

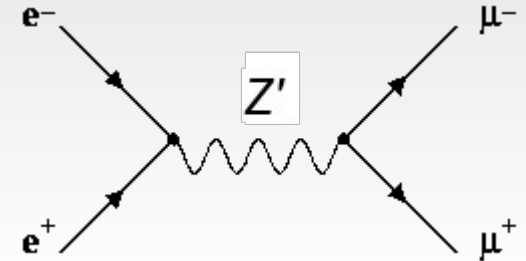
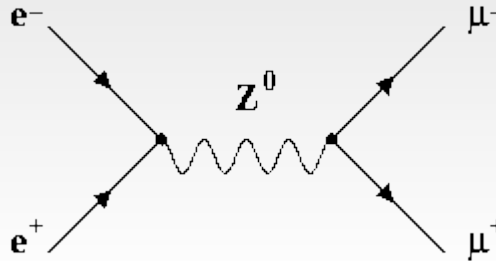
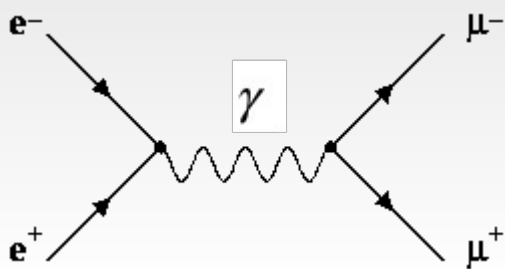
PYTHIA ÖDEV ÇÖZÜMÜ

ÖDEV

- Kütle merkezi enerjisi $\sqrt{s}=3$ TeV olan bir Lineer Çarpıştırıcıda, $e^+e^- \rightarrow \gamma/Z^0/Z'^0 \rightarrow \mu^+\mu^-$ sürecinde $m_{Z'}=3$ TeV alarak fotonun, Z^0 bozonun ve Z'^0 bozonun toplam tesir kesitine katkılarını PYTHIA ile hesaplayınız. Bunların girişimlerinin de hangi durumlarda önemli olabileceğini tartışınız.

Süreç ve Diyagramlar

$$e^+e^- \rightarrow \gamma/Z^0/Z'^0 \rightarrow \mu^+\mu^-$$



- Genlik:

$$M = M_1 + M_2 + M_3$$

$$|M|^2 = |M_1|^2 + |M_2|^2 + |M_3|^2 + 2M_1M_2^* + 2M_1M_3^* + 2M_2M_3^*$$

- Tesir kesiti:

$$\sigma \sim |M|^2$$

- İlerletici:

$$\sim 1/q^2 \quad : \quad \sim 1/(q^2 - m_Z^2 + im_Z\Gamma_Z) \quad : \quad \sim 1/(q^2 - m_{Z'}^2 + im_{Z'}\Gamma_{Z'})$$

PYTHIA 6.4

odev64.f

```
IMPLICIT DOUBLE PRECISION(A-H, O-Z)
INTEGER PYK,PYCHGE,PYCOMP
EXTERNAL PYDATA
COMMON/PYJETS/N,NPAD,K(4000,5),P(4000,5),V(4000,5)
COMMON/PYDAT1/MSTU(200),PARU(200),MSTJ(200),PARJ(200)
COMMON/PYDAT2/KCHG(500,4),PMAS(500,4),PARF(2000),VCKM(4,4)
COMMON/PYDAT3/MDCY(500,3),MDME(8000,2),BRAT(8000),KFDP(8000,5)
COMMON/PYSUBS/MSEL,MSELPD,MSUB(500),KFIN(2,-40:40),CKIN(200)
COMMON/PYPARS/MSTP(200),PARP(200),MSTI(200),PARI(200)
```

C...Baslangic

```
ECM=3000D0
NEV=10000
```

C...Surec secimi

```
MSEL=0
MSUB(141)=1
MSTP(44)=1 ! 1:A, 2:Z, 3:Z', 7:A/Z/Z'
```

