MadGraph5 Tutorial

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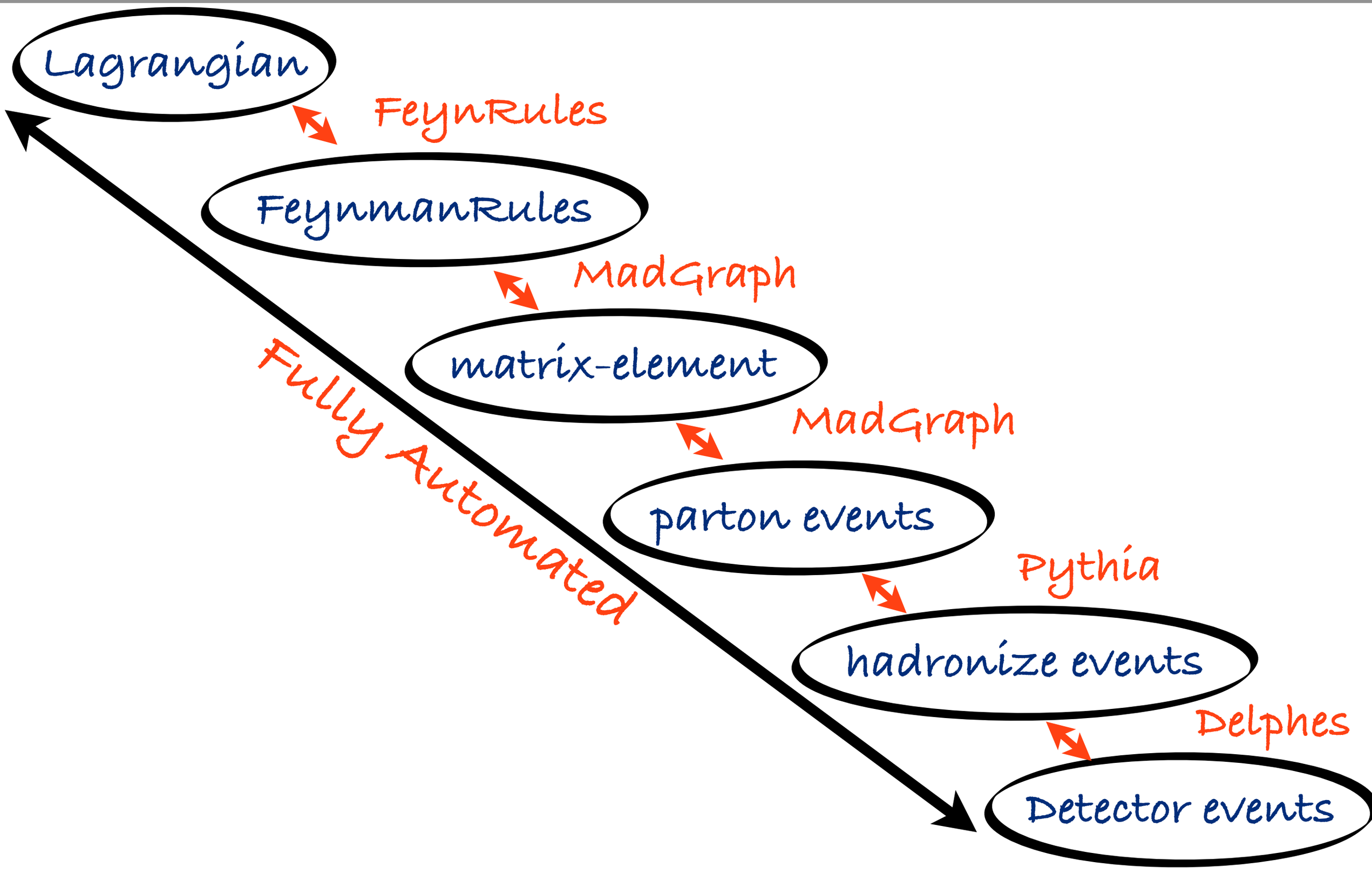
From Theory to Detector



