IX INTERNATIONAL WORKSHOP ON ADVANCED COMPUTING AND ANALYSIS
TECHNIQUES IN PHYSICS RESEARCH (ACAT03)
KEK, Novemember 1, 2003

Progress in FDC Project

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FDC homepage: http://www.ihep.ac.cn/lunwen/wjx/public_html/index.html

Contents

1 Brief Introduction to FDC(Feynman Diagram Calculation)

Standard Model and it's extension, Feynman diagram generator,
   some one-loop manipulation
          ---- developed in 1993 and presented in AIHENP93, Germany

Feynman diagram drawer   ---- completed in 1994

Tree Processes amplitude manipulation and FORTRAN source generation
      ---- completed in 1995 and more optimized method was introduced later

Automatic Kinematics treatment ---- developed in 1997 and presented in AIHENP97, Switzland

Muti-processes Generation ---- developed in 1996,97,98 presented in 1st ACAF workshop
                                in Beijing, 1998

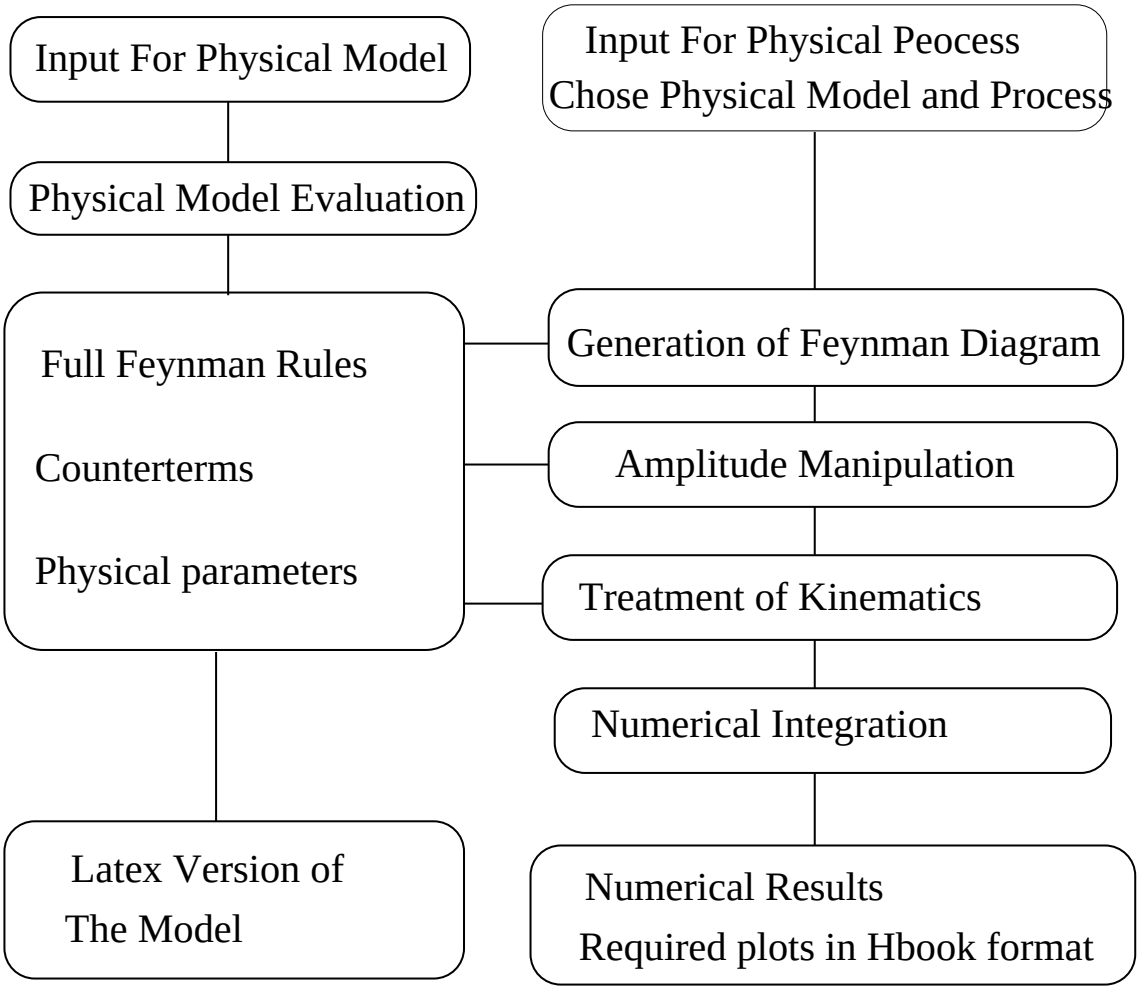
MSSM ------- realized in 1999
Supersymmetry model with R-parity vilation ------ realized in 2000

