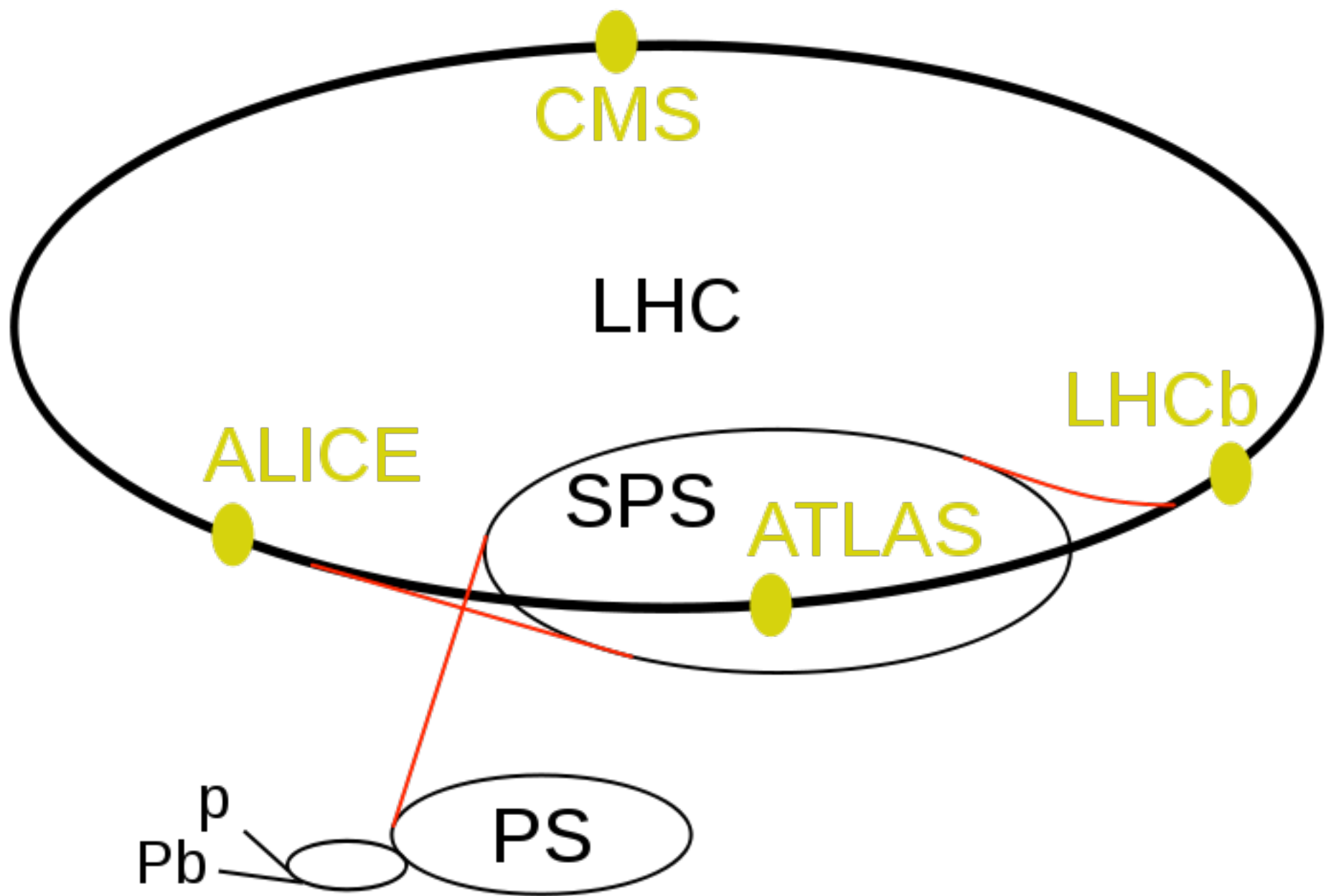


Model Building in the LHC Era

from model to LHC

Neil Christensen

University of Wisconsin - Madison

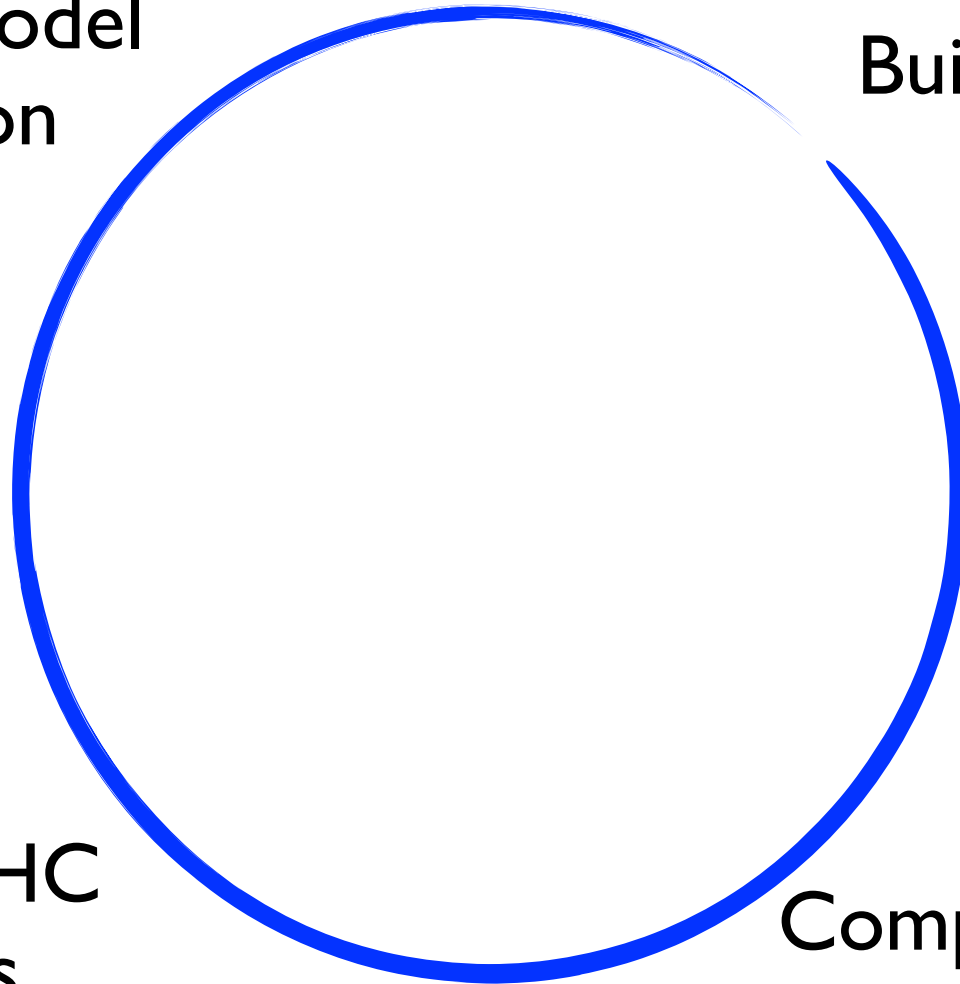


Implement model
in simulation
software

Build Model

Simulate LHC
collisions

Compare predictions
with experiments

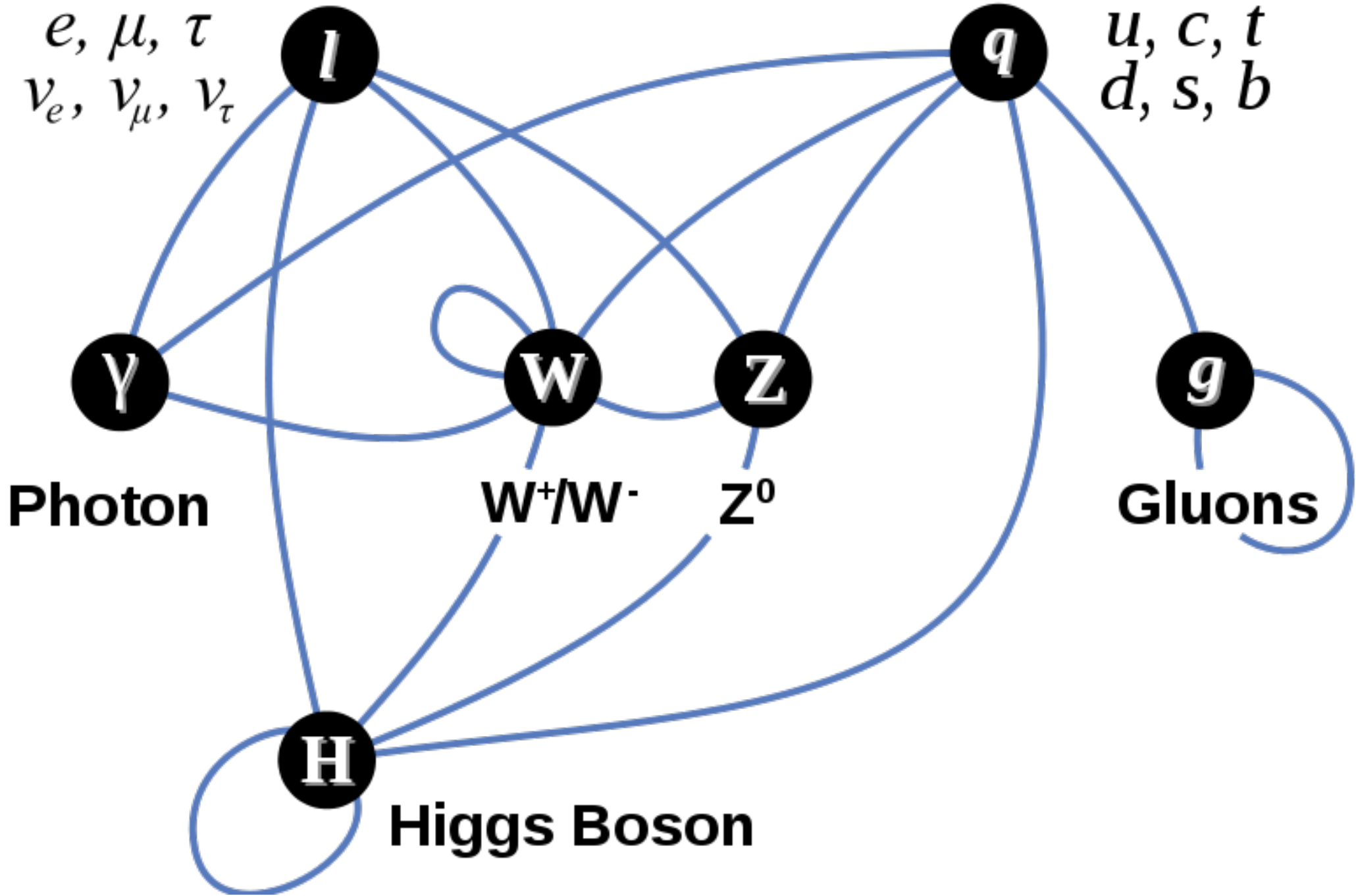


Leptons

e, μ, τ
