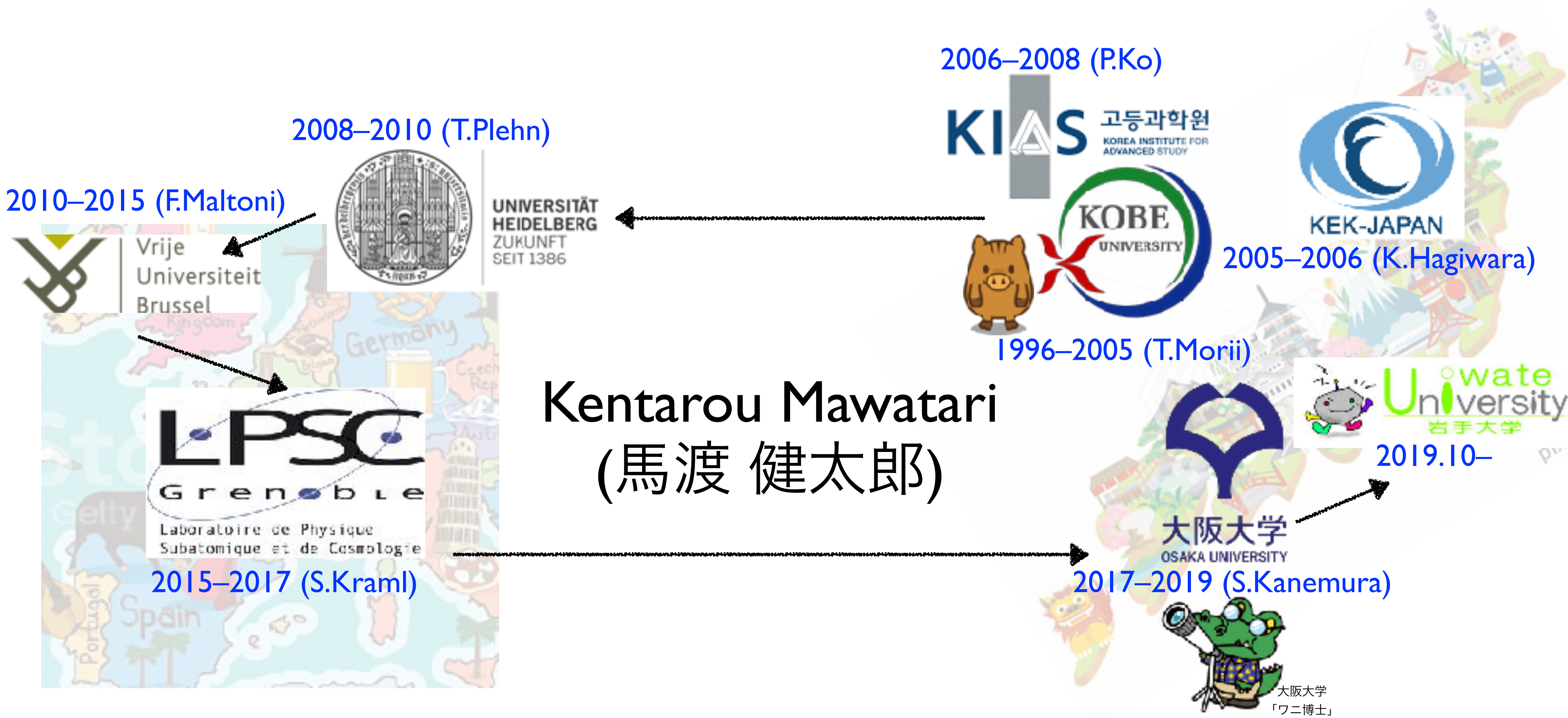
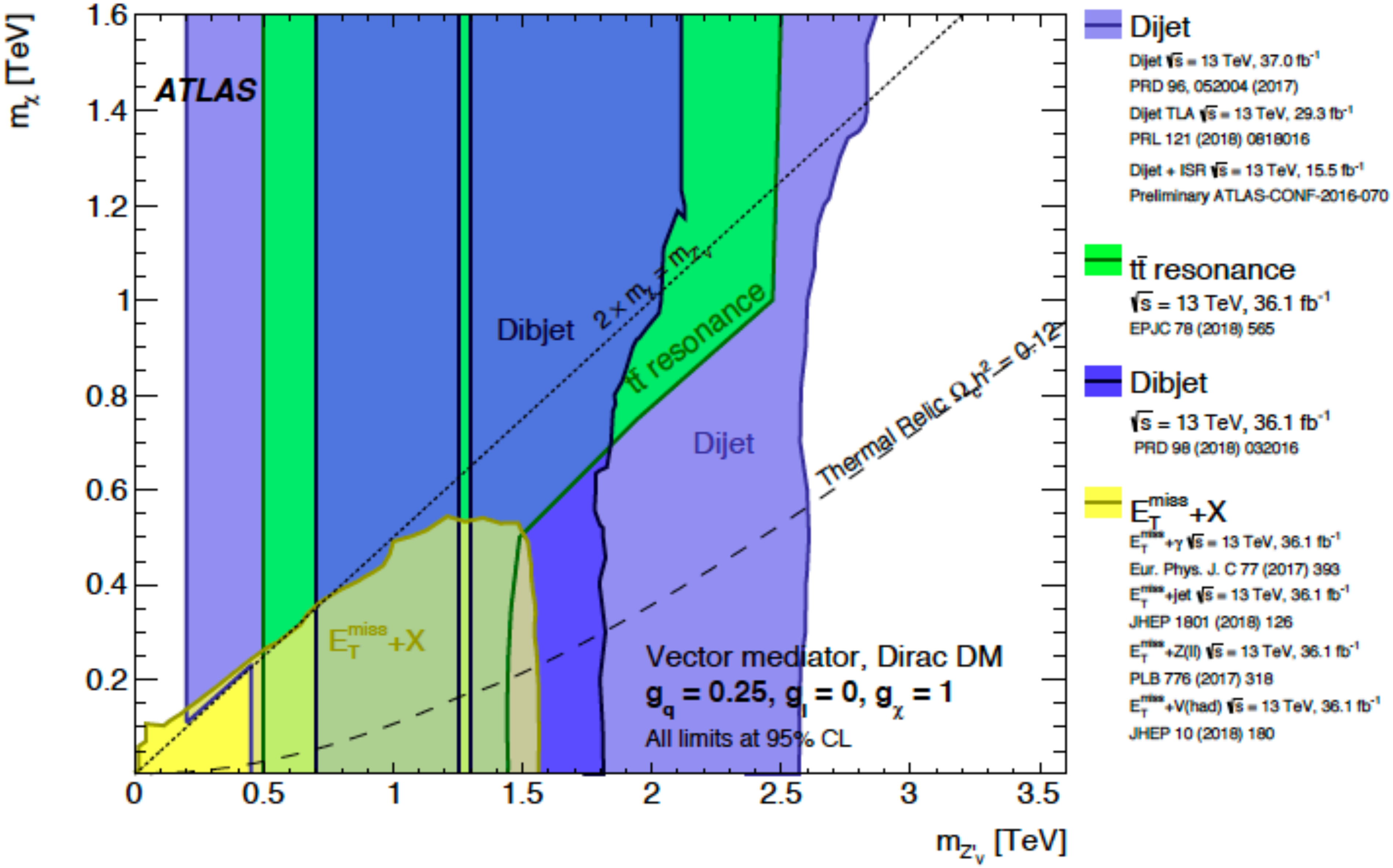
# ICS2025 Simulation Tutorial

Kentarou Mawatari
(馬渡 健太郎)



[1903.01400]

# Constraints on mediator-based dark matter and scalar dark energy models using $\sqrt{s} = 13$ TeV $pp$ collision data collected by the ATLAS detector

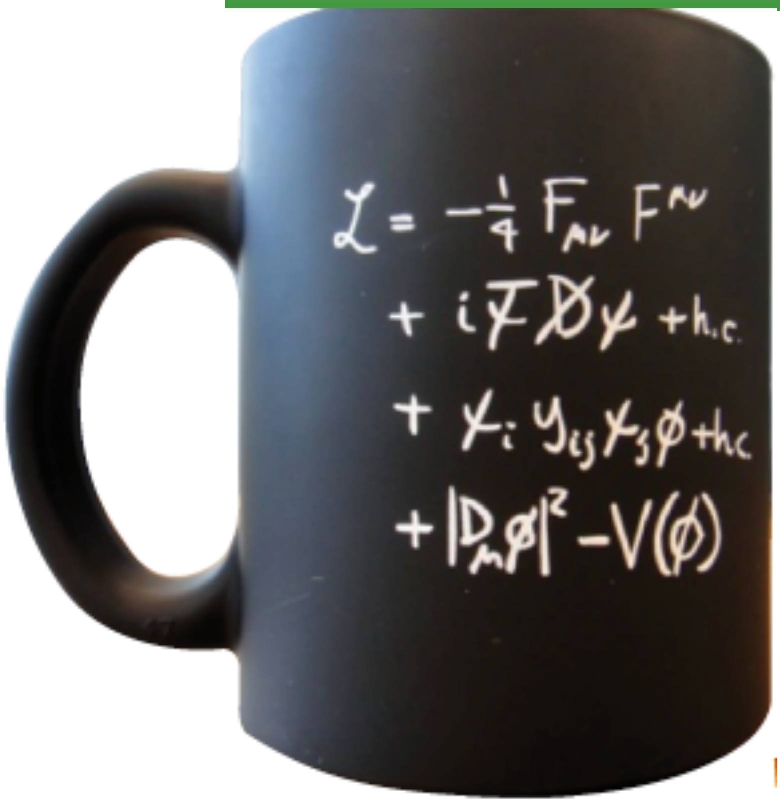


# Event generations

Table 2: Details of the generation setup and Universal FeynRules Output (UFO) model used for the spin-1 mediator simplified models, for each signature considered in this paper. [1903.01400]

| Model and Final State | UFO | Generator and Parton Shower | Cross-section | Additional details |
|---|---|---|---|---|
| $Z'(\chi\bar{\chi})+j$ | DMV [26, 170] | POWHEG-BOX v2 [171] + PYTHIA 8.205 [172] | NLO | Particle-level rescaling of leptophobic $Z'_A$ scenario of Ref. [26] (see Appendix A.1) |
| $Z'(\chi\bar{\chi})+\gamma$ | DMSimp [113, 173] | MG5_aMC@NLO 2.4.3 (NLO) [174] + PYTHIA 8.212 | NLO | Leptophobic $Z'_A$ scenario simulated, other scenarios obtained by cross-section rescaling (see Appendix A.1) |
| $Z'(\chi\bar{\chi})+V$ | DMSimp | MG5_aMC@NLO 2.5.3 (NLO) + PYTHIA 8.212 | NLO | Particle-level rescaling of LO samples of Ref. [20] to each of the four NLO scenarios (see Appendix A.1) |
| $Z'(qq)$ or $Z'(qq)$+ISR | DMSimp | MG5_aMC@NLO 2.2.3 (NLO) + PYTHIA 8.210 | NLO | Leptophobic $Z'_A$ scenario simulated, other scenario obtained by Gaussian resonance limits and cross-section rescaling [175] |
| $Z'(b\bar{b})$ | DMSimp | MG5_aMC@NLO 2.2.3 (NLO) + PYTHIA 8.210 | NLO | Leptophobic $Z'_A$ scenario simulated, other scenario obtained by Gaussian resonance limits and cross-section rescaling [175] |
| $Z'(\ell\ell)$ | DMSimp | MG5_aMC@NLO 2.2.3 (NLO) | NLO | Gaussian resonance limits and cross section rescaling [175] |
| $Z'(t\bar{t})$ | DMSimp | MG5_aMC@NLO 2.4.3 (LO) + PYTHIA 8.186 | LO | Particle level rescaling of the topcolour assisted techni colour samples of Ref. [176] (see Appendix A.1) |

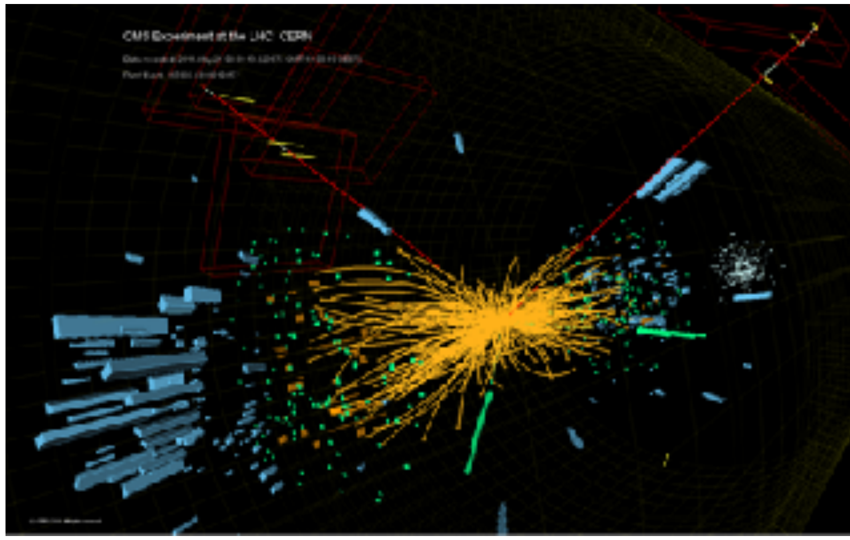
# Lagrangian (TH) ⇔ Data (EXP)




simulation tools

prediction

interpretation

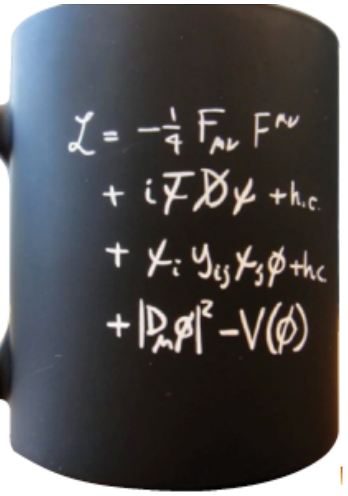


so easy, so powerful!

