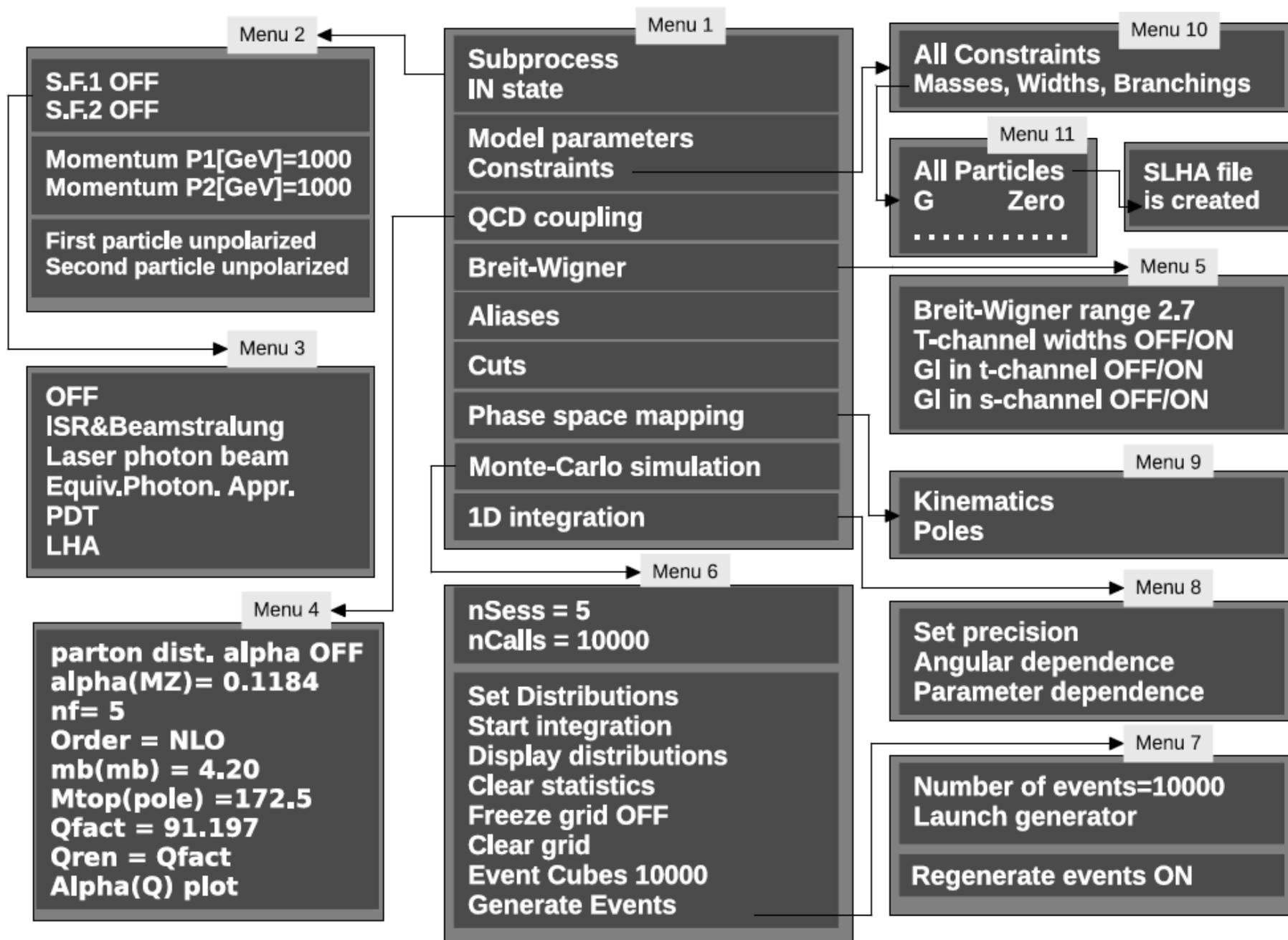


Menu structure of the numerical part



subprocess menu

Subprocess
IN state
Model parameters
Constraints
QCD coupling
Breit-Wigner
Aliases
Cuts
Phase space mapping
Monte Carlo simulation



u	D	->	W+	b	B
u	S	->	W+	b	B
u	B	->	W+	b	B
U	d	->	W-	b	B
U	s	->	W-	b	B
U	b	->	W-	b	B
d	U	->	W-	b	B
d	C	->	W-	b	B
D	u	->	W+	b	B
D	c	->	W+	b	B
s	U	->	W-	b	B
s	C	->	W-	b	B
S	u	->	W+	b	B
S	c	->	W+	b	B
c	D	->	W+	b	B
c	S	->	W+	b	B

PgDn

control of the initial states and parton density functions

```
<
Subprocess
IN state
Model parameters
Constraints
QCD coupling
Breit-Wigner
Aliases
Cuts
Phase space mapping
Monte Carlo simulation
```

```
<
S.F.1: OFF
S.F.2: OFF
First particle momentum[GeV] = 4000
Second particle momentum[GeV] = 4000
First particle unpolarized
Second particle unpolarized
```

```
<
OFF
PDT:
LHA:
```

```
<
S.F.1: PDT:CT10 (proton)
S.F.2: OFF
First particle momentum[GeV] = 4000
Second particle momentum[GeV] = 4000
First particle unpolarized
Second particle unpolarized
```

```
PDT menu
<
MRST2004qed_proton(anti-proton)
MRST2004qed_proton(proton)
NNPDF23_lo_as_0130_qed(anti-proton)
NNPDF23_lo_as_0130_qed(proton)
CT10(anti-proton)
CT10(proton)
cteq611(anti-proton)
cteq611(proton)
```

model parameters

```
<
Subprocess
IN state
Model parameters
Constraints
QCD coupling
Breit-Wigner
Aliases
Cuts
Phase space mapping
Monte Carlo simulation
```



```
<
alfEMZ= 0.0078181
alfSMZ= 0.1172
Q= 100
SW= 0.481
s12= 0.221
s23= 0.041
s13= 0.0035
Mm= 0.1057
Ml= 1.777
McMc= 1.2
Ms= 0
MbMb= 4.25
Mtp= 175
MZ= 91.187
Mh= 120
PgDn
```