 ν_e, ν_μ, ν_τ

Quarks

u, c, t
 d, s, b



Photon

W^+/W^-

Z^0

Gluons

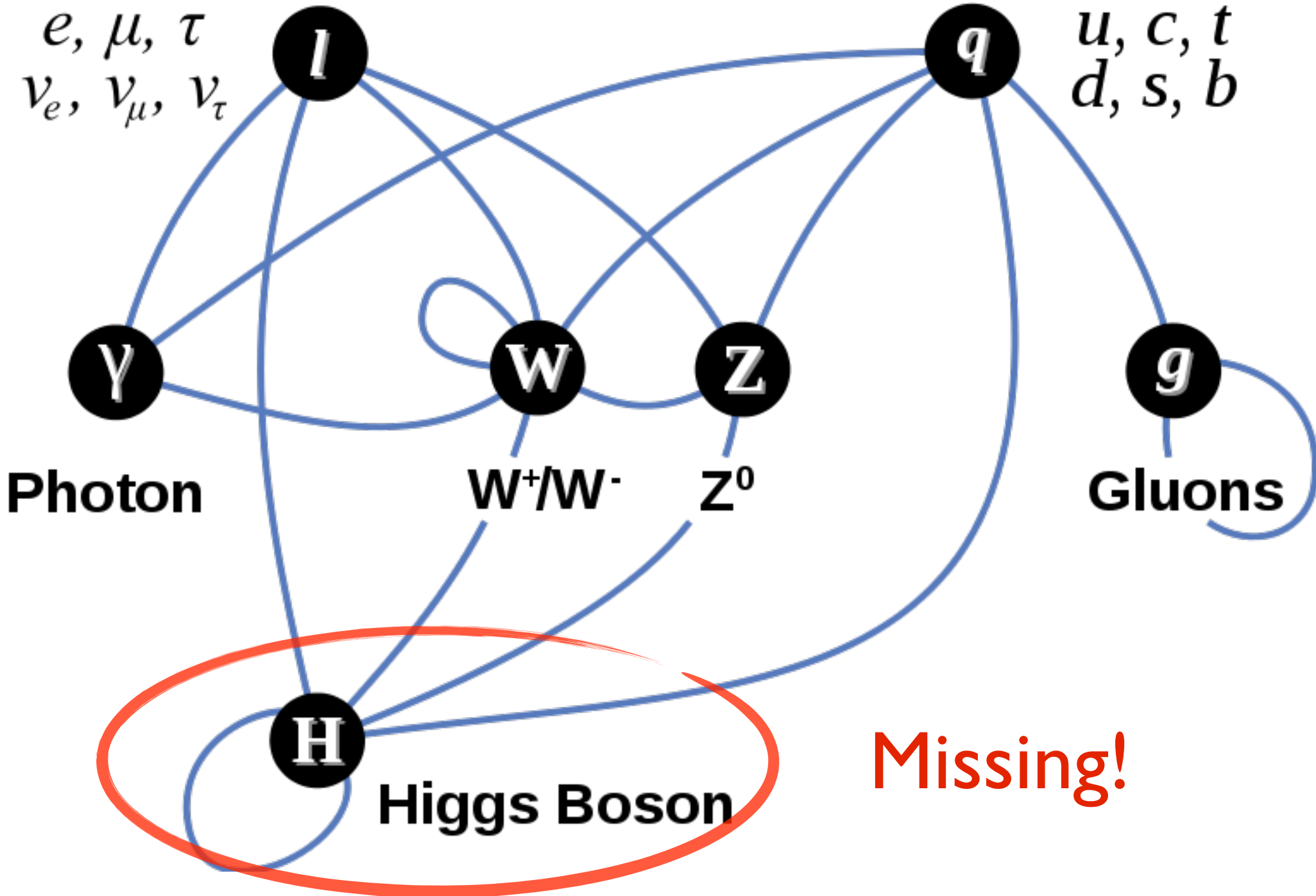
Higgs Boson

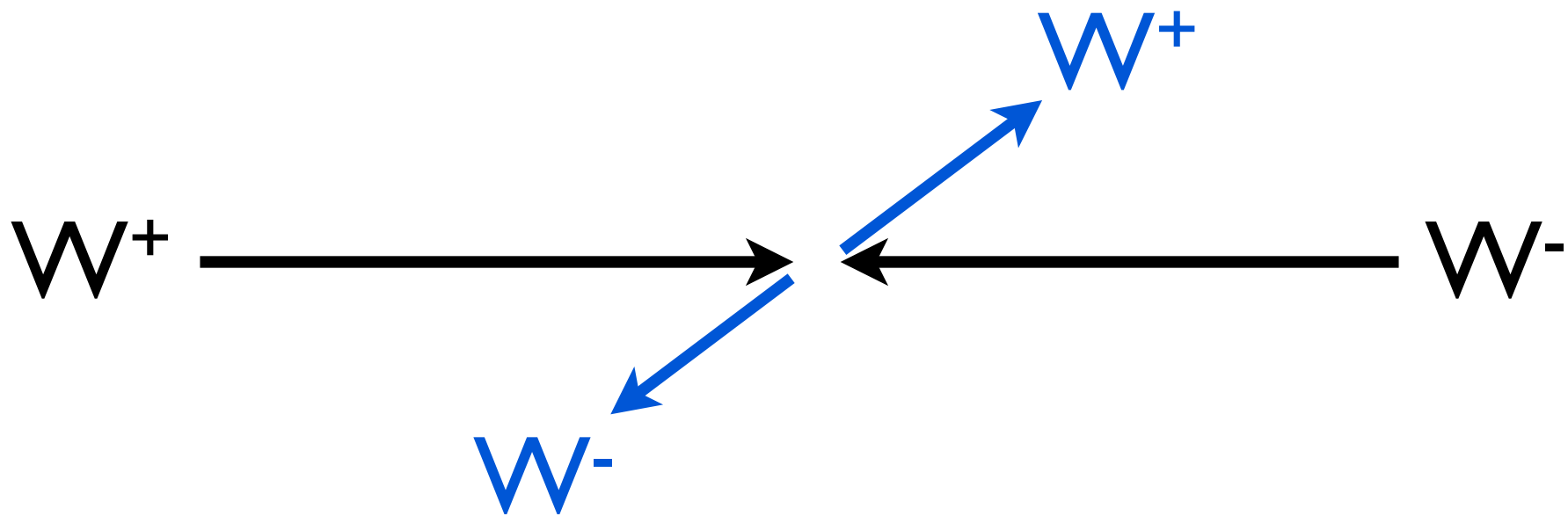
Leptons

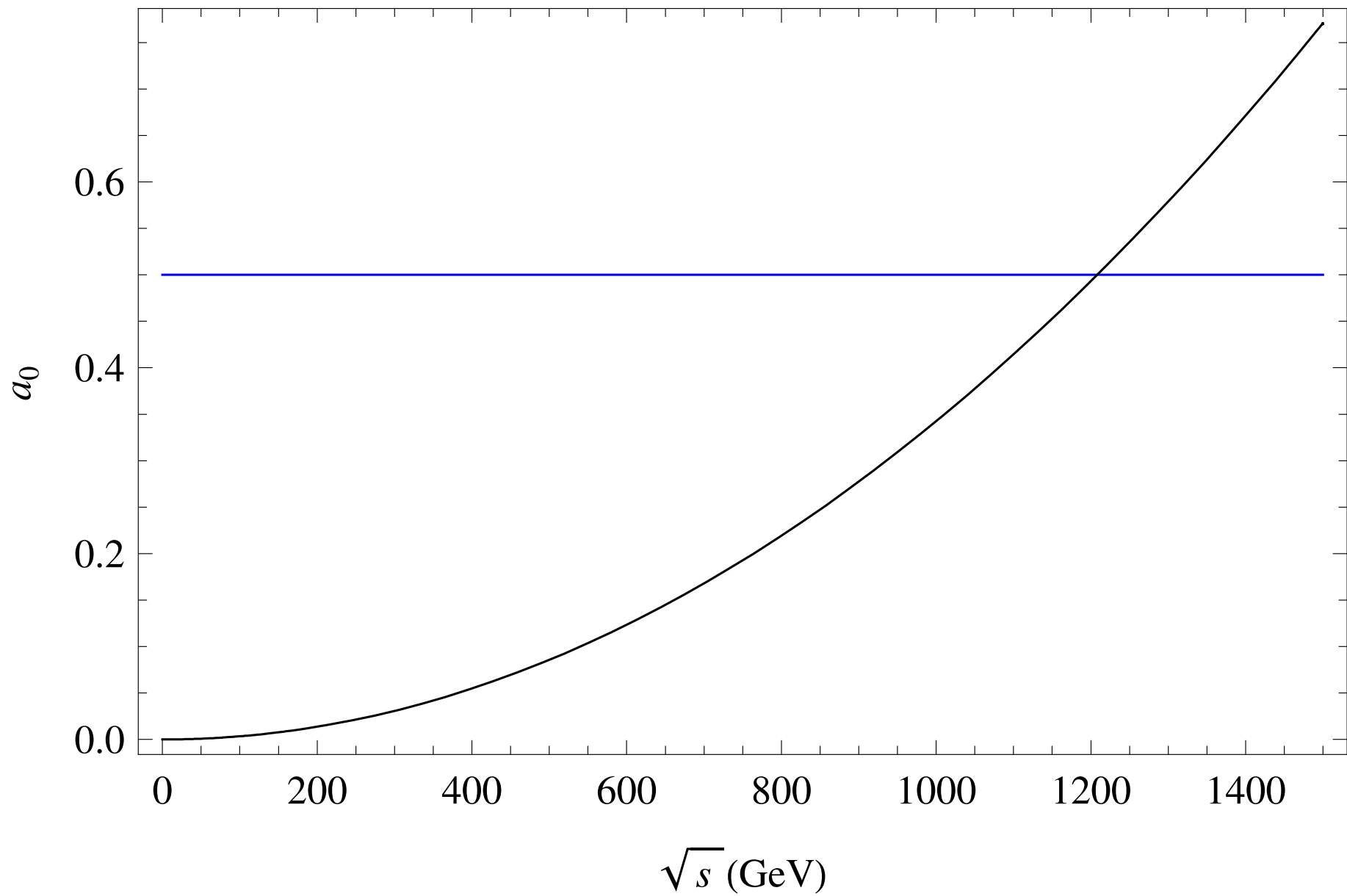
e, μ, τ
 ν_e, ν_μ, ν_τ

Quarks

u, c, t
 d, s, b







SM

???

Supersymmetry

Extra
Dimensions

Little Higgs

Higgsless

New Strong
Dynamics

SM

???

