Computer tools in particle physics

- Lecture 3 : MadGraph -

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MadGraph

MadGraph [The MadTeam]

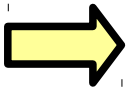
- **Name of the tool:** `MadGraph`
- **Author:** *The MadTeam*, composed by Johan Alwall, Rikkert Frederix, Stefano Frixione, Michel Herquet, Valentin Hirschi, Fabio Maltoni, Olivier Mattelaer, Hua-Sheng Shao, Timothy J. Stelzer, Paolo Torrielli and Marco Zaro.
- **Type of code:** `Python`
- **Website:** http://madgraph.hep.uiuc.edu/

MadGraph

MadGraph [The MadTeam]

Events at the parton level

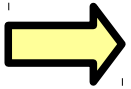
MadEvent



Showering and hadronization

Pythia

Includes other codes:
StdHEP, **LHAPDF** and **Tauola**



Detector response

PGS

Alternative:
Delphes

Scotogenic: benchmark point

BS1 benchmark point

$$\lambda_1 = 0.25 \qquad \lambda_2 = 0.5 \qquad \lambda_3 = 0.5$$
$$\lambda_4 = -0.5 \qquad \lambda_5 = 8 \cdot 10^{-11} \qquad m_\eta^2 = 1.85 \cdot 10^5\,\mathrm{GeV}^2$$

$$M_N = \begin{pmatrix} 345\,\mathrm{GeV} & 0 & 0 \\ 0 & 4800\,\mathrm{GeV} & 0 \\ 0 & 0 & 6800\,\mathrm{GeV} \end{pmatrix}$$

$$Y_N = \begin{pmatrix} 0.0172495 & 0.300325 & 0.558132 \\ -0.891595 & 1.00089 & 0.744033 \\ -1.39359 & 0.207173 & 0.253824 \end{pmatrix}$$

Scotogenic: Simulation 1

$$p\,p \to \eta_R\,\eta^+$$

Chuck Norris fact of the day

Chuck Norris can kill two stones with one bird

Scotogenic: Simulation 2

$$\eta_R \to N_1 \, \nu$$
$$\eta^+ \to N_1 \, \mu^+$$

$$\boxed{p \, p \to N_1 \, N_1 \, \mu^+ \, \nu}$$

Only mechanism?