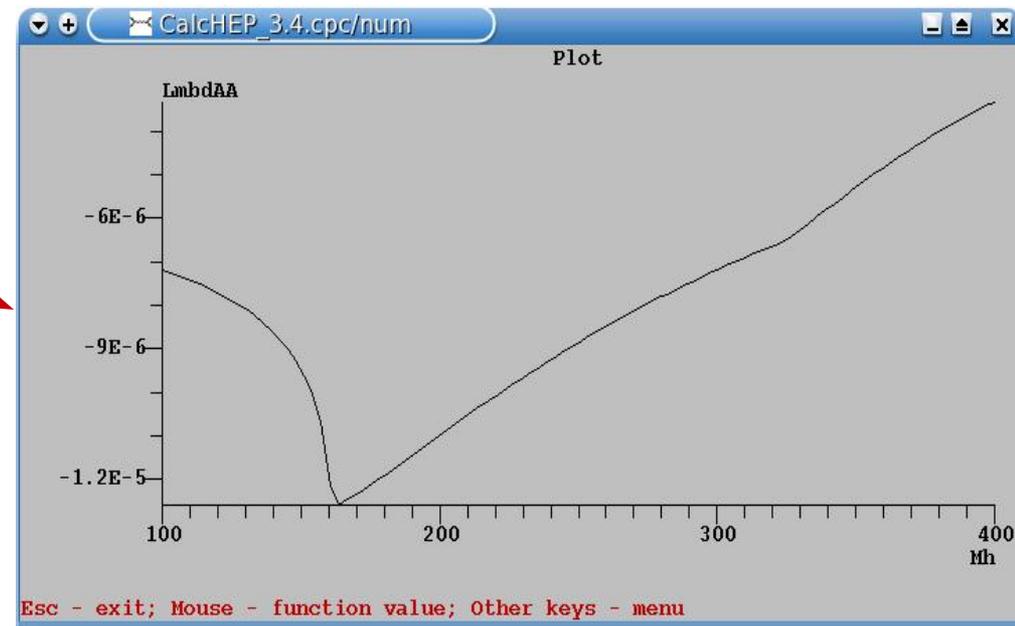
dependent parameters (SM CKM=1 with hGG/AA)

- Subprocess
- IN state
- Model parameters
- Constraints**
- QCD coupling
- Breit-Wigner
- Aliases
- Cuts
- Phase space mapping
- Monte Carlo simulation

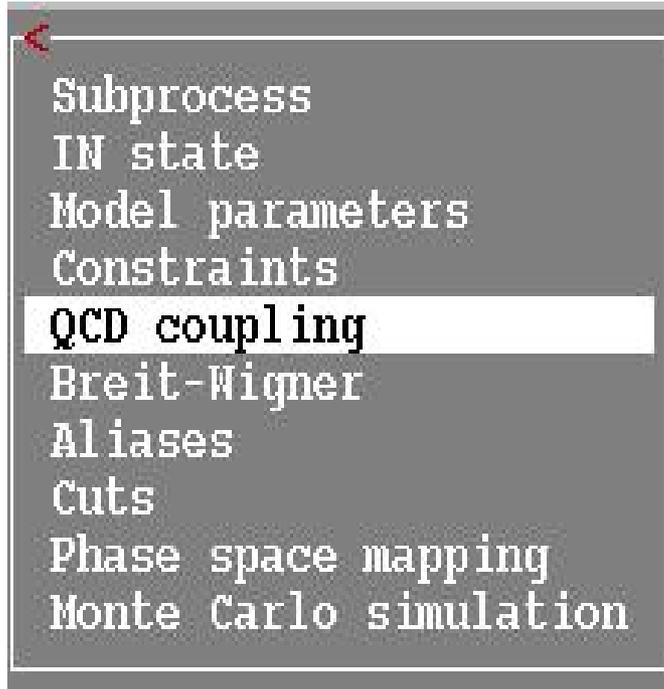
- Constraints**
- All Constraints**
- Masses, Widths, Branching

- Constraints**
- Display dependence**
- PgUp
- LmbdGG -1.6275E-05
- Qu 6.6667E-01
- Qd -3.3333E-01
- tau2c 1.0000E+04
- tau2b 4.2877E+02
- tau2t 1.4728E-01
- tau2l 1.2370E+03
- tau2W 6.0452E-01
- LmbdAA -7.8845E-06**
- (null) 0.0000E+00

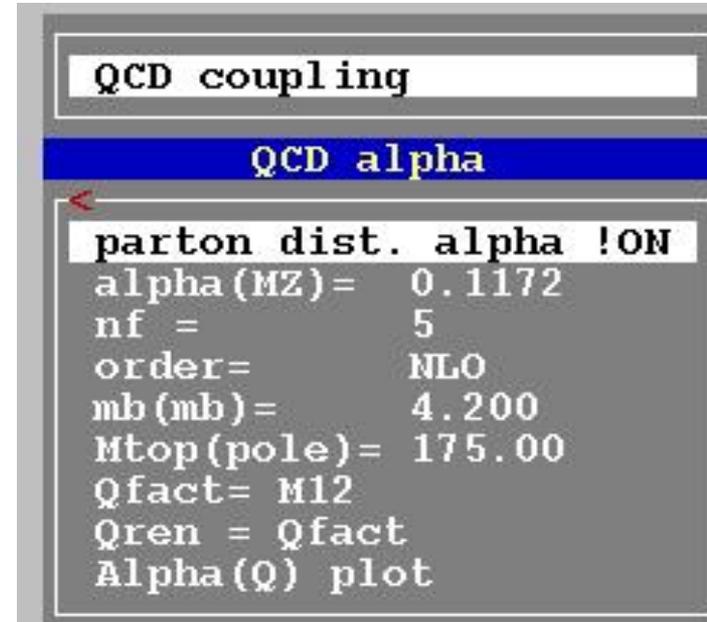
- Constraints**
- Display dependence**
- LmbdAA -7.8845E-06**
- on parameter**
- Mh 1.2500E+02**
- Plot**
- x-Min = 100
- x-Max = 400
- Npoints = 100
- Display**



QCD coupling and the scale



A screenshot of a software menu with a grey background and white text. The menu items are: Subprocess, IN state, Model parameters, Constraints, **QCD coupling** (highlighted with a white background), Breit-Wigner, Aliases, Cuts, Phase space mapping, and Monte Carlo simulation. A red arrow points from the 'QCD coupling' item to the right.