= so dangerous...

Let's learn its proper usage!

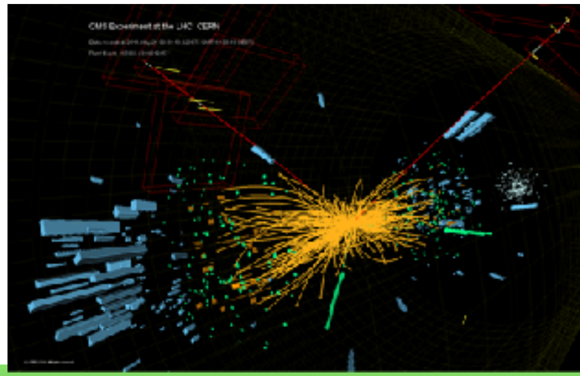
# BSM workflow (I) before LHC



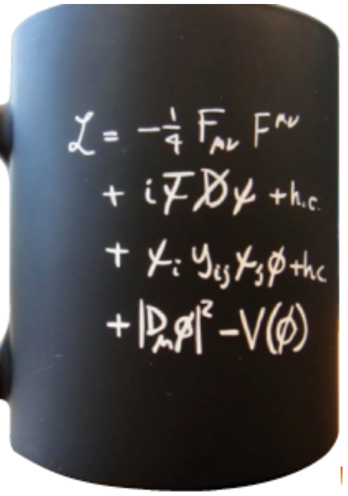

- take a BSM model (symmetry, particle contents,…), i.e. Lagrangian
  - derive the Feynman rules
    - draw Feynman diagrams for interesting 2→2 processes
      - compute the amplitude (squared)
        - implement it into a generator manually
          - generate events
            - parton-shower/hadronisation

Herwig, Pythia

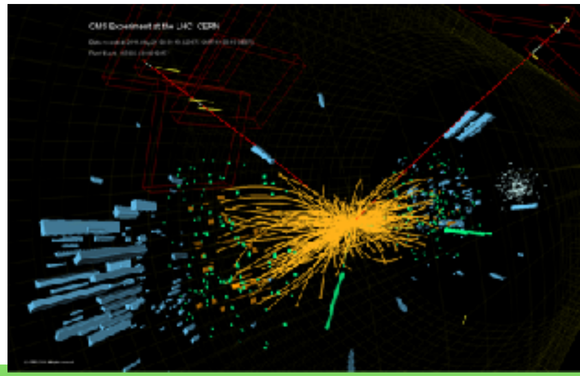
- detector simulation
  - analysis



# BSM workflow (II) before LHC




- take a BSM model (symmetry, particle contents,…), i.e. Lagrangian
  - derive the Feynman rules
    - make the model file (make subroutines to compute helicity amplitudes)
      - draw Feynman diagrams for interesting any processes
        - compute the amplitude (squared) — MadGraph4
          - generate events
            - parton-shower/hadronisation Herwig, Pythia
              - detector simulation
                - analysis



# TH

Idea

# The Hierarchy Problem and New Dimensions at a Millimeter

Nima Arkani–Hamed*, Savas Dimopoulos** and Gia Dvali†
* SLAC, Stanford University, Stanford, California 94309, USA
** Physi , USA

large extra dimension model
"ADD model"

We propose a new framework for solving the hierarchy problem which does not rely on either supersymmetry or technicolor. In this framework, the gravitational and gauge interactions become united at the weak scale, which we take as the only fundamental short distance scale in nature. The observed weakness of gravity on distances $\gtrsim 1$ mm is due to the existence of $n \geq 2$ new compact spatial dimensions large compared to the weak scale. The Planck scale $M_{Pl} \sim G_N^{-1/2}$ is not a fundamental scale; its enormity is simply a consequence of the large size of the new dimensions. While gravitons can freely propagate in the new dimensions, at sub-weak energies the Standard Model (SM) fields must be localized to a 4-dimensional manifold of weak

In summary, there are many new interesting issues that emerge in our framework. Our old ideas about unification, inflation, naturallness, the hierarchy problem and the need for supersymmetry are abandoned, together with the successful supersymmetric prediction of coupling constant unification [12]. Instead, we gain a fresh framework which allows us to look at old problems in new ways. Lagrangean parameters become parameters of solutions and the phenomena that await us at LHC, NLC and beyond are even more exciting and unforseen.

# TH

Idea

Lagrangian

Feyn. Rules

Amplitudes

x secs

↓

Paper

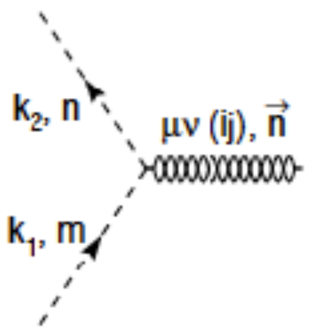
# Kaluza-Klein States from Large Extra Dimensions

Tao Han[a], Joseph D. Lykken[b] and Ren-Jie Zhang[a]

[a] *Department of Physics, University of Wisconsin, Madison, WI 53706*

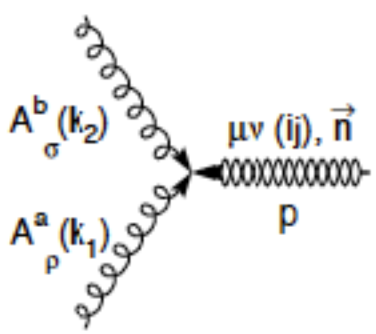
[b] *Theory Group, Fermi National Accelerator Laboratory, Batavia, IL 60510*





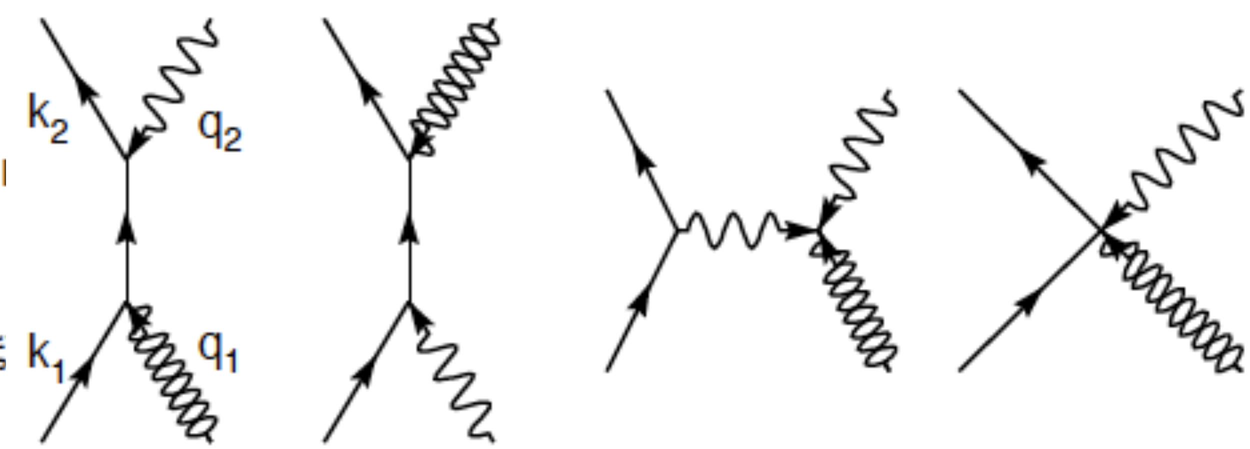

$\tilde{h}^{\vec{n}}_{\mu\nu}\Phi\Phi$ : $-i\,\kappa/2\,\delta_{mn}\,(m_\Phi^2\,\eta_{\mu\nu}+C_{\mu\nu,\rho\sigma}\,k_1^\rho\,k_2^\sigma)$

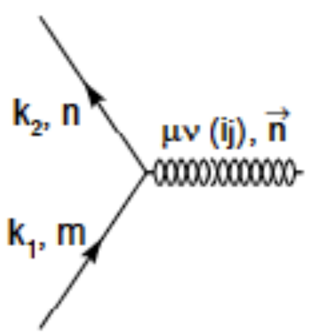
$\tilde{\phi}^{\vec{n}}_{ij}\Phi\Phi$ : $i\,\omega\,\kappa\,\delta_{ij}\,\delta_{mn}\,(k_1\cdot k_2-2\,m_\Phi^2)$




$\tilde{h}^{\vec{n}}_{\mu\nu}AA$ : $-i\,\kappa/2\,\delta^{ab}\,((\,m_A^2+k_1\cdot$

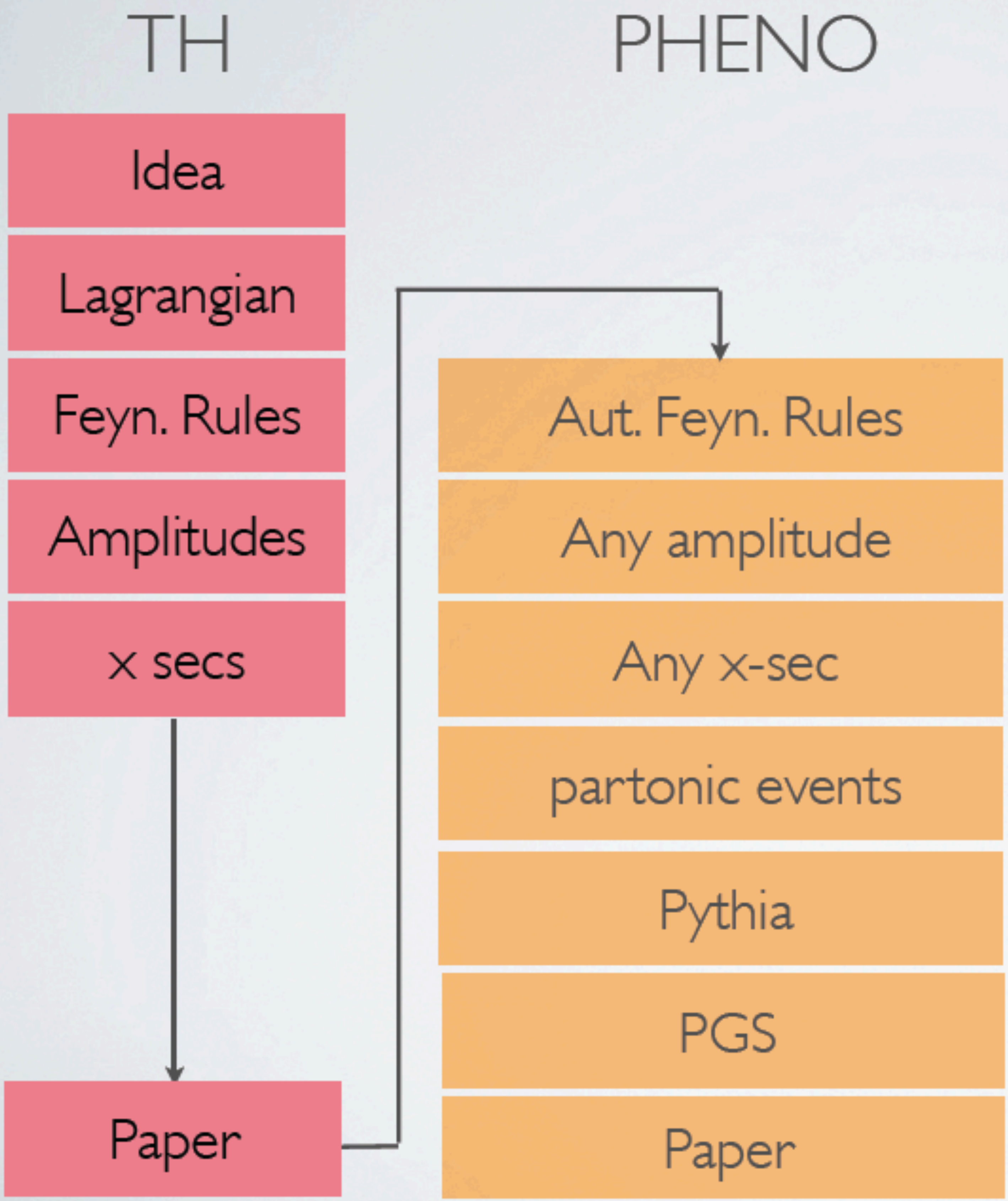
$\tilde{\phi}^{\vec{n}}_{ij}AA$ : $i\,\omega\,\kappa\,\delta_{ij}\,\delta^{ab}\,(\,\eta_{\rho\sigma}\,m_A^2+\xi$




$\tilde{h}^{\vec{n}}_{\mu\nu}\psi\psi$ : $-i\,\kappa/8\,\delta_{mn}\,(\,\gamma_\mu\,(k_{1\nu}+k_{2\nu})+\gamma_\nu\,(k_{1\mu}+k_{2\mu})$
$-\,2\,\eta_{\mu\nu}\,(\not{k}_1+\not{k}_2-2\,m_\psi)\,)$

$\tilde{\phi}^{\vec{n}}_{ij}\psi\psi$ : $i\,\omega\,\kappa\,\delta_{ij}\,\delta_{mn}\,(\,3/4\,\not{k}_1+3/4\,\not{k}_2-2\,m_\psi)$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Pythia
PGS
Paper

Eur. Phys. J. C
DOI 10.1140/epjc/s10052-008-0663-x

THE EUROPEAN PHYSICAL JOURNAL C

Special Article - Tools for Experiment and Theory

[arXiv:0805.2554]