PLAN

- ☐ How to install
- ☐ 2 Common situation
- ☐ 1 Full chain
- ☐ Focus on MG5 command / behavior

Installation

Requirements

- Python 2.6 (default on mac 10.6)

For Madevent Output

- fortran 77 compiler
- bash
- perl 5.8 (or higher)

For C++ Output

- C++ compiler

Note: MadGraph/MadEvent are available online

Where to find the code

- For user:
  - http://madgraph.hep.uiuc.edu/
  - http://madgraph.phys.ucl.ac.be/
  - http://madgraph.roma2.infn.it/
  - https://launchpad.net/madgraph5

- For develloper:
  - install bazaar
  - $> bzr branch lp:madgraph5
  - dev in https://code.launchpad.net/madgraph5

How to install/start?

- $> tar -xzpvf MadGraph5_v1.1.0.tar.gz
- $> cd MadGraph5_v1_1_0/
- $> ./bin/mg5

MadGraph5 is running Now!

For Learning MadGraph5:

- mg5> help
- mg5> tutorial

Important to learn MG5

Standard Model Example

Goal

- W jet cross-section

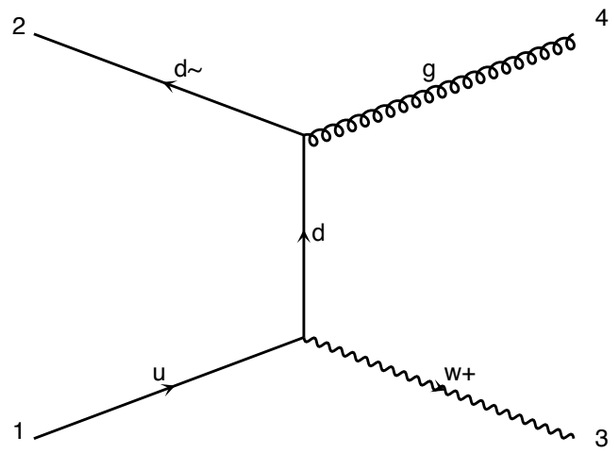


diagram 1 QED=1, QCD=1

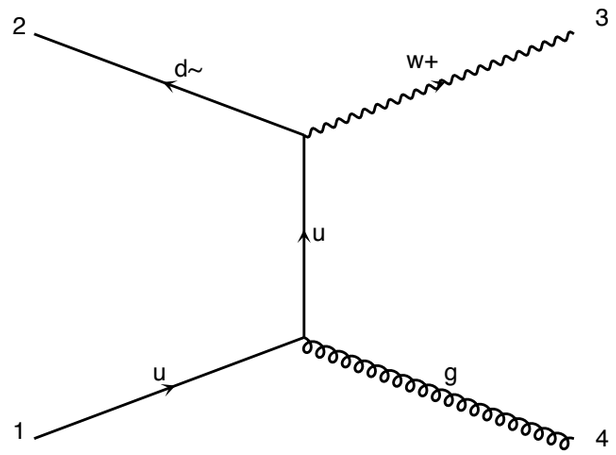


diagram 2 QED=1, QCD=1

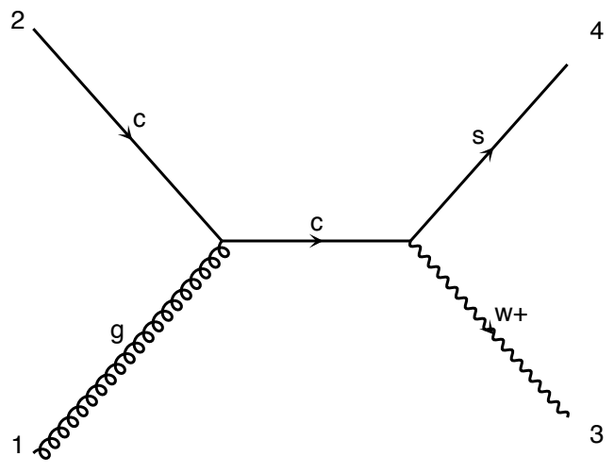