A screenshot of a configuration window titled 'QCD coupling' with a blue header bar labeled 'QCD alpha'. The window contains a list of parameters and their values:

- parton dist. alpha !ON
- alpha(MZ) = 0.1172
- nf = 5
- order = NLO
- mb(mb) = 4.200
- Mtop(pole) = 175.00
- Qfact = M12
- Qren = Qfact
- Alpha(Q) plot

control of resonances

```
<
Subprocess
IN state
Model parameters
Constraints
QCD coupling
Breit-Wigner
Aliases
Cuts
Phase space mapping
Monte Carlo simulation
```



```
Breit-Wigner
<
BreitWigner range 2.7
T-channel widths OFF
GI in t-channel OFF
GI in s-channel OFF
```

control of resonances

```
<
Subprocess
IN state
Model parameters
Constraints
QCD coupling
Breit-Wigner
Aliases
Cuts
Phase space mapping
Monte Carlo simulation
```

```
Breit-Wigner
<
BreitWigner range 2.7
T-channel widths OFF
GI in t-channel OFF
GI in s-channel OFF
```

↓ F1

```
* n_width_1
```

This menu sets value R which defines range of implementation of Breit-Wigner formula. Namely it is used in the region where

$$|p^2 - m^2| < R * m * w$$

For region

$$|p^2 - m^2| > \sqrt{R^2 + 1} * m * w$$

we use zero width propagator. In the intermediate region constant propagator interpolates both formulas.

In general Breit-Wigner leads to breaking of gauge invariance. In its turn it can lead to the lost of diagram cancellation. From the other side just in the point $p^2 = m^2$ the contribution of pole diagram have to be gauge invariant. Thus at this point cancellation between pole and non-pole diagrams is not expected. We assume that close to pole the problem also is not so serious. But far from the pole we ignore width and restore gauge invariance.

Aliases

- Subprocess
- IN state
- Model parameters
- Constraints
- QCD coupling
- Breit-Wigner
- Aliases**
- Cuts
- Phase space mapping
- Monte Carlo simulation

Composites	
Clr-Del-Size-Read-ErrMes	
Name	> Comma separated list of particles
Jet	u,U,d,D,s,S,c,C,G



setting kinematical cuts

←

- Subprocess
- IN state
- Model parameters
- Constraints
- QCD coupling
- Breit-Wigner
- Aliases
- Cuts**
- Phase space mapping
- Monte Carlo simulation

Cuts		5			
Clr	Del	Size	Read	ErrMes	
Parameter	>	Min bound	<	>	Max bound <
T(b)		120			
T(B)		120			
N(b)		1-5			15
N(B)		1-5			15
J(b,B)		10.5			

setting kinematical cuts

```

Subprocess
IN state
Model parameters
Constraints
QCD coupling
Breit-Wigner
Aliases
Cuts
Phase space mapping
Monte Carlo simulation
    
```

```

* Cuts 0
Clr-Del-Size-Read-ErrMes
Parameter |> Min bound <|> Max bound <
    
```

F1

* **n_cut**

This table applies cuts on the phase space. A phase space function is described in the first column. Its limits are defined in the second and the third columns. If one of these fields is empty then a one-side cut is applied.

The phase space function is defined by its name which characterizes type of cut and a particle list for which the cut is applied. For example, "T(u)" means transverse momentum of 'u'-quark; T(u,D) means summary transverse momentum of quark pair.

The following cut functions are available:

- A - Angle in degree units;
- C - Cosine of angle;
- J - Jet cone angle;
- E - Energy of the particle set;
- M - Mass of the particle set;
- P - Cosine in the rest frame of pair;

PgDn

```

* Cuts 5
Clr-Del-Size-Read-ErrMes
Parameter |> Min bound <|> Max bound <
T(b)      | 120      |      |
T(B)      | 120      |      |
N(b)      | 1-5      | 15   |
N(B)      | 1-5      | 15   |
J(b,B)    | 10.5     |      |
    
```

phase-space mapping

```

<
Subprocess
IN state
Model parameters
Constraints
QCD coupling
Breit-Wigner
Aliases
Cuts
Phase space mapping
Monte Carlo simulation
  
```

```

Phase space mapping
<
Kinematics
Regularization
  
```

```

Phase space mapping
<
Kinematics
Regularization
  
```

```

(sub)Process: u, D -> W+, b, B
Monte Carlo session: 1(begin)

===== Current kinematical scheme =====
in= 12   -> out1= 3   out2= 45
in= 45   -> out1= 4   out2= 5
=====

Input new kinematics?
( Y / N ? )
  
```

```

(sub)Process: u, D -> W+, b, B
Regularization
Clr Del Size Read ErrMes
Momentum |> Mass <| Width <| Power
45 | IMZ | lwZ | 12
45 | IMh | lwh | 12
34 | IMtp | lwt | 12
35 | IMtp | lwt | 12
  
```

integration over the phase space

```

Subprocess
IN state
Model parameters
Constraints
QCD coupling
Breit-Wigner
Aliases
Cuts
Phase space mapping
Monte Carlo simulation
    
```