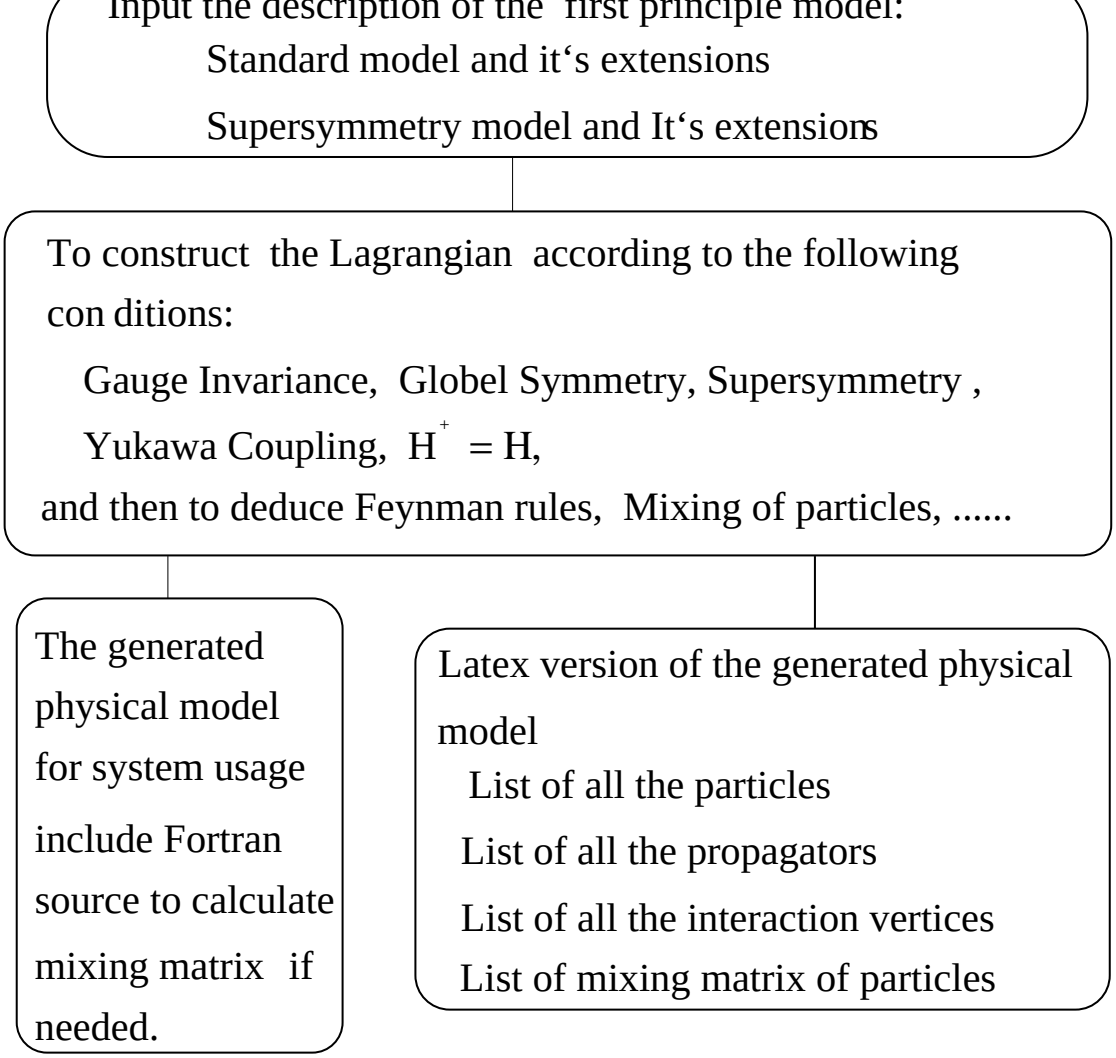
For partial wave analysis method: Phenomenology model, Amplitude manipulation
when High Spin state (3/2, 2, 5/2, 3 ....) included and Likelihood fitting
for experiment data   ----- introduced in 1999 and 2000