diagram 1 QED=1, QCD=1

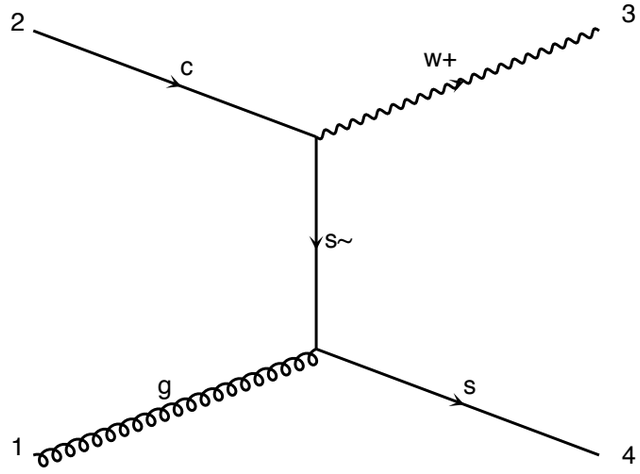


diagram 2 QED=1, QCD=1

List of command

```
mg5> generate p p > w+ j
mg5> output madevent
mg5> launch
```

Note:

- By default QED is set to its minimal value
- To launch pythia/pgs, you need to install the pythia-pgs package. (http://madgraph.phys.ucl.ac.be)

only 3 command

It's very easy!

Generate Command

- require s-channel: p p > w+ > e+ ve
- forbids s-channel: p p > e+ ve $ w+
- forbids particles: p p > j j / z
- alternate s-channel: p p > w+ | h+ > ta+ vt

- Possibility of decay chain

  p p > t t~,

  (t > b w+, w+ > j j),

  (t~ > b~ w-, w- > mu- vm~)

- Minimal QED order is taken by default

  p p > t t~ is the same as p p > t t~ QED=0!

Output Command

- mg5> output OUTPUT_TYPE PATH

OUTPUT_TYPE:

  - madevent (default)
  - standalone
  - standalone_cpp
  - pythia8

launch command

- mg5> launch PATH [options]
  - default PATH is the last created directory
  - possibility to choose to run in cluster/multi cpu mode
  - Can launch pythia/pgs (if install)

