Herwig++

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Herwig++ details

General purpose MC event generator

many matrix elements natively; underlying event;
initial/final state parton showering; Powheg matching;
cluster hadronization; individually modelled hadron/tau decays;
QED radiation

30-year history in its F77 implementation;
Hw++ is a complete redesign from ground up.

currently ~20 members
in Durham, Manchester, Cambridge, Milan, Karlsruhe

Main reference: arXiv:0803.0883
http://projects.hepforge.org/herwig/

ThePEG

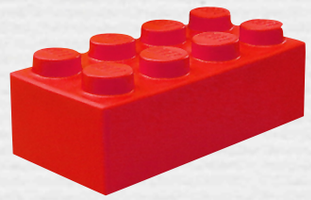
L. Lönnblad

Toolkit for high energy physics event generation

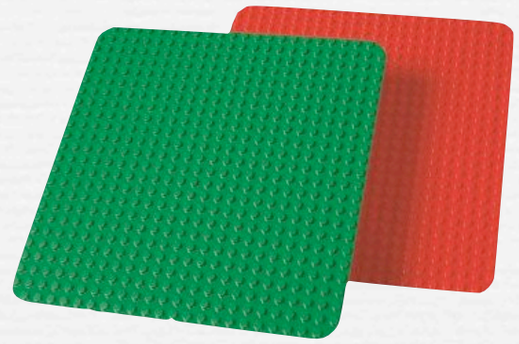
Herwig++

Box of physics implementations

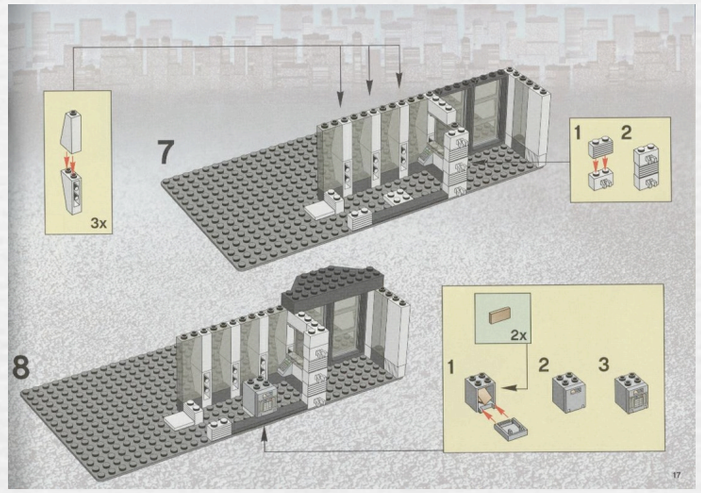
Each building block is a compiled C++ class



