

CompHEP (CalcHEP nedir?)

İlkay TÜRK ÇAKIR
HPFBU Kış Okulu-TOKAT
Şubat 2014

CompHEP (Compute High Energy Physics)

- <http://comphep.sinp.msu.ru/> sayfasından bedava indirilebilir.
- CompHEP 4.5.1 versiyonu okulun sanal bilgisayarında kurulmuş ve sizin çalışmanızı bekliyor.

cd hepWork

cd comphep2014
- Komut satırına geçip ilgili dizine girerek çalışmaya başlayabiliriz.

Okulun Sanal Bilgisayarı Olmasaydı :(

Bilgisayara kurmak için şu komutlar uygulanır:

- Kayıt ol
- tgz dosyasını indir
- *tar xzf comphep-4.5.1.tgz*
- *cd cmphep-4.5.1*
- *./configure*
- *make*
- *make setup WDIR=\${HOME}/tokat_okul1*
- *cd \${HOME}/tokat_okul1*
- *./comphep*



[[news]]

COMPHEP

Show pagesource

Old revisions

Recent changes

Search

Trace: » news



- News
- Overview
- Screen shots
- Downloads
- Community contributions
- Community model library
- Contact us
- CompHEP team
- License
- **Restricted area**

Documentation

- Installation guide
- MAC OS installation
- CompHEP-3.3 Manual
- CompHEP-3.3 Manual (pdf)
- The Bibliography. History.

User support

Highlight news: CompHEP is in the top rating list on The OpenScience Project

CompHEP: a package for evaluation of Feynman diagrams, integration over multi-particle phase space and event generation (supported in part by RFBR grants 96-02-19773-a, 99-02-04011-HHIO_a, 01-02-16710-a, 04-02-17448-a).

CompHEP Collaboration

E.Boos, V.Bunichev, M.Dubinin, L.Dudko, V.Edneral, V.Ilyin, A.Kryukov, V.Savrin - SINP MSU, Moscow, Russia.

A.Semenov - JINR, Dubna, Russia.

A.Sherstnev - SINP MSU, Moscow, Russia and University of Oxford, UK.

ABSTRACT

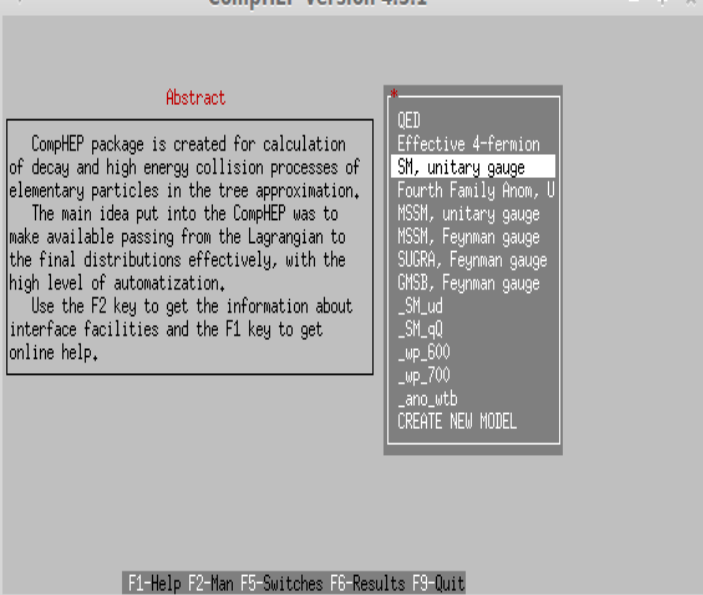
At present time when a new generation of TeV energy colliders is beginning to operate one needs to calculate cross sections for a great number of various reactions. The CompHEP package was created for calculation of multiparticle final states in collision and decay processes. The main idea in

Table of Contents

- CompHEP Collaboration
- ABSTRACT
- News
- Authors of publications containing results obtained by means of CompHEP are requested to include the references

Bu program ile ne yapabiliriz?

- **Compute (veya Calculate) High Energy Physics**
 - Ağaç seviyesinde tesir kesiti hesabı
 - Dallanma oranı hesabı
 - Feynman çizimleri
 - Olay üretimi



Model Seçimi

- SUSY, SM, QED ile ilgili modelleri bulabilir.
- Kendimize ait süreci aşağıdaki kütükleri yazarak girebiliriz.
 1. Variables (kütleler, karışımlar)
 2. Constraints (CKM matrisi)
 3. Particle definitions (fermionlar ve bozonlar)
 4. Lagrangian (etkileşmeler)

Çalışma Sırası - 1

1) Bir model seçelim

- Örneğin Standart Model seçilir

2) Bir süreç seçelim

- Hızlandırıcı da burada seçilir

3) Feynman çizimlerinin karesini alıp sonucu “C” dilinde yazdıralım

- Çizimler mutlaka incelenmeli

4) “C” programını derleyip sayısal inceleme yapalım

- Sonuçlar burada elde edilmeli

5) Tesir kesitlerini elde edelim

Başlayalım :)

```
Terminal
File Edit View Search Terminal Help
Subprocess 14 (B,b -> b,B)

End of CompHEP numerical session.
#IT  Cross section [pb]  Error %    nCall  chi**2
< >  9.9733E+00         2.25E-01  195840  1

The current session is number 15
Subprocess 15 (G,G -> b,B)

End of CompHEP numerical session.
#IT  Cross section [pb]  Error %    nCall  chi**2
< >  9.7035E+02         1.81E-01  195840  1

All of the subprocesses are finished
ilkay@ilkay-VAIO ~/comp451 $
```

```
CompHEP version 4.5.1
Abstract
CompHEP package is created for calculation of decay and high energy collision processes of elementary particles in the tree approximation.
The main idea put into the CompHEP was to make available passing from the Lagrangian to the final distributions effectively, with the high level of automatization.
Use the F2 key to get the information about interface facilities and the F1 key to get online help.
QED
Effective 4-fermion
SM, unitary gauge
Fourth Family Anom, U
MSSM, unitary gauge
MSSM, Feynman gauge
SUGRA, Feynman gauge
GMSB, Feynman gauge
_SM_ud
_SM_qd
_wp_600
_wp_700
_ano_wtb
CREATE NEW MODEL
F1-Help F2-Man F5-Switches F6-Results F9-Quit
```

```
Terminal
File Edit View Search Terminal Help
-rw-r--r--  1 ilkay ilkay    4127 Sep 26  2012
drwxr-xr-x  6 ilkay ilkay    4096 Jan 23  2013
-rw-----  1 ilkay ilkay     121 Feb  4  20:44
-rw-r--r--  1 ilkay ilkay    3398 Feb  4  20:54
drwxr-xr-x  3 ilkay ilkay    4096 Dec  5  2012
ilkay@ilkay-VAIO ~ $ cd comp451/
ilkay@ilkay-VAIO ~/comp451 $ ./comphep
Warning Graphical font not found : -adobe-courier
Font "fixed" is used instead
Text font not found : -adobe-courier-bold-r-norma
Font "fixed" is used instead

End of CompHEP symbolical session.
ilkay@ilkay-VAIO ~/comp451 $ ./comphep
```

```
CompHEP version 4.5.1
Model: SM, unitary gauge
Abstract
CompHEP package is created for calculation of decay and high energy collision processes of elementary particles in the tree approximation.
The main idea put into the CompHEP was to make available passing from the Lagrangian to the final distributions effectively, with the high level of automatization.
Use the F2 key to get the information about interface facilities and the F1 key to get online help.
Enter Decay Process
Enter Scattering Process
Edit Beams Table
Edit Str. Functions Table
Edit Model
Delete Model
F1-Help F2-Man F5-Switches F6-Results F9-Quit
```


CompHEP'de basit bir süreç ile başlayalım

Temel Bir Süreç

elektron+pozitron-->muon+antimüon

$$e^-e^+ \rightarrow \mu\mu$$

* SM Uniter Gauge ile başlayalım

* Sürecimizi girelim:

elektron+pozitron-->muon+antimüon (e⁻e⁺-->μμ)

* Sırasıyla şu adımları uygulayalım:

 Square Diagrams, Symbolic Calculations, Write results (C), C- Compiler

* Şimdi n_comphep dosyası "results" dizininde oluşur..