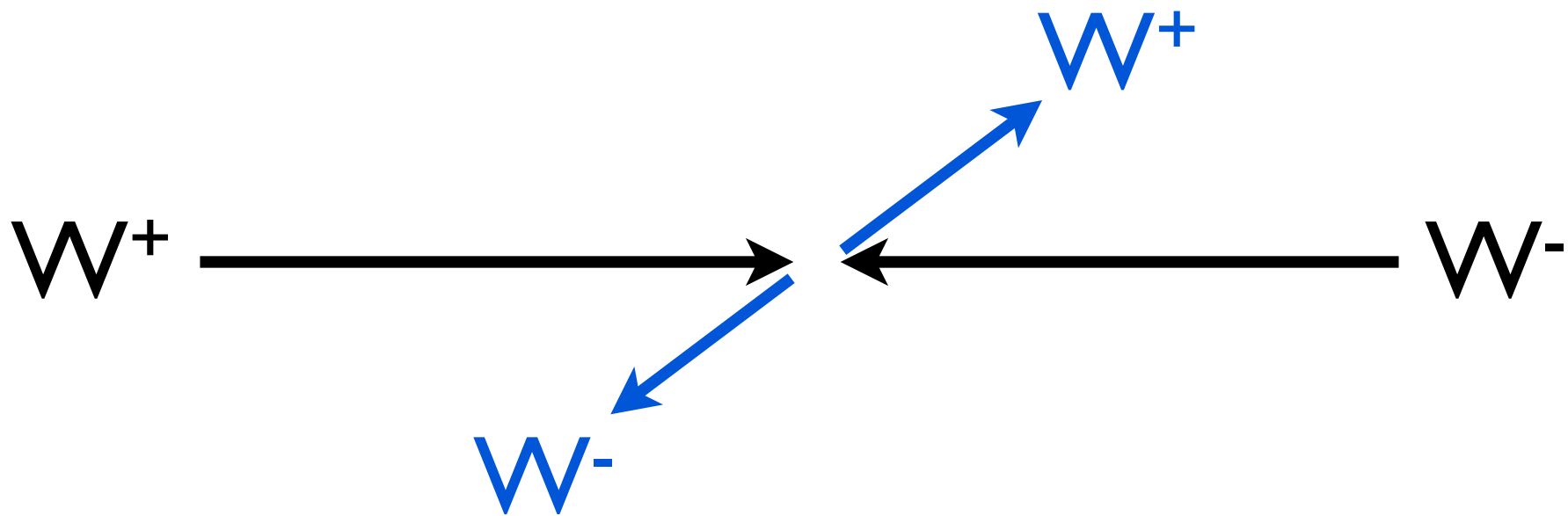
Supersymmetry

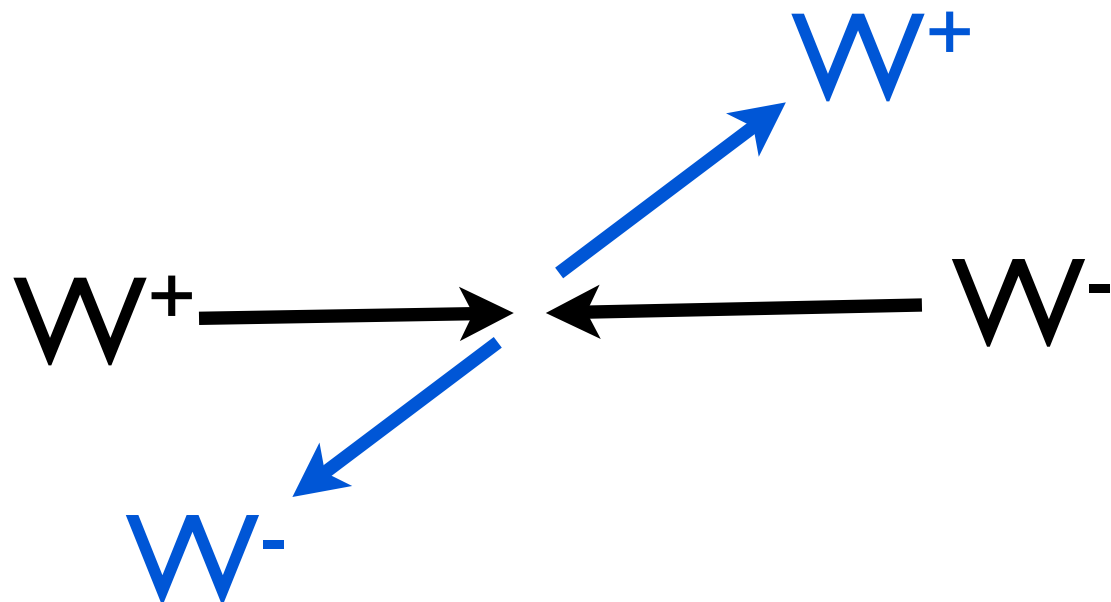
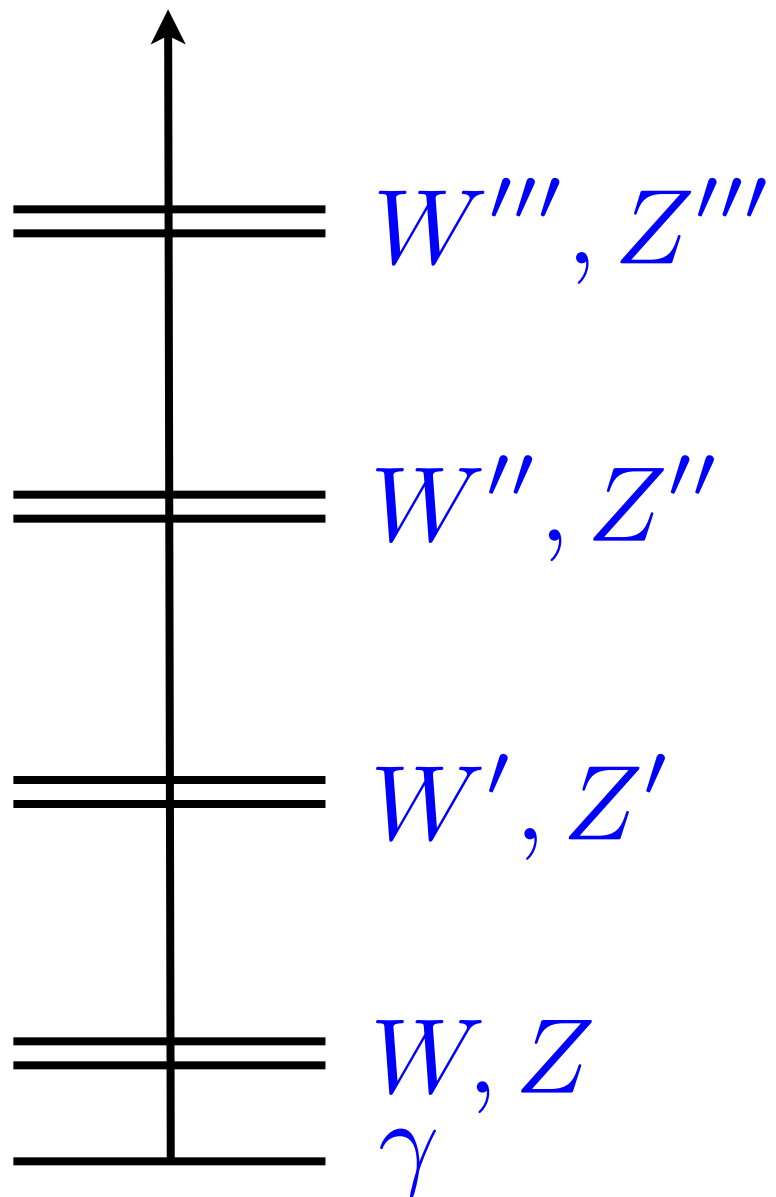
Extra
Dimensions

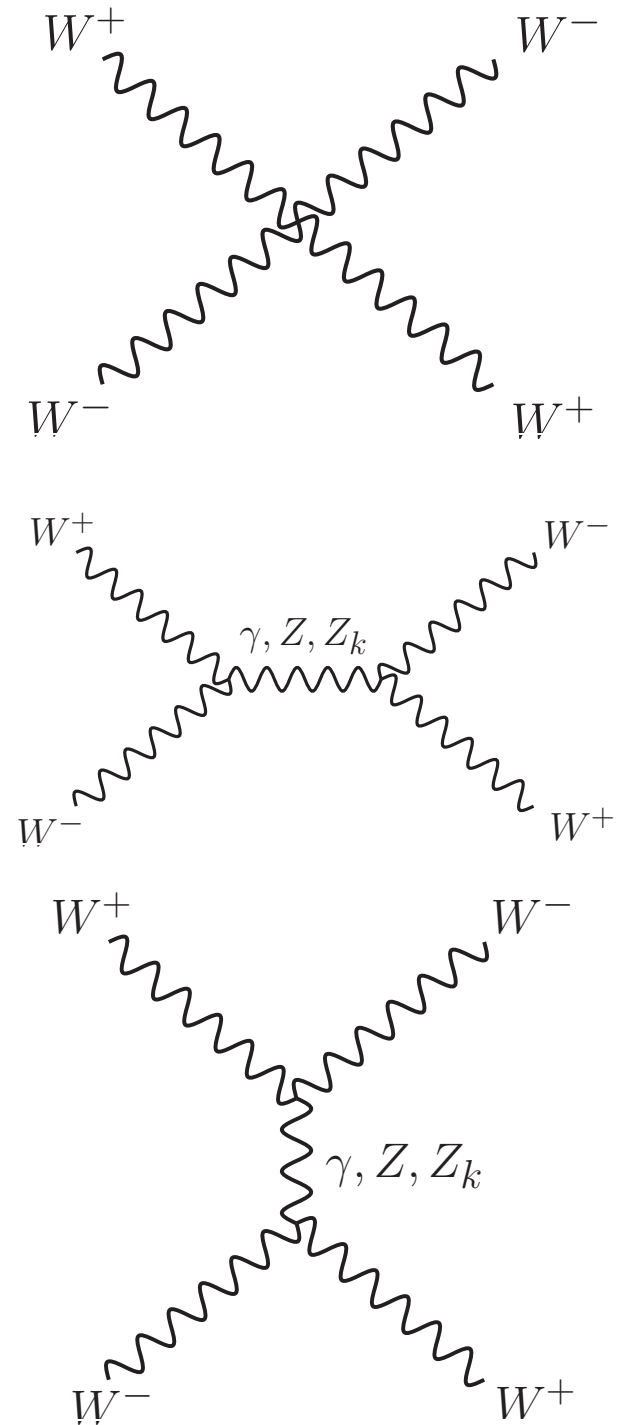
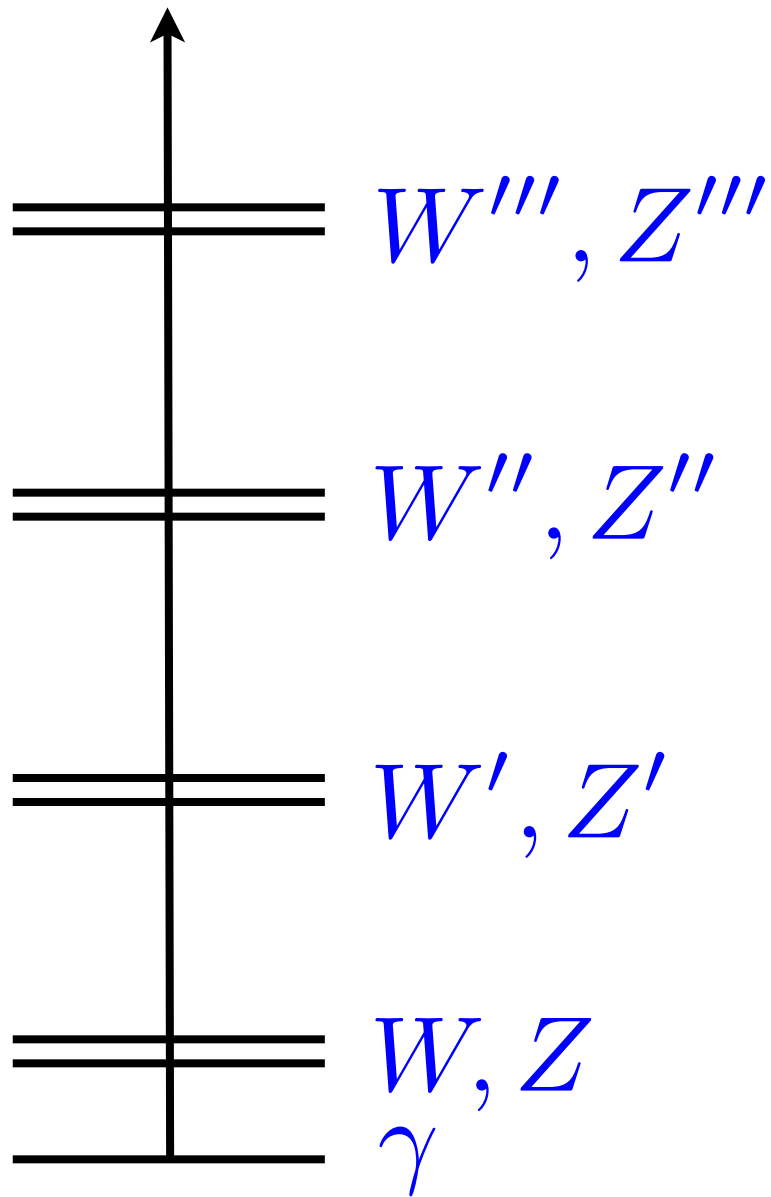
Little Higgs