ThePEG Repository

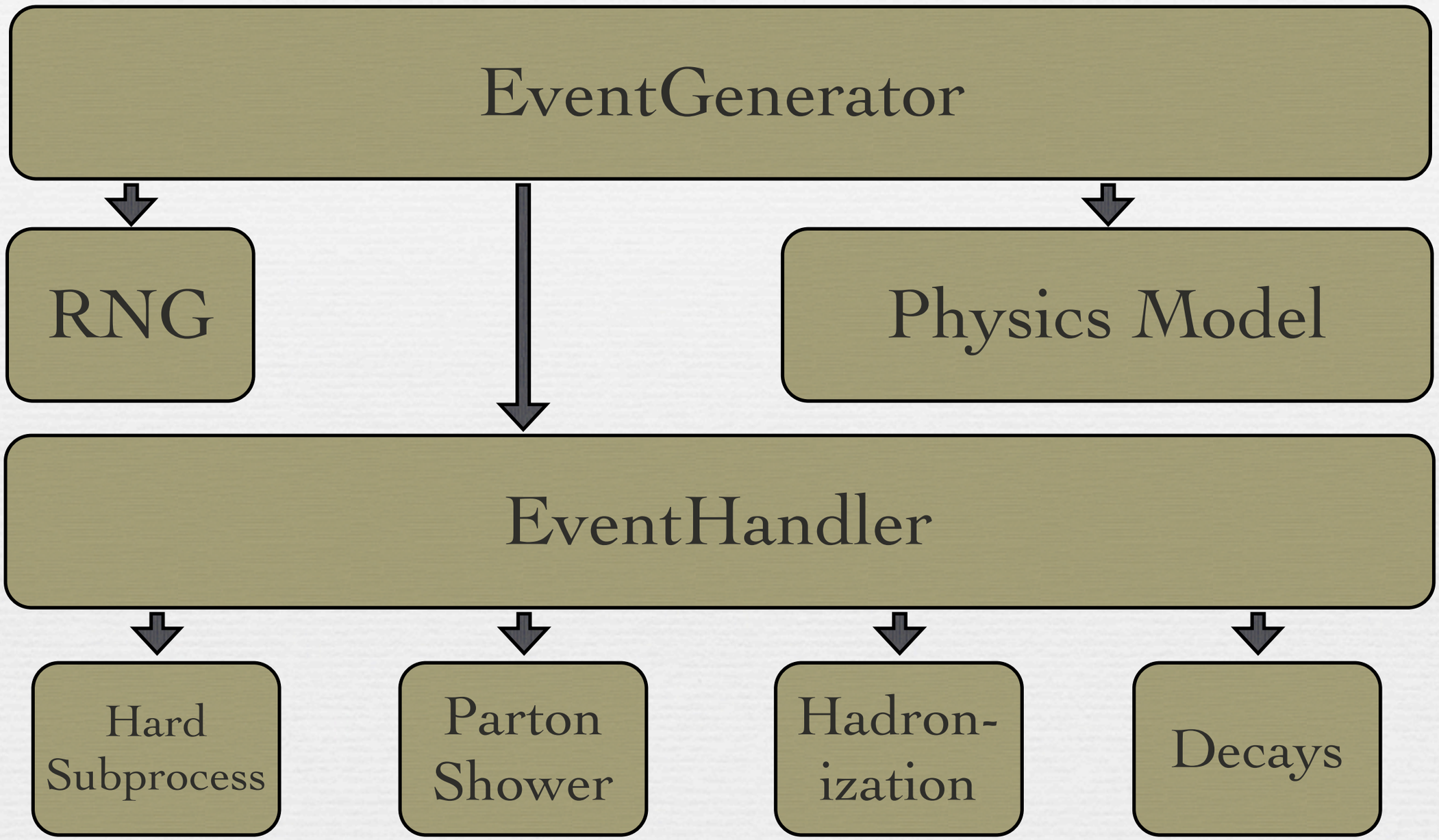


plaintext
setup files



no more compilation needed here

Default Setup



Default Setup

```
create ThePEG::StandardEventHandler /Herwig/LHCHandler
set    LHCHandler:LuminosityFunction FixedLHCLuminosity

insert LHCHandler:SubProcessHandlers[0] /Herwig/SimpleQCD
set    LHCHandler:CascadeHandler        /Herwig/ShowerHandler
set    LHCHandler:HadronizationHandler  /Herwig/ClusterHadHandler
set    LHCHandler:DecayHandler          /Herwig/DecayHandler
[...]


create ThePEG::EventGenerator /Herwig/LHCGenerator ThePEG.so
set    LHCGenerator:EventHandler /Herwig/LHCHandler
[...]


set LHCHandler:BeamA /Herwig/Particles/p+
set LHCHandler:BeamB /Herwig/Particles/p+
set FixedLHCLuminosity:Energy 14000.0
[...]
```

Default Setup

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set    LHCHandler:DecayHandler          /Herwig/DecayHandler
[...]


create ThePEG::EventGenerator /Herwig/LHCGenerator ThePEG.so
set    LHCGenerator:EventHandler /Herwig/LHCHandler
[...]