 Bu dosya sonraki çalışmalarımızda işimize çooooookkkk yarayacak.

Model: SM, unitary gauge

List of (anti)particles

G(G)	gluon	A(A)	photon	Z(Z)	Z boson
W+(W-)	W boson	ne(Ne)	neutrino	e(E)	electron
nm(Nm)	mu-neutrino	m(M)	muon	nl(Nl)	tau-neutrino
l(L)	tau-lepton	u(U)	u-quark	d(D)	d-quark
c(C)	c-quark	s(S)	s-quark	t(T)	t-quark
b(B)	b-quark	H(H)	Higgs		

```
Enter 1st Beam: e
Enter 1st Beam Energy (GeV) : 500,000000
Enter 2nd Beam: E
Enter 2nd Beam Energy (GeV) : 500,000000
```

Model: SM, unitary gauge

List of (anti)particles

G(G)	gluon	A(A)	photon	Z(Z)	Z boson
W+(W-)	W boson	ne(Ne)	neutrino	e(E)	electron
nm(Nm)	mu-neutrino	m(M)	muon	nl(Nl)	tau-neutrino
l(L)	tau-lepton	u(U)	u-quark	d(D)	d-quark
c(C)	c-quark	s(S)	s-quark	t(T)	t-quark
b(B)	b-quark	H(H)	Higgs		

Temel Bir Süreç

elektron+pozitron-->muon+antimüon

$$e^-e^+ \rightarrow \mu\mu$$

```
Enter Final State: e,E -> m,M
Exclude diagrams with
Keep diagrams with
```

CompHEP version 4.5.1

Model: SM, unitary gauge

Process: $e, E \rightarrow m, M$

Feynman diagrams

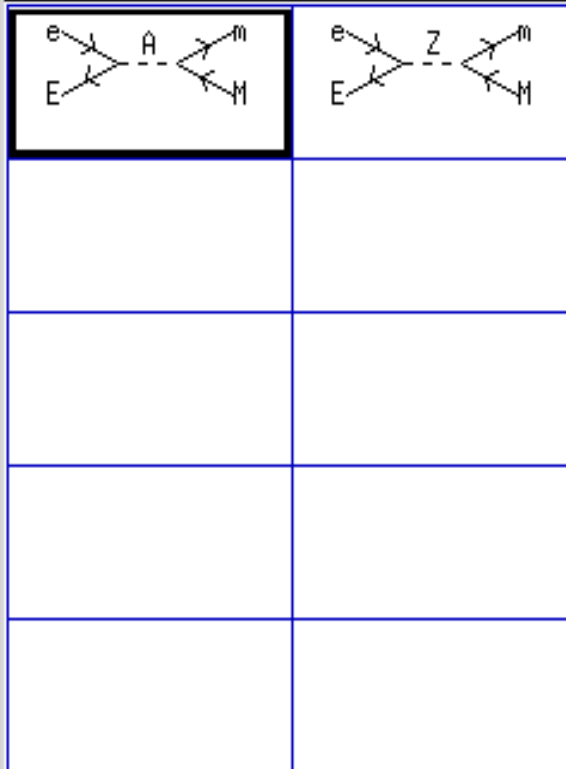
2 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted.

View diagrams
Square diagrams

CompHEP version 4.5.1

Delete, On/off, Restore, Latex

1/2



F1-Help, F2-Man, PgUp, PgDn, Home, End, # , Esc

CompHEP version 4.5.1

Model: SM, unitary gauge

Process: $e, E \rightarrow m, M$

Feynman diagrams

2 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted.

View diagrams
Square diagrams

F1-Help F2-Man F3-Model F5-Switches F6-Results F9-Quit

CompHEP version 4.5.1

Model: SM, unitary gauge

Process: e,E -> m,M

Feynman diagrams

2 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted.

Squared diagrams

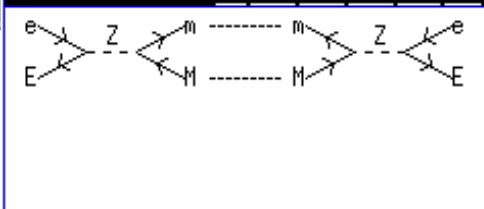
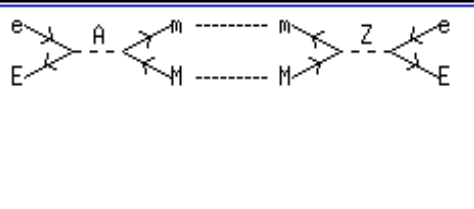
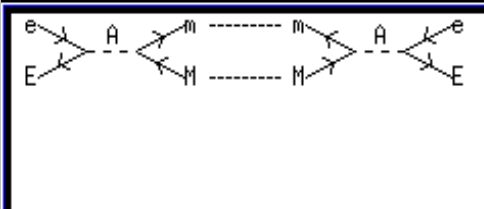
3 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted,
0 diagrams are calculated.

View squared diagrams
Symbolic calculations
REDUCE program
Make n_comphep
Prepare process.dat
Enter new process

CompHEP version 4.5.1

Delete, On/off, Restore, Latex, Ghosts

1/3



F1-Help, F2-Man, PgUp, PgDn, Home, End, # , Esc

CompHEP version 4.5.1

Model: SM, unitary gauge

Process: e,E -> m,M

Feynman diagrams

2 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted.

Squared diagrams

3 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted,
0 diagrams are calculated.

View squared diagrams
Symbolic calculations
REDUCE program
Make n_comphep
Prepare process.dat
Enter new process

CompHEP version 4.5.1

Model: SM, unitary gauge

Process: e,E -> m,M

Feynman diagrams

2 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted.

Squared diagrams

3 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted,
3 diagrams are calculated,
0 Out of memory

View squared diagrams
Write results
C-compiler
Enter new process

CompHEP version 4.5.1

Model: SM, unitary gauge

Process: e,E -> m,M

Feynman diagrams

2 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted.

Squared diagrams

3 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted,
3 diagrams are calculated,
0 Out of memory