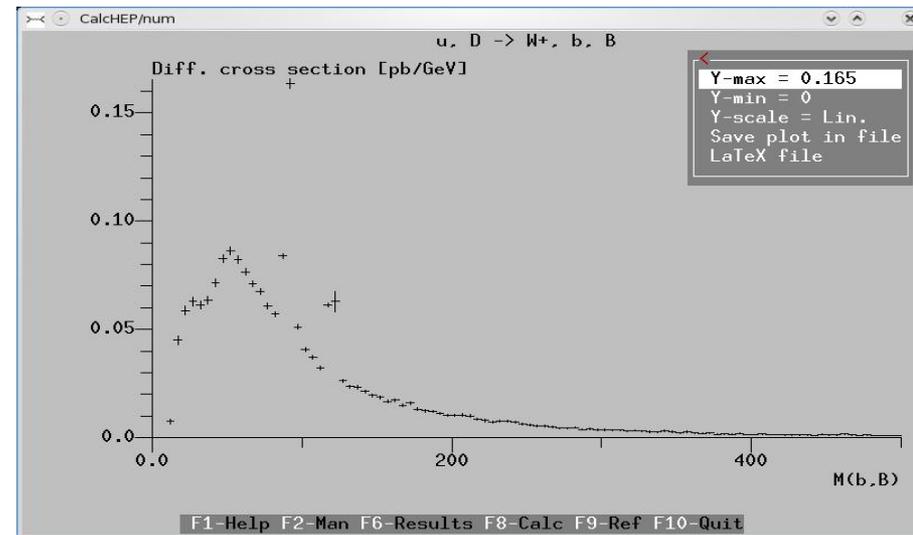
```

Monte Carlo simulation
nSess = 5
nCalls = 10000
Set Distributions
*Start integration
Display Distributions
Clear statistic
Freeze grid OFF
Clear grid
Event Cubes 10000
Generate Events
    
```

Distributions								
Clr	Del	Size	Read	ErrMes				
Parameter_1	>	Min_1	<	Max_1	< Parameter_2 >	Min_2	<	Max_2
T(b)		10		1200				
T(B)		10		1200				
N(b)		1-5		15				
N(B)		1-5		15				
M(b,B)		10		1500				
M(W+,b)		10		1500				
T(b)		10		1500	IM(b,B)	10		1500

```

nSess = 5
nCalls = 10000
Set Distributions
*Start integration
Display Distributions
Clear statistic
Freeze grid OFF
Clear grid
Event Cubes 10000
Generate Events
    
```



```

nSess = 5
nCalls = 10000
Set Distributions
*Start integration
Display Distributions
Clear statistic
Freeze grid OFF
Clear grid
Event Cubes 10000
Generate Events
    
```

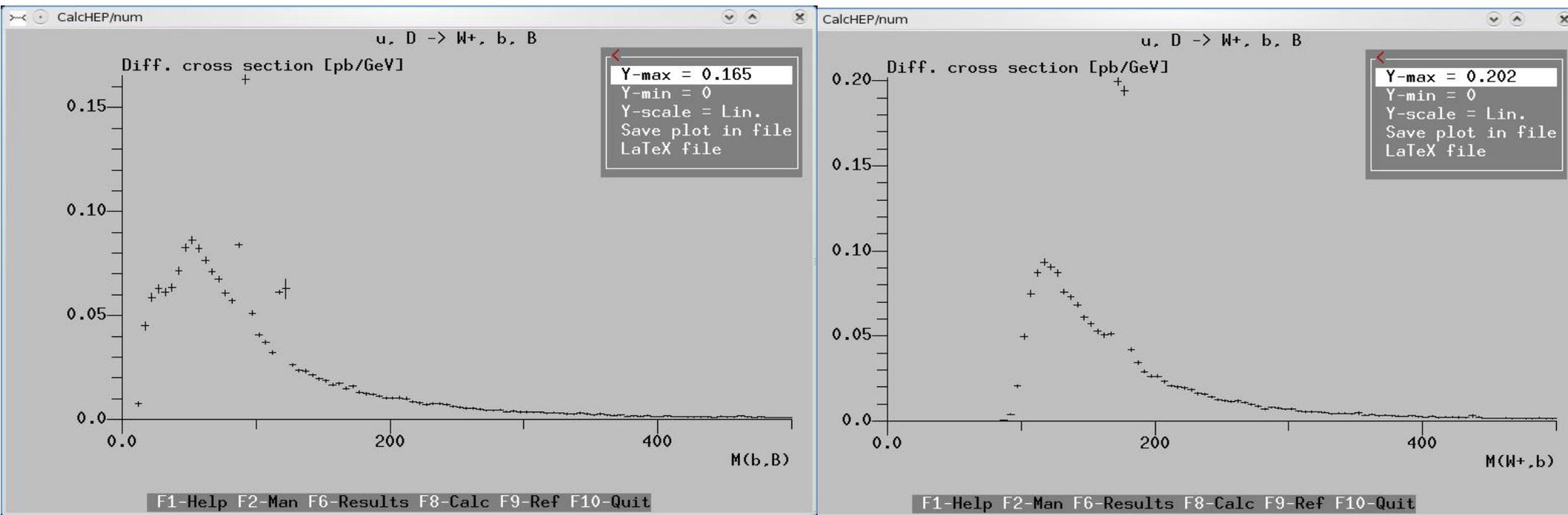
```

(sub)Process: u, D -> W+, b, B
Monte Carlo session: 2(continue)

#IT  Cross section [pb]  Error %
6    9.5931E+00          7.10E-01
7    9.5686E+00          6.79E-01
8    9.5669E+00          6.82E-01
9    9.6892E+00          7.93E-01
10   9.6267E+00          7.51E-01
1    9.7757E+00          7.32E-01
clear statistics.
2    9.6557E+00          6.82E-01
3    9.7464E+00          1.38E+00
4    9.6945E+00          1.05E+00
5    9.7032E+00          7.68E-01
< > 9.7095E+00          3.74E-01
    
```