# HELAS and MadGraph/MadEvent with spin-2 particles

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[3]Institut für Theoretische Physik, Universität Karlsruhe, Postfach 69
[4]School of Physics, Korea Institute for Advanced Study, Seoul 130-7

| Vertex | Inputs | Output | Subroutine |
|---|---|---|---|
| SST | SST | Amplitude | SSTXXX |
| | ST | S | HSTXXX |
| | SS | T | USSXXX |
| FFT | FFT | Amplitude | IOTXXX |
| | FT | F | FTIXXX, FTOXXX |
| | FF | T | UIOXXX |
| VVT | VVT | Amplitude | VVTXXX |
| | VT | V | JVTXXX |
| | VV | T | UVVXXX |
| FFVT | FFVT | Amplitude | IOVTXX |
| | FVT | F | FVTIXX, FVTOXX |
| | FFT | V | JIOTXX |
| | FFV | T | UIOVXX |
| VVVT | VVVT | Amplitude | VVVTXX |
| | VVT | V | JVVTXX |
| | VVV | T | UVVVXX |
| VVVVT | GGGGT | Amplitude | GGGGTX |
| | GGGT | G | JGGGTX |
| | GGGG | T | UGGGGX |

```
TKK = TKK - T12*(pv1(1)*pv2(2) + pv1(2)*pv2(1))
&         - T13*(pv1(1)*pv2(3) + pv1(3)*pv2(1))
&         - T14*(pv1(1)*pv2(4) + pv1(4)*pv2(1))
&         + T23*(pv1(2)*pv2(3) + pv1(3)*pv2(2))
&         + T24*(pv1(2)*pv2(4) + pv1(4)*pv2(2))
&         + T34*(pv1(3)*pv2(4) + pv1(4)*pv2(3))

TK1V2 = TK1V2 - T12*(pv1(1)*v2(2) + pv1(2)*v2(1))
&             - T13*(pv1(1)*v2(3) + pv1(3)*v2(1))
&             - T14*(pv1(1)*v2(4) + pv1(4)*v2(1))
&             + T23*(pv1(2)*v2(3) + pv1(3)*v2(2))
&             + T24*(pv1(2)*v2(4) + pv1(4)*v2(2))
&             + T34*(pv1(3)*v2(4) + pv1(4)*v2(3))

TVV = TVV - T12*(v1(1)*v2(2) + v1(2)*v2(1))
&         - T13*(v1(1)*v2(3) + v1(3)*v2(1))
&         - T14*(v1(1)*v2(4) + v1(4)*v2(1))
&         + T23*(v1(2)*v2(3) + v1(3)*v2(2))
&         + T24*(v1(2)*v2(4) + v1(4)*v2(2))
&         + T34*(v1(3)*v2(4) + v1(4)*v2(3))

TK2V1 = TK2V1 - T12*(v1(1)*pv2(2) + v1(2)*pv2(1))
&             - T13*(v1(1)*pv2(3) + v1(3)*pv2(1))
&             - T14*(v1(1)*pv2(4) + v1(4)*pv2(1))
&             + T23*(v1(2)*pv2(3) + v1(3)*pv2(2))
&             + T24*(v1(2)*pv2(4) + v1(4)*pv2(2))
&             + T34*(v1(3)*pv2(4) + v1(4)*pv2(3))

vertex = (ft(1,1)-ft(2,2)-ft(3,3)-ft(4,4))*( K1V2*K2V1 - V1V2*F )
&      + F*TVV + V1V2*TKK - K2V1*TK1V2 - K1V2*TK2V1
```

[arXiv:0801.1794]

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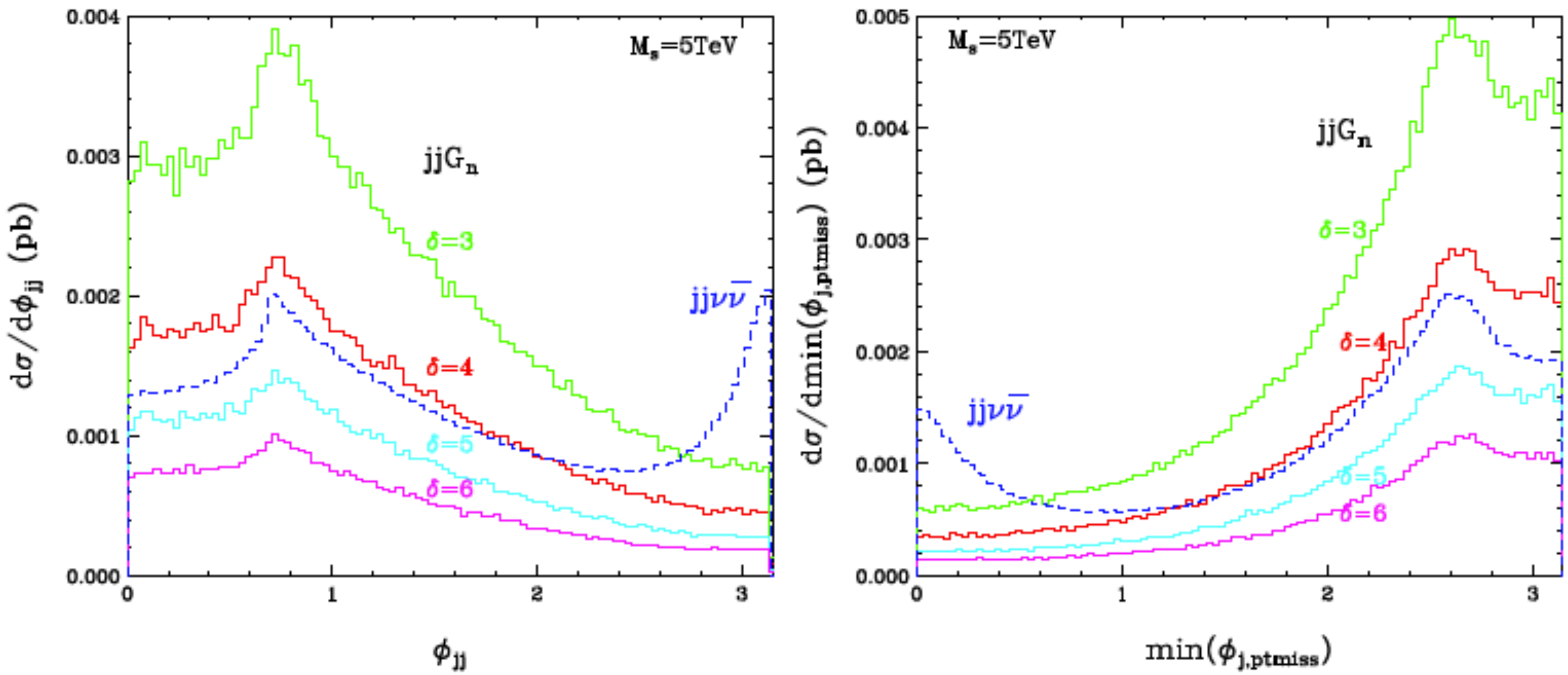
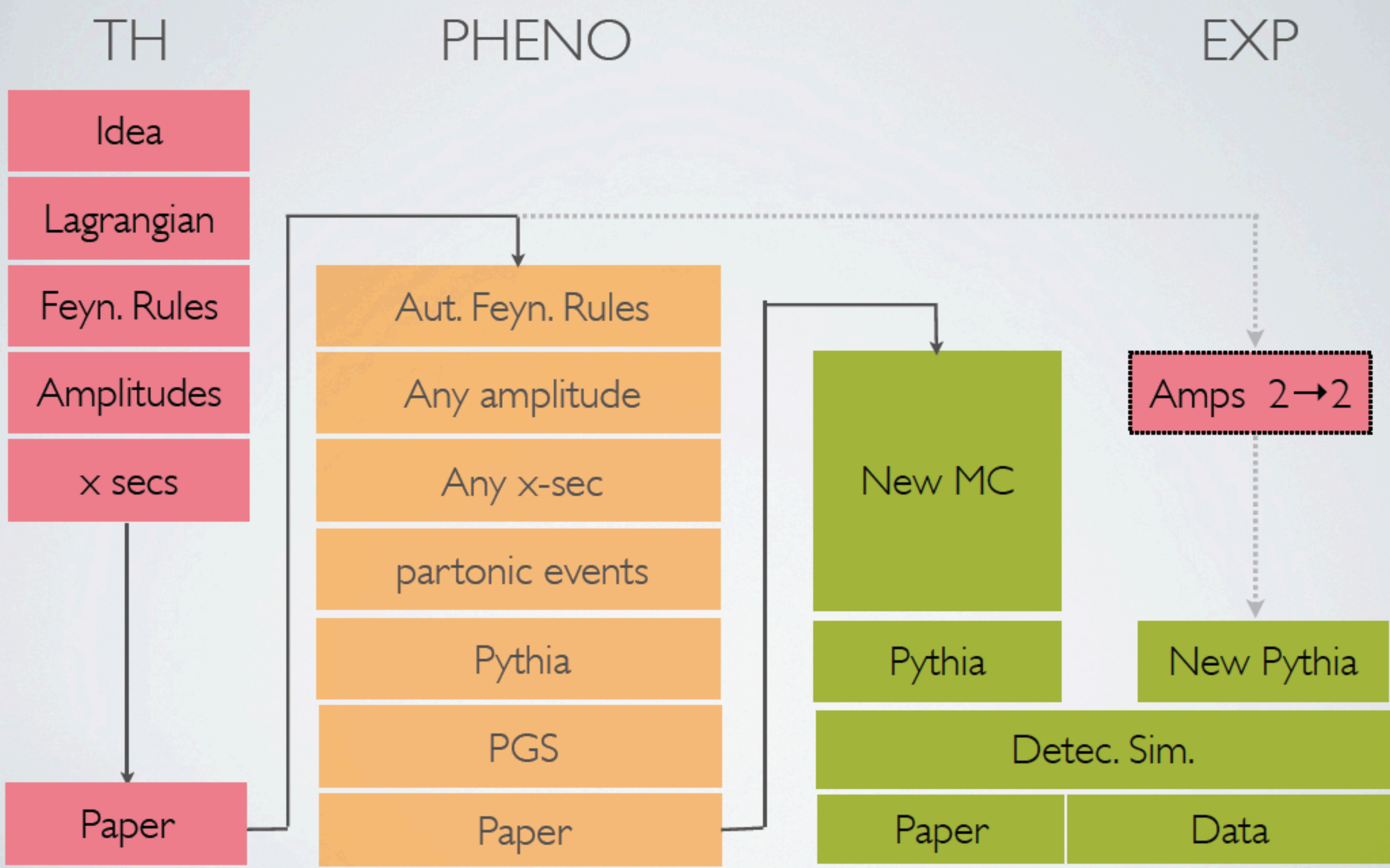
# Graviton production with 2 jets at the LHC in large extra dimensions

Kaoru Hagiwara,[a] Partha Konar,[bc] Qiang Li,[c] Kentarou Mawatari[d] and Dieter Zeppenfeld[c]

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Any x-sec
partonic events
Pythia
PGS
Paper
New MC
Pythia
Detec. Sim.
Paper
Data
Amps 2→2
New Pythia

# Search for Large Extra Dimensions in the Monojet + $\not\!\!E_T$ Channel at DØ

V.M. Abazov,[21] B. Abbott,[55] A. Abdesselam,[11] M. Abolins,[48] V. Abramov,[24] B.S. Acharya,[17] D.L. Adams,[53]
M. Adams,[35] S.N. Ahmed,[20] G.D. Alexeev,[21] A. Alton,[47] G.A. Alves,[2] E.W. Anderson,[40] Y. Arnoud,[9] C. Avila,[5]
V.V. Babintsev,[24] L. Babukhadia,[52] T.C. Bacon,[26] A. Baden,[44] S. Baffioni,[10] B. Baldin,[34] P.W. Balm,[19]
S. Banerjee,[17] E. Barberis,[46] P. Baringer,[41] J. Barreto,[2] J.F. Bartlett,[34] U. Bassler,[12] D. Bauer,[26] A. Bean,[41]
F. Beaudette,[11] M. Begel,[51] A. Belyaev,[33] S.B. Beri,[15] G. Bernardi,[12] I. Bertram,[25] A. Besson,[9] R. Beuselinck,[26]
V.A. Bezzubov,[24] P.C. Bhat,[34] V. Bhatnagar,[15] M. Bhattacharjee,[52] G. Blazey,[36] F. Blekman,[19] S. Blessing,[33]
A. Boehnlein,[34] N.I. Bojko,[24] T.A. Bolton,[42] F. Borcherding,[34] K. Bos,[19] T. Bose,[50] A. Brandt,[57] R. Breedon,[29]
…oss,[34] D. Buchholz,[37] M. Buehler,[35] V. Buescher,[14]
…alho,[3] D. Casey,[48] Z. Casilum,[52] H. Castilla-Valdez,[18]
…K. Cho,[51] S. Choi,[32] S. Chopra,[53] J.H. Christenson,[34]
… W.E. Cooper,[34] D. Coppage,[41] S. Crépé-Renaudin,[9]
… Davis,[51] K. De,[57] S.J. de Jong,[20] M. Demarteau,[34]
… S. Desai,[52] H.T. Diehl,[34] M. Diesburg,[34] S. Doulas,[46]
…A. Duperrin,[10] A. Dyshkant,[36] D. Edmunds,[48] J. Ellison,[32]
… G. Eppley,[59] P. Ermolov,[23] O.V. Eroshin,[24] J. Estrada,[51]
… F. Filthaut,[20] H.E. Fisk,[34] Y. Fisyak,[53] F. Fleuret,[12]
…A.N. Galyaev,[24] M. Gao,[50] V. Gavrilov,[22] R.J. Genik II,[25]
… B. Gómez,[5] P.I. Goncharov,[24] H. Gordon,[53] L.T. Goss,[58]