Write results
C code
FORM code
REDUCE code
MATHEMATICA code

F1-Help F2-Man F3-Model F4-Diagrams F5-Switches F6-Results F9-Quit

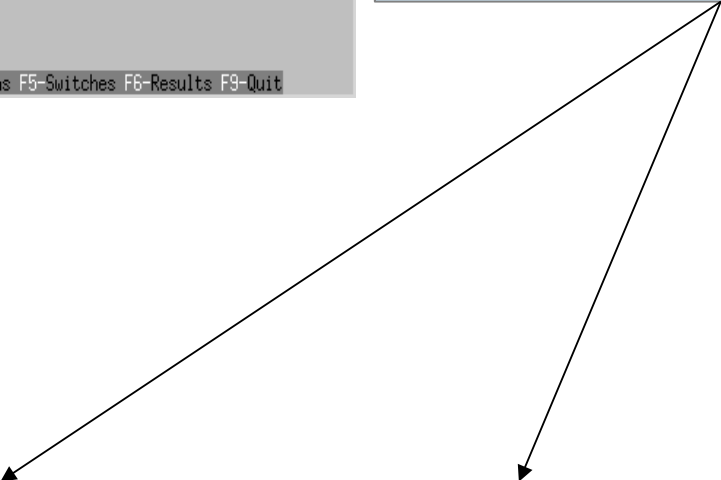
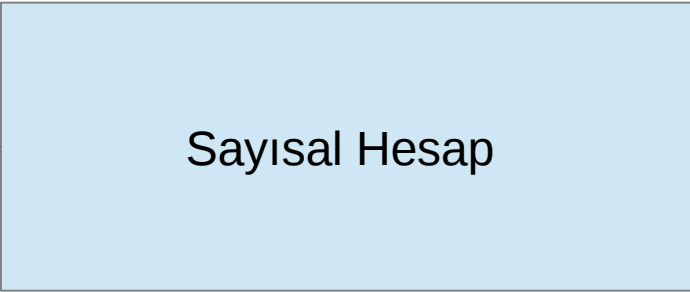
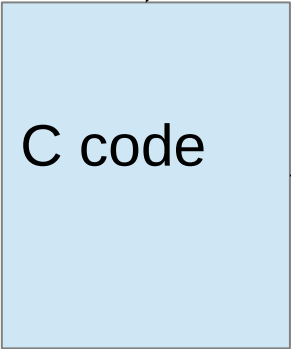
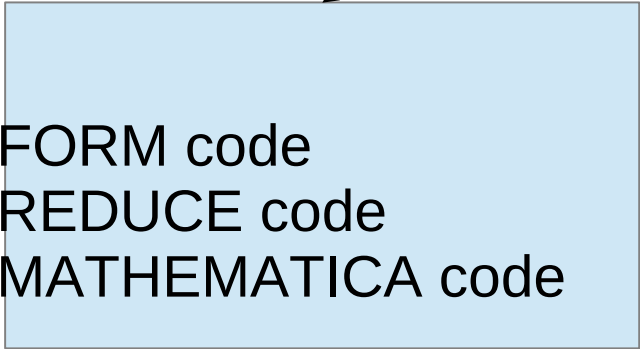
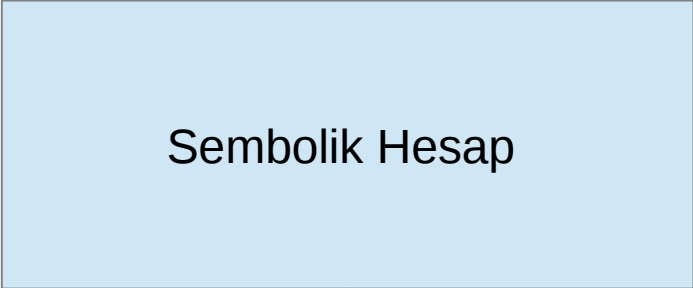
```
CompHEP version 4.5.1
Model: SM, unitary gauge
Process: e,E -> m,M

Feynman diagrams
2 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted,

Squared diagrams
3 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted,
3 diagrams are calculated,
0 Out of memory

Write results
C code
FORM code
REDUCE code
MATHEMATICA code

F1-Help F2-Man F3-Model F4-Diagrams F5-Switches F6-Results F9-Quit
```



```
CompHEP version 4.5.1
Model: SM, unitary gauge
Process: e,E -> m,M

Feynman diagrams
2 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted.

Squared diagrams
3 diagrams in 1 subprocesses are constructed,
0 diagrams are deleted,
3 diagrams are calculated,
0 Out of memory
```

```
*
View squared diagrams
Write results
C-compiler
Enter new process
```

```
C Code Compilation
Process.....e,E -> m,M
Total number of files.. 4
Current file..... 4
Total size Compiled....100 (%)
Press Esc to stop

F1-Help F2-Man F3-Model F4-Diagram
```

```
CompHEP version 4.5.1
(sub)Process: e,E -> m,M
Monte Carlo session: 1(begin)

Subprocess
Initial state
Model parameters
Constraints
QCD scale
Width scheme: Fixed
Cuts
Kinematics
Regularization
Numerical Session
Simpson

F1-Help F2-Man F4-Diagrams F5-Squared D
```

```
CompHEP version 4.5.1
(sub)Process: e,E -> m,M
Monte Carlo session: 1(begin)

Subprocess
Initial state
Model parameters
Constraints
QCD scale
Width scheme: Fixed
Cuts
Kinematics
Regularization
Numerical Session

F1-Help F2-Man F4-Diagrams F5-Squared Diagrams F6-Results F9-Quit
```

CompHEP version 4.5.1

(sub)Process: e,E -> m,M
Monte Carlo session: 1(begin)

Initial state

*
Beam particle 1: parton
Beam particle 2: parton
Str.Fun.1: OFF
Str.Fun.2: OFF
1 particle momentum[GeV] = 500
2 particle momentum[GeV] = 500

CompHEP version 4.5.1

(sub)Process: e,E -> m,M
Monte Carlo session: 1(begin)

Initial state

*
Beam particle 1: electron
Beam particle 2: electron
Str.Fun.1: ISR(100 Beamstr.: OFF)
Str.Fun.2: ISR(100 Beamstr.: OFF)
1 particle momentum[GeV] = 500
2 particle momentum[GeV] = 500

F1-Help F2-Man F4-Diagrams F5

CompHEP version 4.5.1

(sub)Process: e,E -> m,M
Monte Carlo session: 1(begin)

*
Subprocess
Initial state
Model parameters
Constraints
QCD scale
Width scheme: Fixed
Cuts
Kinematics
Regularization
Numerical Session
Simpson

F1-Help F2-Man F4-Diagrams F5-Squared Dia

F1-Help F2-Man F4-Diagrams F5-Squared Diagrams F6-Results F9-Quit

Numerical Session

Basit süreçler için
Itmx=10 alınabilir.

Itmax=20 veya daha fazla alınabilir.

nCall=20000 yapılabilir.

Tüm bunlar kikare değerimizin
yaklaşık bir veya birden küçük
olmasını zorlamak içindir.

