Introduction to CalcHEP

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Abstract

In this manual, we calculate $e^-e^+ \to \mu^-\mu^+$ process symbolically using CalcHep, and partially Mathematica.

CalcHep could be useful when you just want quick result but would not be appropriate for complicated processes, such as loop level processes.

Initializing CalcHep

1) Go to your CalcHEP folder(the directory of this folder may vary among computers).

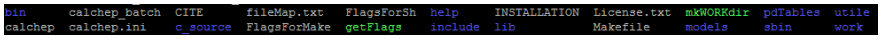

Figure 1: This is a caption

2) Type

[] ./mkWORKdir test

Then you can find new 'test' directory generated.

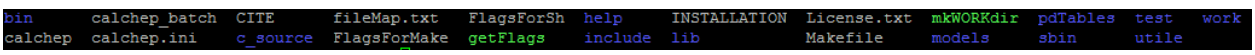

Figure 2: This is a caption

3) Go in to the 'test' directory, and type

[] ./calchep

Then, a GUI screen will pop up in the following form.

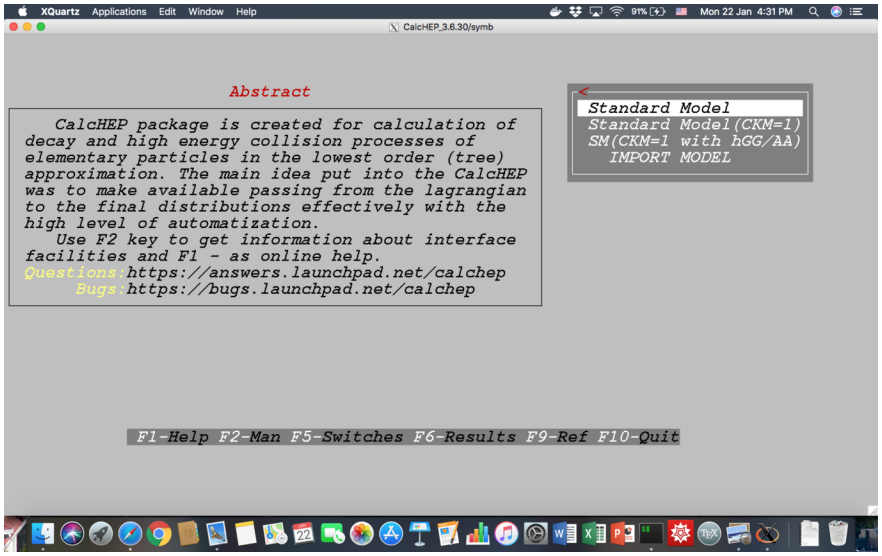

Figure 3: This is a caption

$e^-e^+ \to \mu^-\mu^+$ Calculation using CalcHep

4) Enter 'Standard Model' -> 'Enter Process'

(You may use or modify other options, but CalcHep is usually not appropriate to calculate such a complicated processes)

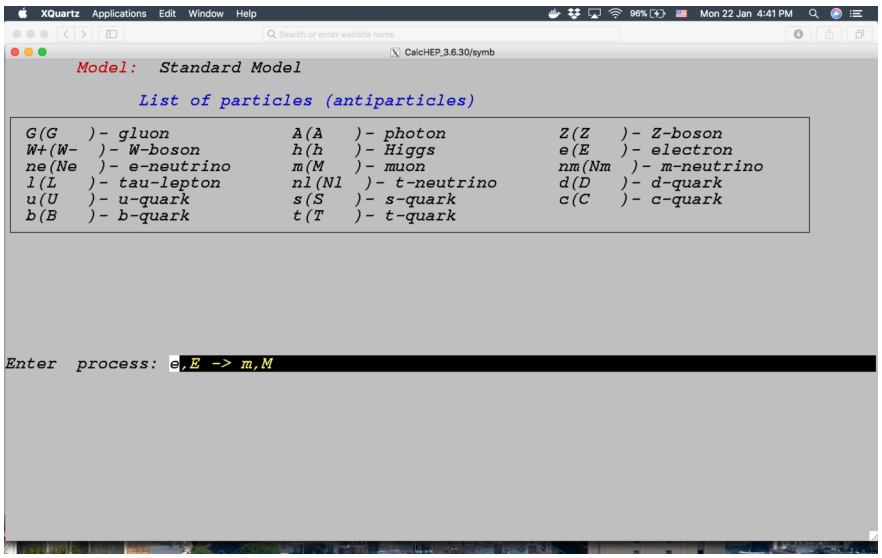

Figure 4: This is a caption

5) Type the process in which you want to calculate in the black line. (Capital letters mean anti-particle).

You do not need to type anything in 'Exclude diagrams with' line.

6) Enter ‘View Diagram’

Now, we only want to calculate QED processes, so we will exclude the second diagram, which is a Z-boson mediated process.