C...Z'0 kütleli

```
PMAS(32,1)=3000D0
```

C...Z'0 bozonun sadece muonlara bozunmasi

```
DO IDC=289,310
```

```
MDME(IDC,1)=0
```

```
ENDDO
```

```
MDME(299,1)=1 ! Z'0 -->mu+ mu-
```

C...Hazirlik

```
CALL PYINIT('CMS','e+','e-',ECM)
```

C...Bozunum kanallari listesi

```
CALL PYSTAT(2)
```

C...Olay cevrimi

```
DO 200 IEV=1,NEV
```

```
CALL PYEVNT
```

C...Ilk uc olayin listelenmesi

```
IF(IEV.LE.3) CALL PYLIST(1)
```

```
200 CONTINUE
```

C...Sonuclarin yazilmasi

```
CALL PYSTAT(1)
```

```
END
```

```
gfortran odev64.f libpythia6426.a -o odev64.x
./odev64.x > odev64.txt
tail -22 odev64.txt
```

PYTHIA 6.4

MSTP(44)=1

1***** PYSTAT: Statistics on Number of Events and Cross-sections *****

```
=====
I                               I                               I                               I                               I
I      Subprocess                I      Number of points        I      Sigma                I
I                               I                               I                               I
I-----I-----I      (mb)                I
I                               I                               I                               I
I N:o Type                      I      Generated          Tried I                               I
I                               I                               I                               I
=====
I                               I                               I                               I
I   0 All included subprocesses  I      10000              78639 I   2.222D-11 I
I 141 f + fbar -> gamma*        I      10000              78639 I   2.222D-11 I
I                               I                               I                               I
=====
```

PYTHIA 6.4

MSTP(44)=2

1***** PYSTAT: Statistics on Number of Events and Cross-sections *****

```
=====
I          I          I          I          I
I          Subprocess      I      Number of points      I      Sigma      I
I          I          I          I          I          I
I-----I-----I          I      (mb)      I
I          I          I          I          I          I
I N:o Type      I      Generated      Tried I          I
I          I          I          I          I          I
=====
I          I          I          I          I
I  0 All included subprocesses      I      10000      248023 I  1.219D-11 I
I 141 f + fbar -> Z0      I      10000      248023 I  1.219D-11 I
I          I          I          I          I          I
=====
```

PYTHIA 6.4

MSTP(44)=3

1***** PYSTAT: Statistics on Number of Events and Cross-sections *****

```
=====
I          I          I          I          I
I          Subprocess      I      Number of points      I      Sigma      I
I          I          I          I          I
I-----I-----I          I      (mb)      I
I          I          I          I          I
I N:o Type      I      Generated      Tried I          I
I          I          I          I          I
=====
I          I          I          I          I
I  0 All included subprocesses      I      10000      150284 I  9.379D-10 I
I 141 f + fbar -> Z'0      I      10000      150284 I  9.379D-10 I
I          I          I          I          I
=====
```

PYTHIA 6.4

MSTP(44)=7

1***** PYSTAT: Statistics on Number of Events and Cross-sections *****

```
=====
```

| I | I | I | I | I | I |
|---|-------------------------------|---|------------------|---|--------|
| I | Subprocess | I | Number of points | I | Sigma |
| I | | I | | I | |
| I | ----- | I | ----- | I | (mb) |
| I | | I | | I | |
| I | N:o Type | I | Generated | I | Tried |
| I | | I | | I | |
| I | | I | | I | |
| I | 0 All included subprocesses | I | 10000 | I | 198718 |
| I | 141 f + fbar -> gamma*/Z0/Z'0 | I | 10000 | I | 198718 |
| I | | I | | I | |

```
=====
```


SONUÇLAR

- $e^+e^- \rightarrow \gamma / Z / Z' \rightarrow \mu^+\mu^-$ sürecine katkılar
 - $\sigma_\gamma = 2.222 \times 10^{-2}$ pb
 - $\sigma_Z = 1.219 \times 10^{-2}$ pb
 - $\sigma_{Z'} = 9.379 \times 10^{-1}$ pb
 - $\sigma_{\text{top}} = 9.535 \times 10^{-1}$ pb
- $\Delta\sigma = \sigma_{\text{top}} - \sigma_\gamma - \sigma_Z - \sigma_{Z'}$ girişim terimlerinden gelmiştir.