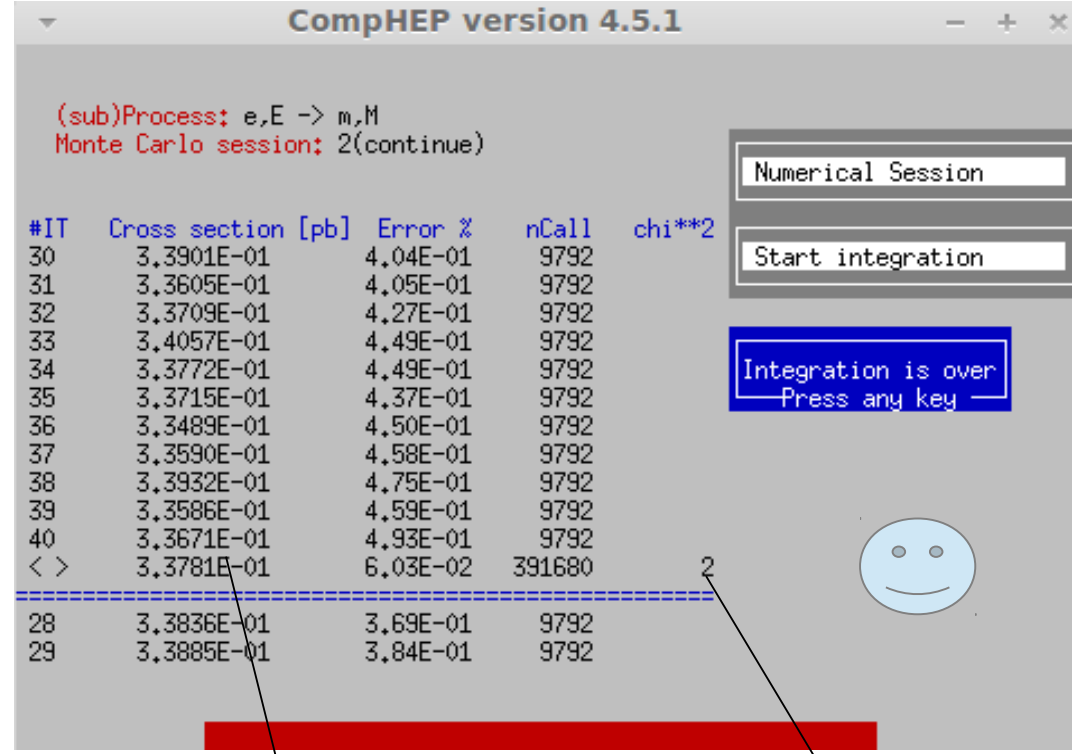
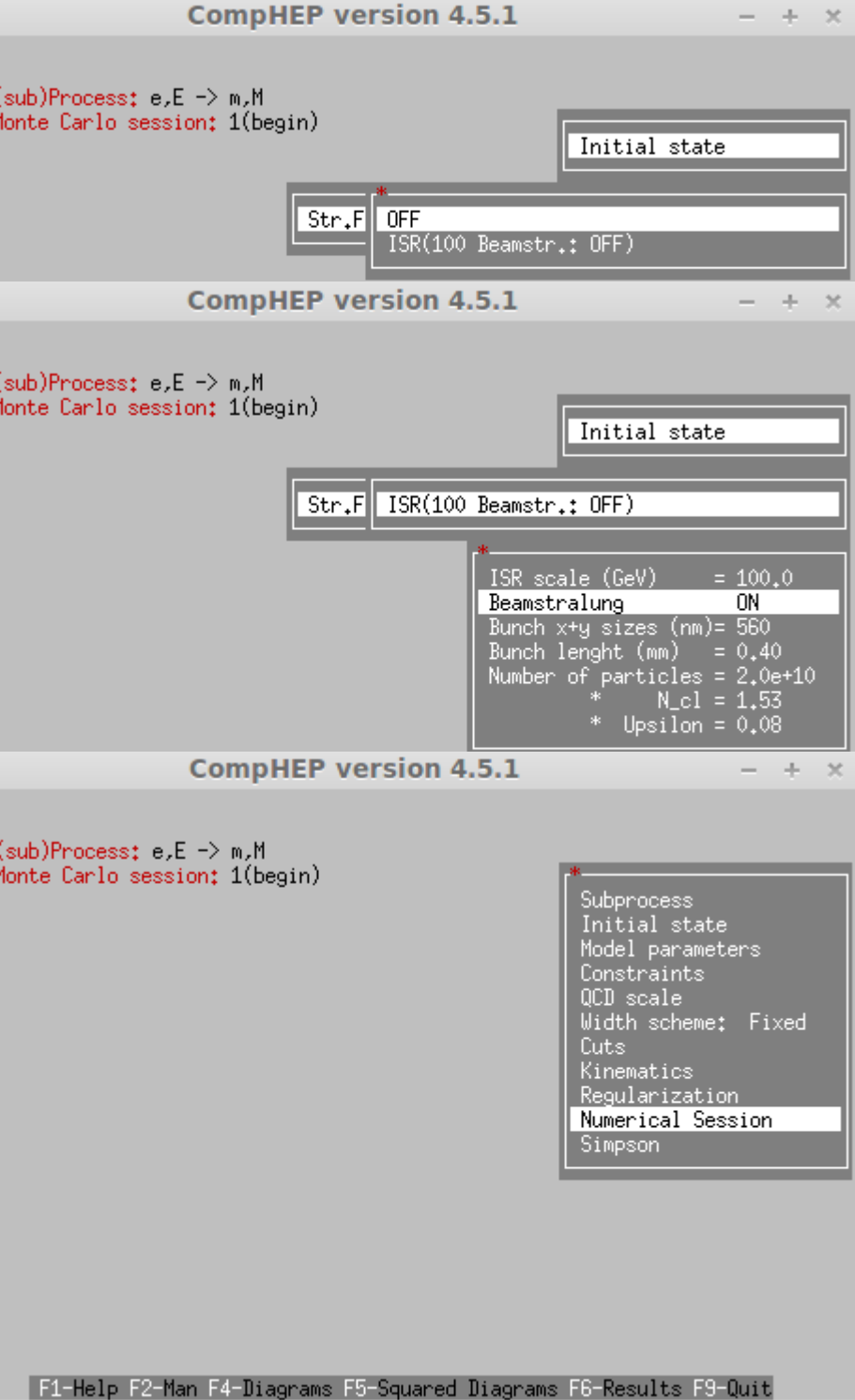
The screenshot shows two windows of the CompHEP version 4.5.1 software. The top window displays the 'Numerical Session' menu with options: Itmx = 20, nCall = 9826, Set Distributions, Start integration, Display Distributions, Combine ROOT-hist, Clear statistic, Clear grid, and Generate events. The bottom window shows the same menu with 'Start integration' highlighted. Below the menu is a table of results for various IT values. A blue oval with the text 'Tesir kesiti sonucu' (Cross section result) has an arrow pointing to the table. A blue smiley face icon is also visible in the bottom window.

#IT	Cross section [pb]	Error %	nCall	chi**2
16	1.1279E-01	1.80E-03	9826	
17	1.1279E-01	2.02E-03	9826	
18	1.1279E-01	1.85E-03	9826	
19	1.1279E-01	2.45E-03	9826	
20	1.1279E-01	2.30E-03	9826	
< >	1.1279E-01	1.39E-04	196520	0.5
8	1.1279E-01	1.68E-03	9826	
9	1.1279E-01	1.96E-03	9826	
10	1.1279E-01	1.98E-03	9826	
11	1.1279E-01	1.76E-03	9826	
12	1.1279E-01	1.78E-03	9826	
13	1.1279E-01	1.70E-03	9826	
14	1.1279E-01	1.61E-03	9826	
15	1.1279E-01	1.63E-03	9826	