The accuracy and the stability of the cross section indicate that you can trust your results

Resulting M_{bb} and M_{Wtb} kinematical distributions



ex#4

1. Calculate WbB production rates at the LHC for PT b-jet > 20 GeV, b-Jet separation > 0.5 , max pseudorapidity < 3
2. Plot bb - and Wb invariant mass distributions for PT b-jet > 20 GeV and PT b-jet > 40 GeV

events generations

```
Monte Carlo simulation
nSess = 5
nCalls = 10000
Set Distributions
*Start integration
Display Distributions
Clear statistic
Freeze grid          ON
Clear grid
Event Cubes 10000
Generate Events
```



```
Monte Carlo simulation
2
Generate Events
Number of events=10000
Launch generator
Regenerate events   ON
```

```
Statistic
efficiency: 2.1E-02
Reached max: 4.9E+01
Mult. events: 6.4E-03
Neg.events: 0.0E+00
-----
Accept events?
—( Y / N ? ) —
```

File with events in the native CalcHEP format

```
events_1.txt - /home/belyaev/Dropbox/hep_tools/calchep/calc_work/pp_Wbb_example/
File Edit Search Preferences Shell Macro Windows Help
/home/belyaev/Dropbox/hep_tools/calchep/calc_work/pp_Wbb_example/events_1.txt 243603 bytes L: 1 C: 0
#CalcHEP 3.4.cpc
#Type 2 -> 3
#Initial_state
  P1_3=4.000000E+03  P2_3=-4.000000E+03
  StrFun1="PDT:cteq6m(proton)" 2212
  StrFun2="PDT:cteq6m(proton)" 2212
#PROCESS 2(u) -1(D) -> 24(W+) 5(b) -5(B)
#MASSES 0.0000000000E+00 0.0000000000E+00 8.0385000000E+01 3.2414139578E+00 3.2414139578E+00
#Cross_section(Width) 6.473084E+01
#Number_of_events 1000
#Events
  P1_3 [Gev] P2_3 [Gev] P3_1 [Gev] P3_2 [Gev] P3_3 [Gev] P4
1 7.0828325272E+02 -3.8182148276E+00 -5.8685533663E+00 2.4810106784E+00 6.8128552155E+02 1.995
1 1.5237718262E+02 -2.5952742306E+01 1.1734367441E+01 -2.1669699291E+01 5.6645397996E+01 4.499
1 7.2370755716E+02 -3.3186893665E+00 -3.4449322581E+00 -5.1815667765E+00 5.8508268207E+02 -3.584
1 2.6295673814E+02 -1.1370528114E+01 8.9463043464E+00 -3.4258266547E+00 2.2732569389E+02 -9.675
1 5.7099697940E+02 -3.3943984194E+01 7.2879879961E+00 -2.3531627752E+01 1.9857446272E+01 -8.750
1 3.6709401207E+02 -2.4124155464E+01 -4.8101350483E+00 6.6698730251E+01 2.0295672218E+02 -4.597
1 3.7196555447E+01 -4.1553021555E+02 -3.1735918986E+00 2.8330641675E-01 -6.6745521993E+00 4.343
1 4.0543944850E+01 -1.1104274125E+02 -8.2903700266E+00 -4.3292277920E+00 -9.0241583360E-01 6.562
1 4.0084952687E+02 -1.0215920577E+01 1.1427574950E+01 2.6016502364E+00 3.8645254998E+02 -4.666
1 2.2620009412E+01 -1.2387066011E+02 -5.0869818859E+00 1.1389105773E+01 -7.1200204784E+01 1.176
1 7.2046251695E+02 -2.1091178466E+01 -1.4887347954E+01 8.1292985197E+01 5.8742582956E+02 -5.134
1 6.8661185459E+01 -8.3534206530E+01 -5.5091602956E+00 -1.7099072377E+01 4.1559702536E+01 2.604
1 1.5145483971E+03 -3.1164597600E+00 -7.8325298677E+00 3.6606202670E+01 1.2782056265E+03 1.074
```

GUI gives user a full control of details of symbolic/numerical session.

To sum over the sub-processes one should use **scripts**

there are several scripts which run various loops to facilitate calculation

➔ *cycle over subprocesses*

- *exit from the numerical session*
- **cd results**
- `../bin/subproc_cycle lumi nmax`

requires 2 parameters:

1. luminosity

2. max number of events per process

e.g.

`../bin/subproc_cycle 1000 100000`

You should run it from results dir where the `n_calchep` binary is!

running `subproc_cycle` for SM CKM=1 model

```
^ ../bin/subproc_cycle 100 1000
#Subprocess 1 ( u, D -> W+, b, B ) Cross section = 3.9103E+00 , 1000 events
#Subprocess 2 ( U, d -> W-, b, B ) Cross section = 2.0301E+00 , 1000 events
#Subprocess 3 ( d, U -> W-, b, B ) Cross section = 2.0992E+00 , 1000 events
#Subprocess 4 ( D, u -> W+, b, B ) Cross section = 3.9088E+00 , 1000 events
#Subprocess 5 ( s, C -> W-, b, B ) Cross section = 2.6165E-01 , 1000 events
#Subprocess 6 ( S, c -> W+, b, B ) Cross section = 2.6151E-01 , 1000 events
#Subprocess 7 ( c, S -> W+, b, B ) Cross section = 2.6073E-01 , 1000 events
#Subprocess 8 ( C, s -> W-, b, B ) Cross section = 2.5592E-01 , 1000 events
Total Cross Section 12.98821 [pb]
see details in prt_37 - prt_44 files
```

- ➔ bunch of `events_nn.txt` event files are created,
so how do we combine them?

We need Events in LHE format to talk to MC generators!