Higgsless

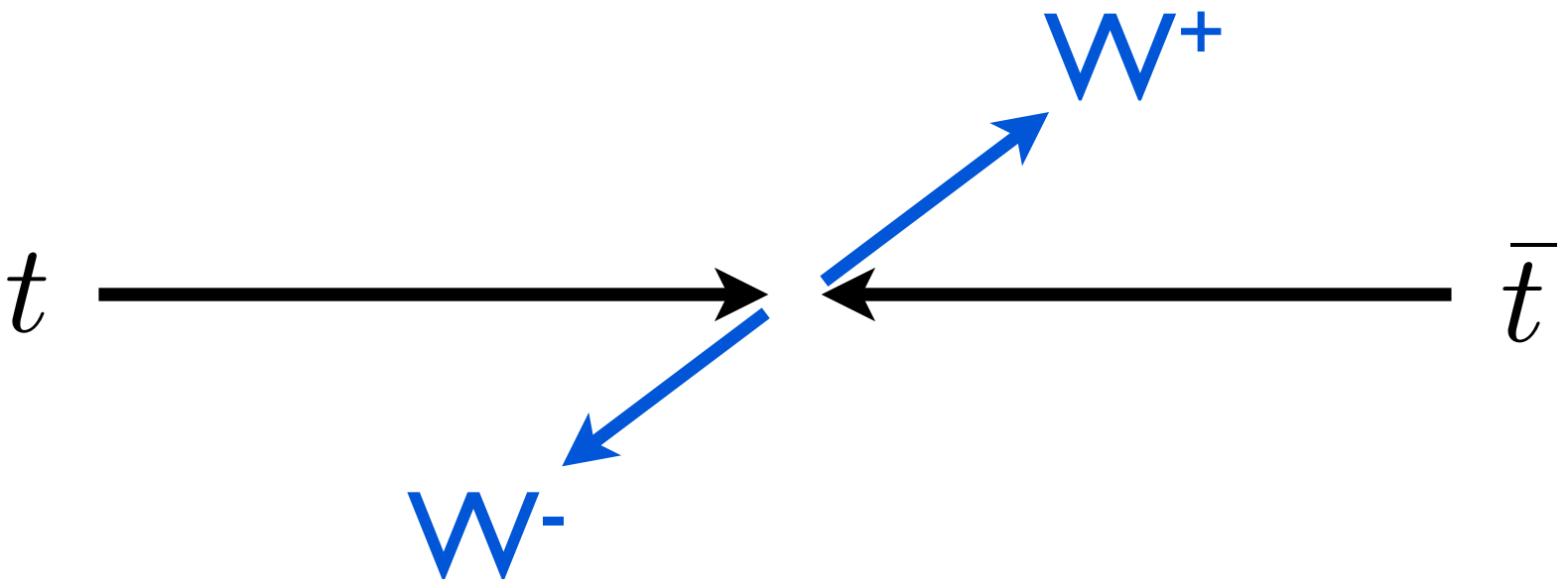
New Strong
Dynamics

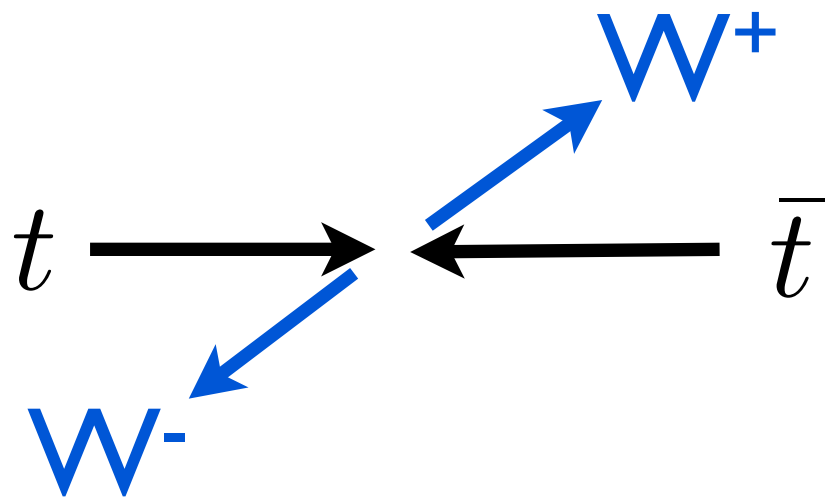
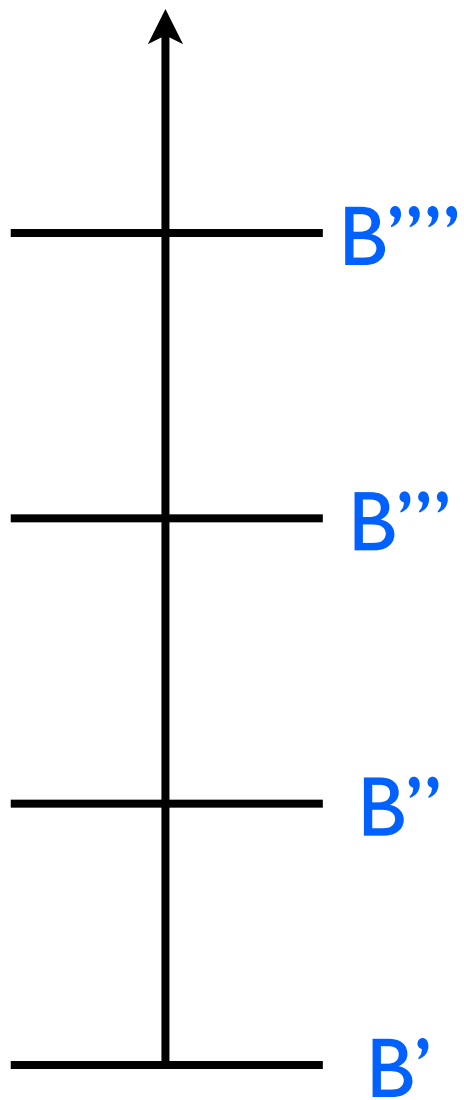


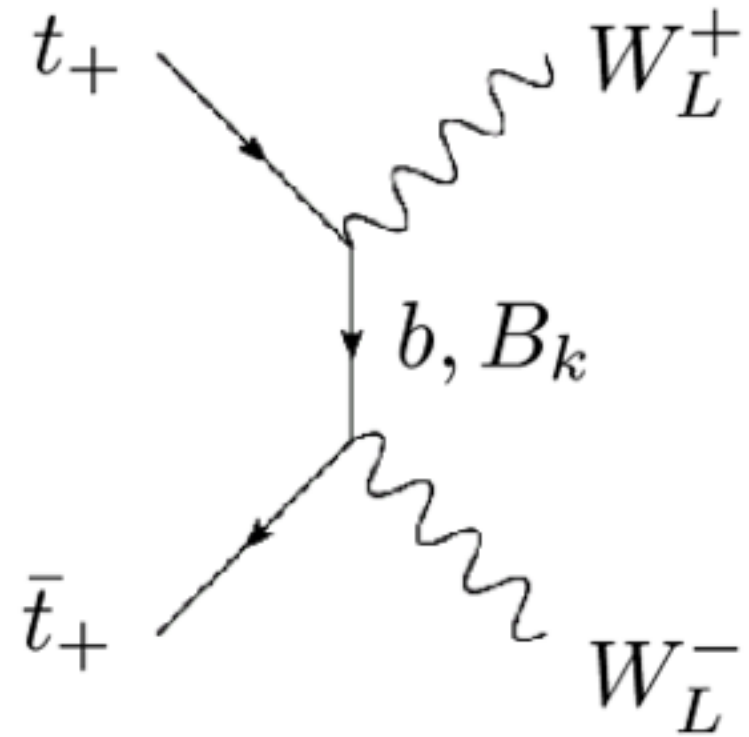
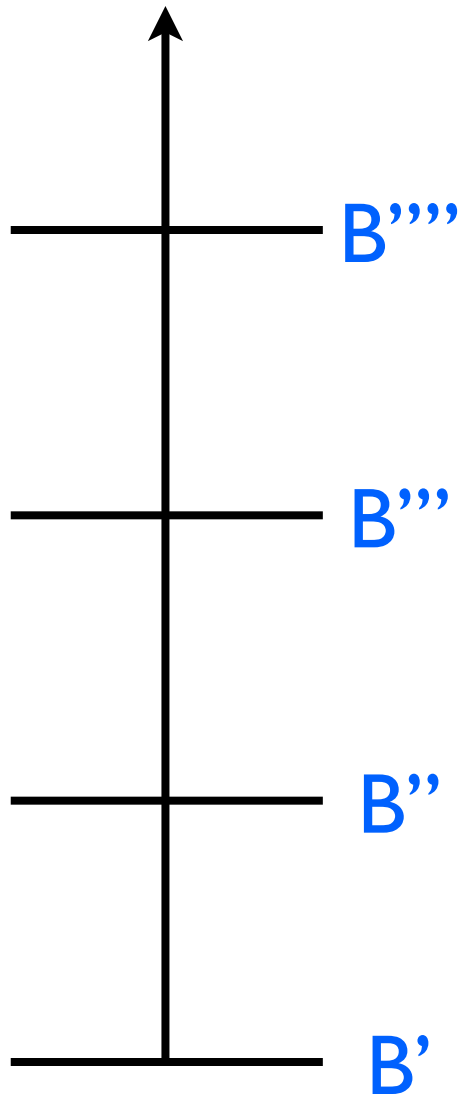




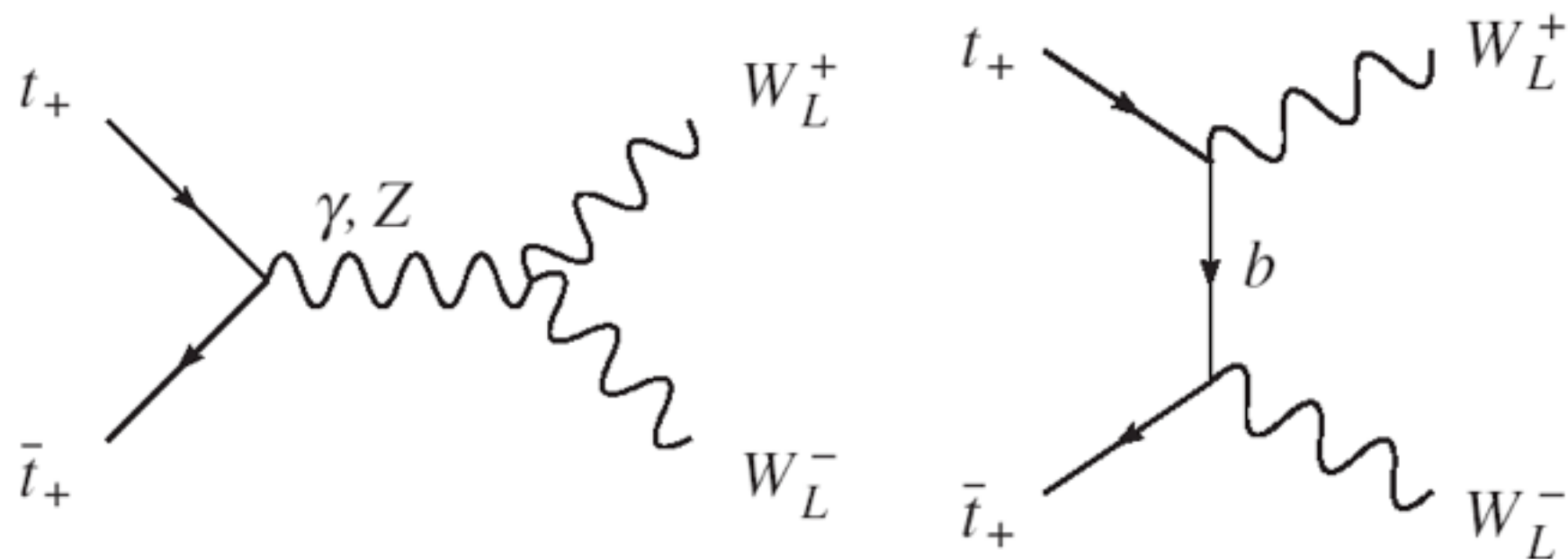
PLB 525, 175 (2002), PLB 532, 121 (2002),
 PLB 562, 109 (2003), IJMPA 20, 3362 (2005)



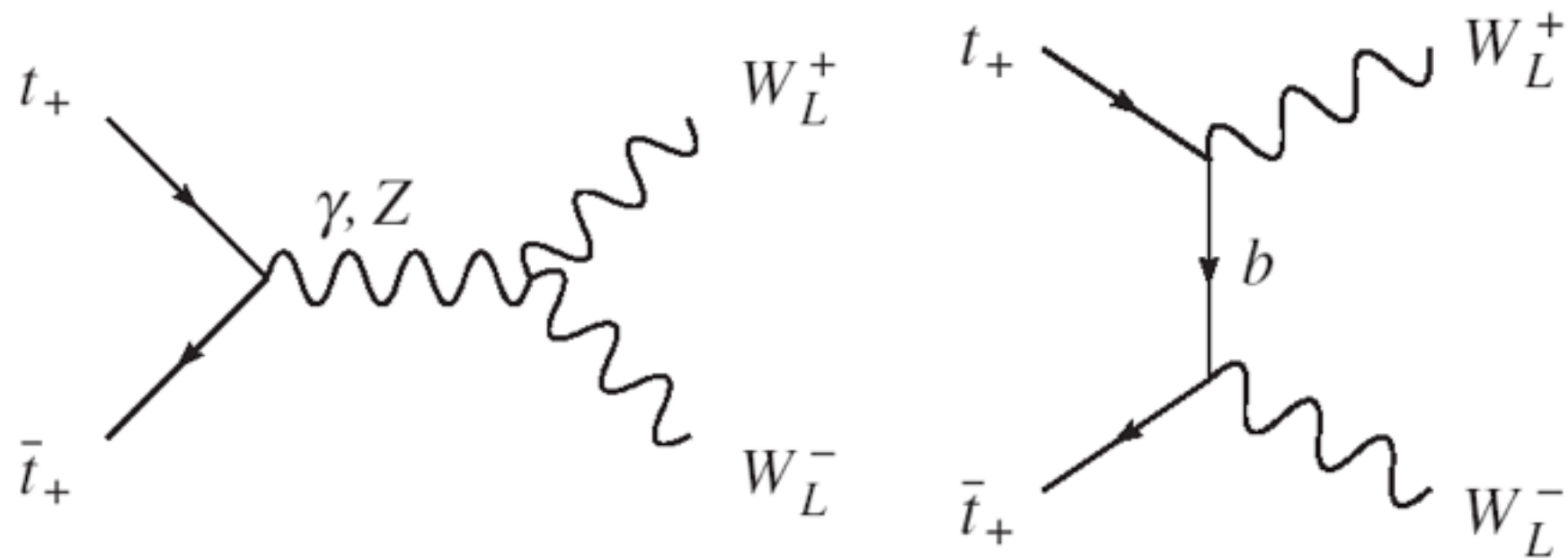




Phys. Rev. D 75, 073018 (2007)

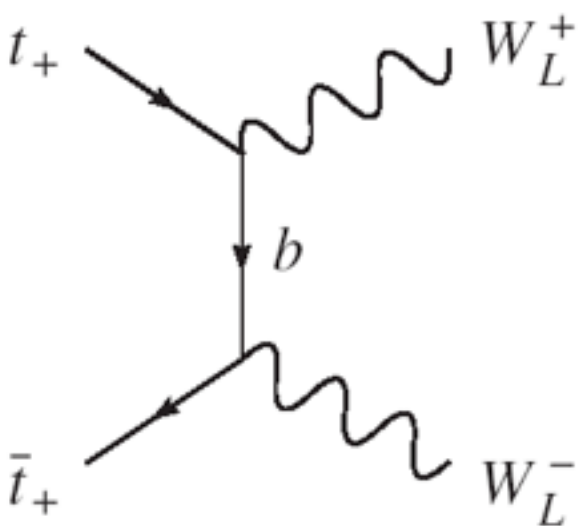


$$\mathcal{M} \simeq \frac{\sqrt{6s} m_t \cos\theta}{2M_W^2} \left(2g_{tt\gamma}g_{\gamma WW} + g_{LttZ}g_{ZWW} + g_{RttZ}g_{ZWW} - g_{LtbW}^2 \right) \\ + \frac{\sqrt{6s} m_t}{2M_W^2} g_{LtbW}^2$$