Tesir kesiti sonucu

ISR&BS etkisini (hızlandırıcımıza uygun olarak) göz önüne alalım

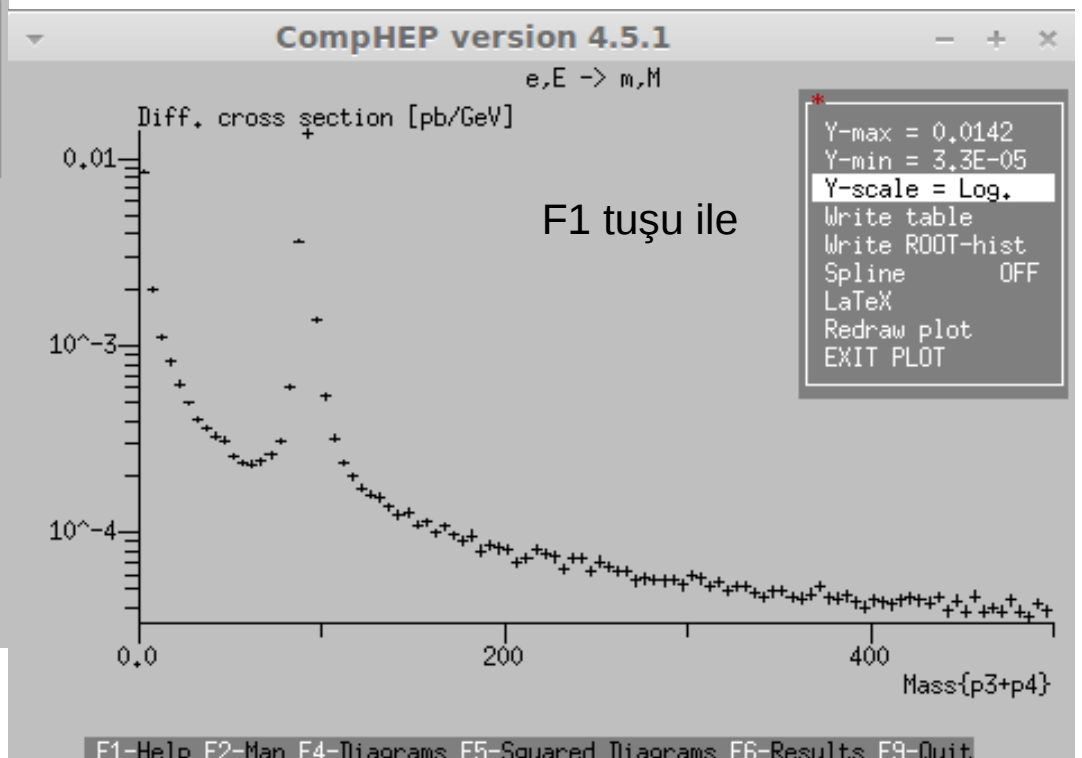
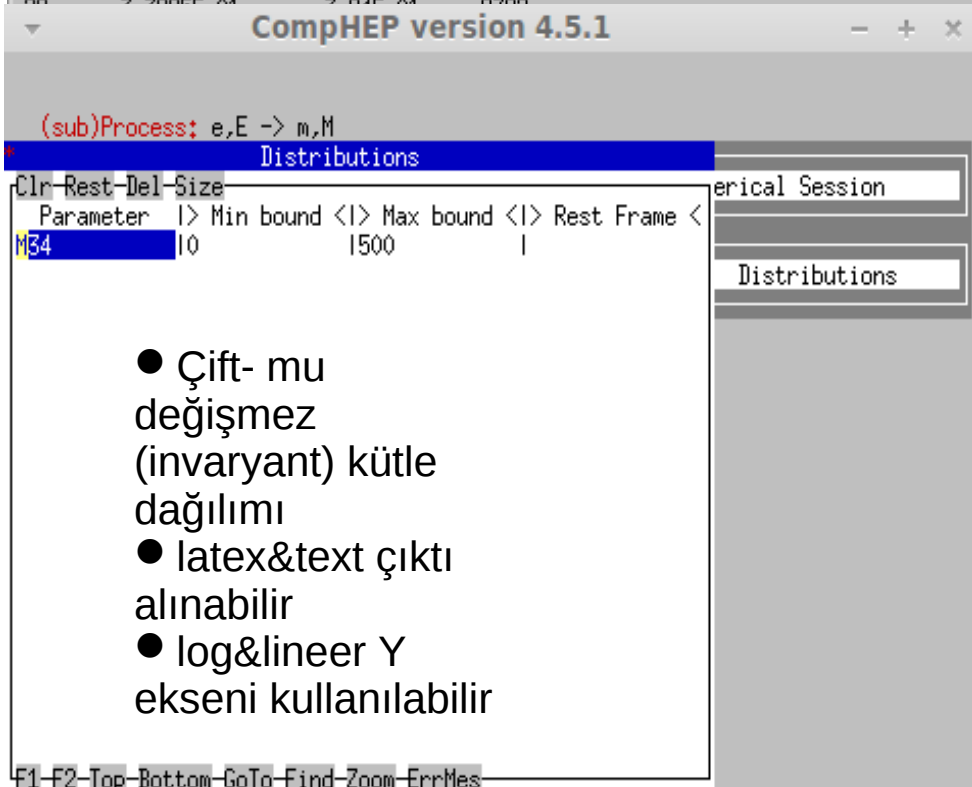
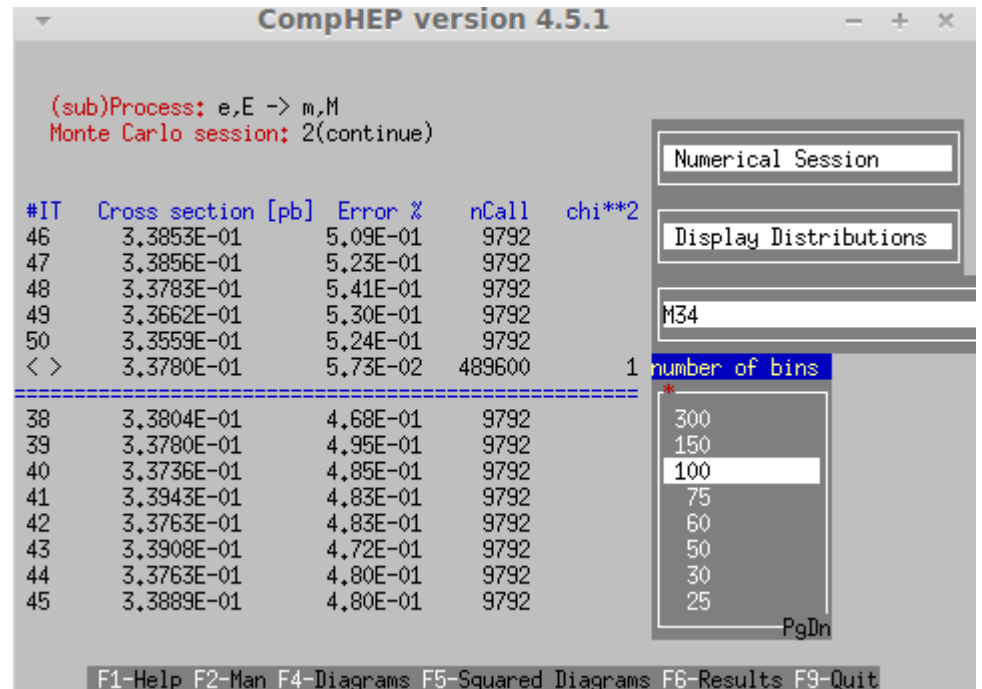
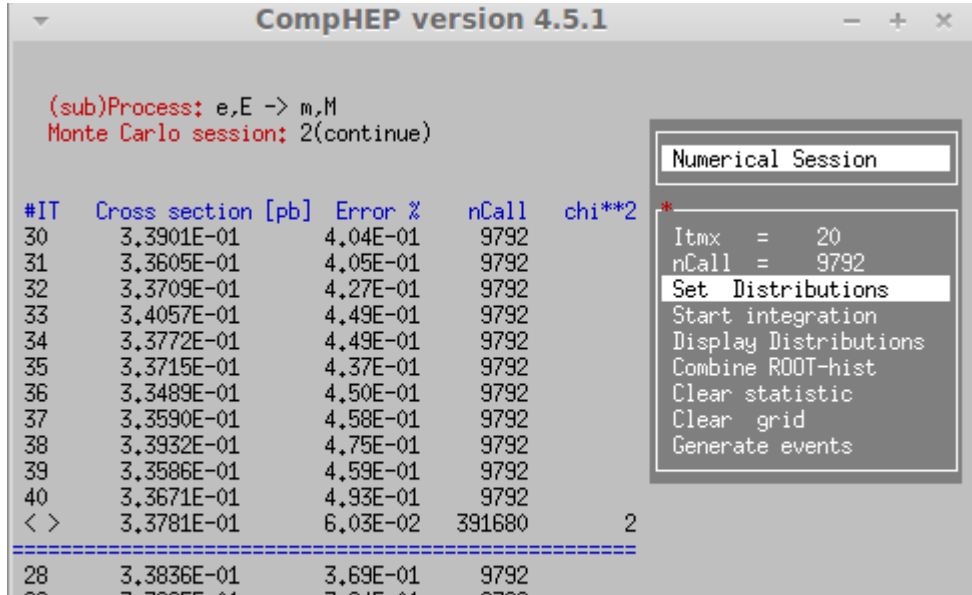
- **ISR:** İlk ışımadan yayınlanan foton radyasyonu-KM enerjisini azaltır.
- **BS:** Parçacıkların EM alanından dolayı enerji kaybediyor. Bu spektrum doğrusal çarpıştırıcının geometrisine (bunch x+y sizes), demetin boyutlarına (bunch length), demetdeki parçacık sayısına (bunch of particles), demet enerjisine göre değişim göstermektedir.



Tesir kesiti sonucu

1 veya birden küçük yapmaya çalışmalıyız

Önceki sonuçla karşılaştırdığında sonucun değiştiğini görüyoruz yani hızlandırıcı parametrelerinin tesir kesiti üzerindeki etkisini görüyoruz.



Çalışma Sırası-2

- Şimdi protonlarla örnek yapalım.
- Aynı yollardan tesir kesitlerini bu sefer kesmeler (cutlar) koyarak hesaplayalım.
- Sonra da olay üretimi yapıp biraz da CalcHEP'e bahsedip dersimizi bitirelim.

Bir de protonlara bakalım...