This is in addition to "old" way

- $> cd PATH
- $> ./bin/generate_events

MSSM Example

Goal

- squark pair production

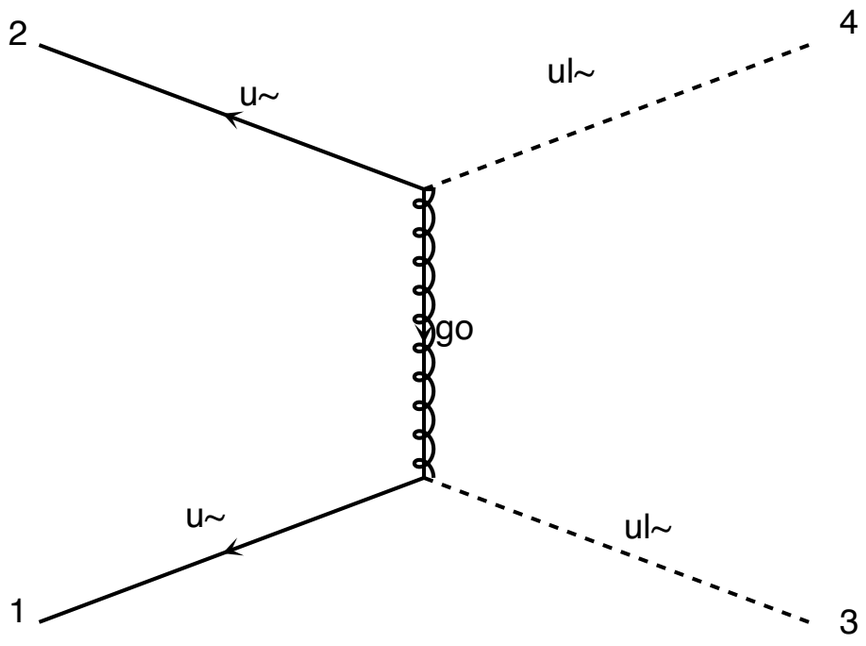


diagram 1 QED=0, QCD=2

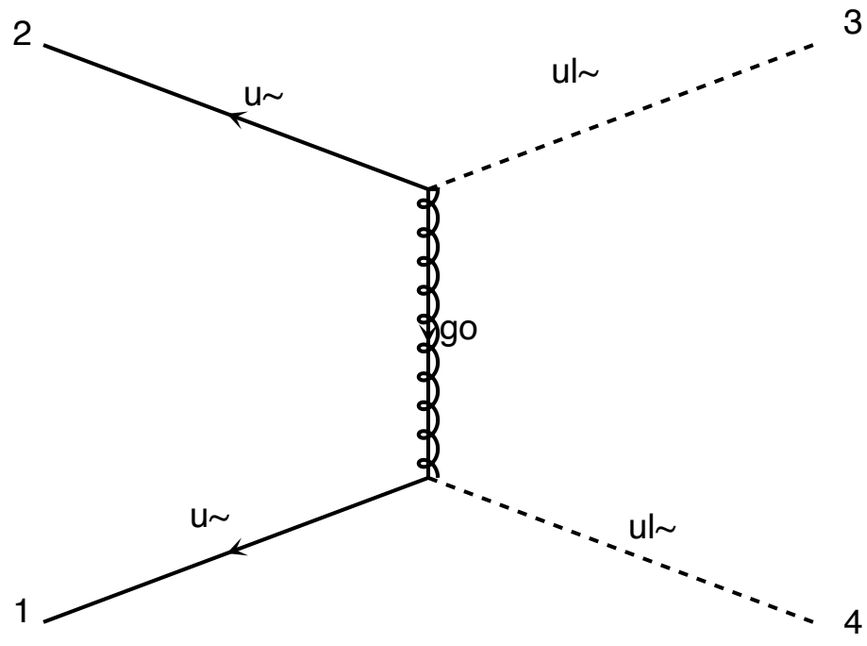


diagram 2 QED=0, QCD=2

List of command

```
mg5> import model mssm
mg5> define su = ur ur~ ul ul~
mg5> generate p p > su su
mg5> define sd = dr dr~ dl dl~
mg5> add process p p > sd sd
mg5> output
mg5> launch
```

import command

- mg5> import MODE PATH

MODE

  - model
  - model_v4
  - proc_v4
  - command

other command

- Define : define a multi-particles
- add process : same as generate but add a process
- set : some configuration
- check : validation of processs
- display : status of diagram / model / ...
- history : look at what you have done
- open : open a file
- shell : execute a shell command (or !)

The Full Chain

Objectives

- generate events for chromo-magnetic operator

$$\mathcal{L} = \frac{(H\bar{Q})\sigma^{\mu\nu}T^A t G^A_{\mu\nu}}{\Lambda^2} + h.c.,$$