- **bin/event_mixer** *Luminosity[1/fb] nevents event_dirs*
mixes subprocesses and connects production and decay events

```
bin/event_mixer 10 1000 pp_wbb w_2x
9.327E+00 -total cross section[pb]
3265 -maximum number of events
```

- **the output is event_mixer.lhe file**

```
<LesHouchesEvents version="1.0">
<!--
File generated with CalcHEP-PYTHIA interface
-->
<header>
<slha>
</slha>
</header>
<init>
  2212 2212 7.000000006860E+03 7.000000006860E+03 -1 -1 -1 -1 3 1
  1.16593335502E+01 0.000000000000E+00 1.000000000000E+00 1
</init>
<event>
  7 1 1.00000000E+00 2.8420000E+02 -1.00000000E+00 -1.00000000E+00
    -3 -1 0 0 0 501 0.000000000000E+00 0.000000000000E+00 1.54424456520E+02
    4 -1 0 0 500 0 0.000000000000E+00 0.000000000000E+00 -1.30792414700E+02
    24 2 1 2 0 0 -9.99292465447E+01 -1.63668803915E+01 -6.48692987742E+01
    5 1 1 2 500 0 7.34149473360E+01 2.15593961832E+01 4.23390519202E+01
    -5 1 1 2 0 501 2.65142992097E+01 -5.19251579179E+00 4.61622886720E+01
    -11 1 3 3 0 0 -7.19345413730E+01 7.47572186340E-01 -8.03452022142E+01
    12 1 3 3 0 0 -2.79947051718E+01 -1.71144525779E+01 1.54759034400E+01
</event>
```

Accessing all your results

- results are stored in “results” directory
- output files:
 - ➔ `n_calchep` numerical module
 - ➔ `prt_nn` protocol
 - ➔ `distr_nn_mm` summed distributions
 - ➔ `distr_nn` individual distribution
 - ➔ `events_nn.txt` events file
 - ➔ `list_prc.txt` list of processes
 - ➔ `qnumbers` qnumbers – PYTHIA input with new prt definitions
 - ➔ `session.dat` current session status – format is similar to `prt_nn` one
- for every new process the “results” directory is offered to be renamed or removed

protocol prt_nn

```
CalcHEP kinematics module
The session parameters:

#Subprocess 1 ( u, D -> W+, b, B )
#Session_number 1
#Initial_state inP1=7.000000E+03 inP2=7.000000E+03
Polarizations= { 0.000000E+00 0.000000E+00 }
StrFun1="PDT:cteq6m(proton)" 2212
StrFun2="PDT:cteq6m(proton)" 2212

#Physical_Parameters
  alfEMZ = 7.8180609999999999E-03
  alfSMZ = 1.1720000000000000E-01
.....
#Cuts
*** Table ***
Cuts
  Parameter  |> Min bound <|> Max bound <|
T(b)         |20          |
T(B)         |20          |
.....
#Regularization
*** Table ***
Regularization
Momentum     |> Mass   <|> Width <| Power |
45            |MZ      |wZ      |2
45            |Mh      |wh      |2
.....
#END
=====
#IT  Cross section [pb]  Error %  nCall  chi**2
1    2.0373E+00          3.30E+01 20000
2    8.6164E+00          2.86E+01 20000
.....
[
```

useful scripts for numerical session

see `calchep_x.x.x/bin/` directory and **README** file!

- `subproc_cycle` `../bin/subproc_cycle 1000 100000`
- `sum_distr` `../bin/sum_distr distr_2 distr_3 > distr_sum`
- `show_distr` `../bin/show_distr distr_sum`
- `plot_view` `../bin/plot_view < tab_1.txt`
- `events2tab`
- `lhe2tab`
- `gen_events`
- `name_cycle`
- `pcm_cycle`
- `par_scan`

ex#5

produce LHE file
and use `lhe2tab`
to produce
distributions

scripts for numerical session

- **events2tab**

Parameters:

- 1- name of variable,
- 2- minimum limit,
- 3- maximum limit,
- 4- number of bins(<=300).

File with events must be passed to input.

```
../bin/events2tab "T(b)" 1 100 200 < events_1.txt >tab.txt
```

```
../bin/tab_view < tab.txt
```

- **name_cycle**

- 1: Name of parameter
- 2: Initial value
- 3: Step
- 4: Number of steps

```
../bin/name_cycle Mh 100 10 11
```

scripts above became a part of **calchep_batch** interface – will be discussed below

the most general scan with par_scan

- Usage:

```
$CALCHEP/bin/par_scan < data_file
```

- Data file structure:

```
# Comments following the '#' symbol
par_name_1  par_name_2  ...  par_name_N & fun_name_1  fun_name_2  ...
  val11      val12      ....  val1N
  val21      val12      ....  val1N
.....
```

- where `par_name_i` present free parameters of the models. Among them one also can write momenta of incoming particles as `momentum1` and `momentum2`.
- `fun_name_i` is the name of constrained parameter which will be presented in output file
- Output file has the same structure as input plus calculated numerical values for constrained parameters, and an additional column for evaluated cross section with statistical error
- If you are not interested in the `prt_#` files you can clean it using `$CALCHEP/bin/par_scan clean < data_file`

CalcHEP batch interface

CalcHEP batch interface: all results in one shot

```
Model:          Standard Model(CKM=1)
Model changed: False
Gauge:         Feynman
#####
Process:       p,p->W,b,B
Decay:        W->le,n
#####
Composite:    p=u,U,d,D,s,S,c,C,b,B,G
Composite:    W=W+,W-
Composite:    le=e,E,m,M
Composite:    n=ne,Ne,nm,Nm
Composite:    jet=u,U,d,D,s,S,c,C,b,B,G
#####
pdf1:         cteq6l (proton)
pdf2:         cteq6l (proton)
#####
p1:           4000
p2:           4000
#####
Run parameter: Mh
Run begin:    120
Run step size: 5
Run n steps:  3
#####
alpha Q :     M45
#####
Cut parameter: M(b,B)
Cut invert:   False
Cut min:     100
#####
```

```
#####
Kinematics :   12 -> 3, 45
Kinematics :   45 -> 4 , 5
Regularization momentum:1: 45
Regularization mass:1:     Mh
Regularization width:1:    wh
Regularization power:1:    2
#####
Dist parameter: M(b,B)
Dist min:      100
Dist max:      200
Dist n bins:   100
Dist title:    p,p->W,b,B
Dist x-title:  M(b,B) (GeV)
#####
Number of events (per run step): 1000
Filename:      test
#####
Parallelization method:    local
Max number of cpus:        2
sleep time:                 3
#####
nSess_1:  5
nCalls_1: 100000
nSess_2:  5
nCalls_2: 100000
```