CompHEP version 4.5.1
Model: SM, unitary gauge

List of structure functions

```

0: OFF
1: WWA (m=0.000511 Ch=-1 Q=100)
2: Laser Photons
3: ISR(100 Beamstr.:OFF)
10: PDF:cteq6m(proton)
11: PDF:cteq6m(anti-proton)
12: PDF:cteq6l1(proton)
13: PDF:cteq6l1(anti-proton)
14: PDF:cteq6d(proton)
15: PDF:cteq6d(anti-proton)
16: PDF:cteq5m1(proton)
17: PDF:cteq5m1(anti-proton)

```

Enter 1st Beam: pb
Enter 1st Beam Energy (GeV) : 4000.000000
Enter 2nd Beam: pb
Enter 2nd Beam Energy (GeV) : 4000.000000
Enter PDF number : 12

CompHEP version 4.5.1
Model: SM, unitary gauge

List of (anti)particles

G(G)	gluon	A(A)	photon	Z(Z)	Z boson
W+(W-)	W boson	ne(Ne)	neutrino	e(E)	electron
nm(Nm)	mu-neutrino	m(M)	muon	nl(Nl)	tau-neutrino
l(L)	tau-lepton	u(U)	u-quark	d(D)	d-quark
c(C)	c-quark	s(S)	s-quark	t(T)	t-quark
b(B)	b-quark	H(H)	Higgs		

Enter Final State: pb,pb -> b,B
Exclude diagrams with
Keep diagrams with

CompHEP version 4.5.1
Model: SM, unitary gauge

Process: pb,pb -> b,B

Feynman diagrams

diagrams in 15 subprocesses are constructed,
diagrams are deleted.

NN	Subprocess	Del	Rest
12	C,c -> b,B	0	5
13	b,B -> b,B	0	8
14	B,b -> b,B	0	8
15	G,G -> b,B	0	3

1/8

--	--	--	--

F1-Help F2-Man F3-Mo

```

CompHEP version 4.5.1
Process: pb,pb -> b,B (15 subprocesses)
(sub)Process: u,U -> b,B
Monte Carlo session: 1(begin)
Initial state
*
Beam particle 1: proton
Beam particle 2: proton
Str.Fun.1: PDF:cteq6l1
Str.Fun.2: PDF:cteq6l1
1 particle momentum[GeV] = 1000
2 particle momentum[GeV] = 1000

```

```

CompHEP version 4.5.1
Process: pb,pb -> b,B (15 subprocesses)
(sub)Process: B,b -> b,B
Monte Carlo session: 3(begin)
#IT  Cross section [pb]  Error %  nCall  chi**2
Subprocess
Initial state
Model parameters
Constraints
QCD scale
Width scheme: Fixed
Cuts
Kinematics
Regularization
Numerical Session

```

```

CompHEP version 4.5.1
Process: pb,pb -> b,B (15 subprocesses)
(sub)Process: B,b -> b,B
Monte Carlo session: 3(begin)
Numerical Session
Start integration
Integration is over
Press any key

```

#IT	Cross section [pb]	Error %	nCall	chi**2
20	1.7014E+53	1.58E+01	9792	
< >	2.1594E+05	2.82E+01	195840	5
15	3.6554E+32	7.30E+01	9792	
16	1.4944E+42	9.05E+01	9792	
17	4.0335E+50	7.65E+01	9792	
18	7.6530E+53	9.67E+01	9792	
19	1.2532E+53	2.50E+01	9792	

• Kesmeler (Cut)
Neden gerekli ???

• Cuts

- T3

- T4

- N3

- N4 gibi

konulabilir...

Sonuçlar iyi değil :(

```

CompHEP version 4.5.1
Process: pb,pb -> b,B (15 subprocesses)
(sub)Process: b,B -> b,B
Monte Carlo session: 2(begin)

#IT  Cross section [pb]  Error %  nCall  chi**2

Subprocess
Initial state
Model parameters
Constraints
QCD scale
Width scheme: Fixed
Cuts
Kinematics
Regularization
Numerical Session

```

```

CompHEP version 4.5.1
Process: pb,pb -> b,B (15 subprocesses)
(sub)Process: b,B -> b,B
Monte Carlo session: 2(begin)

#IT  Cross section [pb]  Error %  nCall  chi**2
16   9.9421E+00  6.64E-01  19404
17   9.9000E+00  6.08E-01  19404
18   9.9793E+00  6.27E-01  19404
19   9.8923E+00  5.83E-01  19404
20   9.9307E+00  5.65E-01  19404
< > 9.9481E+00  1.50E-01  388080  0.8

-----
 8   1.0052E+01  6.50E-01  19404
 9   9.9701E+00  6.26E-01  19404
10   9.8661E+00  5.60E-01  19404
11   9.8989E+00  5.59E-01  19404
12   9.9682E+00  5.89E-01  19404
13   9.9710E+00  6.36E-01  19404
14   1.0032E+01  7.49E-01  19404
15   9.9985E+00  6.34E-01  19404

```

Numerical Session
Start integration
Integration is over
Press any key

```

CompHEP version 4.5.1
Process: pb,pb -> b,B (15 subprocesses)
(sub)Process: b,B -> b,B

Cuts
Clr Rest Del Size
Parameter |> Min bound <|> Max bound <|> Exclusive <
T3        150          |          |
T4        150          |          |
N3        1-2,5      | 12,5     |
N4        1-2,5      | 12,5     |

```

Sadece C-compiler kısmına kadar geri çıkılır

```

CompHEP version 4.5.1
Model: SM, unitary gauge
Process: pb,pb -> b,B

Feynman diagrams
55 diagrams in 15 subprocesses are constructed,
0 diagrams are deleted,

Squared diagrams
164 diagrams in 15 subprocesses are constructed,
0 diagrams are deleted,
164 diagrams are calculated,
0 Out of memory

C Code Compilation
Process.....pb,pb -> b,B
Total number of files.. 147
Current file..... 147
Total size Compiled...100 (%)
Press Esc to stop

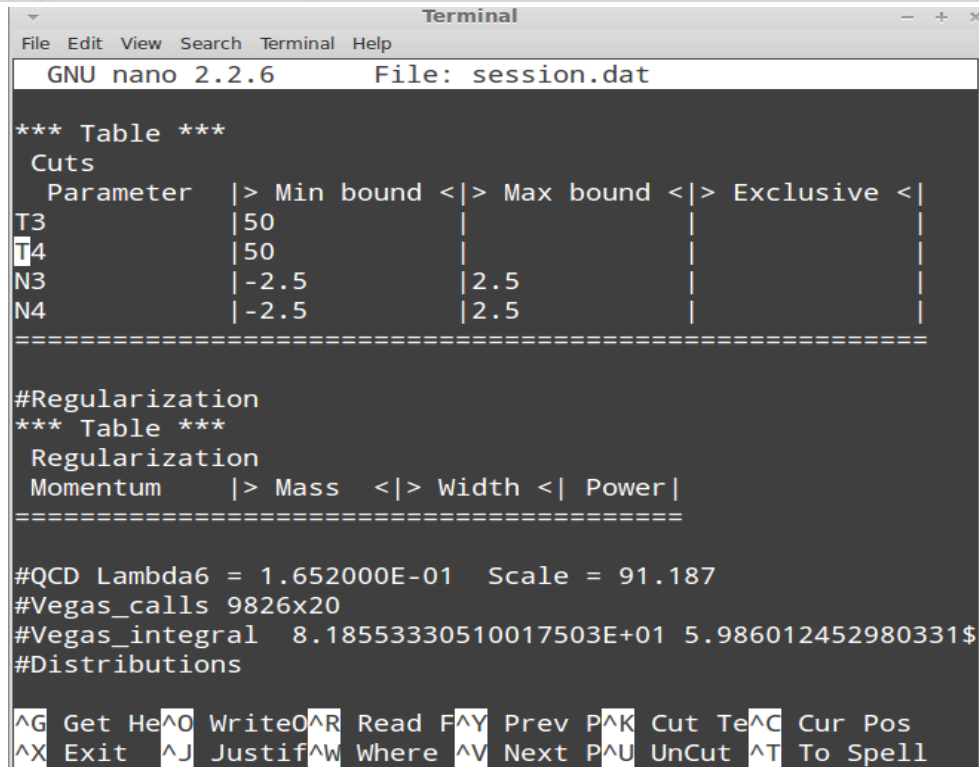
```