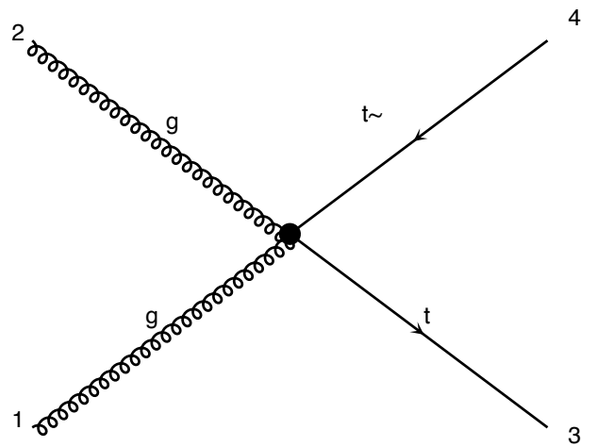


diagram 1 NP=2, QCD=1

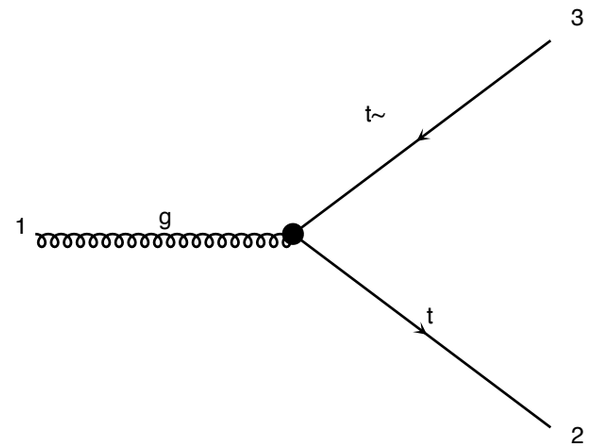


diagram 2 NP=2

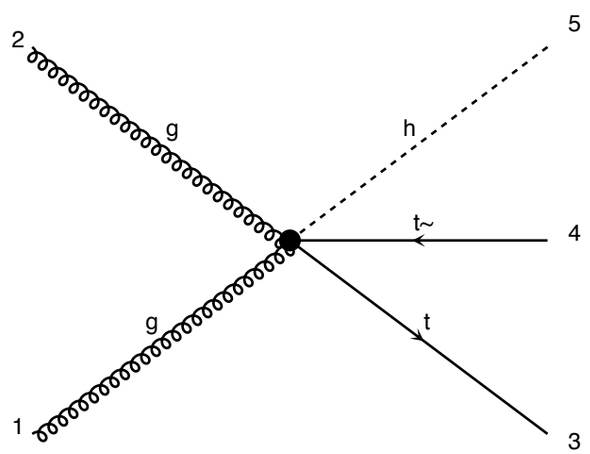


diagram 3 NP=2, QED=1, QCD=1

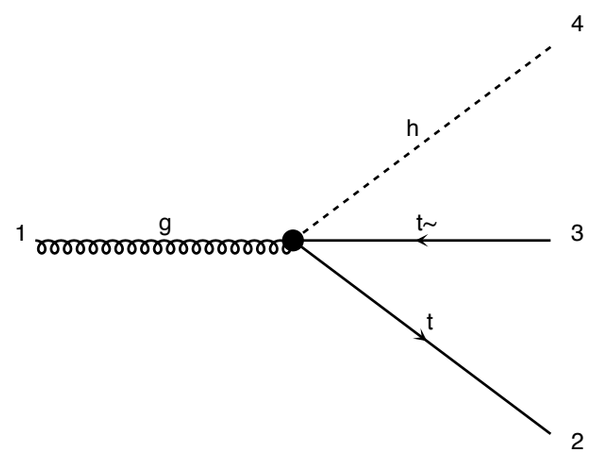


diagram 4 NP=2, QED=1

WorkSheet

- Write the Lagrangian in FR
- Write the UFO (WriteUFO command)
- mg5> import model Chromo
- mg5> display interactions
- mg5> check full p p > t t~ NP=2
- mg5> generate p p > t t~ NP
- output
- launch

Note

- FeynRules creates the UFO model (see FR talk)
- UFO model is the new type of model for MG5
- ALOHA creates automaticaly the HELAS routine (see talk on UFO/ALOHA)

The Full chain is automatic for BSM