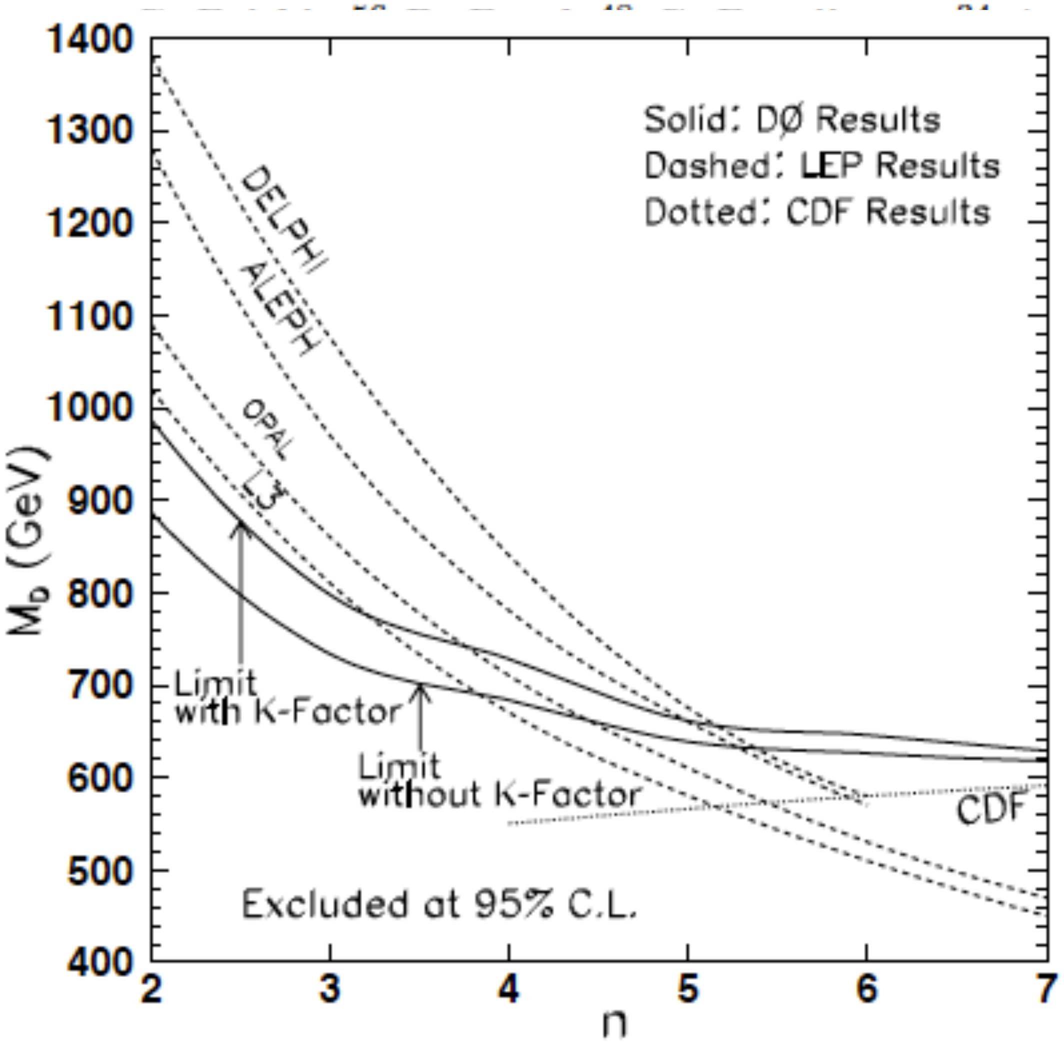
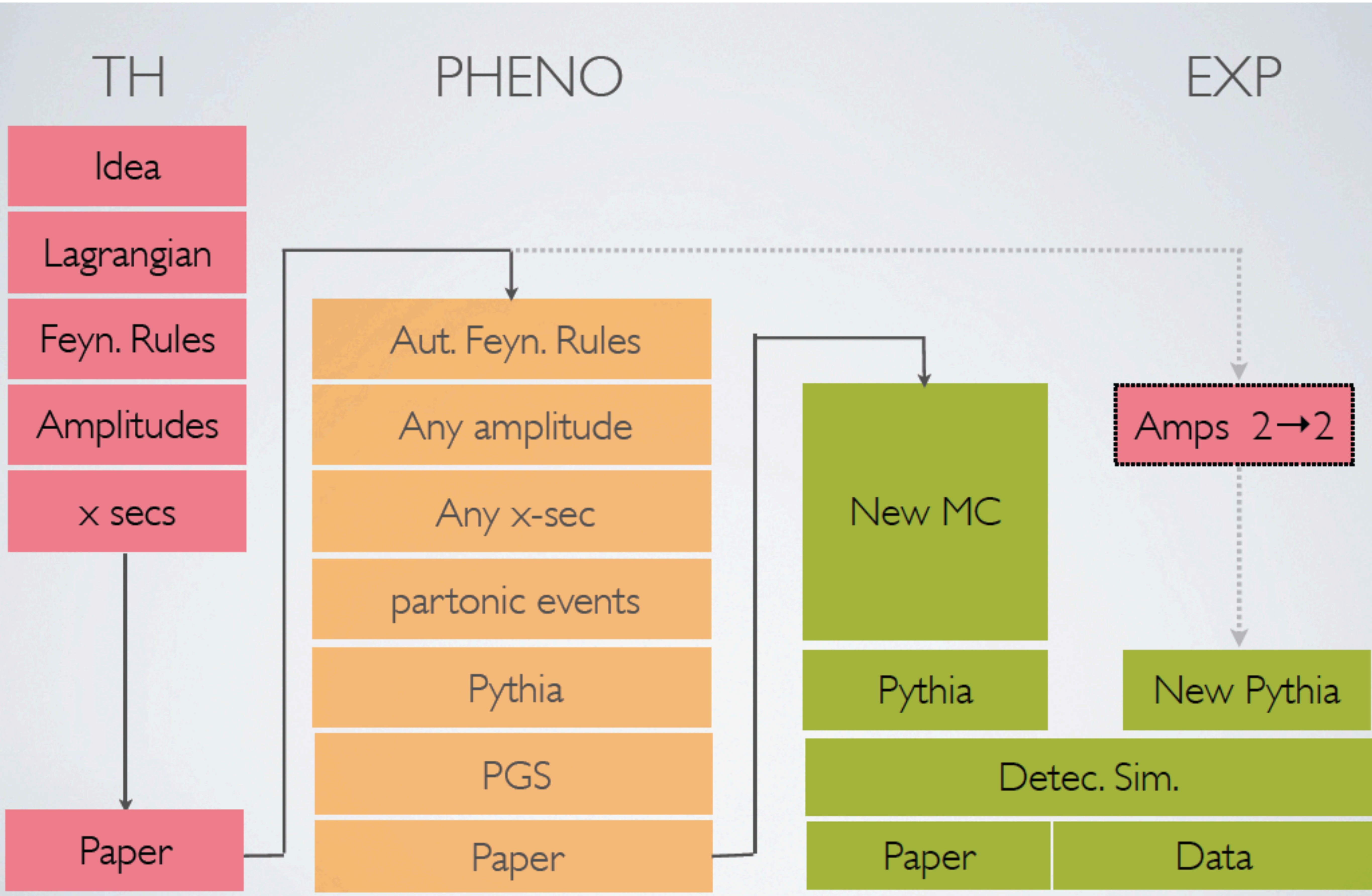



FIG. 2: The 95% C.L. exclusion contours on the fundamental Planck scale ($M_D$) and number of extra dimensions ($n$) for monojet production at DØ (solid lines). The dashed curves correspond to limits from LEP, and the dotted curve is the limit from CDF, both for $\gamma + G_{KK}$ production.

TABLE III: 95% C.L. lower limits on $M_D$.

| $n$ | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| $M_D$ limit without $K$-factor scaling (TeV) | 0.89 | 0.73 | 0.68 | 0.64 | 0.63 | 0.62 |
| $M_D$ limit with $K$-factor scaling (TeV) | 0.99 | 0.80 | 0.73 | 0.66 | 0.65 | 0.63 |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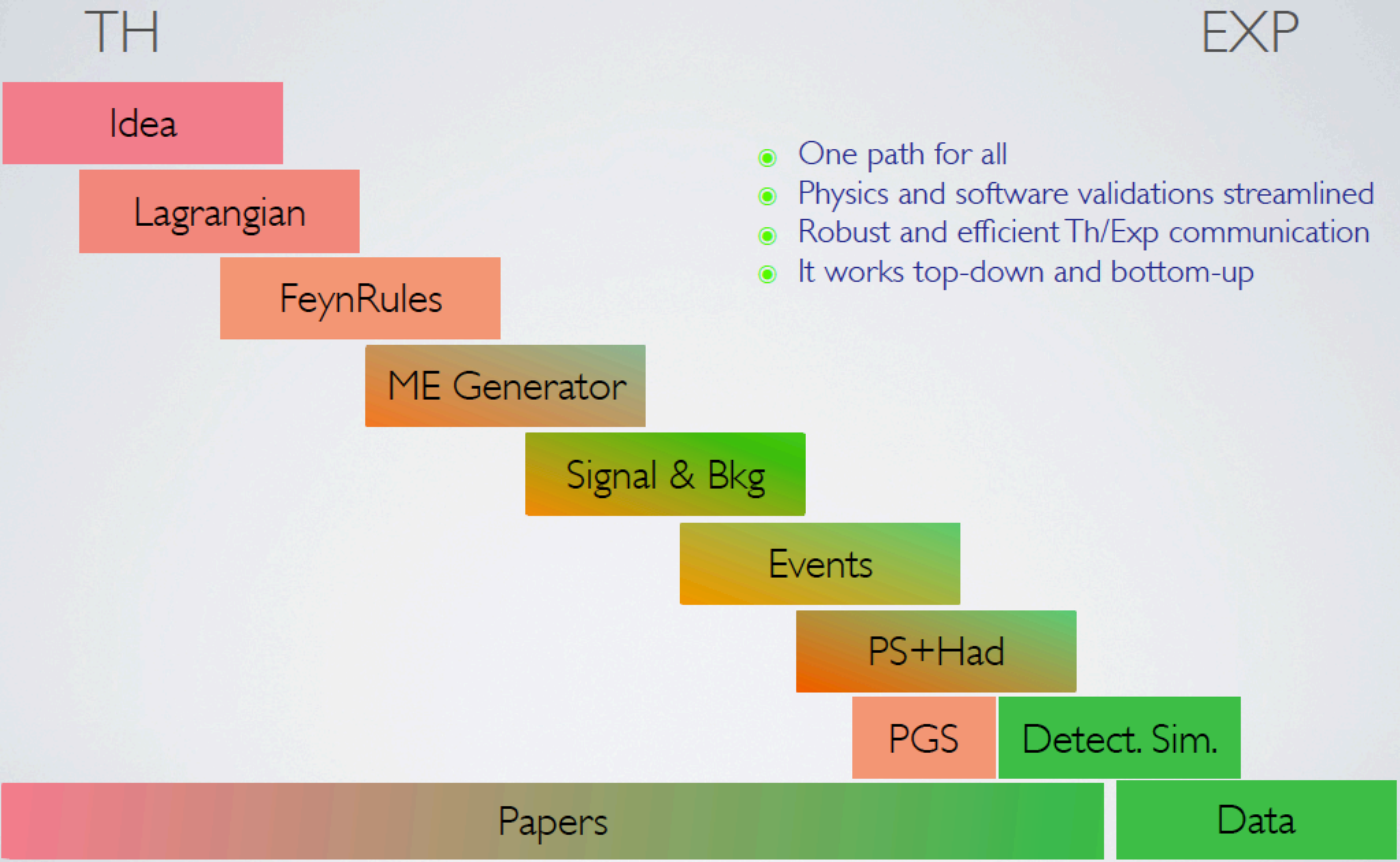
Data




- One path for all
- Physics and software validations streamlined
- Robust and efficient Th/Exp communication
- It works top-down and bottom-up

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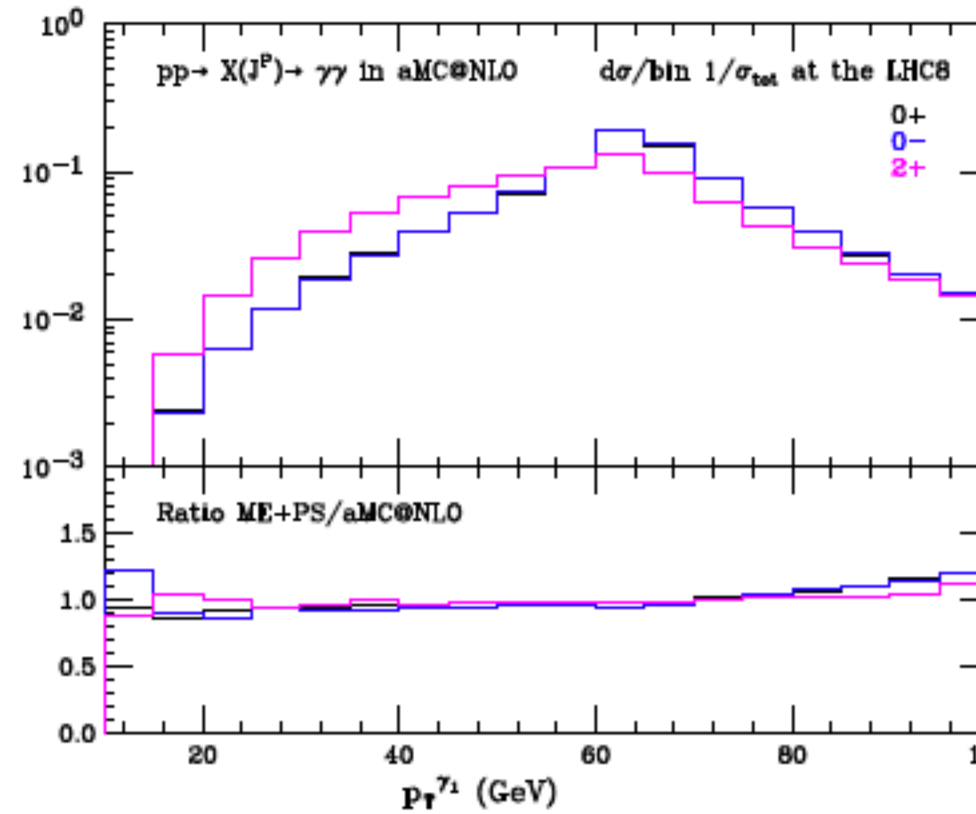
[arXiv:1306.6464]

