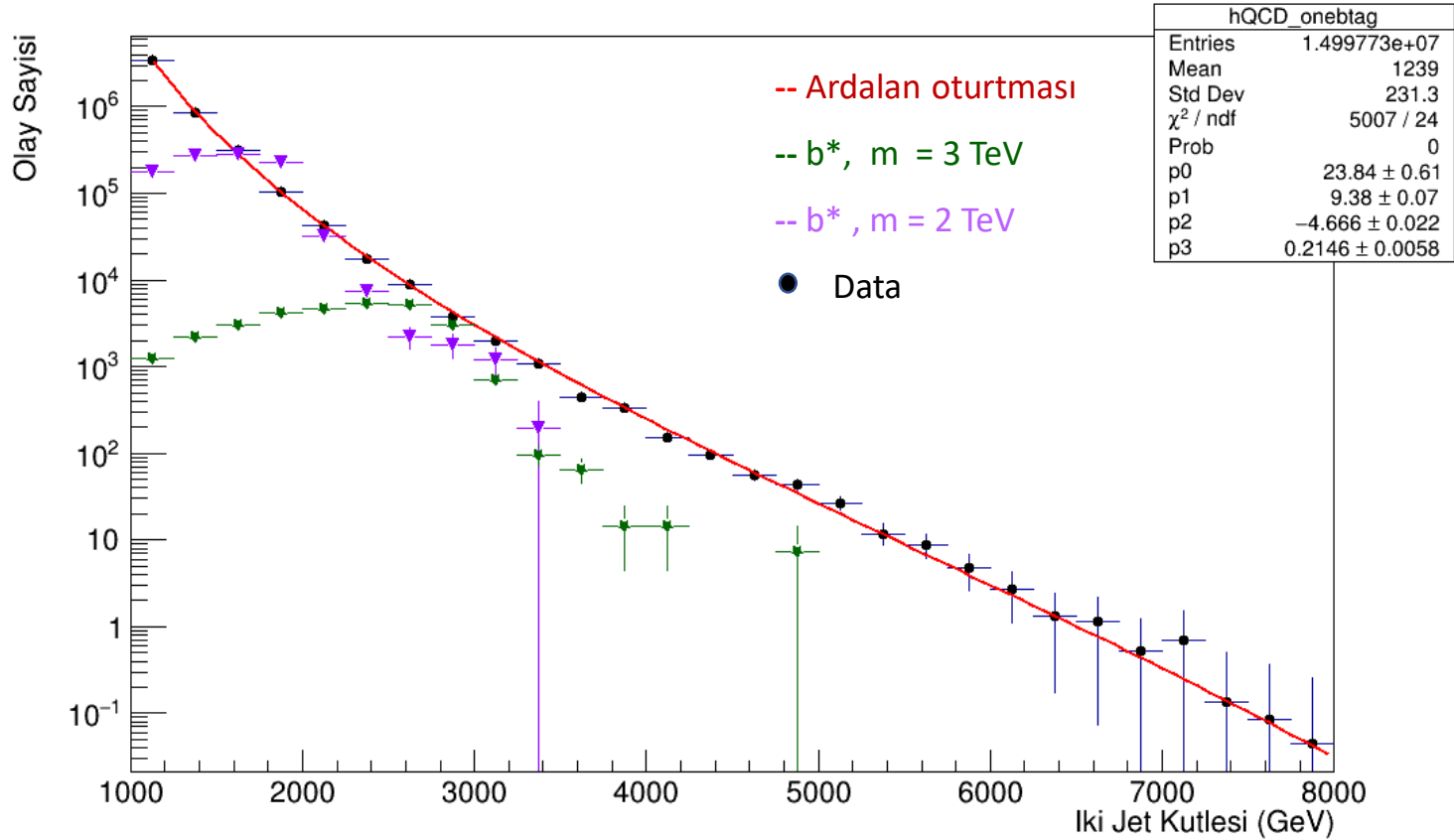
$$q^* \rightarrow gq$$

"Dijet Mass"



# $b^* \rightarrow bg$

"Dijet Mass"



# RSG $\rightarrow b\bar{b}$

"Dijet Mass"