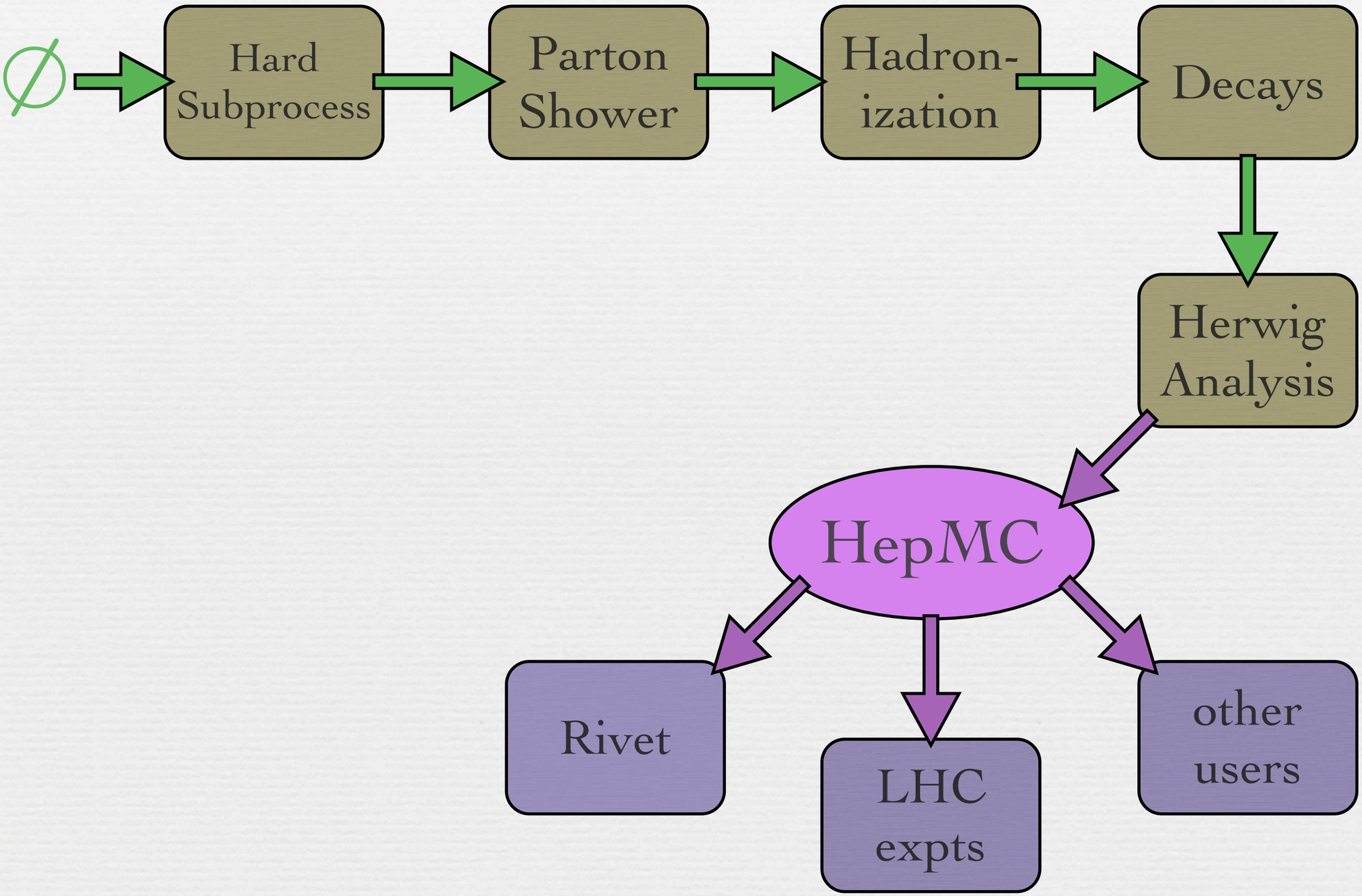

set
set
set
[...]
```

Arbitrary user extensions use dlopen():

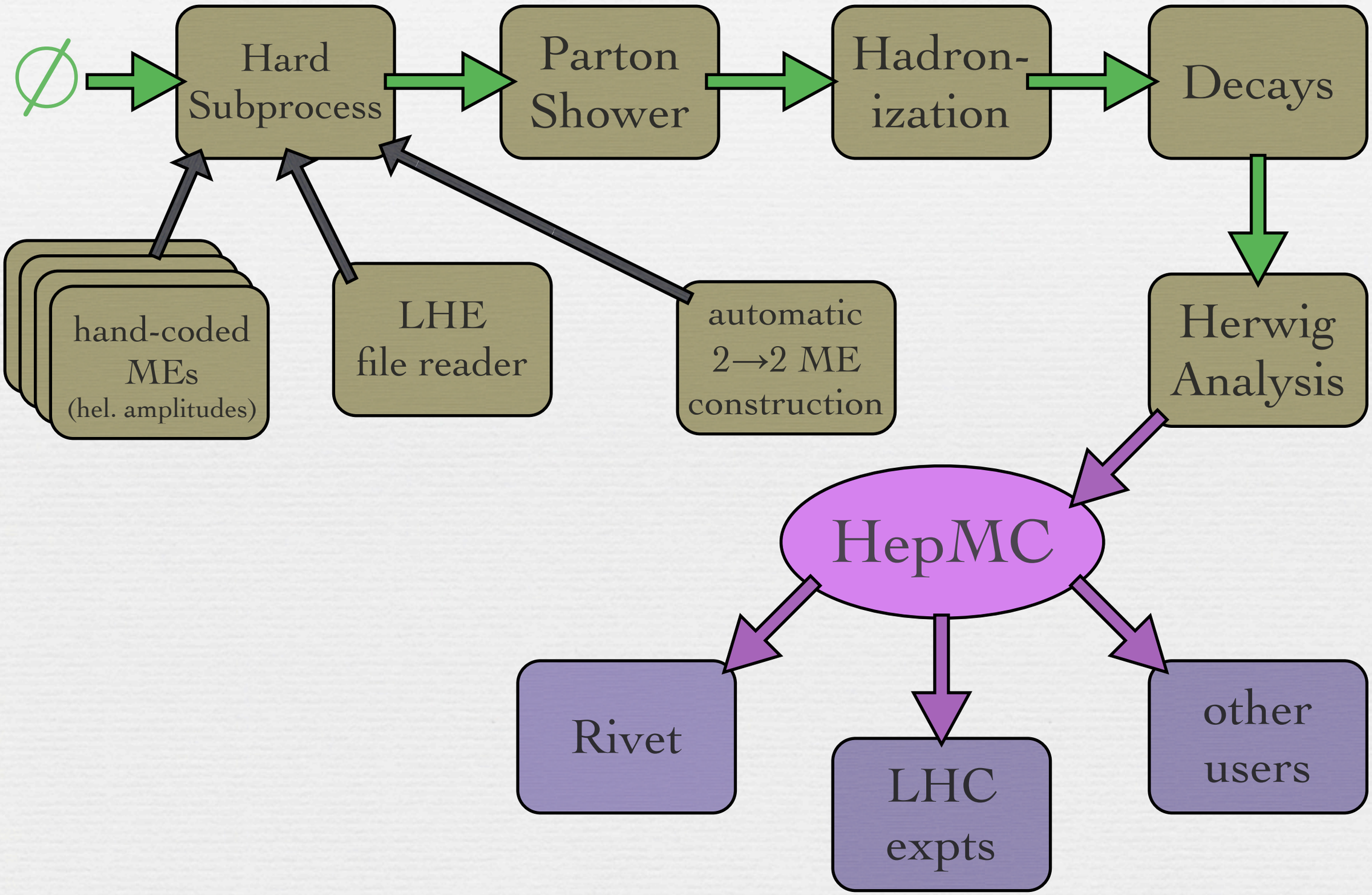
```
create DGrell::Foo /DGrell/Foomaker DGrellHwPlugin.so
```