# A framework for Higgs characterisation

P. Artoisenet,[a] P. de Aquino,[b] F. Demartin,[c] R. Frederix,[d] S. Frixione,[d,e] F. Maltoni,[c] M. K. Mandal,[f] P. Mathews,[g] K. Mawatari,[b] V. Ravindran,[h] S. Seth,[g] P. Torrielli[i] and M. Zaro[c]

$$\mathcal{L}_2^V = -\frac{1}{\Lambda} \sum_{V=Z,W,\gamma,g} \kappa_V T^V_{\mu\nu} X_2^{\mu\nu}$$

$$T^{\gamma}_{\mu\nu} = -g_{\mu\nu}\left[-\frac{1}{4}A^{\rho\sigma}A_{\rho\sigma} + \partial^\rho\partial^\sigma A_\sigma A_\rho + \frac{1}{2}(\partial^\rho A_\rho)^2\right] - A_\mu^{\ \rho} A_{\nu\rho} + \partial_\mu\partial^\rho A_\rho A_\nu + \partial_\nu\partial^\rho A_\rho A_\mu \,,$$



[arXiv:1503.05678]

PHYSICAL REVIEW D **91,** 115015 (2015)

# Search for Kaluza-Klein gravitons in extra dimension models via forward detectors at the LHC

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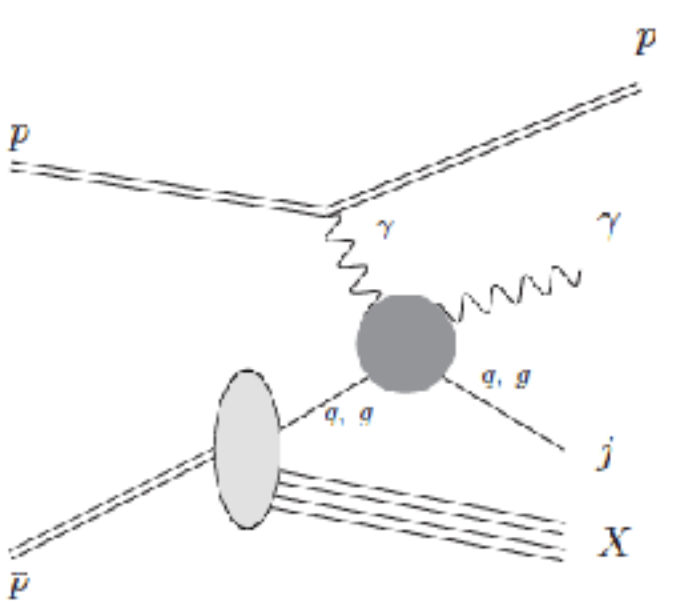


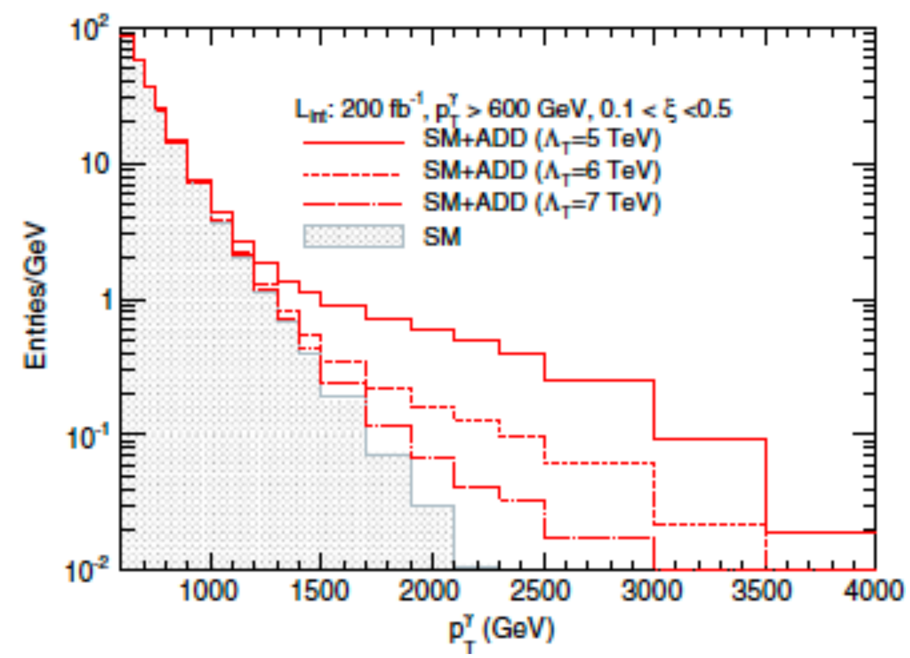


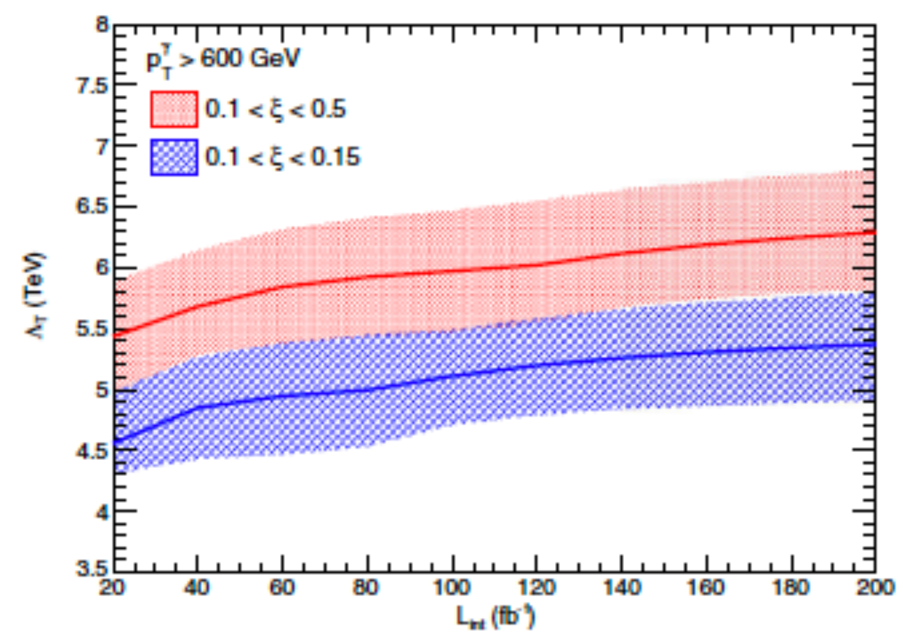

Eur. Phys. J. C (2017) 77:326
DOI 10.1140/epjc/s10052-017-4871-0

THE EUROPEAN PHYSICAL JOURNAL C

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Regular Article - Theoretical Physics

# Simplified dark matter models with a spin-2 mediator at the LHC

**Sabine Kraml**[1], **Ursula Laa**[1,2], **Kentarou Mawatari**[1,3,a], **Kimiko Yamashita**[4]

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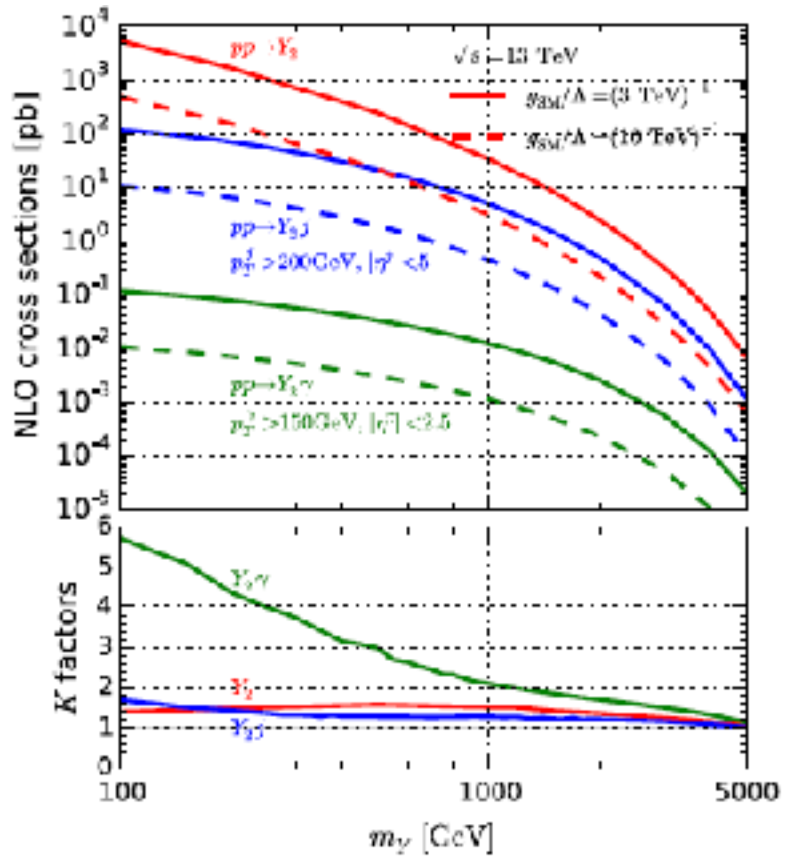
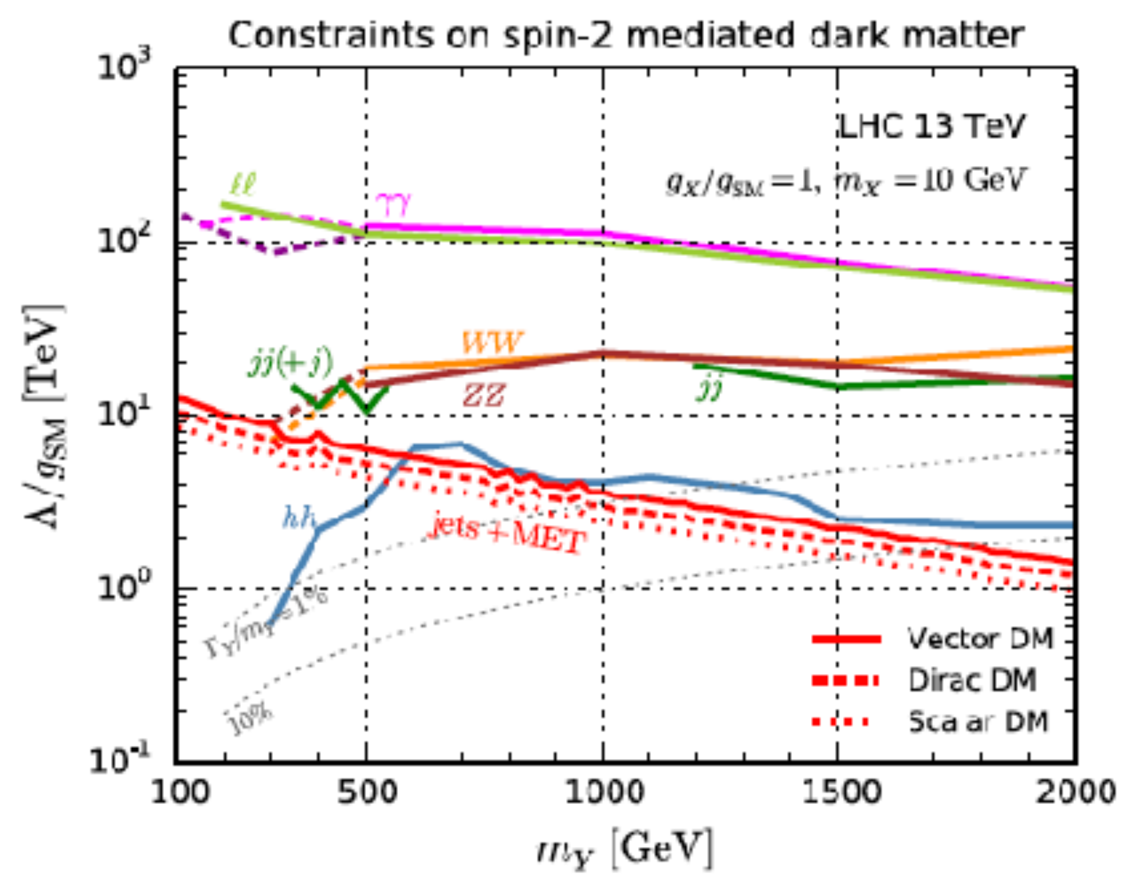
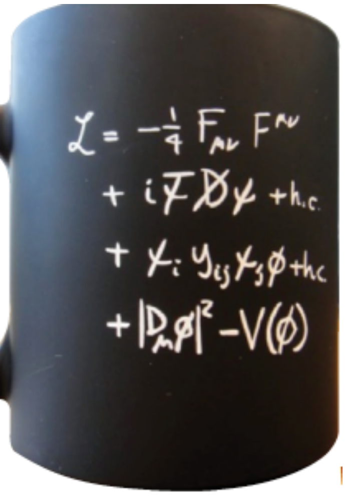


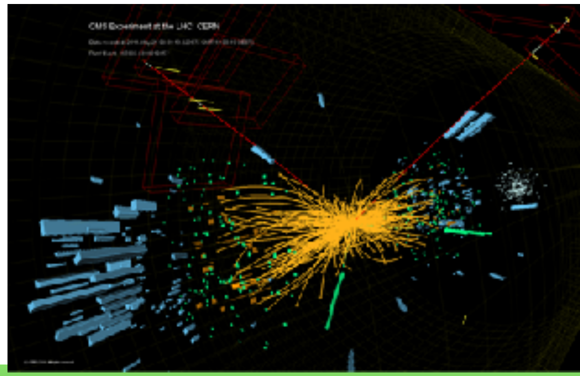



# BSM workflow after LHC

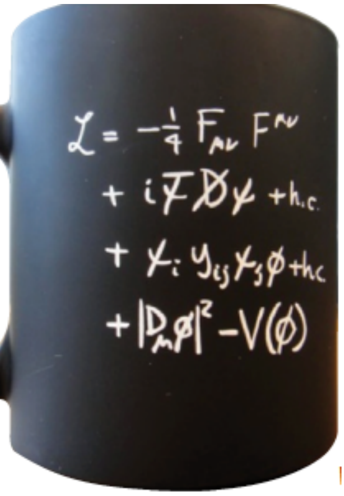



- take a BSM model (symmetry, particle contents,…), i.e. Lagrangian
  - derive the Feynman rules — Model providers
    - draw Feynman diagrams for interesting any processes
      - compute the amplitude (squared) — Matrix-element generators
        - generate events
          - parton-shower/hadronisation — Shower MC
            - detector simulation — Detector simulation tools
              - analysis — Analysis tools