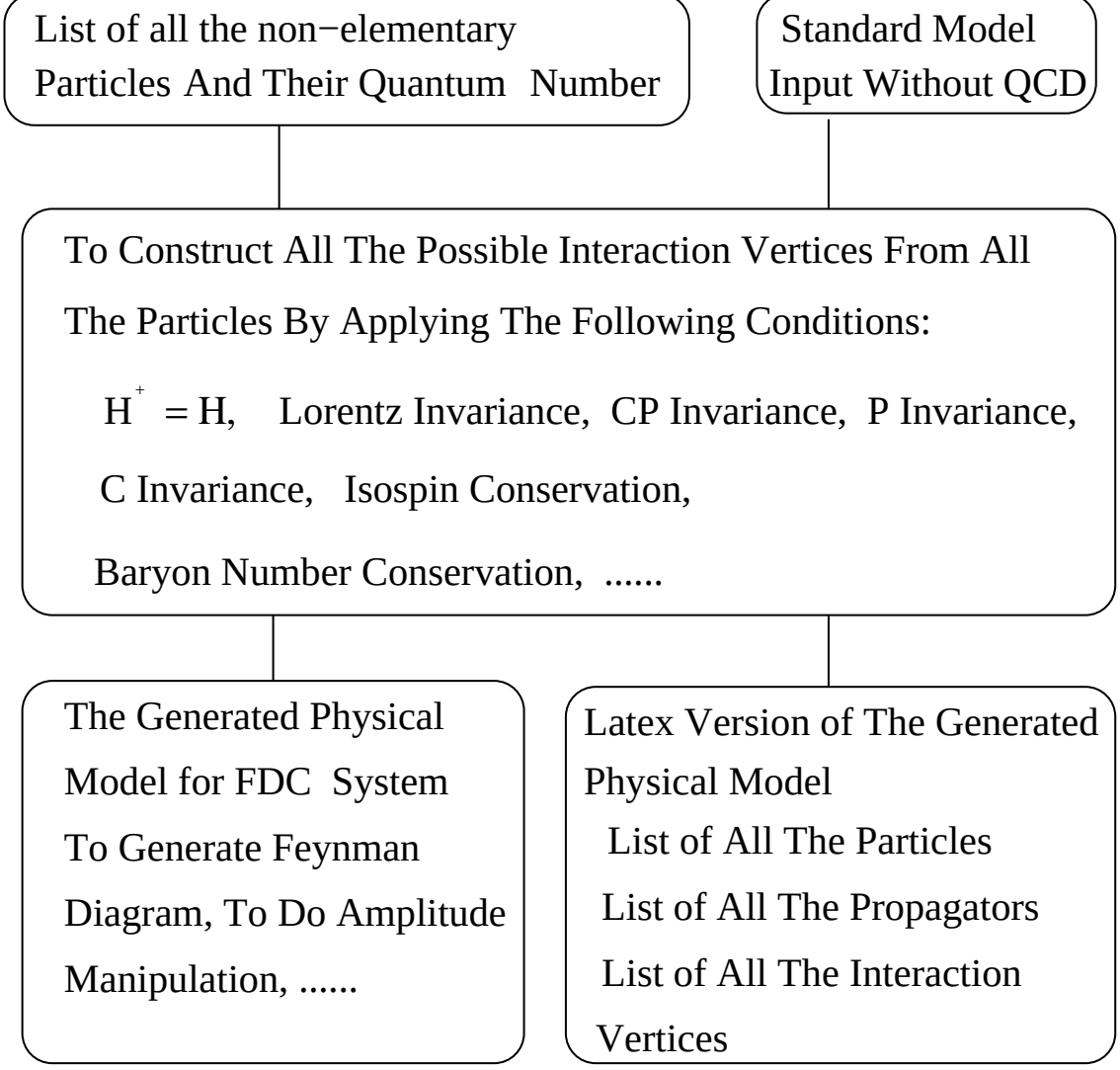
Effective Meson Theory(Bin-An Li's): Feynman rules deduction and amplitude calcualtion
                           ----- introduced in 2001 and 2002