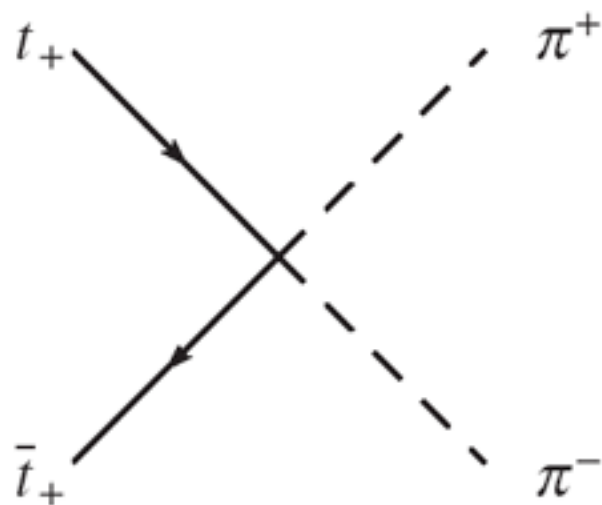


$$\mathcal{M} \simeq \frac{\sqrt{6s} m_t \cos\theta}{2M_W^2} \left(2g_{tt\gamma}g_{\gamma WW} + g_{LttZ}g_{ZWW} + g_{RttZ}g_{ZWW} - g_{LtbW}^2 \right) + \frac{\sqrt{6s} m_t}{2M_W^2} g_{LtbW}^2$$

$$2g_{tt\gamma}g_{\gamma WW} + g_{LttZ}g_{ZWW} + g_{RttZ}g_{ZWW} - g_{LtbW}^2 = 0$$



$$\mathcal{M} \simeq \frac{\sqrt{6s} m_t}{2M_W^2} g_{LtbW}^2 = \frac{\sqrt{6s} m_t}{v^2}$$



$$\mathcal{M} \simeq \sqrt{6s} g_{tt\pi\pi} = \frac{\sqrt{6s} m_t}{v^2}$$

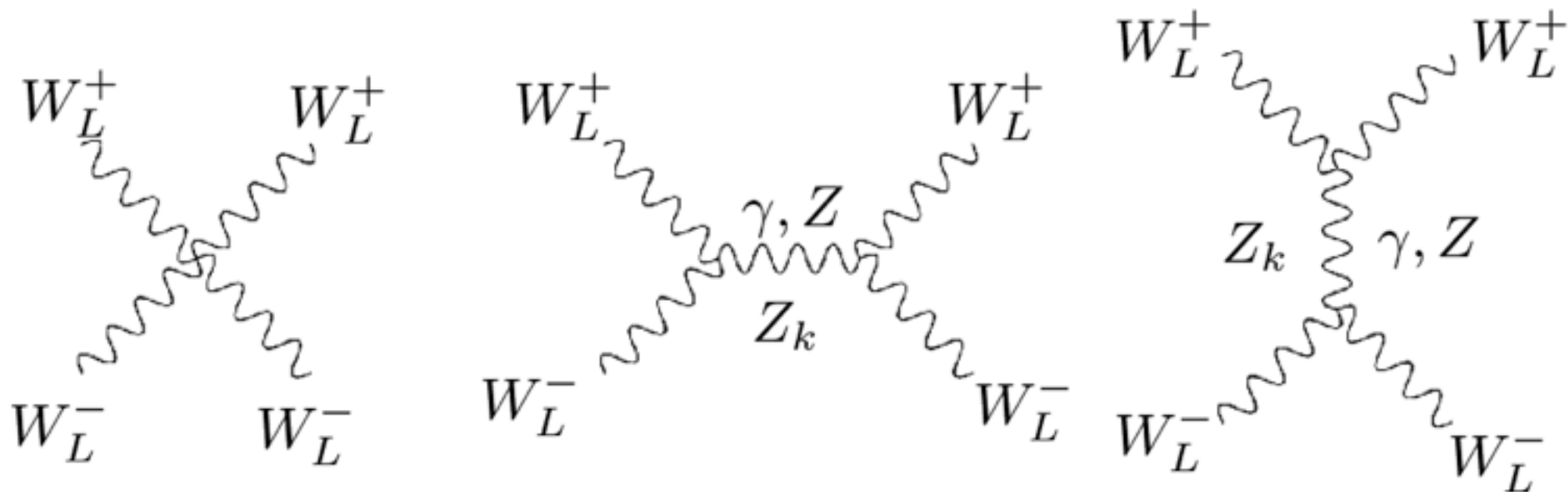
$$a_0 = \frac{1}{32\pi} \int_{-1}^1 d\cos\theta \mathcal{M} < \frac{1}{2}$$

$$a_0 \sim \frac{m_t \sqrt{6s}}{16\pi v^2}$$

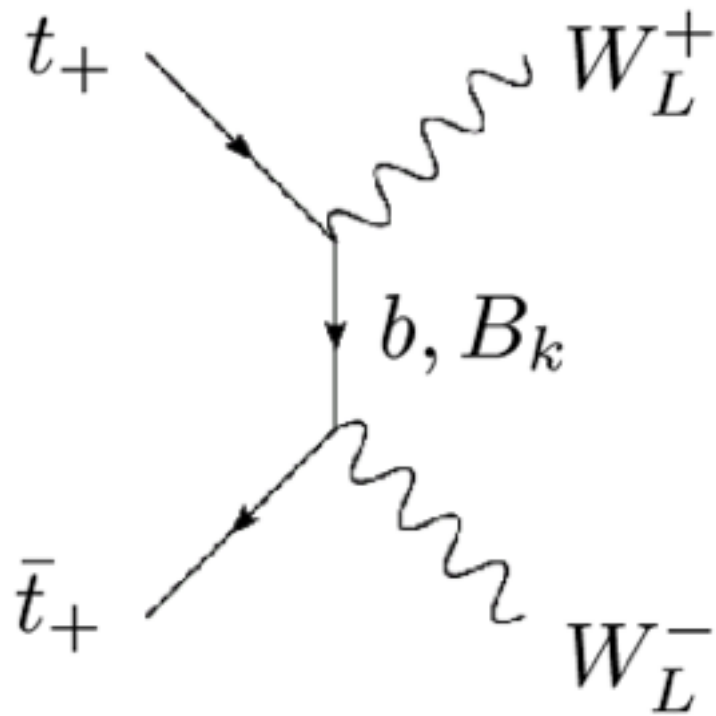
$$\sqrt{s} \lesssim \frac{8\pi v^2}{m_t \sqrt{6}} \sim 3.5 \text{TeV}$$

PRL 59, 2405

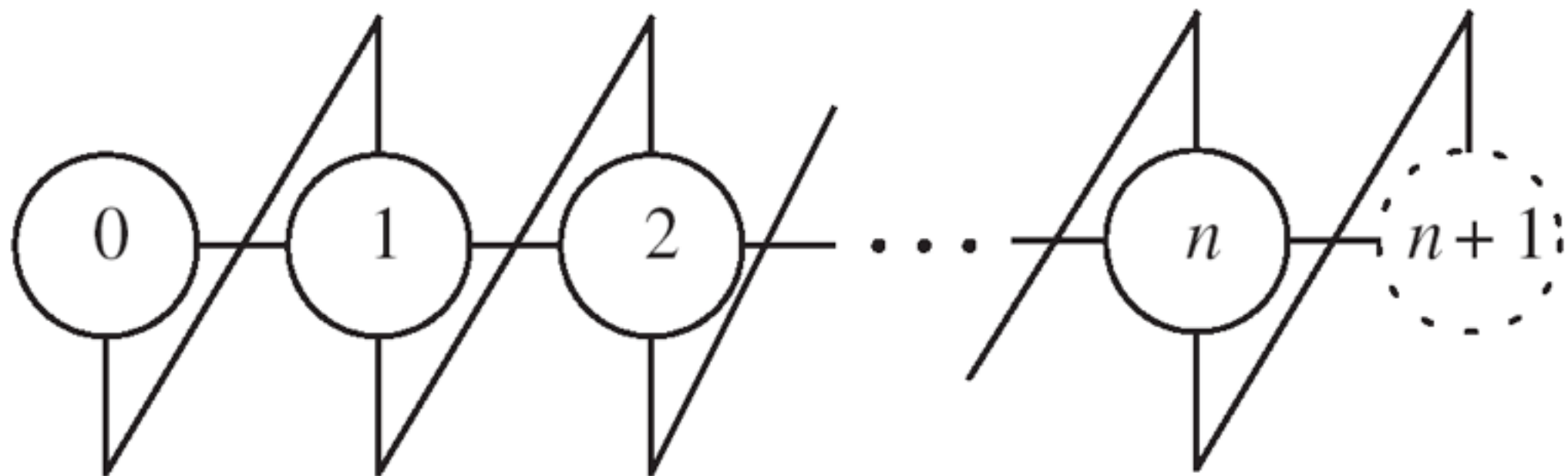
- M. Golden: PLB **338**, 295 (1994)
- Won't the fields that unitarize $W^+W^- \rightarrow W^+W^-$ also unitarize $t\bar{t} \rightarrow W^+W^-$?

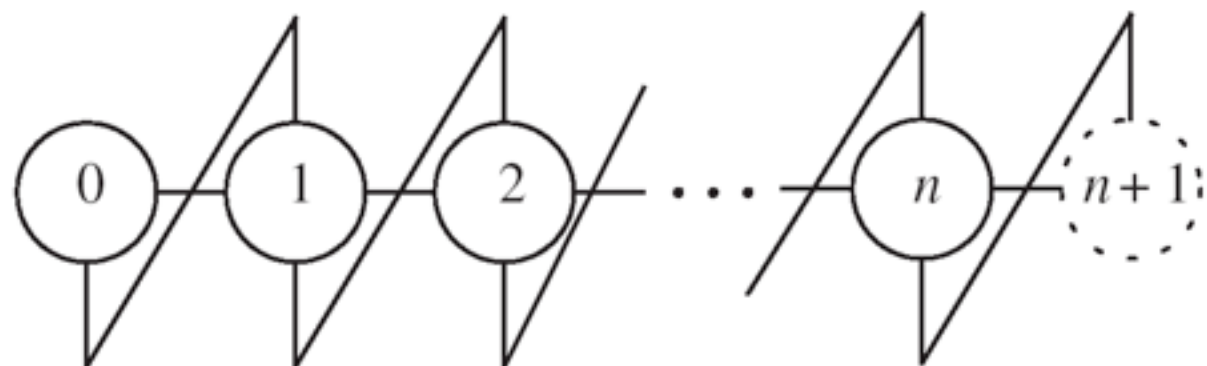


PLB 525, 175 (2002), PLB 532, 121 (2002),
 PLB 562, 109 (2003), IJMPA 20, 3362 (2005)

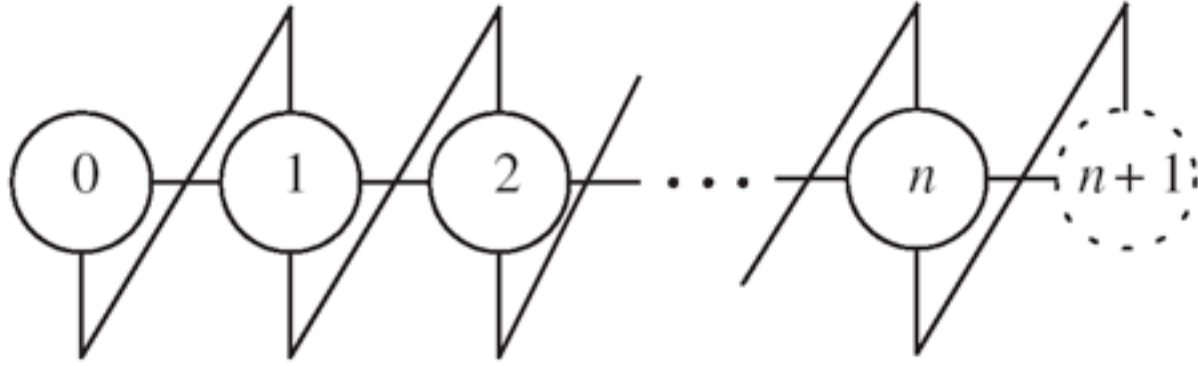


Phys. Rev. D 75, 073018 (2007)