DM physics tool
- DM annihilation (relic, indirect detection)
- DM-N cross section (direct detection)

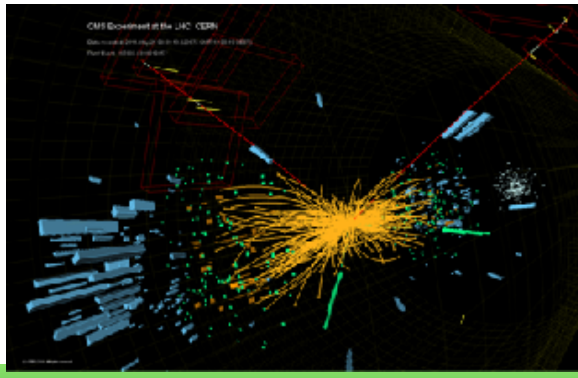


# BSM workflow after LHC



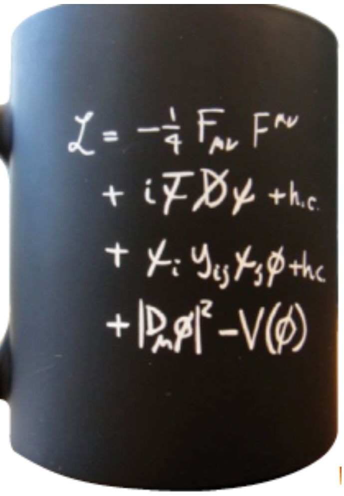

- take a BSM model (symmetry, particle contents,…), i.e. Lagrangian
  - derive the Feynman rules — FeynRules
    - draw Feynman diagrams for interesting any processes
      - compute the amplitude (squared) — MadGraph5_aMC@NLO
        - generate events
          - parton-shower/hadronisation — Pythia8
            - detector simulation — Delphes
              - analysis — MadAnalsysi5

MadDM
MicrOMEGAs



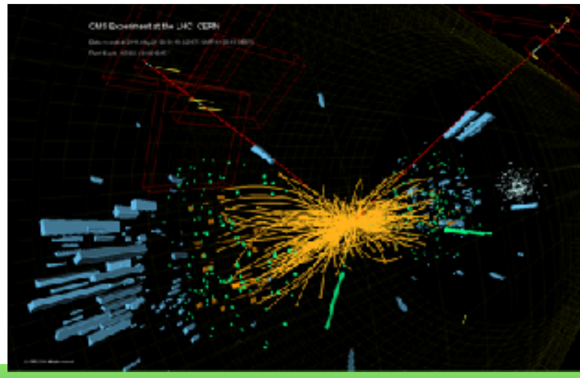
# BSM workflow after LHC

at NLO

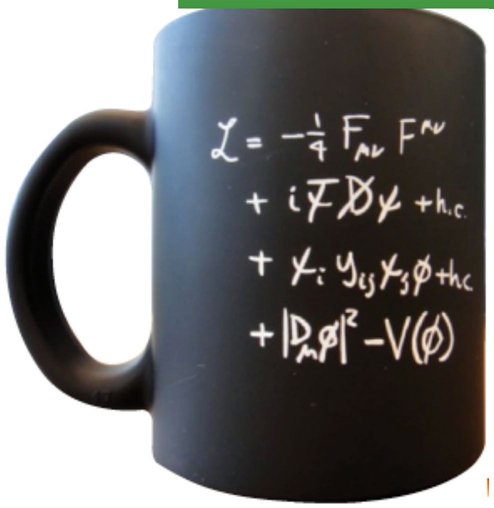


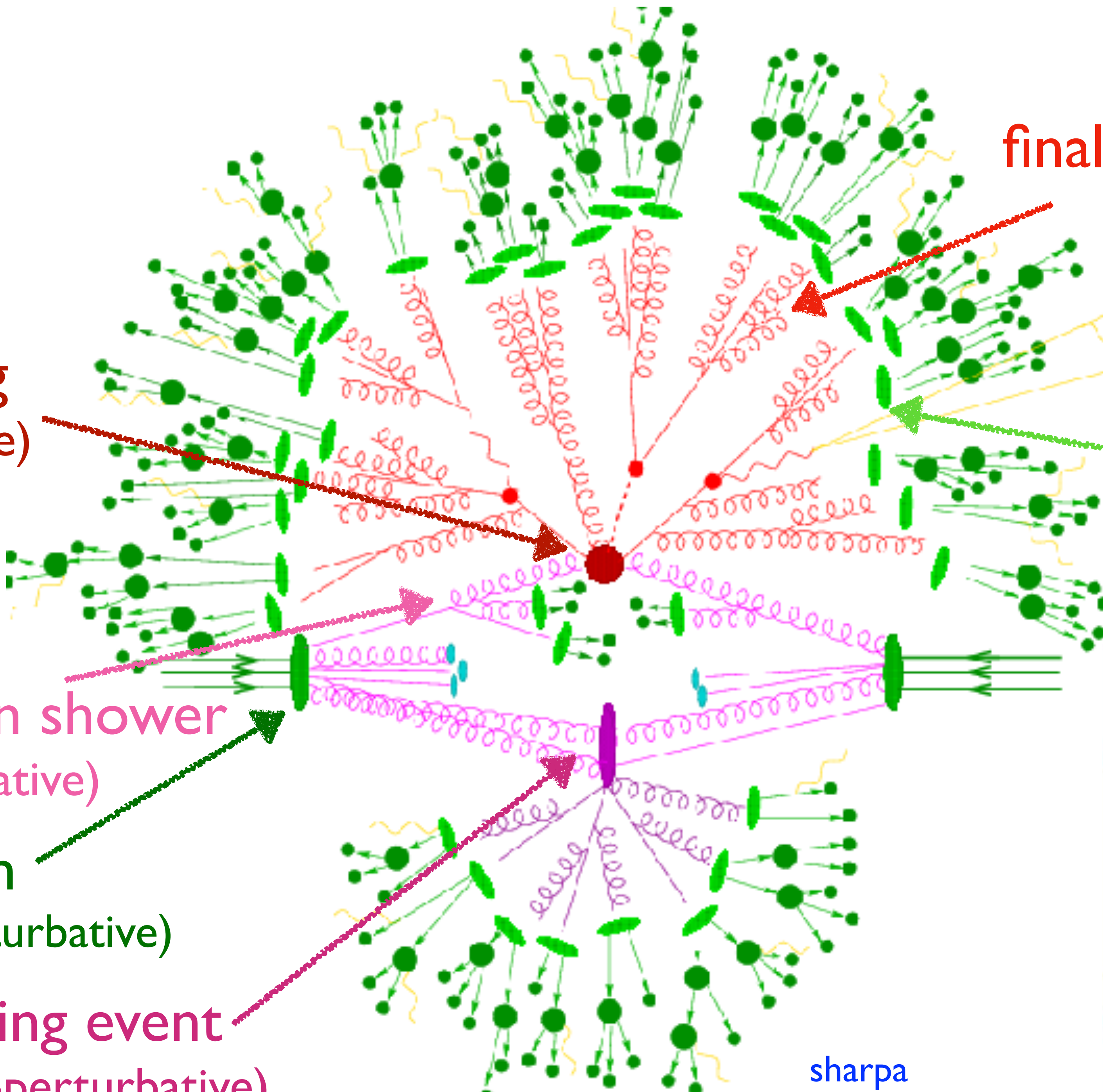

- take a BSM model (symmetry, particle contents,…), i.e. Lagrangian
  - derive the Feynman rules — FeynRules+NLOCT
    - draw Feynman diagrams for interesting any processes
      - compute the amplitude (squared) — MadGraph5_aMC@NLO
        - generate events
          - parton-shower/hadronisation — Pythia8
            - detector simulation — Delphes
              - analysis — MadAnalsysi5

MadDM
MicrOMEGAs



# Monte Carlo generator representation




final-state parton shower
(QCD; perturbative)

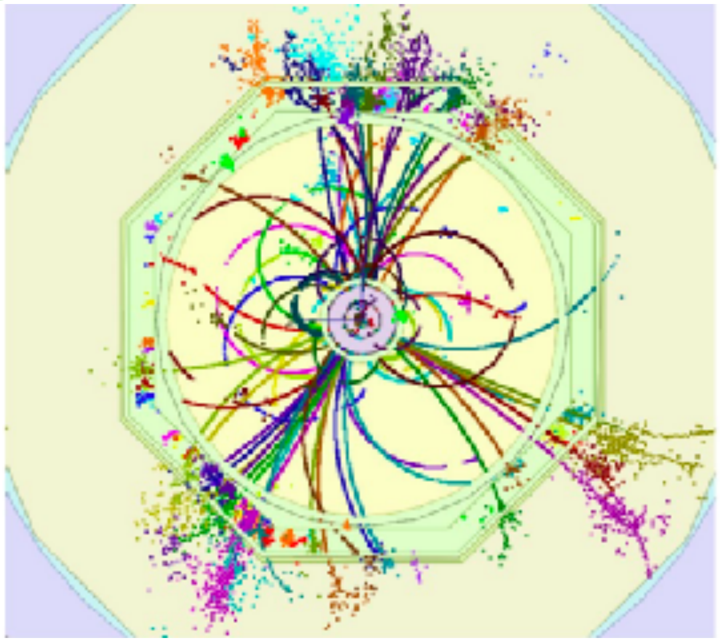
hard scattering
((B)SM; perturbative)

hadronization
(QCD; non-perturbative)

initial-state parton shower
(QCD; perturbative)

proton
(QCD; non-perturbative)

underlying event
(QCD; non-perturbative)

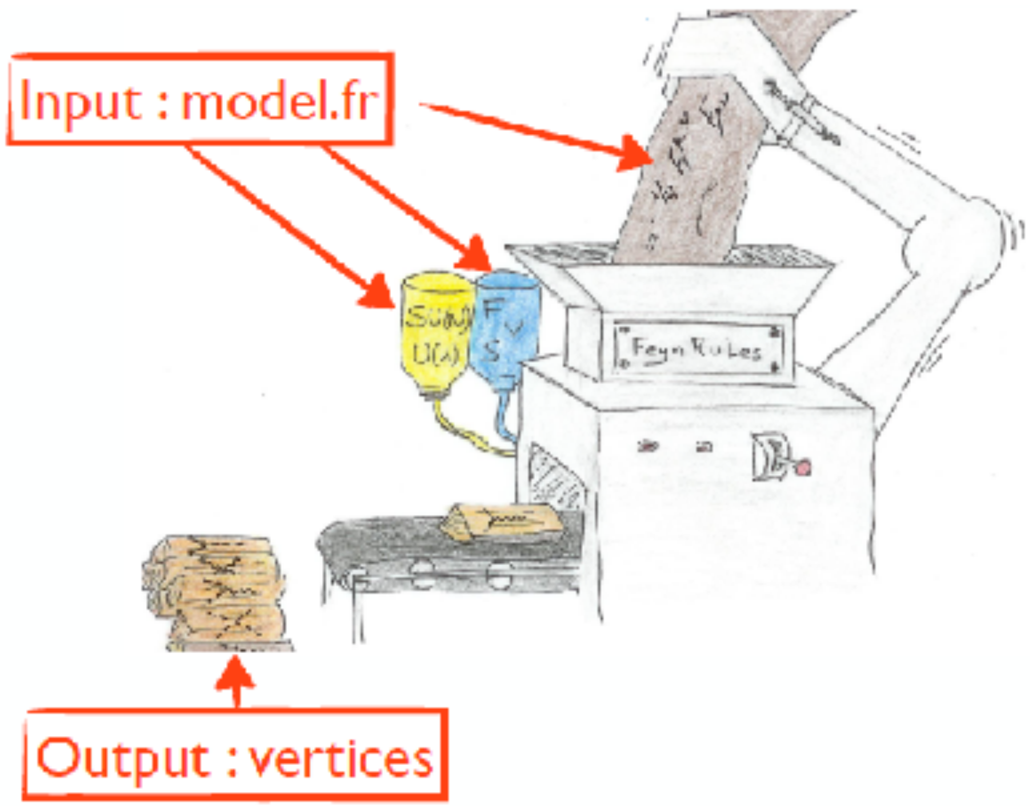


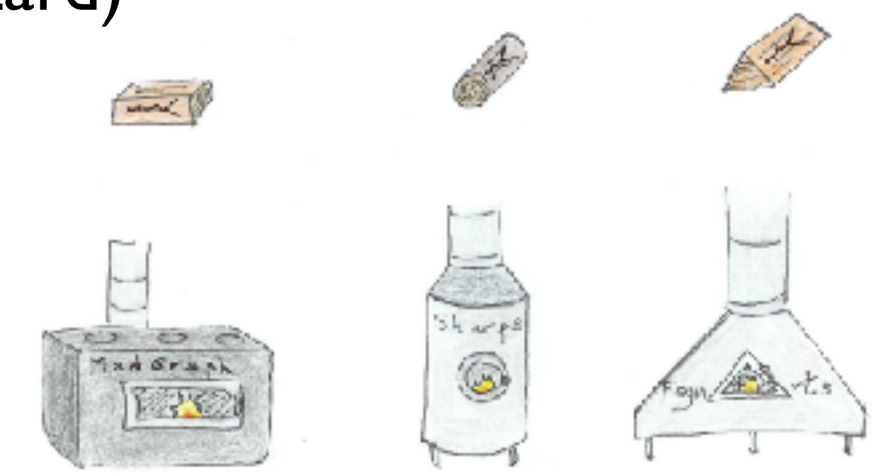
https://feynrules.irmp.ucl.ac.be

# FeynRules in a nutshell

Alloul, Christensen, Degrande, Duhr, Fuks [1310.1921, CPC]
Degrande [1406.3030, CPC]