View squared diagrams
Write results
C-compiler
Enter new process

F1-Help F2-Man F3-Model F4-Diagrams F5-Switches F6-Results F9-Quit

Başka bir pencere açalım

```
ilkay@ilkay-VAIO ~/comp451/results $ ls
diags.tar  f_0.a      models      prt_1      session.dat
diag_view  ffile_0    n_comphep   service.c  sqme.c
extern.h   Makefile   n_comphep.exe service.o  sqme.o
ilkay@ilkay-VAIO ~/comp451/results $ nano session.dat
```



```
Terminal
File Edit View Search Terminal Help
GNU nano 2.2.6 File: session.dat

*** Table ***
Cuts
Parameter |> Min bound <|> Max bound <|> Exclusive <|
T3         |50          |          |          |
T4         |50          |          |          |
N3         |-2.5        |2.5       |          |
N4         |-2.5        |2.5       |          |
=====

#Regularization
*** Table ***
Regularization
Momentum   |> Mass   <|> Width <| Power |
=====

#QCD Lambda6 = 1.652000E-01 Scale = 91.187
#Vegas_calls 9826x20
#Vegas_integral 8.18553330510017503E+01 5.986012452980331$
#Distributions

^G Get He^O WriteO^R Read F^Y Prev P^K Cut Te^C Cur Pos
^X Exit ^J Justif^W Where ^V Next P^U UnCut ^T To Spell
```



```

Terminal
File Edit View Search Terminal Help
ilkay@ilkay-VAIO ~/comp451/results $ rm -r prt*
rm: cannot remove `prt*': No such file or directory
ilkay@ilkay-VAIO ~/comp451/results $ ls
batch.dat  extern.h  Makefile  n_comphep.exe  session.d
diags.tar  f_0.a    models    service.c      sqme.c
diag_view  ffile_0  n_comphep  service.o      sqme.o
ilkay@ilkay-VAIO ~/comp451/results $ nano session.dat
ilkay@ilkay-VAIO ~/comp451/results $ ls
batch.dat  extern.h  Makefile  n_comphep.exe  session.d
diags.tar  f_0.a    models    service.c      sqme.c
diag_view  ffile_0  n_comphep  service.o      sqme.o
ilkay@ilkay-VAIO ~/comp451/results $ nano batch.dat
ilkay@ilkay-VAIO ~/comp451/results $ rm batch.dat
ilkay@ilkay-VAIO ~/comp451/results $ cd ..
ilkay@ilkay-VAIO ~/comp451 $ ./num_batch.pl -run vegas

```

Alt süreçler

Subprocesses				
1.	+	u	U	-> b B
2.	+	u	C	-> b B
3.	+	d	D	-> b B
4.	+	U	u	-> b B
5.	+	U	c	-> b B
6.	+	D	d	-> b B
7.	+	s	S	-> b B
8.	+	c	U	-> b B
9.	+	c	C	-> b B
10.	+	S	s	-> b B
11.	+	C	u	-> b B
12.	+	C	c	-> b B
13.	+	b	B	-> b B
14.	+	B	b	-> b B
15.	+	G	G	-> b B

./num_batch.pl -show cs

./num_batch.pl -run vegas

```

Terminal
File Edit View Search Terminal Help
Subprocess 14 (B,b -> b,B)
End of CompHEP numerical session.
#IT  Cross section [pb]  Error %  nCall  chi**2
< >  9.9733E+00         2.25E-01  195840  1
The current session is number 15
Subprocess 15 (G,G -> b,B)
End of CompHEP numerical session.
#IT  Cross section [pb]  Error %  nCall  chi**2
< >  9.7035E+02         1.81E-01  195840  1
All of the subprocesses are finished
ilkay@ilkay-VAIO ~/comp451 $

```

```

Terminal
File Edit View Search Terminal Help
Subprocess 11 (C,u -> b,B): cross section [pb] = 3.948
1e-01 % )
Subprocess 12 (C,c -> b,B): cross section [pb] = 3.859
7e-01 % )
Subprocess 13 (b,B -> b,B): cross section [pb] = 3.803
6e-01 % )
Subprocess 14 (B,b -> b,B): cross section [pb] = 3.794
3e-01 % )
Subprocess 15 (G,G -> b,B): cross section [pb] = 2.655
4e-01 % )
Total CS [pb] = 2.8690e+04 +/- 3.56e+01 ( 1.24e-01
ilkay@ilkay-VAIO ~/comp451 $

```

Tüm alt süreçlerin
tesir kesir toplamları



```
terminal
File Edit View Search Terminal Help
< > 9.7014E+02 1.29E-01 391680 1

All of the subprocesses are finished
ilkay@ilkay-VAIO ~/comp451 $ ./n_comphep
bash: ./n_comphep: No such file or directory
ilkay@ilkay-VAIO ~/comp451 $ cd results/
ilkay@ilkay-VAIO ~/comp451/results $ ./n_comphep
Warning Graphical font not found : -adobe-courier-bold-r-normal--14-*
Font "fixed" is used instead
Text font not found : -adobe-courier-bold-r-normal--14-*
Font "fixed" is used instead

End of CompHEP numerical session.
ilkay@ilkay-VAIO ~/comp451/results $ ./n_comphep
```

./n_comphep

UYARI

Değişiklik yaptıktan sonra
“results” dizininde
“batch.dat” silmeyi
unutmayınız...

```
CompHEP version 4.3.1

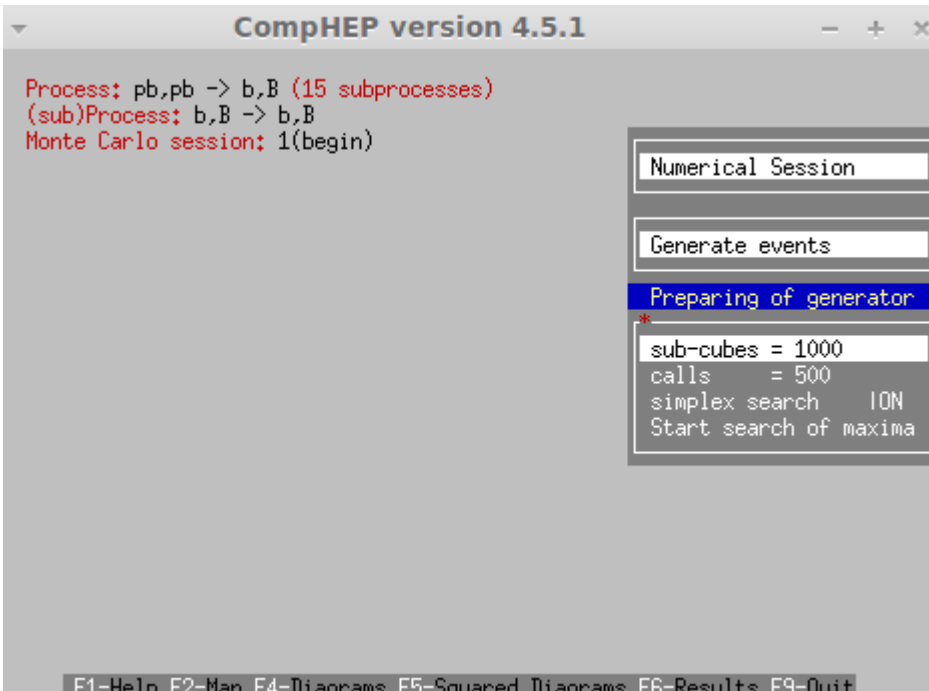
Process: pb,pb -> b,B (15 subprocesses)
(sub)Process: G,G -> b,B
Monte Carlo session: 30(continue)

Subprocess
Initial state
Model parameters
Constraints
QCD scale
Width scheme: Fixed
Cuts
Kinematics
Regularization
Numerical Session

F1-Help F2-Man F4-Diagrams F5-Squared Diagrams F6-Results F9-Quit
```