CalcHEP batch interface: running and monitoring

```
sasha:~/calchep/work> ./calchep_batch
```

```
Main usage: "./calchep_batch batch_file_name"
```

```
An example batch file can be seen in:
```

```
file:///home/belyaev/calchep/calchep_last/utile/batch_file
```

```
Help files can be created with the command:
```

```
"./calchep_batch -help".
```

```
The files and directories created by the batch script can
```

```
be removed with the command: "./calchep_batch -clean".
```

```
This will remove the Events, Processes and html directories.
```

```
sasha:~/calchep/work> ./calchep_batch batch_file
```

```
calchep_batch version 1.38
```

```
Processing batch:
```

```
Progress information can be found in the html directory.
```

```
Simply open the following link in your browser:
```

```
file:///home/belyaev/calchep/work/html/index.html
```

```
You can also view textual progress reports in /home/belyaev/calchep/work/html/index.txt  
and the other .txt files in the html directory.
```

```
Events will be stored in the batch_results directory.
```

CalcHEP batch interface: monitoring the progress

CalcHEP Batch Details

Standard Model(CKM=1)

Done!

Finished Time(hr)

Symbolic	12/12	0.00
σ	3/3	0.03
Events	3/3	0.01

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CalcHEP batch interface: monitoring details of the symbolic section

Symbolic Sessions

Standard Model(CKM=1)

Processes	Removes Lib PID Time(hr)
$u, D \rightarrow W^+, b, B$	✓
$U, d \rightarrow W^-, b, B$	✓
$d, U \rightarrow W^-, b, B$	✓
$D, u \rightarrow W^+, b, B$	✓
$s, C \rightarrow W^-, b, B$	✓
$S, c \rightarrow W^+, b, B$	✓
$c, S \rightarrow W^+, b, B$	✓
$C, s \rightarrow W^-, b, B$	✓
$W^+ \rightarrow E, ne$	✓
$W^+ \rightarrow M, nm$	✓
$W^- \rightarrow e, Ne$	✓
$W^- \rightarrow m, Nm$	✓
Widths	✓

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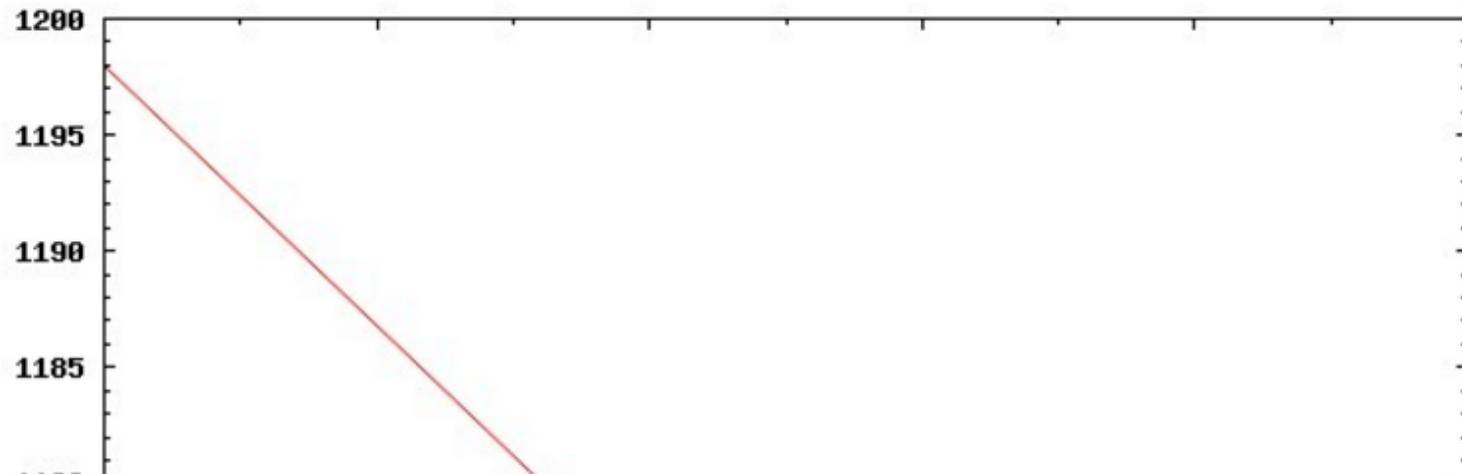
CalcHEP batch interface: monitoring results of the numerical session

Numerical Sessions

Standard Model(CKM=1)

Done!

Scans	σ (fb)	Running	Finished	Time (hr)	N events
Mh=120	1198	0/13	13/13	0.01	1000
Mh=125	1170	0/13	13/13	0.01	1000
Mh=130	1157	0/13	13/13	0.01	1000
				0.03	



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CalcHEP batch interface: details of the numerical session

Numerical Sessions

Standard Model(CKM=1)

Done!

