FeynRules tutorial

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Outline

First steps

1. Load FeynRules from http://server06.fynu.ucl.ac.be/projects/feynrule
2. Extract its content
3. Go to the directory FeynRules-current/FeynRules-current-4/Models
4. Open the template.fr file

You can find the manual on the web page (bottom)

Model information

```
MSModelName = "the name of your model";

M$Information = {Authors -> {"your name"},
 Institutions -> {"your institute"},
 Emails -> {"your email addres"},
 Version -> "1.0",
 Date -> "15.04.2010",
 References -> {"the first ref of your model",
    "the second one", ...},
 URLs -> {"the web site of the model"}
 }
```

Every option than end with a "s" require a list.

Index definitions

```
IndexRange[ Index[Color] ] = Range[3]

IndexRange[ Index[Gluon] ] = Range[8]

IndexStyle[ Color, i ]

IndexStyle[ Gluon, a ]
```

Lorentz (Lorentz) and dirac (Spin) indices are predefined

Gauge groups

```
M$GaugeGroups = {
  gaugegroup1 == { options },
  gaugegroup2 == { options },
  ...}
```

Use == to define a gauge groups

Gauge groups options

For an abelian group:

```
U(1)EM == {
          Abelian -> True,
          Gauge Boson -> A,
          Charge -> Q,
          CouplingConstant -> ee
          }
```

ee and Q are special parameter names, i.e. they cannot be used for any other parameters.

Gauge groups options

For a non-abelian group:

```
SU3C == {
        Abelian -> False,
        GaugeBoson -> G,
        StructureConstant -> f,
        SymmetricTensor -> dSUN,
        Representations -> {T, Colour},
        CouplingConstant -> gs
        }
```

f,T and gs are special parameter names.

Parameters

```
M$Parameters = {
  param1 == { options },
  param2 == { options },
  ...}
```

Parameters

External scalar parameter

```
\[Alpha]EWM1== {
        ParameterType -> External,
        BlockName -> SMINPUTS(FRBlock),
        OrderBlock -> 1(the order in the LH file),
        ParameterName -> aEWM1,
        InteractionOrder -> {QED, -2},
        Value -> 127.9,
        Description -> "Inverse of the electroweak
```

Parameters

Internal tensor parameter

```
CKM == {
        Indices -> {Index[Generation], Index[Generat
        TensorClass -> CKM,
        Unitary -> True,
        Definitions -> {CKM[3, 3] -> 1,
                        CKM[i_, 3] :> 0 /; i != 3,
                        CKM[3, i_] :> 0 /; i != 3},
        Value -> {CKM[1,2] -> Sin[cabi],
                  CKM[1,1] -> Cos[cabi],
                  CKM[2,1] -> -Sin[cabi],
                  CKM[2,2] -> Cos[cabi]},
        Description -> "CKM-Matrix"}
```

The parameters in value should appear before in the model file

Particles:V,F,S,U,T

```
V[1] == {
ClassName -> G,
SelfConjugate -> True,
Indices -> {Index[Gluon]},
Mass -> 0,
Width -> 0,
PDG -> 21
},
```

For W_i Unphysical->True