- a mathematica package that allows to
  - calculate Feynman rules for any QFT models, i.e. Lagrangians
  - output them to various event generators (CalcHEP, FeynArts, MG5aMC, Sherpa, Whizard)



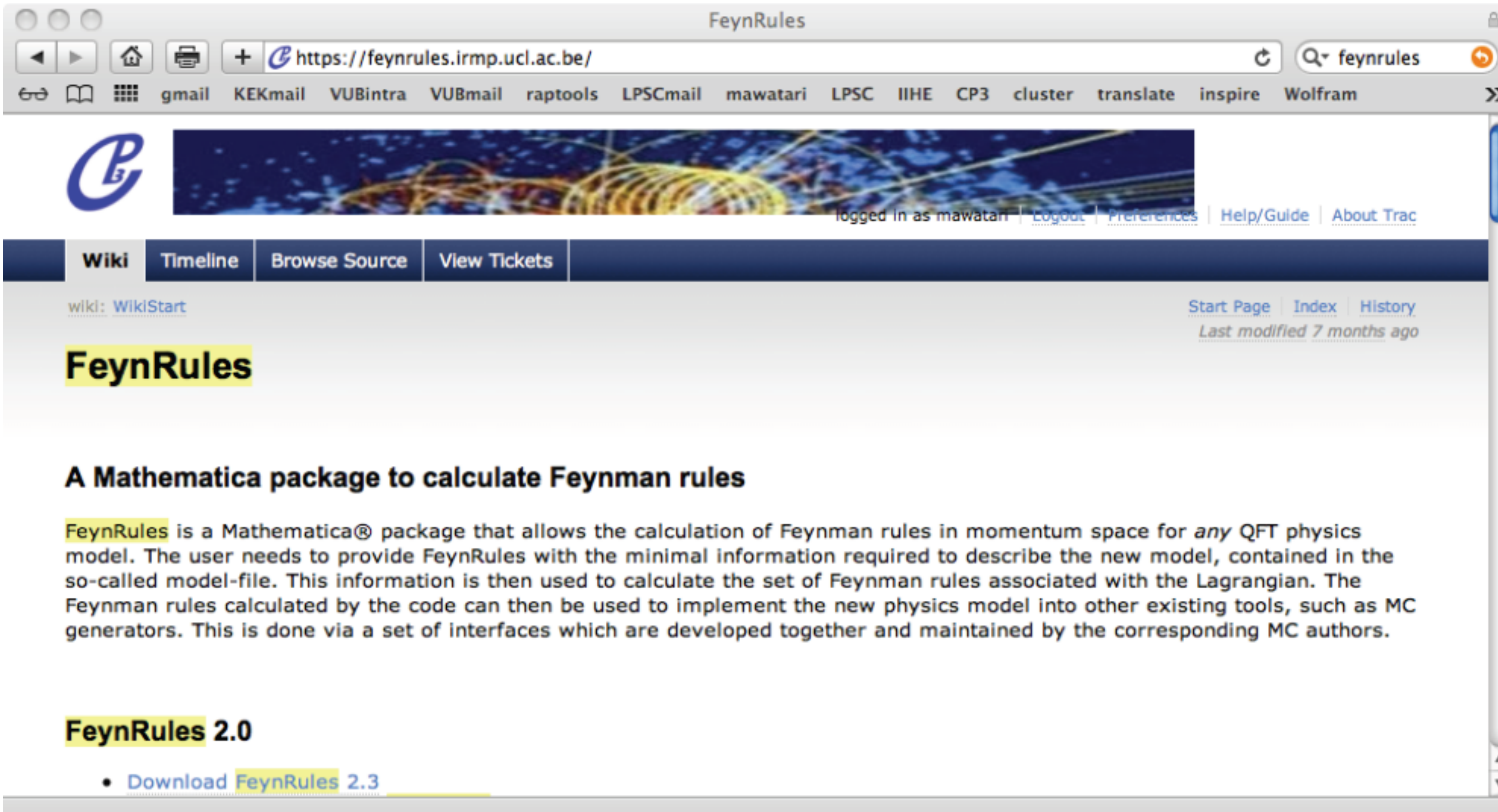
FeynRules outputs can be used directly by event generators

UFO : output with the full information used by several generators

C. Degrande

* Universal FeynRules Output
Degrande et al. [1108.2040, CPC]

Alloul, Christensen, Degrande, Duhr, Fuks [1310.1921]



# BSM models in the FeynRules model database

feynrules.irmp.ucl.ac.be/wiki/ModelDatabaseMainPage

## FeynRules model database

This page contains a collection of models that are already implemented in FeynRules. For each model, a complete model-file is available, containing all the information that is needed, as well as the Lagrangian, as well as the references to the papers were this Lagrangian was taken from. All model-files can be freely downloaded and changed, serving like this as the starting point for building new models. A TeX-file for each model containing a summary of the Feynman Rules produced by FeynRules is also available.

The Standard model model-file is already included in the distribution of the FeynRules, but it can also be downloaded independently from the corresponding link below.

**We encourage model builders writing a FeynRules implementation of their model to make their model file(s) public in the FeynRules model database, in order to make them useful to a community as wide as possible. For further information on how to make your model implementation public via the FeynRules model database, please send an email to**

- neil@...
- celine.degrande@...
- claude.duhr@...
- benjamin.fuks@...

### Available models

| | |
|---|---|
| Standard Model | The SM implementation of FeynRules, included into the distribution of the FeynRules package. |
| Simple extensions of the SM | Several models based on the SM that include one or more additional particles, like a 4th generation, a second Higgs doublet or additional colored scalars. |
| Supersymmetric Models | Various supersymmetric extensions of the SM, including the MSSM, the NMSSM and many more. |
| Extra-dimensional Models | Extensions of the SM including KK excitations of the SM particles. |
| Strongly coupled and effective field theories | Including Technicolor, Little Higgs, as well as SM higher-dimensional operators, vector-like quarks. |
| Miscellaneous | |
| NLO | Models ready for NLO computations |

feynrules.irmp.ucl.ac.be/wiki/EffectiveModels

**Strongly-coupled models and effective field theories**

| Model | Short Description | Contact | Status |
|---|---|---|---|
| Axion-Like Particles | Effective Theories for a light Axion-Like Particle | I. Brivio | Available |
| Anomalous Gauge Boson Couplings | Model including anomalous couplings among gauge bosons | O.J.P. Eboli, M.C. Gonzalez-Garcia | Available |
| BSM Characterisation | The SM EFT Lagrangian in the mass basis | B. Fuks, K. Mawatari | Available |
| Complete top-quark EFT implementation | A complete top-quark EFT implementation | G. Durieux and C. Zhang | Available |
| Chiral perturbation theory | The effective Lagrangian describing the low-energy interaction of mesons. | C. Degrande | Available |
| EFT mass basis | The SM EFT Lagrangian in the mass basis | B. Fuks, K. Mawatari | Available |
| Effective theory for 4 top production | Dimension-six operators invariant under the SM symmetries affecting 4 top interactions | C.Degrande | Available |
| Effective theory for weak gauge boson production | Dimension-six operators invariant under the SM symmetries affecting triple gauge boson interactions | C.Degrande | Available |
| Effective top-Higgs interactions | Dimension 6 Higgs-top interactions. | E. Salvioni and J. Dror | Available |
| FCNC Higgs Interactions | The SM | | |
| FCNC Top interactions | The SM Interacti | | |
| HiggsCharacterisation | The mod resonan | | |
| Higgs Effective Lagrangian | Higgs ef | | |
| Higgs effective theory | An add-on for the SM implementation containing the dimension 5 gluon fusion operator. | C. Duhr | Available |
| Mimimal Higgsless Model (3-Site Model) | A higgsless model, including new heavy fermions and a Z' and a W' boson. | N. Christensen | Available |
| nTGC Effective theory | dimension-8 operators invariant under the SM symmetries affecting neutral triple gauge boson couplings | C. Degrande | Available |
| Strongly Interacting Light Higgs | A model including higher-dimensional SM operators to describe strongly coupled theories of EWSB. | C. Degrande | Available |
| Technicolor | The Minimal Walking Technicolor Model | M. Järvinen, T. Hapola, E. Del Nobile, C. Pica | Available |
| TFCNC | The SM, plus FCNC top interactions. | M. Buchkremer, G. Cacciapaglia, A. Deandrea, L. Panizzi | Available |
| The SMEFT in the Warsaw basis | Standard Model Effective Field Theory | I. Brivio, Y. Jiang, M. Trott, | Available |
| Top Effective theory | Higher-dimensional operators invariant under the SM symmetries affecting top production and decay | C. Degrande | Available |
| Top Effective theory for FCNC | Dimension-six operators invariant under the SM symmetries affecting top FCNC | C.Degrande, G. Durieux, F. Maltoni, C. Zhang | Available |

To download models in the FR repository:

MG5_aMC> display modellist

inspirehep.net

f a alwall and topcite 1000+ | Brief format | Search | Easy Search | Advanced Search

find j "Phys.Rev.Lett.,105*" :: more

Sort by: earliest date | desc. | - or rank by - 

Display results: 25 results | single list

**HEP** 3 records found — Search took 0.56 seconds.

1. **The automated computation of tree-level and next-to-leading order differential cross sections, and their matching to parton shower simulations**
J. Alwall (Taiwan, Natl. Taiwan U.), R. Frederix, S. Frixione (CERN), V. Hirschi (SLAC), F. Maltoni, O. Mattelaer (Louvain U., CP3), H. -S. Shao (Peking U. & Peking U., SKLNPT), T. Stelzer (Illinois U., Urbana), P. Torrielli (Zurich U.), M. Zaro (Paris U., IV & Paris, LPTHE). May 1, 2014. 157 pp.
Published in **JHEP 1407 (2014) 079**
CERN-PH-TH-2014-064, CP3-14-18, LPN14-066,
DOI: 10.1007/JHEP07(2014)079
e-Print: **arXiv:1405.0301 [hep-ph]** | PDF
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
CERN Document Server; ADS Abstract Service; Link to Article from SCOAP3; Link to MadGraph5_aMC@NLO homepage; Link to Launchpad page
Detailed record - Cited by 2759 records 1000+

**MadGraph5_aMC@NLO**

2. **MadGraph 5 : Going Beyond** the SM (but at the tree level)
Johan Alwall (Fermilab), Michel Herquet (NIKHEF, Amsterdam), Fabio Maltoni, Olivier Mattelaer (Louvain U., CP3), Tim Stelzer (Illinois U., Urbana). Jun 2011. 37 pp.
Published in **JHEP 1106 (2011) 128**
FERMILAB-PUB-11-448-T
DOI: 10.1007/JHEP06(2011)128
e-Print: **arXiv:1106.0522 [hep-ph]** | PDF
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
ADS Abstract Service; Fermilab Library Server (fulltext available)
Detailed record - Cited by 2654 records 1000+

3. **MadGraph/MadEvent v4: The New Web Generation**
Johan Alwall (SLAC), Pavel Demin, Simon de Visscher, Rikkert Frederix, Michel Herquet, Fabio Maltoni (Louvain U., CP3), Tilman Plehn (Edinburgh U.), David L. Rainwater (Rochester U.), Tim Stelzer (Illinois U., Urbana). Jun 2007. 38 pp.
Published in **JHEP 0709 (2007) 028**
SLAC-PUB-12603, CP3-07-17
DOI: 10.1088/1126-6708/2007/09/028
e-Print: **arXiv:0706.2334 [hep-ph]** | PDF
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
ADS Abstract Service; OSTI.gov Server; SLAC Document Server
Detailed record - Cited by 1645 records 1000+

https://launchpad.net/mg5amcnlo

Kentarou Mawatari (kentarou-mawatari) • Log Out

MADGRAPH 5

# MadGraph5_aMC@NLO

Overview | Code | Bugs | Blueprints | Translations | Answers

Registered 2009-09-15 by Michel Herquet

MadGraph5_aMC@NLO is a framework that aims at providing all the elements necessary for SM and BSM phenomenology, such as the computations of cross sections, the generation of hard events and their matching with event generators, and the use of a variety of tools relevant to event manipulation and analysis. Processes can be simulated to LO accuracy for any user-defined Lagrangian, an the NLO accuracy in the case of models that support this kind of calculations -- prominent among these are QCD and EW corrections to SM processes. Matrix elements at the tree- and one-loop-level can also be obtained.

MadGraph5_aMC@NLO is the new version of both MadGraph5 and aMC@NLO that unifies the LO and NLO lines of development of automated tools within the MadGraph family. It therefore supersedes all the MadGraph5 1.5.x versions and all the beta versions of aMC@NLO.

The standard reference for the use of the code is: J. Alwall et al, "The automated computation of tree-level and next-to-leading order differential cross sections, and their matching to parton shower simulations", arXiv:1405.0301 [hep-ph]. In addition to that, computations in mixed-coupling expansions and/or of NLO corrections in theories other than QCD (eg NLO EW) require the citation of: R. Frederix et al, "The automation of next-to-leading order electroweak calculations", arXiv:1804.10017 [hep-ph]. A more complete

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## Get Involved

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- Ask a question
- Register a blueprint
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## Downloads

Latest version is 2.6.x

MG5_aMC_v2.6.2.tar.gz

MG5_aMC_v3....beta.tar.gz

released on 2017-08-15

All downloads

https://answers.launchpad.net/mg5amcnlo/+addquest

Kentarou Mawatari (kentarou-mawatari) • Log Out

# MadGraph5_aMC@NLO

Overview Code Bugs Blueprints Translations **Answers**

## Ask a question

These other questions seem similar to yours. You may want to take a look at them.