Main code *never* needs recompilation.

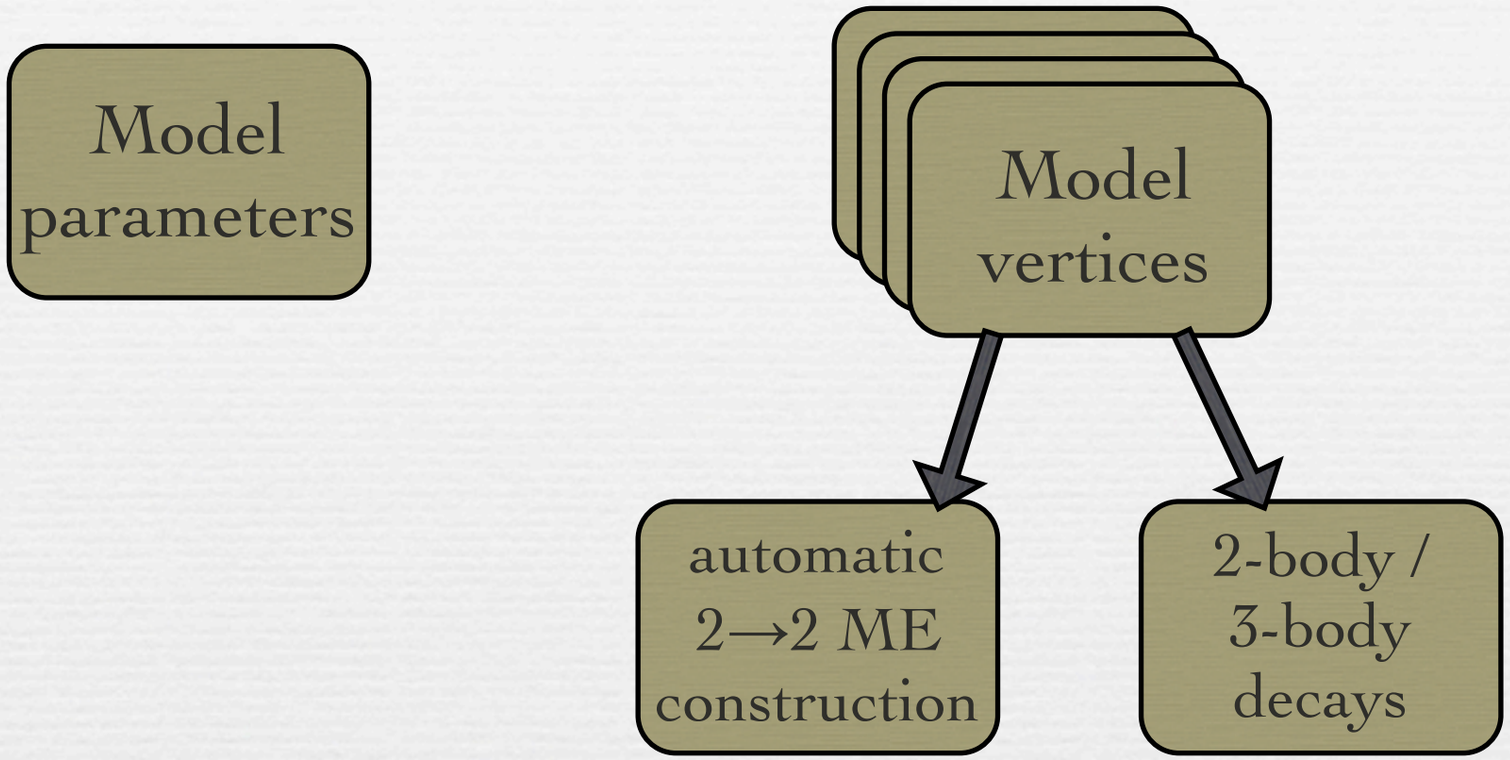
Event record flow



Event record flow



BSM model



Available models:

MSSM (includes SLHA reader)

Universal extra dimensions

Randall-Sundrum gravitons; Z'; anomalous hVV