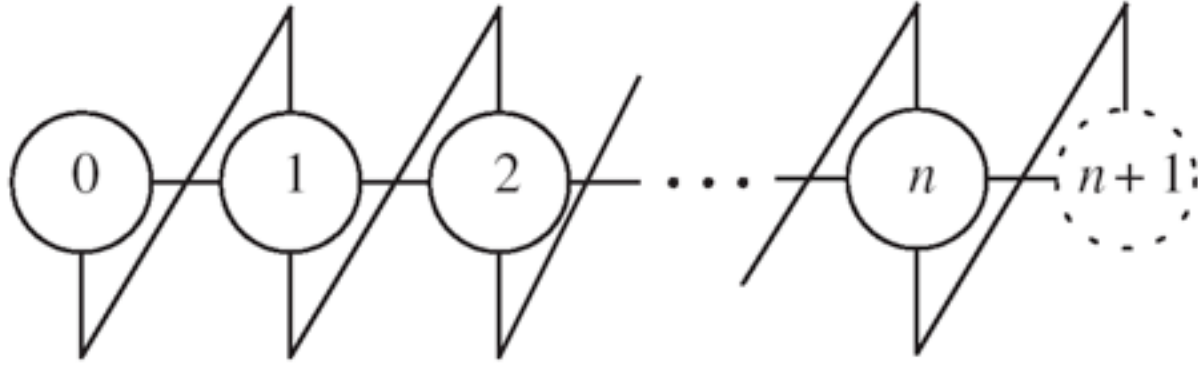


$$\begin{aligned}
 \mathcal{L}_{\psi\Sigma} = & -M_F \left[\epsilon_L \bar{\psi}_{L0} \Sigma_0 \psi_{R1} - \sum_j \bar{\psi}_{Lj} \psi_{Rj} \right. \\
 & \left. + \sum_j \bar{\psi}_{Lj} \Sigma_j \psi_{R,j+1} + \bar{\psi}_{Ln} \epsilon_R \Sigma_n \psi_{R,n+1} + \text{H.c.} \right]
 \end{aligned}$$



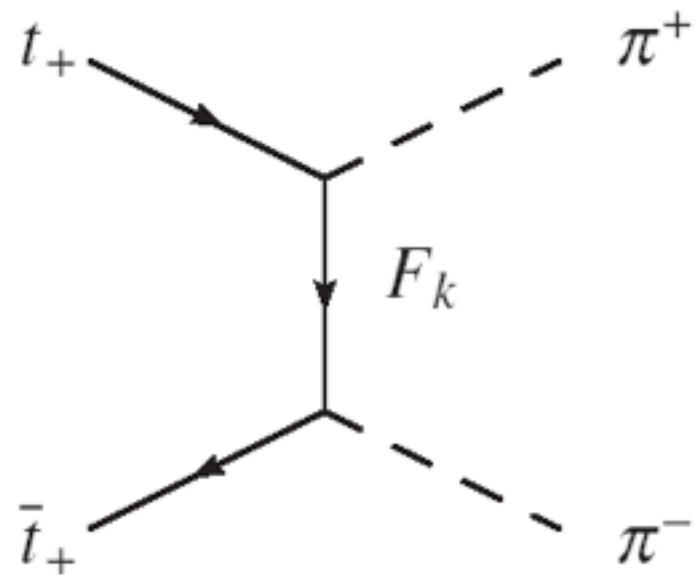
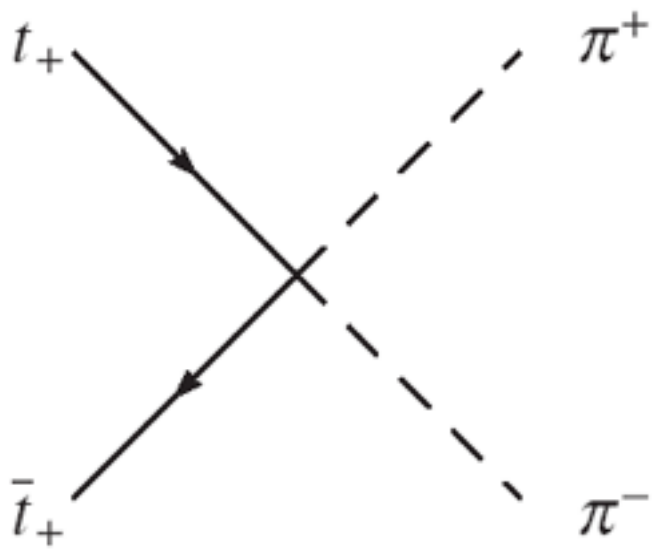
$$\mathcal{L}_{\psi\Sigma} = -M_F \left[\epsilon_L \bar{\psi}_{L0} \Sigma_0 \psi_{R1} - \sum_j \bar{\psi}_{Lj} \psi_{Rj} \right. \\ \left. + \sum_j \bar{\psi}_{Lj} \Sigma_j \psi_{R,j+1} + \bar{\psi}_{Ln} \epsilon_R \Sigma_n \psi_{R,n+1} + \text{H.c.} \right]$$

$$g_{RtF_k\pi} = -i \frac{\sqrt{2} M_F}{f} \left[\epsilon_L v_{LF_k}^0 v_{Rt}^1 v_{\pi}^{[0]} + \sum_i v_{LF_k}^i v_{Rt}^{i+1} v_{\pi}^{[i]} \right. \\ \left. + \epsilon_{Rt} v_{LF_k}^n v_{Rt}^{n+1} v_{\pi}^{[n]} \right] \\ = \frac{i\sqrt{2} M_F \epsilon_R}{\sqrt{2n+1}(n+1)v} \tan \left[\frac{(n-k+1)\pi}{2n+1} \right]$$

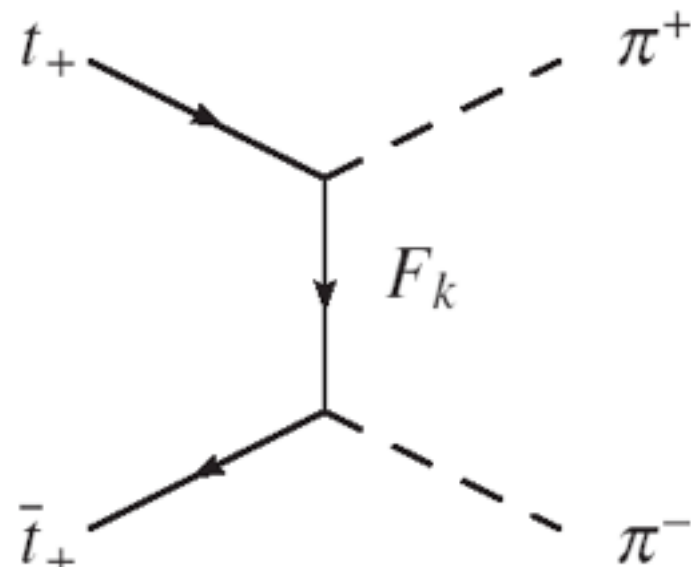
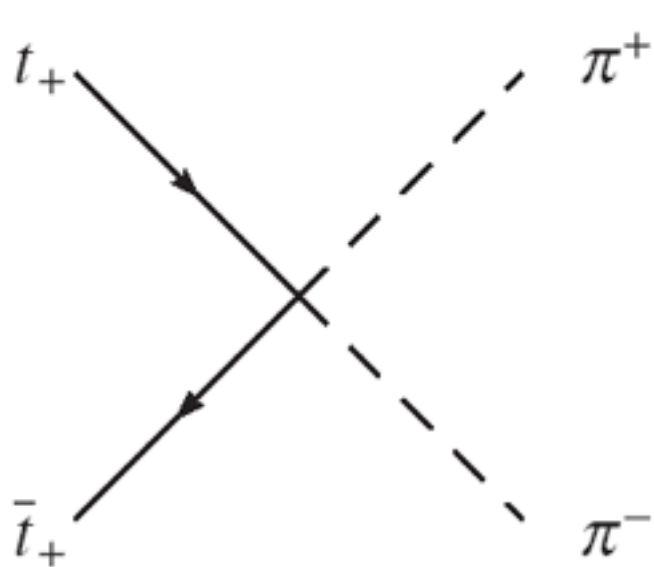


$$\mathcal{L}_{\psi\Sigma} = -M_F \left[\epsilon_L \bar{\psi}_{L0} \Sigma_0 \psi_{R1} - \sum_j \bar{\psi}_{Lj} \psi_{Rj} \right. \\ \left. + \sum_j \bar{\psi}_{Lj} \Sigma_j \psi_{R,j+1} + \bar{\psi}_{Ln} \epsilon_R \Sigma_n \psi_{R,n+1} + \text{H.c.} \right]$$

$$g_{tt\pi^+\pi^-} = \frac{M_F}{f^2} \left[\epsilon_L v_{Lt}^0 v_{Rt}^1 (v_{\pi}^{[0]})^2 + \sum_i v_{Lt}^i v_{Rt}^{i+1} (v_{\pi}^{[i]})^2 \right. \\ \left. + \epsilon_{Rt} v_{Lt}^n v_{Rt}^{n+1} (v_{\pi}^{[n]})^2 \right] \\ = \frac{m_t}{(n+1)v^2}.$$



$$\mathcal{M} = \sqrt{6s} \left(g_{tt\pi^+\pi^-} - \sum_k \frac{M_{F_k} g_{LtF_k\pi} g_{RtF_k\pi}}{t - M_{F_k}^2} \right)$$

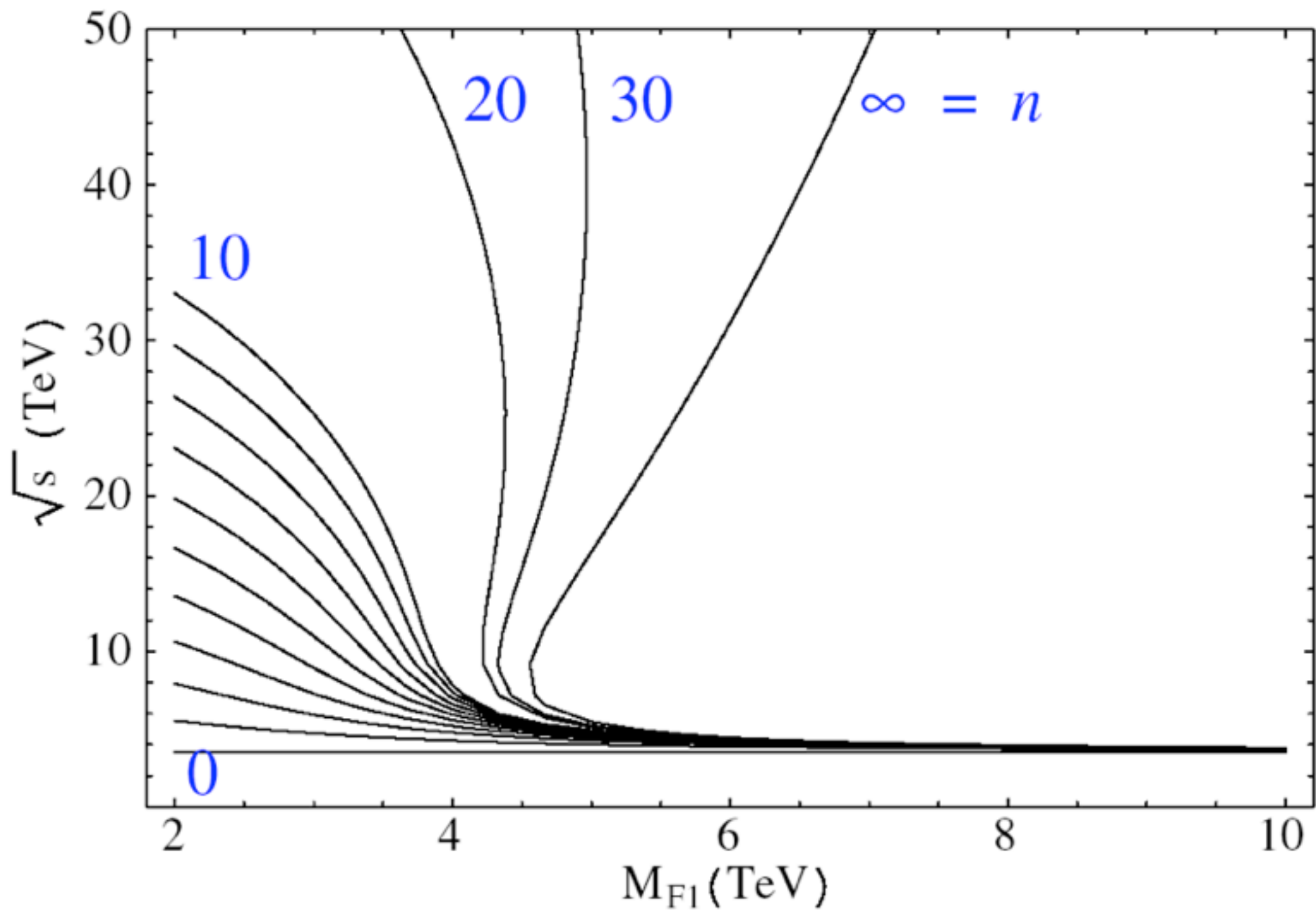


$$\mathcal{M} = \sqrt{6s} \left(g_{tt\pi^+\pi^-} - \sum_k \frac{M_{F_k} g_{LtF_k\pi} g_{RtF_k\pi}}{t - M_{F_k}^2} \right)$$