- 263917: bwcutoff in top pair gluon gluon/ e+ e- production and decay (Answered)
  posted on 2015-03-20 in MadGraph5_aMC@NLO
- 244869: e- e+ Interactions (Solved)
  posted on 2014-03-03 in MadGraph5_aMC@NLO
- 227310: ISR/FSR for e+ e- Interactions (Answered)
  posted on 2013-04-23 in MadGraph5_aMC@NLO
- 647442: Including ISR in Collisions (Solved)
  posted on 2017-07-11 in MadGraph5_aMC@NLO
- 224726: PhotonFlux subprocess (Answered)
  posted on 2013-03-20 in MadGraph5_aMC@NLO
- 218770: 2>1 process issue? (Answered)
  posted on 2013-01-09 in MadGraph5_aMC@NLO

If you did not find your problem in these existing FAQs or questions, enter the details of your problem to alert the MadGraph5_aMC@NLO support community, so they can help you resolve the issue.

Change your preferred languages to modify the list of languages available for writing the question.

**Language:**

English (en) *

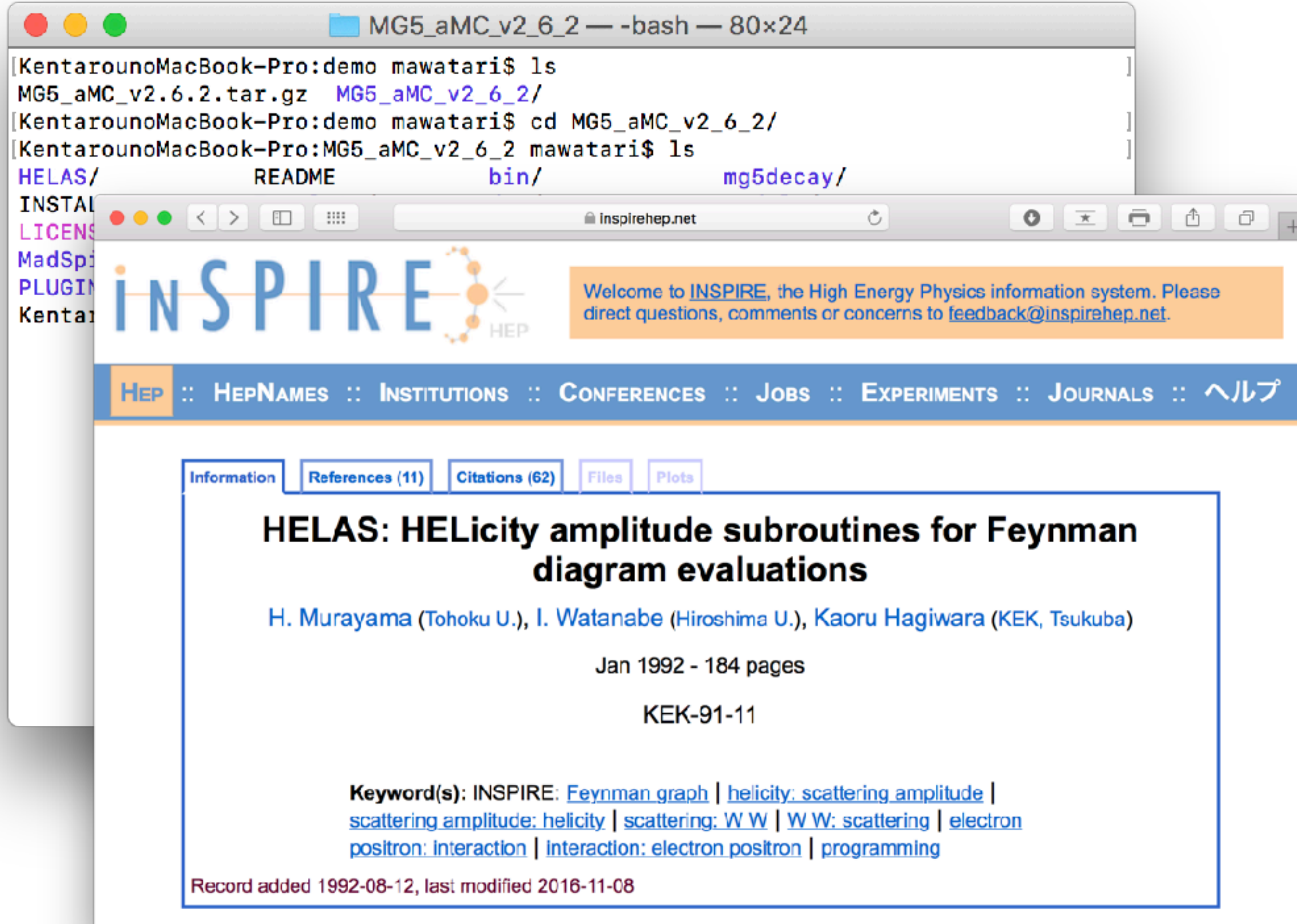
The language in which this question is written. The languages marked with a star (*) are the languages spoken by at least one answer contact in the community.

**Summary:**

e+e- linear collider top

A one-line summary of the issue or problem.

One can directly communicate with the developers via Launchpad (ask questions, report bugs, etc).


MG5_aMC_v2_6_2 — -bash — 80×24
KentarounoMacBook-Pro:demo mawatari$ ls
MG5_aMC_v2.6.2.tar.gz MG5_aMC_v2_6_2/
KentarounoMacBook-Pro:demo mawatari$ cd MG5_aMC_v2_6_2/
KentarounoMacBook-Pro:MG5_aMC_v2_6_2 mawatari$ ls
HELAS/ README bin/ mg5decay/
inspirehep.net
Welcome to INSPIRE, the High Energy Physics information system. Please direct questions, comments or concerns to feedback@inspirehep.net.
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Information
References (11)
Citations (62)
Files
Plots
HELAS: HELicity amplitude subroutines for Feynman diagram evaluations
H. Murayama (Tohoku U.), I. Watanabe (Hiroshima U.), Kaoru Hagiwara (KEK, Tsukuba)
Jan 1992 - 184 pages
KEK-91-11
Keyword(s): INSPIRE: Feynman graph | helicity: scattering amplitude | scattering amplitude: helicity | scattering: W W | W W: scattering | electron positron: interaction | interaction: electron positron | programming
Record added 1992-08-12, last modified 2016-11-08

Conte, Fuks, Serret [1206.1599]
Conte, Dumont, Fuks, Wymant [1405.3982]
Dumont, Fuks, Kraml, Bein, Chalons, Conte, Kulkarni, Sengupta, Wymant [1407.3278]

Canonical Group Ltd launchpad.net/madanalysis5

Kentarou Mawatari (kentarou-mawatari) • Log Out

# MadAnalysis 5

**Overview** Code Bugs Blueprints Translations Answers

Registered 2013-04-13 by Eric Conte

MadAnalysis 5 is a new framework for phenomenological investigations at particle colliders. Based on a C++ kernel, this program allows to efficiently perform, in a straightforward and user-friendly fashion, sophisticated physics analyses of event files such as those generated by a large class of Monte Carlo event generators.

MadAnalysis 5 has been recently extended to allow for the recasting of existing LHC analyses. These features are available from version 1.1.12 onwards (currently available as beta version). For documentation on the MA5 PAD (public analysis database) and on instructions to implement new analyses, see http://madanalysis.irmp.ucl.ac.be/wiki/PublicAnalysisDatabase

The latest stable version of the MadAnalysis 5 package can be obtained in two ways:
- directly from the Bazaar versioning system by typing in a shell:
  bzr branch lp:madanalysis5
- as a tar-ball (to be downloaded from the right of this page).

More information on the program can be found on the wiki http://madanalysis.irmp.ucl.ac.be

If you use MadAnalysis 5, please cite
1. E. Conte, B. Fuks and G. Serret,
   Comput. Phys. Commun. 184 (2013) 222
   http://arxiv.org/abs/1206.1599

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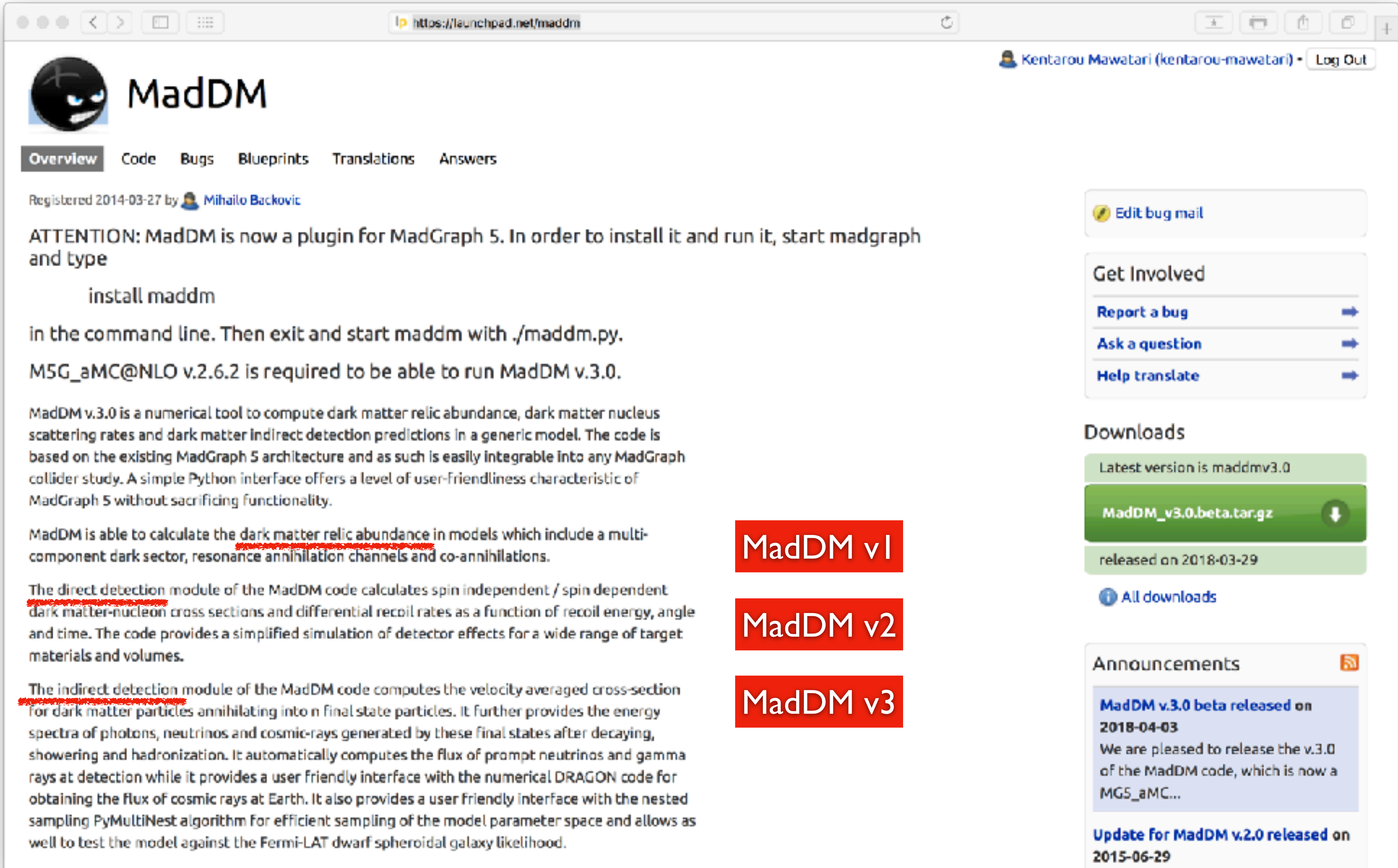
## Downloads

Latest version is v1.3
MadAnalysis5_v1.3.tar.gz
released on 2016-03-01
All downloads

MadDM1: Backovic, Kong, McCaskey [1308.4955]
MadDM2: Backovic, Kong, Martini, Mattelaer, Mohlabeng [1505.04190]
MadDM3: Ambrogi, Arina, Backovic, Heisig, Maltoni, Mantani, Mattelaer, Mohlabeng [1804.00044]


https://launchpad.net/maddm

Kentarou Mawatari (kentarou-mawatari) • Log Out

# MadDM

Overview Code Bugs Blueprints Translations Answers

Registered 2014-03-27 by Mihailo Backovic

ATTENTION: MadDM is now a plugin for MadGraph 5. In order to install it and run it, start madgraph and type

install maddm

in the command line. Then exit and start maddm with ./maddm.py.

MG5_aMC@NLO v.2.6.2 is required to be able to run MadDM v.3.0.

MadDM v.3.0 is a numerical tool to compute dark matter relic abundance, dark matter nucleus scattering rates and dark matter indirect detection predictions in a generic model. The code is based on the existing MadGraph 5 architecture and as such is easily integrable into any MadGraph collider study. A simple Python interface offers a level of user-friendliness characteristic of MadGraph 5 without sacrificing functionality.

MadDM is able to calculate the dark matter relic abundance in models which include a multi-component dark sector, resonance annihilation channels and co-annihilations.

**MadDM v1**

The direct detection module of the MadDM code calculates spin independent / spin dependent dark matter-nucleon cross sections and differential recoil rates as a function of recoil energy, angle and time. The code provides a simplified simulation of detector effects for a wide range of target materials and volumes.

**MadDM v2**

The indirect detection module of the MadDM code computes the velocity averaged cross-section for dark matter particles annihilating into n final state particles. It further provides the energy spectra of photons, neutrinos and cosmic-rays generated by these final states after decaying, showering and hadronization. It automatically computes the flux of prompt neutrinos and gamma rays at detection while it provides a user friendly interface with the numerical DRAGON code for obtaining the flux of cosmic rays at Earth. It also provides a user friendly interface with the nested sampling PyMultiNest algorithm for efficient sampling of the model parameter space and allows as well to test the model against the Fermi-LAT dwarf spheroidal galaxy likelihood.

**MadDM v3**

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Downloads

Latest version is maddmv3.0

MadDM_v3.0.beta.tar.gz

released on 2018-03-29

All downloads

Announcements

**MadDM v.3.0 beta released** on 2018-04-03
We are pleased to release the v.3.0 of the MadDM code, which is now a MG5_aMC...

**Update for MadDM v.2.0 released** on 2015-06-29