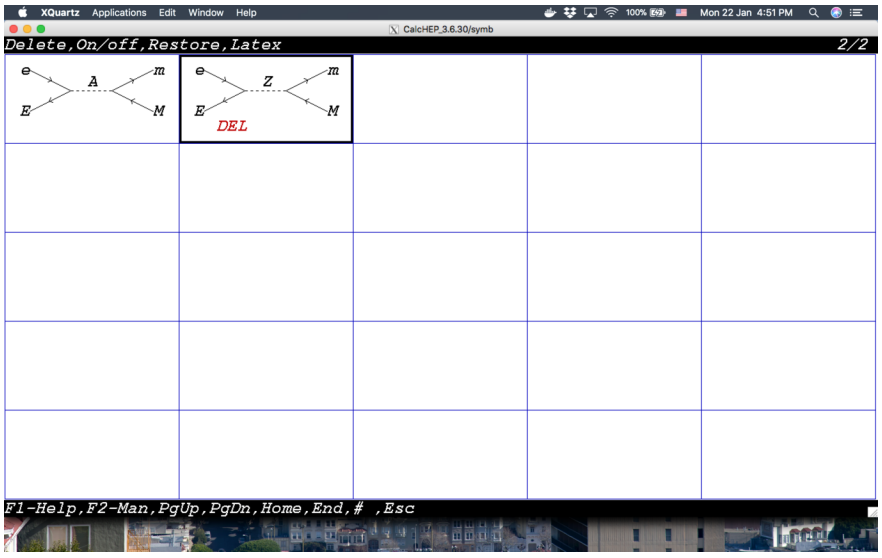

Figure 5: This is a caption

D : Exclude all diagrams, O : Exclude a selected diagram. (for others, use F1)

7) Back to previous menu, (click ESC) and enter ‘Square diagrams’->’Symbolic Calculations’->’MATHEMATICA code’

When you enter ‘MATHEMATICA code’, it seems nothing happens, but don’t worry. It really generated m-file script in your folder.

8) Escape from CalcHep GUI.

Symbolic Calculation through Mathematica

9) Go to ‘results’ directory in your ‘test’ directory. You can find ‘symb1.m’ file generated.

[] cd results

10) Open ‘symb1.m’

[] vi symb1.m

Now, you can change and copy this m-files script.

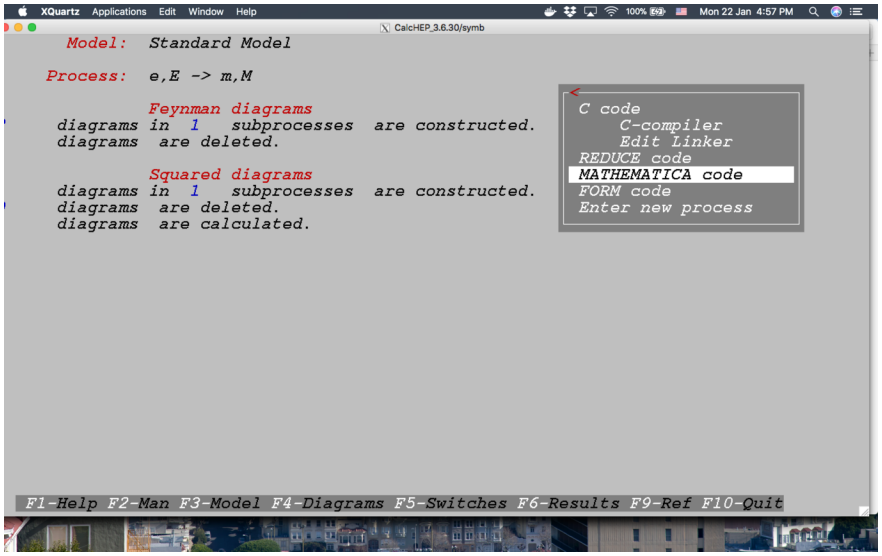

Figure 6: This is a caption

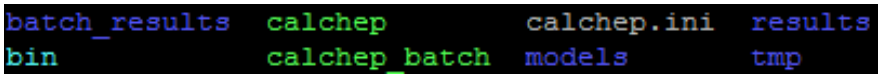

Figure 7: This is a caption

Figure 8: This is a caption

11) Copy the script and paste to the Mathematica terminal.

11) Close the m-files. (Esc->q->Enter or Esc + : ->q -> Enter)

12) Go to 'utile' in 'calchep_3.6.30'

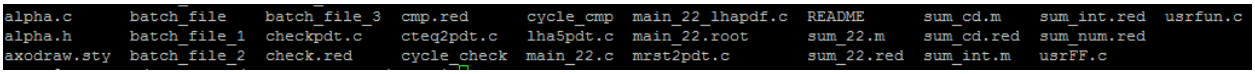

Figure 9: This is a caption

13) Open 'sum_int.m'.

[] vi sum$_i nt.m$

14) Copy the script and paste to the Mathematica terminal. (above the previous symb1.m script!!!)

15) Run the scripts.

16) The final result is :

[] res = totFactor*numerator/denominator res/.{Mm-¿0}//Simplify

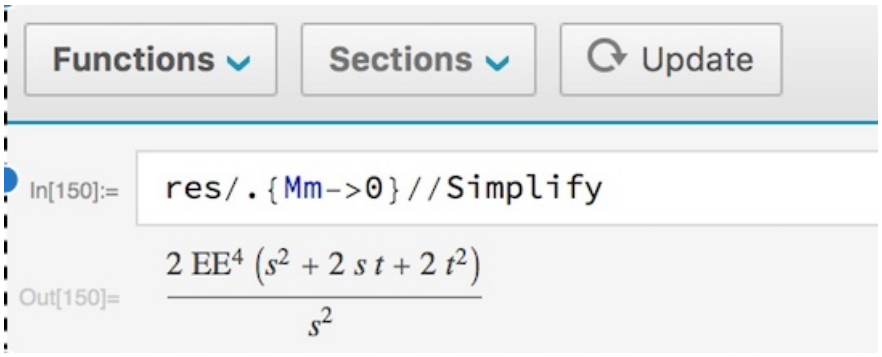

Figure 10: This is a caption