NRQCD method: Effective model and amplitude calcaculation ----- introduced in 1997 and 2003

Many other options, functions were introduced during 1993-now


Input For Physical Model
Physical Model Evaluation
Full Feynman Rules
Counterterms
Physical parameters
Latex Version of
The Model
Input For Physical Peocess
Chose Physical Model and Process
Generation of Feynman Diagram
Amplitude Manipulation
Treatment of Kinematics
Numerical Integration
Numerical Results
Required plots in Hbook format


Input the description of the first principle model:
Standard model and it's extensions
Supersymmetry model and It's extensions
To construct the Lagrangian according to the following con ditions:
Gauge Invariance, Globel Symmetry, Supersymmetry ,
Yukawa Coupling, $H^+ = H$,
and then to deduce Feynman rules, Mixing of particles, ...
The generated physical model for system usage include Fortran source to calculate mixing matrix if needed.
Latex version of the generated physical model
List of all the particles
List of all the propagators
List of all the interaction vertices
List of mixing matrix of particles


List of all the non−elementary Particles And Their Quantum Number
Standard Model Input Without QCD
To Construct All The Possible Interaction Vertices From All The Particles By Applying The Following Conditions:
$H^{+} = H$, Lorentz Invariance, CP Invariance, P Invariance, C Invariance, Isospin Conservation, Baryon Number Conservation, ...
The Generated Physical Model for FDC System To Generate Feynman Diagram, To Do Amplitude Manipulation, ...
Latex Version of The Generated Physical Model
List of All The Particles
List of All The Propagators
List of All The Interaction Vertices

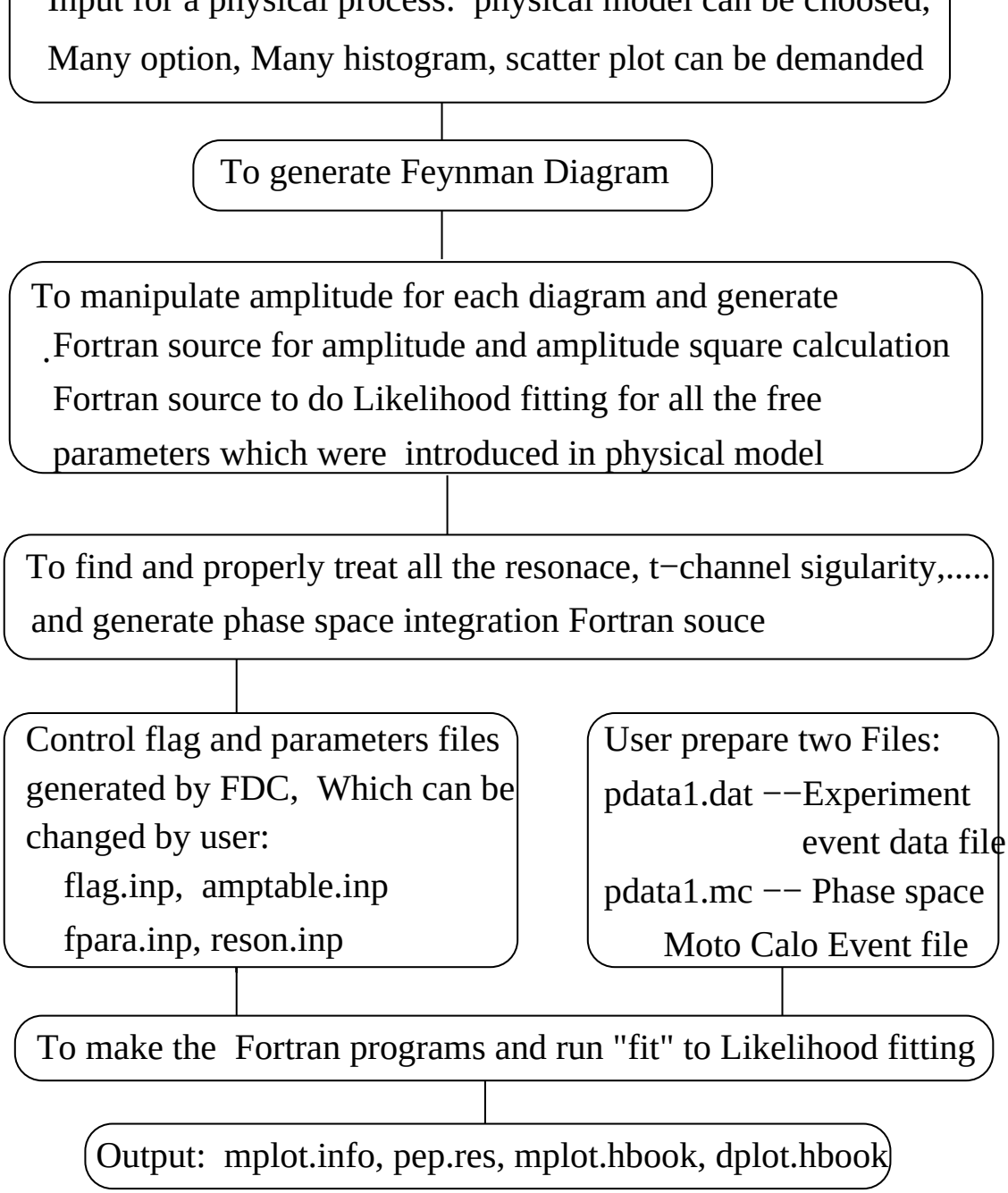
Input for a physical process. "physical model can be choosed,
Many option, Many histogram, scatter plot can be demanded