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Processes	σ (fb)	$\Delta\sigma$ (%)	PID	Time (hr)	N events	Details
u,D->W+,b,B	1582.1	0.53	28919	0.00	383/382	prt_1 session.dat
U,d->W-,b,B	837.97	0.41	28923	0.00	218/217	prt_1 session.dat
d,U->W-,b,B	838.94	0.49	28928	0.00	218/217	prt_1 session.dat
D,u->W+,b,B	1621.4	2.7	28935	0.00	390/389	prt_1 session.dat
s,C->W-,b,B	111.07	0.41	28942	0.00	41/40	prt_1 session.dat
S,c->W+,b,B	111.15	0.38	28947	0.00	41/40	prt_1 session.dat
c,S->W+,b,B	111.5	0.46	28955	0.00	41/40	prt_1 session.dat
C,s->W-,b,B	111.76	0.41	28962	0.00	41/40	prt_1 session.dat
Total	5325.9	0.85				

Decays	Γ (GeV)	$\Delta\Gamma$ (%)	PID	Time (hr)	N events	Details
W+->E,ne	0.23493	0	29144	0.00	5099/5100	prt_1 session.dat
W+->M,nm	0.23493	0	29148	0.00	5099/5100	prt_1 session.dat

CalcHEP batch interface: numerical results and distributions

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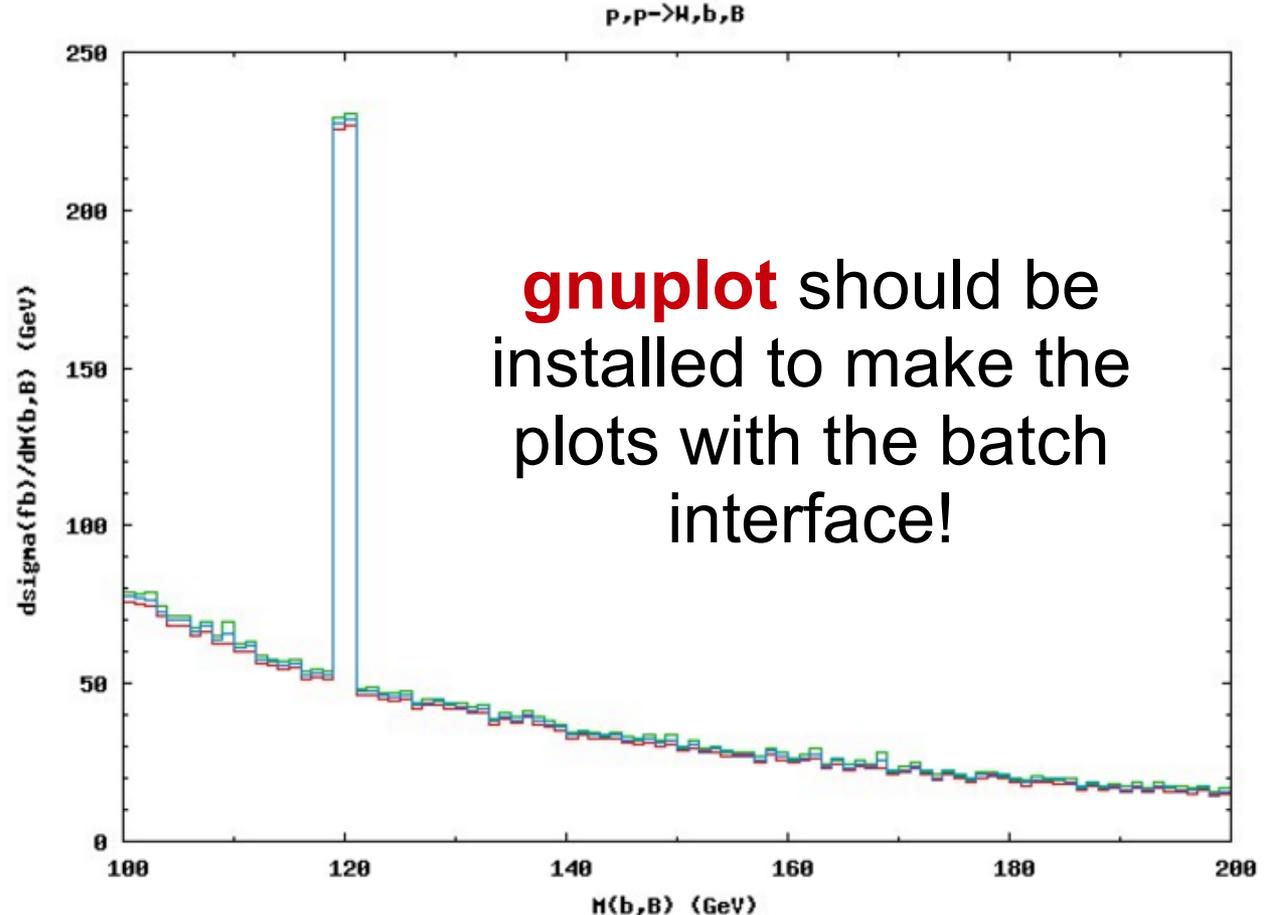
Widths
Widths

PID Time (hr)
29167 0.00

Details
session.dat

Total 1198 0.01 1000/1000

Distributions



ex#6: using
`calchep_batch`
evaluate complete
cross section for
 $pp \rightarrow Wbb$ process
with the same cuts as
for ex#4

CalcHEP batch interface: access to your results

- results are located in **batch_results** folder
- ***.lhe.gz** : LHE event files
- ***.jpg** : figures
- ***.distr** : files with distributions which can be used to re-produce plots using **\$CALCHEP/bin/show_distr**
- ***.tgz** : zipped html folder with all numerical details, .txt and .html files of the batch run

CalcHEP batch interface: some additional features/tricks

- see <https://answers.launchpad.net/calchep> for many “tricky” questions/answers
- scanning over the collider energy
 - Run parameter: `rtS`
 - Run begin: 7
 - Run step size: 1
 - Run n steps: 2

 - `p1: 1000*rtS/2`
 - `p2: 1000*rtS/2`
 - `rtS` here is some “fake” parameter
- you can use “fake” parameter only if you define it as a loop parameter
 - ➔ It can be used in the cut statement (assigning cut to the symbol)
 - ➔ It can be assigned to the parameter model – this way you can run use complicated scan

CalcHEP interface to MC generators via Events in the LHE format