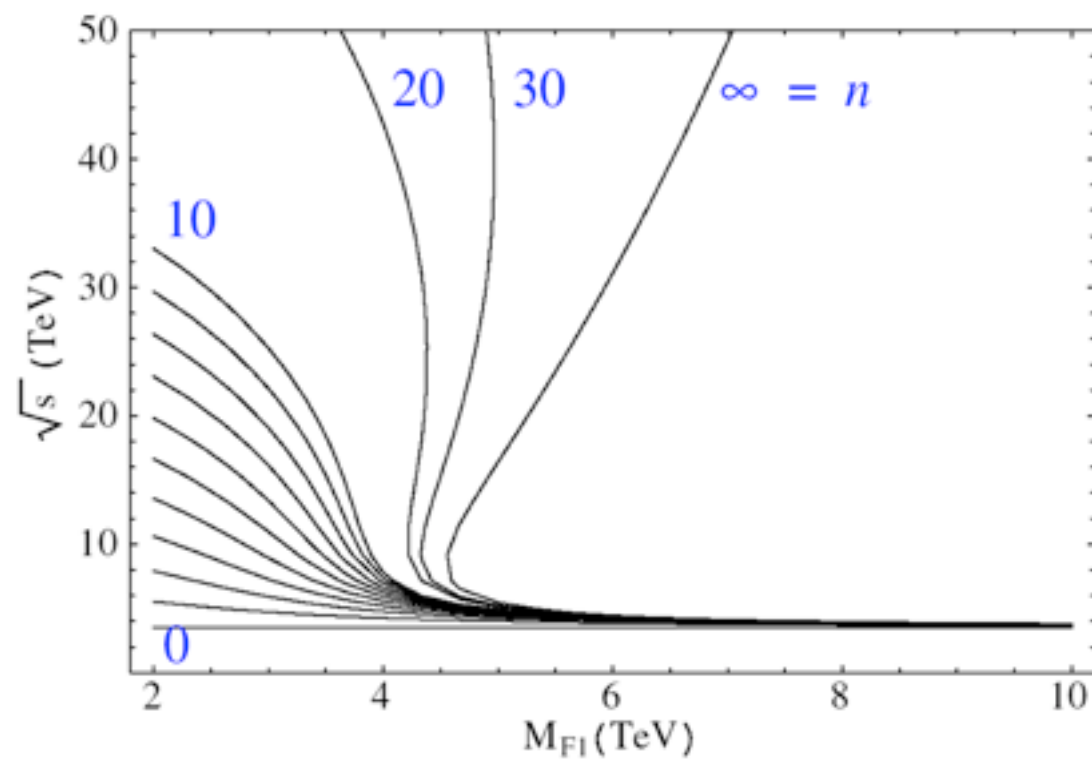
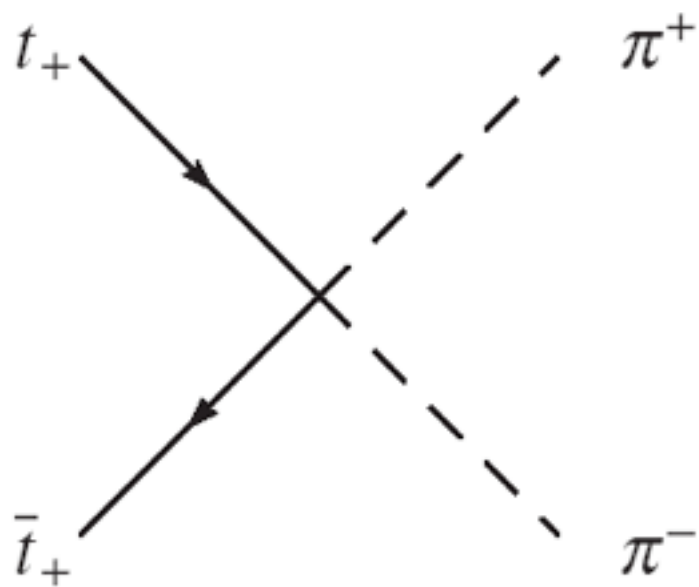
$$a_0 = \frac{1}{32\pi} \int_{-1}^1 d\cos\theta \mathcal{M}$$

$$= \frac{\sqrt{6}}{16\pi} \left[g_{tt\pi^+\pi^-} \sqrt{s} + \sum_k g_{LtF_k\pi} g_{RtF_k\pi} g\left(\frac{\sqrt{s}}{M_{F_k}}\right) \right]$$

$$g(x) = \frac{1}{x} \ln(1 + x^2)$$

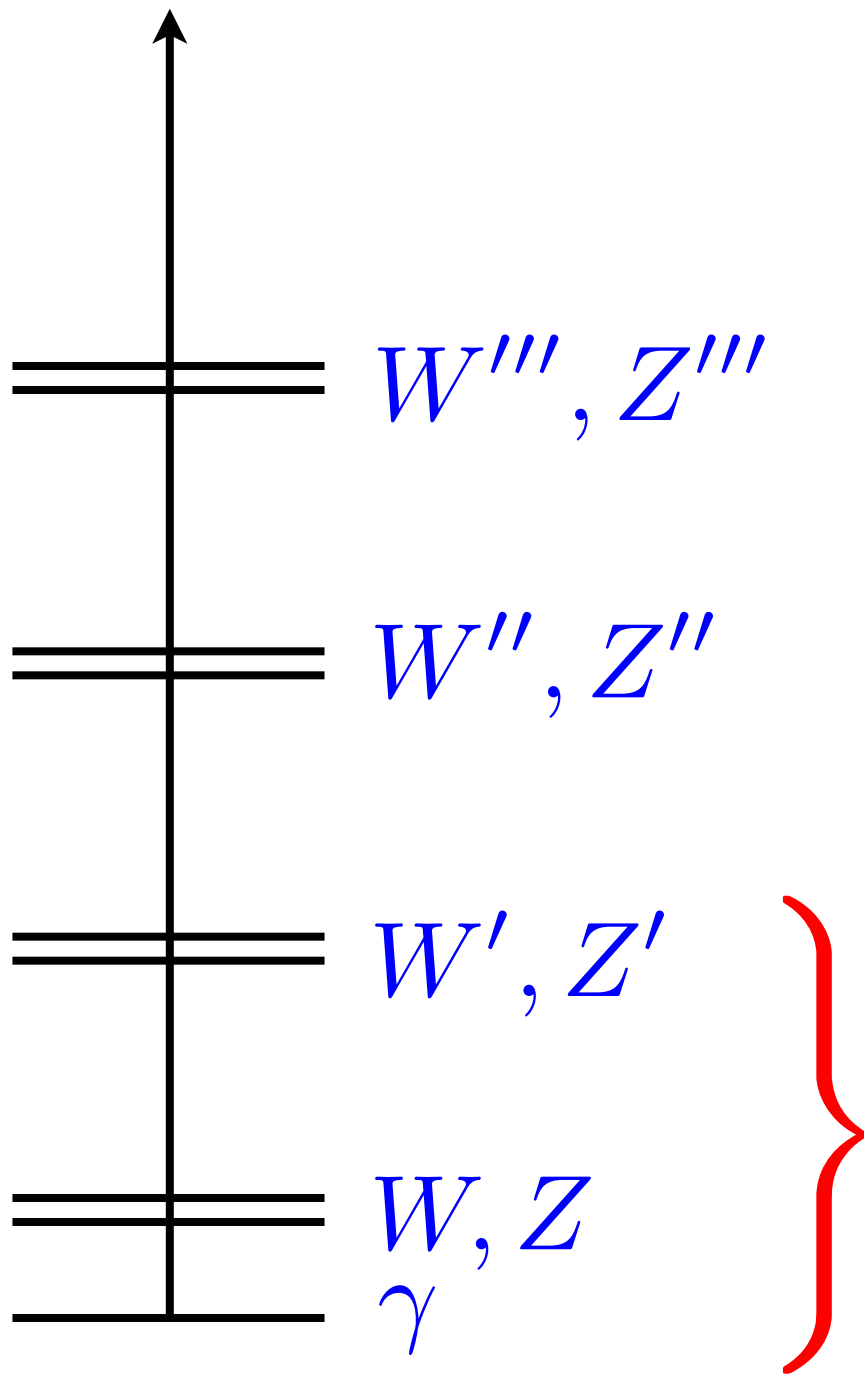


$$M_{F1} \ll 4.5 \text{ TeV}$$

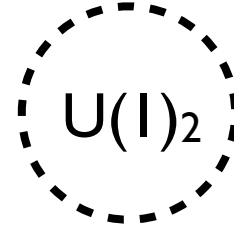
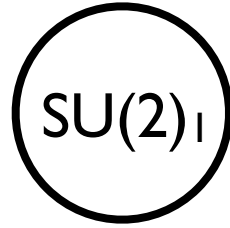
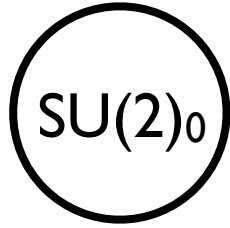


$$a_0 \simeq \frac{\sqrt{6}sm_t}{16\pi v^2(n+1)} \simeq \frac{1}{2}$$

$$\sqrt{s} \lesssim (n+1)3.5 \text{ TeV}$$

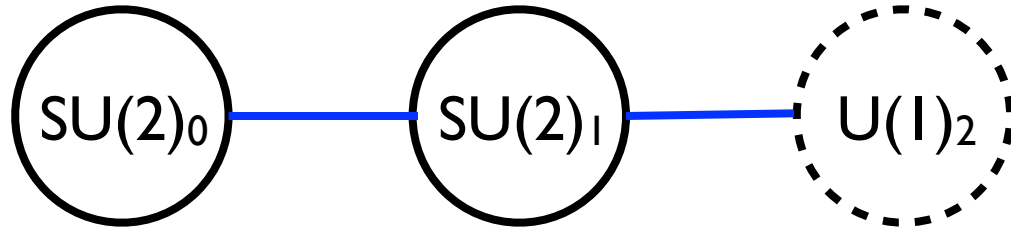


Accessible
at the LHC



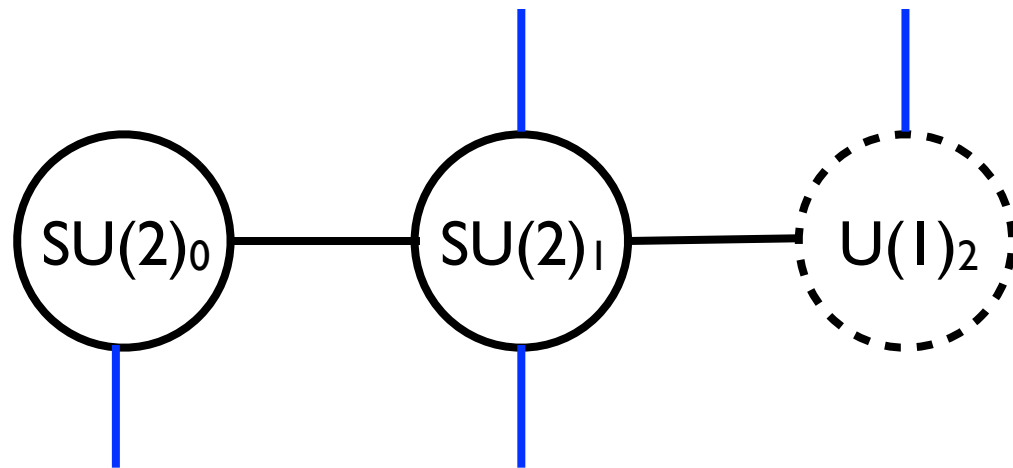
$$\begin{aligned} W_0 & : (3, 1)_0 \\ W_1 & : (1, 3)_0 \\ W_2 & : (1, 1)_0 \end{aligned}$$

$$\mathcal{L} = -\frac{1}{4}F_{0\mu\nu}F_0^{\mu\nu} - \frac{1}{4}F_{1\mu\nu}F_1^{\mu\nu} - \frac{1}{4}F_{2\mu\nu}F_2^{\mu\nu}$$



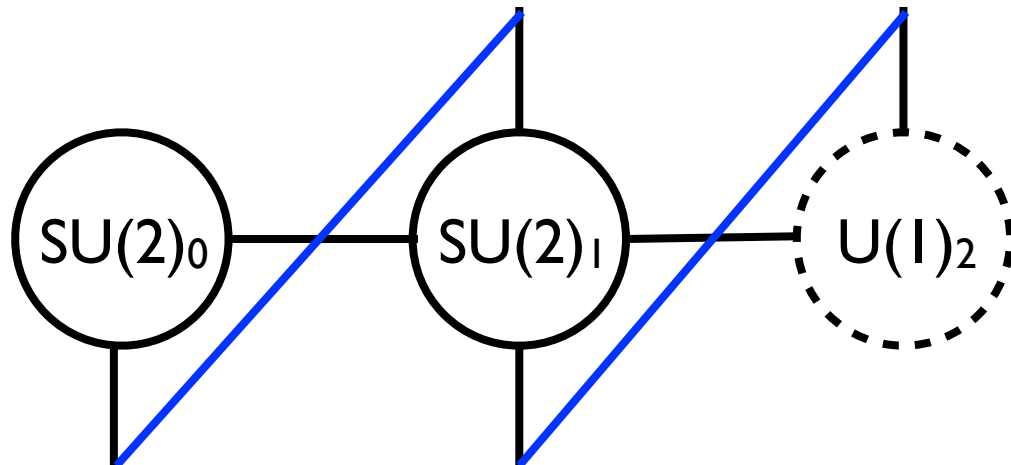
$$\begin{aligned} \Sigma_{01} & : (2, \bar{2})_0 \\ \Sigma_{12} & : (1, 2)_{\pm \frac{1}{2}} \end{aligned}$$

$$\begin{aligned} \mathcal{L} = & \frac{f^2}{4} \text{Tr} \left[(D_\mu \Sigma_{01})^\dagger D^\mu \Sigma_{01} + (D_\mu \Sigma_{12})^\dagger D^\mu \Sigma_{12} \right] \\ & + \frac{F^2}{4} \text{Tr} \left[(D_\mu (\Sigma_{01} \Sigma_{12}))^\dagger D^\mu (\Sigma_{01} \Sigma_{12}) \right] \end{aligned}$$