PYTHIA 8.1

```
#include "Pythia.h"

using namespace Pythia8;

int main() {

    // Generator. Process selection. LHC
    initialization. Histogram.

    Pythia pythia;

    pythia.readString("Beams:idA = 11");

    pythia.readString("Beams:idB =
-11");

    pythia.readString("Beams:eCM =
3000.");
    pythia.readString("NewGaugeBoson:ff
bar2gmZZprime = on");

    pythia.readString("Zprime:gmZmode=1");
    pythia.readString("32:onMode = off");
    pythia.readString("32:onIfAny= 13 -13");
    pythia.readString("32:m0 = 3000");

    pythia.init();

    for (int iEvent = 0; iEvent < 100; ++iEvent) {
        if (!pythia.next()) continue;
    }

    pythia.stat();

    return 0;

}
```

PYTHIA 8.1

- `pythia.readString("Zprime:gmZmode=1");`
Foton katkısı
- `pythia.readString("Zprime:gmZmode=2");`
Z bozon katkısı
- `pythia.readString("Zprime:gmZmode=3");`
Z' bozon katkısı
- `pythia.readString("Zprime:gmZmode=0");`
Toplam katkı

- `pythia.readString("Zprime:gmZmode=1");`
Foton katkısı

```
*----- PYTHIA Event and Cross Section Statistics -----*
```

| Subprocess | Code | Number of events | | | sigma +- delta | |
|-----------------------------|------|------------------|----------|----------|----------------|-----------|
| | | Tried | Selected | Accepted | (estimated) | (mb) |
| f fbar -> gamma*/Z0/Zprime0 | 3001 | 8512 | 1000 | 1000 | 2.093e-11 | 2.906e-13 |
| sum | | 8512 | 1000 | 1000 | 2.093e-11 | 2.906e-13 |

```
*----- End PYTHIA Event and Cross Section Statistics -----*
```

- `pythia.readString("Zprime:gmZmode=2");`
Z bozon katkısı

```

*----- PYTHIA Event and Cross Section Statistics -----*
| Subprocess                Code |      Number of events      |      sigma +- delta      |
|                               |      Tried  Selected  Accepted |      (estimated) (mb)   |
|-----|-----|-----|-----|-----|
| f fbar -> gamma*/Z0/Zprime0 | 3001 |      23308      1000      1000 |      1.254e-11  2.381e-13 |
| sum                        |      |      23308      1000      1000 |      1.254e-11  2.381e-13 |
|-----|-----|-----|-----|-----|
*----- End PYTHIA Event and Cross Section Statistics -----*

```

- `pythia.readString("Zprime:gmZmode=3");`
Z' bozon katkısı

```
*----- PYTHIA Event and Cross Section Statistics -----*
```

| Subprocess | Code | Number of events | | | sigma +- delta | |
|-----------------------------|------|------------------|----------|----------|------------------|-----------|
| | | Tried | Selected | Accepted | (estimated) (mb) | |
| f fbar -> gamma*/Z0/Zprime0 | 3001 | 16036 | 1000 | 1000 | 9.900e-10 | 1.588e-11 |
| sum | | 16036 | 1000 | 1000 | 9.900e-10 | 1.588e-11 |

```
*----- End PYTHIA Event and Cross Section Statistics -----*
```

- `pythia.readString("Zprime:gmZmode=0");`
Toplam tesir kesiti

```
*----- PYTHIA Event and Cross Section Statistics -----*
```

| Subprocess | Code | Number of events | | | sigma +- delta | |
|-----------------------------|------|------------------|----------|----------|----------------|-----------|
| | | Tried | Selected | Accepted | (estimated) | (mb) |
| f fbar -> gamma*/Z0/Zprime0 | 3001 | 16853 | 1000 | 1000 | 1.010e-09 | 1.646e-11 |
| sum | | 16853 | 1000 | 1000 | 1.010e-09 | 1.646e-11 |

```
*----- End PYTHIA Event and Cross Section Statistics -----*
```

+