To generate Feynman Diagram

To manipulate amplitude for each diagram and generate
Fortran source for amplitude and amplitude square calculation
(Three menthod to calculate amplitude square, up to 6 final
state processes have been calculated.)

To find and properly treat all the resonace, t−channel sigularity,.....
and generate phase space integration Fortran souce

To compile all the Fortran souce and run "int" to
get total coress section and required plots, coorelation
quantity, ...


Input for a physical process: physical model can be choosed;
Many option, Many histogram, scatter plot can be demanded
To generate Feynman Diagram
To manipulate amplitude for each diagram and generate
Fortran source for amplitude and amplitude square calculation
Fortran source to do Likelihood fitting for all the free
parameters which were introduced in physical model
To find and properly treat all the resonace, t−channel sigularity,.....
and generate phase space integration Fortran souce
Control flag and parameters files
generated by FDC, Which can be
changed by user:
flag.inp, amptable.inp
fpara.inp, reson.inp
User prepare two Files:
pdata1.dat −−Experiment
event data file
pdata1.mc −− Phase space
Moto Calo Event file
To make the Fortran programs and run "fit" to Likelihood fitting
Output: mplot.info, pep.res, mplot.hbook, dplot.hbook

2 Supersymmetry model

There are five parts in FDC project to work together to calculate Feynman Diagram. One of them is to construct Lagrangian and deduce Feynman Rule automatically. We have added super-symmetry model to FDC in 1999. From a very simple and easy understanding input, It can construct Lagrangian, deduce all mixing matrices, all Feynman rules and then prepare the Latex version of the result and internal version for later using in FDC. A parameterization scheme can be chose under some interface with user and the Fortran source is prepared to calculate the deduced parameters which are needed in following calculation. It is very easy to add more leptons, more Higgs, ..., to break global symmetry such as lepton number conservation, bayon number conservation in the input file. It was used to generate MSSM, and super-symmetry model with different R-parity violation.

3 Effective Lagrangian Model

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For partial wave analysis method:
   Phenomenology model Amplitude manipulation when High Spin state (3/2, 2, 5/2, 3 ....)
   included  and Likelihood fitting for experiment data It is using for BES experiment
   analysis.
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4 Muti-Processes Generation

```
e+ e-    --> 2, 3, 4 final particles
e- p     --> 2, 3, 4 final particles
p p      --> 2, 3, 4 final particles
e+ e-    --> J/psi + 1 , 2 , 3
```

5 Summary

To deal with very complicate model like supersymmetry model, there are lengthly deduce have be done. to automatic contructe Lagrangian and deduce Feynman rules have obiously advantages.

Easy to change many thing:

contents of particles

gauge fix terms

notation

softbreaking terms

super potential

More Easy to check and control mistake