BSM model

inclusive production, no need to specify all 2→N contributions

spin correlations preserved throughout, including SM decay chains

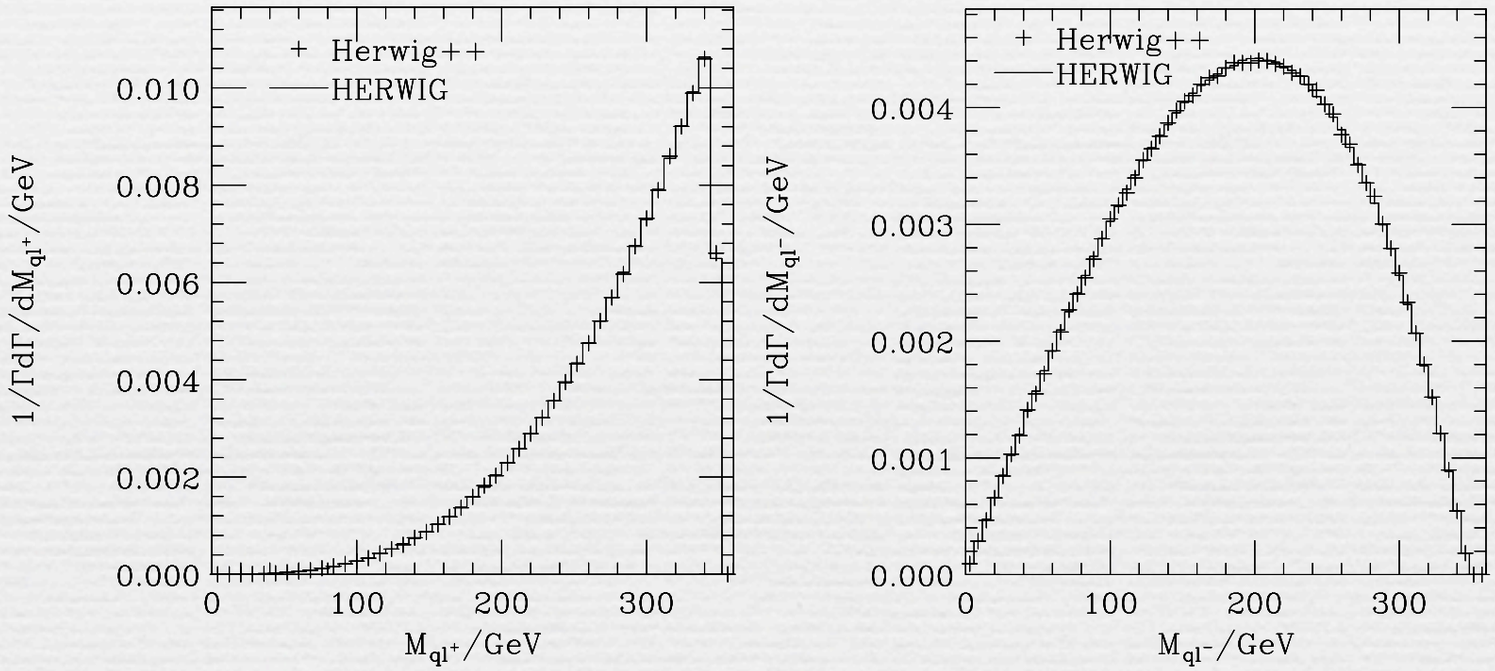


Figure 1: Mass distribution of the quark and lepton in the decay $\tilde{q}_L \to q\tilde{\chi}_2^0 \to q\ell^{\pm}\tilde{\ell}_R^{\mp}$ for (a) ℓ^+ and (b) ℓ^-.

parton showering possible in all BSM particle decays

finite width effects included

BSM setup