OLAY ÜRETİMİ

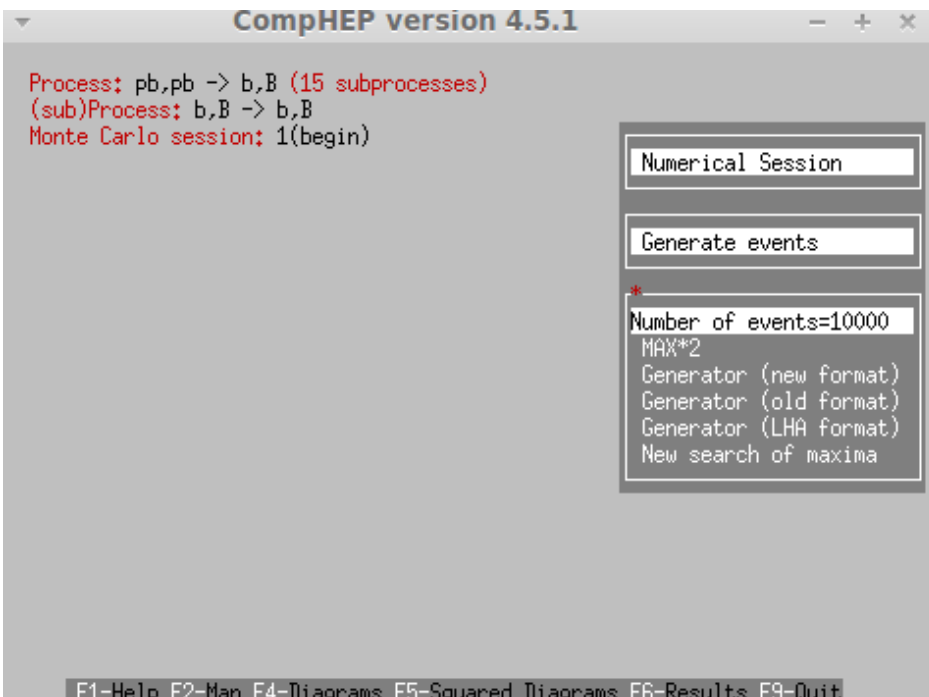
- “Generate events” maddesinden “start search of maxima” seçin
(eğer bulunamazsa “simplex”i kapatın)
- Olay üretimi tamamlanınca program kırmızı pencereyi çıkartıp onay bekler
(Negatif olay var mı?)
(Aynı olay tekrar ediyor mu?)



```
CompHEP version 4.5.1
Process: pb,pb -> b,B (15 subprocesses)
(sub)Process: b,B -> b,B
Monte Carlo session: 1(begin)

Numerical Session
Generate events
Preparing of generator
*
sub-cubes = 1000
calls = 500
simplex search 1ON
Start search of maxima

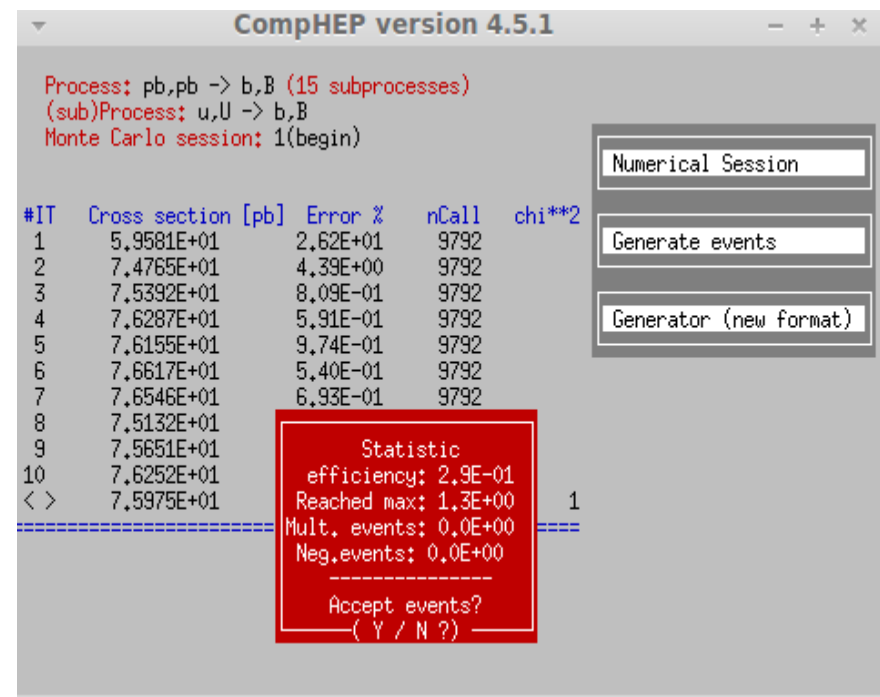
F1-Help F2-Man F4-Diagrams F5-Squared Diagrams F6-Results F9-Quit
```



```
CompHEP version 4.5.1
Process: pb,pb -> b,B (15 subprocesses)
(sub)Process: b,B -> b,B
Monte Carlo session: 1(begin)

Numerical Session
Generate events
*
Number of events=10000
MAX*2
Generator (new format)
Generator (old format)
Generator (LHA format)
New search of maxima

F1-Help F2-Man F4-Diagrams F5-Squared Diagrams F6-Results F9-Quit
```



```
CompHEP version 4.5.1
Process: pb,pb -> b,B (15 subprocesses)
(sub)Process: u,U -> b,B
Monte Carlo session: 1(begin)

Numerical Session
Generate events
Generator (new format)

#IT  Cross section [pb]  Error %  nCall  chi**2
1    5.9581E+01          2.62E+01  9792
2    7.4765E+01          4.39E+00  9792
3    7.5392E+01          8.09E-01  9792
4    7.6287E+01          5.91E-01  9792
5    7.6155E+01          9.74E-01  9792
6    7.6617E+01          5.40E-01  9792
7    7.6546E+01          6.93E-01  9792
8    7.5132E+01
9    7.5651E+01
10   7.6252E+01
< > 7.5975E+01

Statistic
efficiency: 2.9E-01
Reached max: 1.3E+00
Mult. events: 0.0E+00
Neg.events: 0.0E+00
-----
Accept events?
(Y / N ?)

1
```

Olayları harmanlayalım mı?

- Alt süreçler için teker teker olay üretilir.
- Bunların harmanlanıp tek bir dosyaya yazmamız gerekir.
- Harmanlama için results dizininde bulunan mix yazılımı kullanılır.
cd results
../mix events_1.txt events_2.txt
- Sonuçta harmanlanmış dosyada (Mixed.cpyth2) olay ile ilgili bilgiler (enerjiler, momentumlar, tesir kesitleri v.s.)

CalcHEP (Calculation High Energy Physics)

Nasıl Kurarız?

- <http://theory.sinp.msu.ru/~pukhov/calchep.html>

sayfasından indirebilir.

- tar -zxvf calchep_2.x.x.tgz
- cd calchep_2.x.x
- make
- Work dizini yaratın
 - ./mkUsrDir ../work_calc
 - cd ../work_calc

CalcHEP

- Paracıklara polarize etkilerini koyabiliriz.

```
Enter process: e%,E%→m,M
```

- Kesme (cut) değerlerini koyarken parçacığın numarası yerine sembolü yazılmalıdır.
- Protonun tanımı yok.
- Higgs için küçük h kullanılmış.

Kaynaklar

- HPFBU Kars Kış Okulu notları (G. Ünel)
- A Particle Physics Tour with CompHEP (J.D.Richman)
- CompHEP (E. Boos)
- 807/547/548 Ders notları (O.Çakır)
- Programların kılavuzları
- CalcHEP-from model building down to collider phenomenology (A. Belyaev)

NOT: SORULARINIZ İÇİN

ilkay.turkcakir@gmail.com

ÖDEV

- 1- $p, p \rightarrow W^+, b, b\bar{b}$ sürecinin toplam tesir kesitini hesaplayınız.
- 2- $u, D \rightarrow W^+, b, B$ altsüreci için diferensiyel tesir kesitinin b, B değişmez (invariant) kütleye göre grafiğini çiziniz. Sonucu yorumlayınız.
- 3- $u, D \rightarrow W^+, b, B$ altsüreci için b -kuarkların enine momentumu $p_T > 20$ GeV, b -kuarkların $|\eta| < 2.5$ kesmeleri (cutları) ile W^+b değişmez kütle dağılımını çiziniz. Sonucu yorumlayınız.