```
read   MSSM.model
set    HPConstructor:IncludeEW No

insert HPConstructor:Incoming 0 g
insert HPConstructor:Incoming 1 u
insert HPConstructor:Incoming 2 ubar
insert HPConstructor:Incoming 3 d
insert HPConstructor:Incoming 4 dbar

insert HPConstructor:Outgoing 0 ~u_L
insert HPConstructor:Outgoing 1 ~u_Lbar
insert HPConstructor:Outgoing 2 ~d_L
insert HPConstructor:Outgoing 3 ~d_Lbar

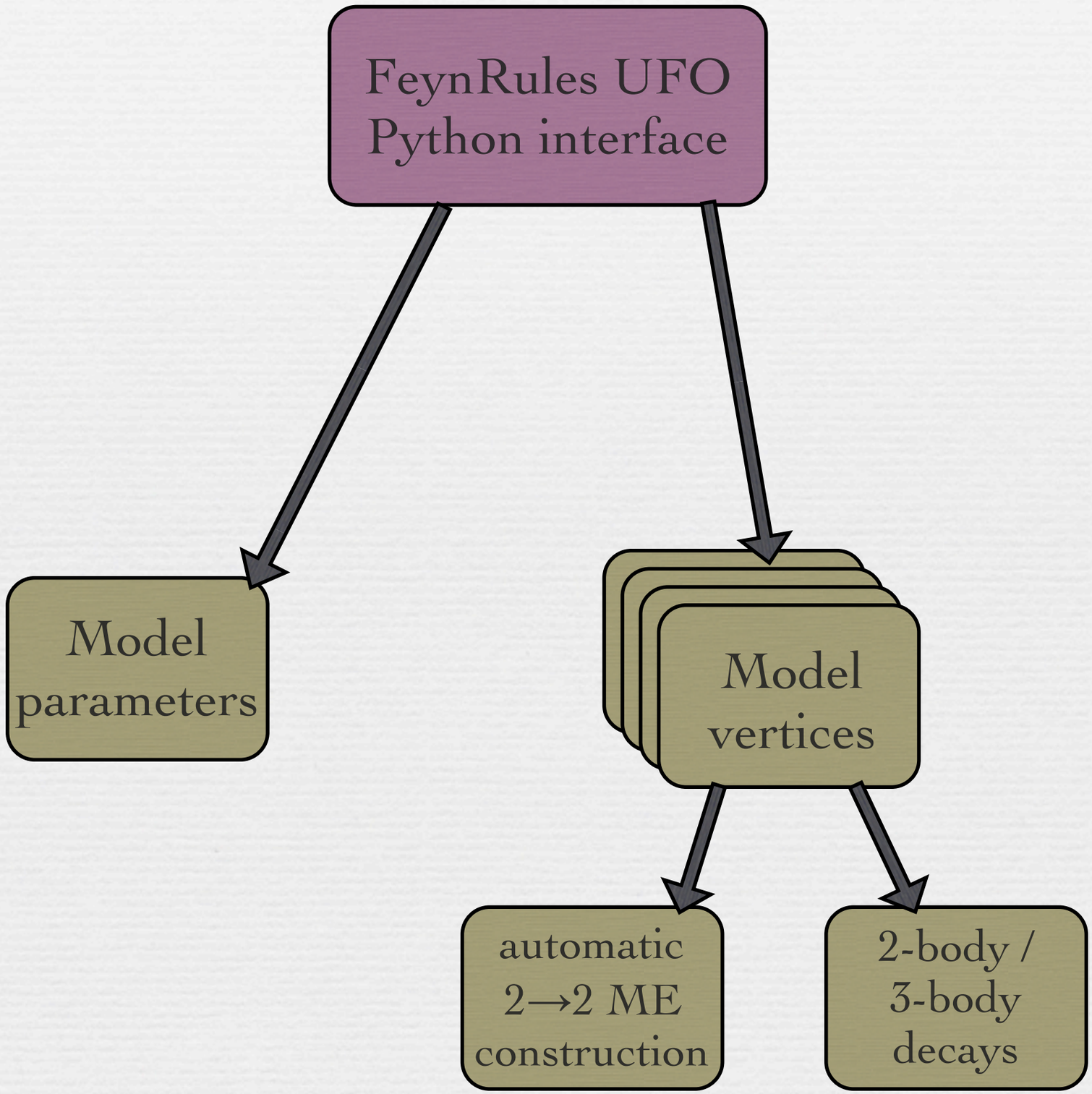
setup  MSSM/Model SPhenoSPS1a.spc
set    TwoBodyDC:CreateDecayModes No
set    ThreeBodyDC:CreateDecayModes No

#insert DecayConstructor:DisableModes 0 ~u_L->~chi_20,u;
#insert DecayConstructor:DisableModes 1 ~chi_20->~e_R-,e+;
```

BSM result

```
=============================================================================
Total:                                5000          5013      13.5(2)e-03
=============================================================================
Per matrix element breakdown:
MEgg2~d_L~d_Lbar                        55            55      0.15(2)e-03
MEgg2~u_L~u_Lbar                        70            70      0.19(2)e-03
MEdg2~g~d_L                            840           842      2.27(8)e-03
MEdbarg2~g~d_Lbar                      213           215      0.58(4)e-03
MEug2~g~u_L                           2212          2215       6.0(1)e-03
MEubarg2~g~u_Lbar                      149           152      0.40(3)e-03
MEdd2~d_L~d_L                           32            32       90(20)e-06
MEdd2~d_L~d_R                           40            40      0.11(2)e-03
MEddbar2~d_R~d_Lbar                     41            41      0.11(2)e-03
MEddbar2~d_L~d_Rbar                     47            47      0.13(2)e-03
MEddbar2~d_L~d_Lbar                     25            25       70(10)e-06
MEddbar2~u_L~u_Lbar                      8             8        22(8)e-06
MEud2~u_R~d_L                           89            89      0.24(3)e-03
MEud2~u_L~d_L                          225           225      0.61(4)e-03
MEud2~u_L~d_R                           66            66      0.18(2)e-03
[...]
```

Current development: FeynRules interface



Ready for use by experiments and theorists!

Feedback very welcome!

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