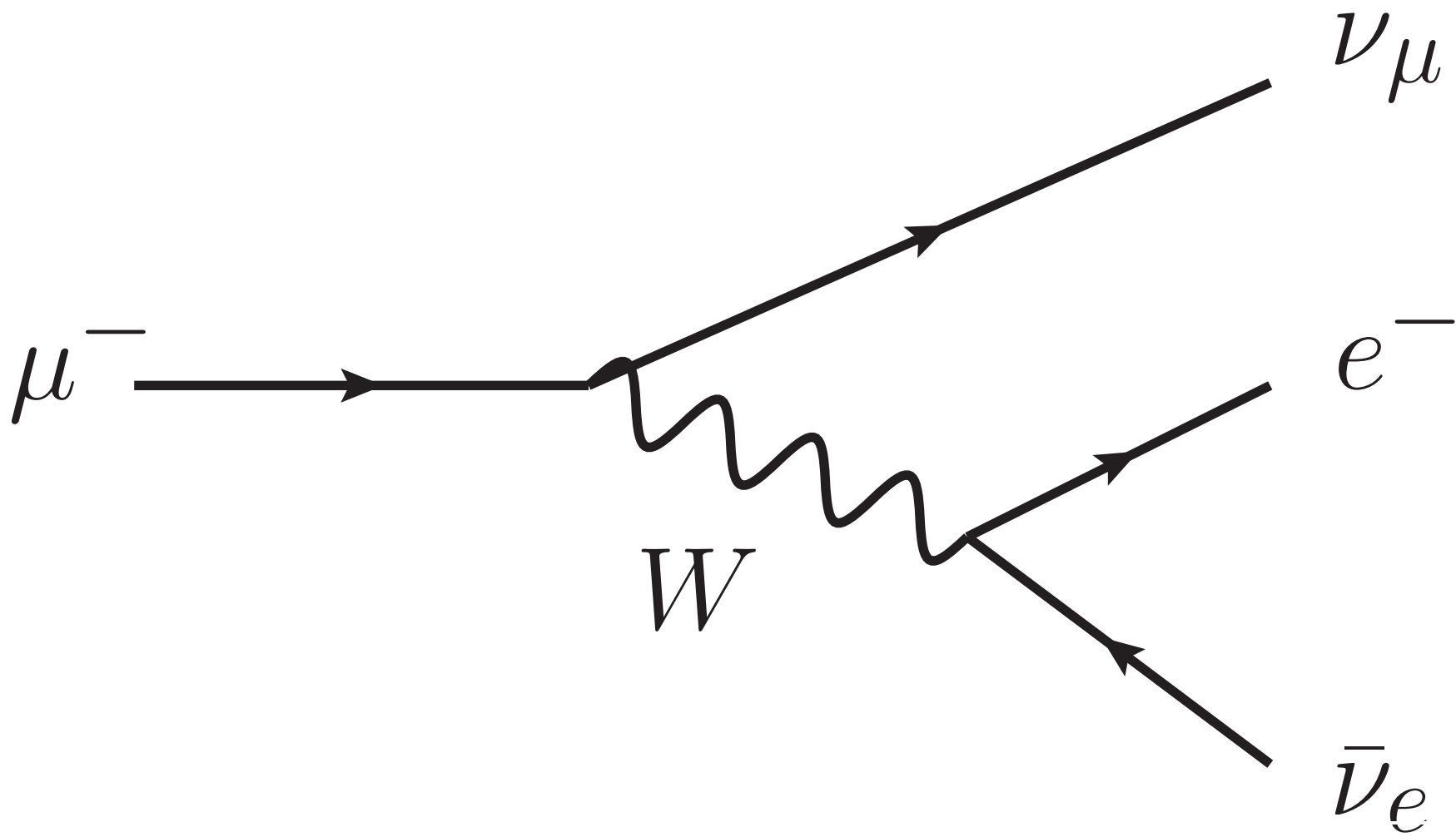
$$\begin{array}{ll}
 Q_{L0} & : \quad (2, 1)_{\frac{1}{6}} & L_{L0} & : \quad (2, 1)_{-\frac{1}{2}} \\
 Q_1 & : \quad (1, 2)_{\frac{1}{6}} & L_1 & : \quad (1, 2)_{-\frac{1}{2}} \\
 u_{R2} & : \quad (1, 1)_{\frac{2}{3}} & & \\
 d_{R2} & : \quad (1, 1)_{-\frac{1}{3}} & e_{R2} & : \quad (1, 1)_{-1}
 \end{array}$$

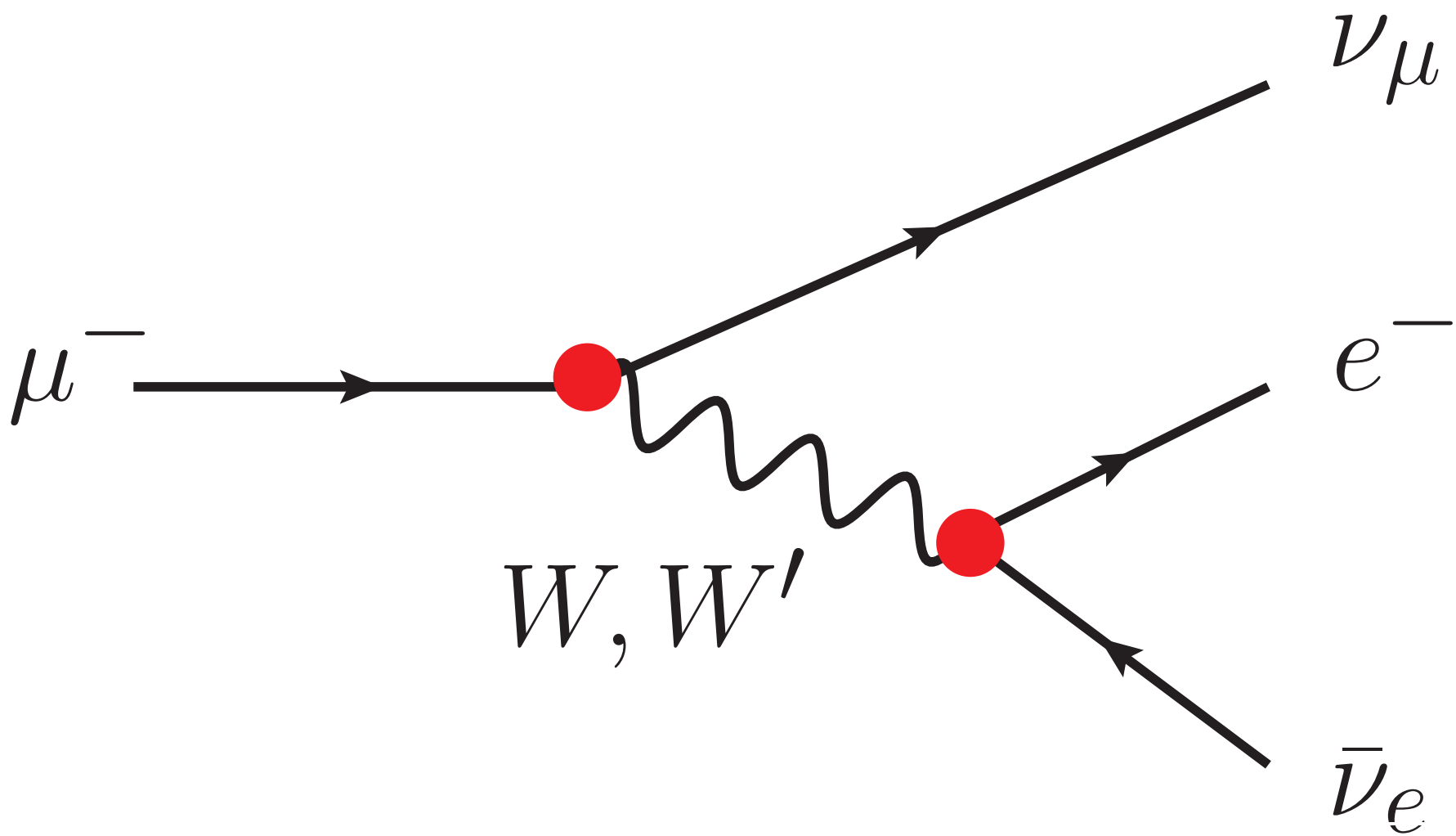
$$\mathcal{L} = i\bar{\psi}_{L0}\not{D}\psi_{L0} + i\bar{\psi}_{L1}\not{D}\psi_{L1} + i\bar{\psi}_{R1}\not{D}\psi_{R1} + i\bar{\psi}_{R2}\not{D}\psi_{R2}$$

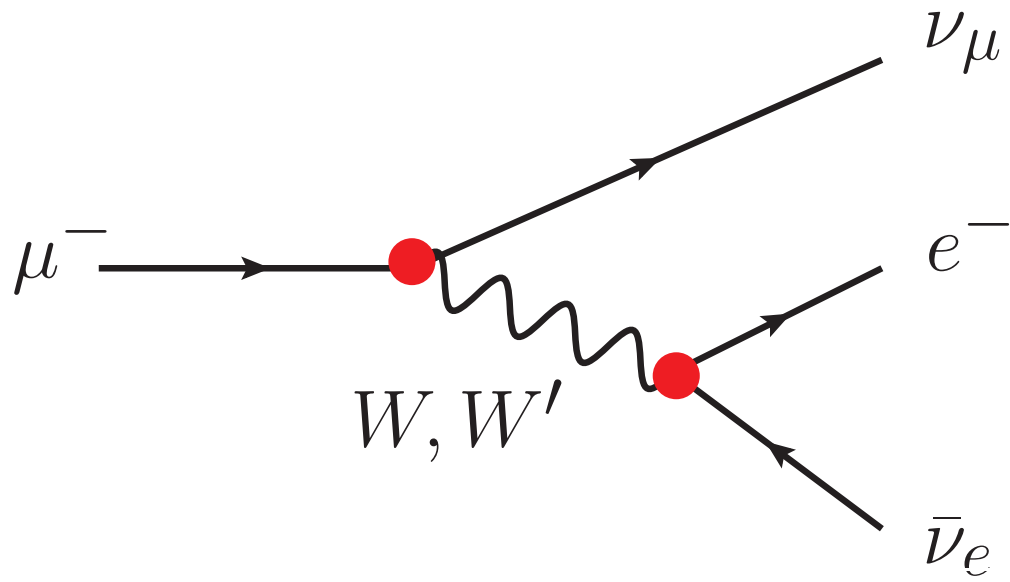


$$\begin{array}{ll}
 Q_{L0} & : \quad (2, 1)_{\frac{1}{6}} & L_{L0} & : \quad (2, 1)_{-\frac{1}{2}} \\
 Q_1 & : \quad (1, 2)_{\frac{1}{6}} & L_1 & : \quad (1, 2)_{-\frac{1}{2}} \\
 u_{R2} & : \quad (1, 1)_{\frac{2}{3}} & & \\
 d_{R2} & : \quad (1, 1)_{-\frac{1}{3}} & e_{R2} & : \quad (1, 1)_{-1}
 \end{array}$$

$$\mathcal{L} = -M_F \left(\epsilon_L \bar{\psi}_{L0} \Sigma_{01} \psi_{R1} + \bar{\psi}_{L1} \psi_{R1} + \bar{\psi}_{L1} \epsilon_R \Sigma_{12} \psi_{R2} \right)$$







$$g_{W e \nu} = g_0 v_W^0 (v_L^0)^2 + g_1 v_W^1 (v_L^1)^2$$

Ideal Fermion Delocalization

$$g_i (v_L^i)^2 \propto v_W^i$$

Ideal Fermion Delocalization

$$g_i (v_L^i)^2 \propto v_W^i$$

$$\begin{aligned} g_{f_L f_L W'} &= \sum_i g_i (v_L^i)^2 v_{W'}^i \\ &= \sum_i v_W^i v_{W'}^i \\ &= 0 \end{aligned}$$

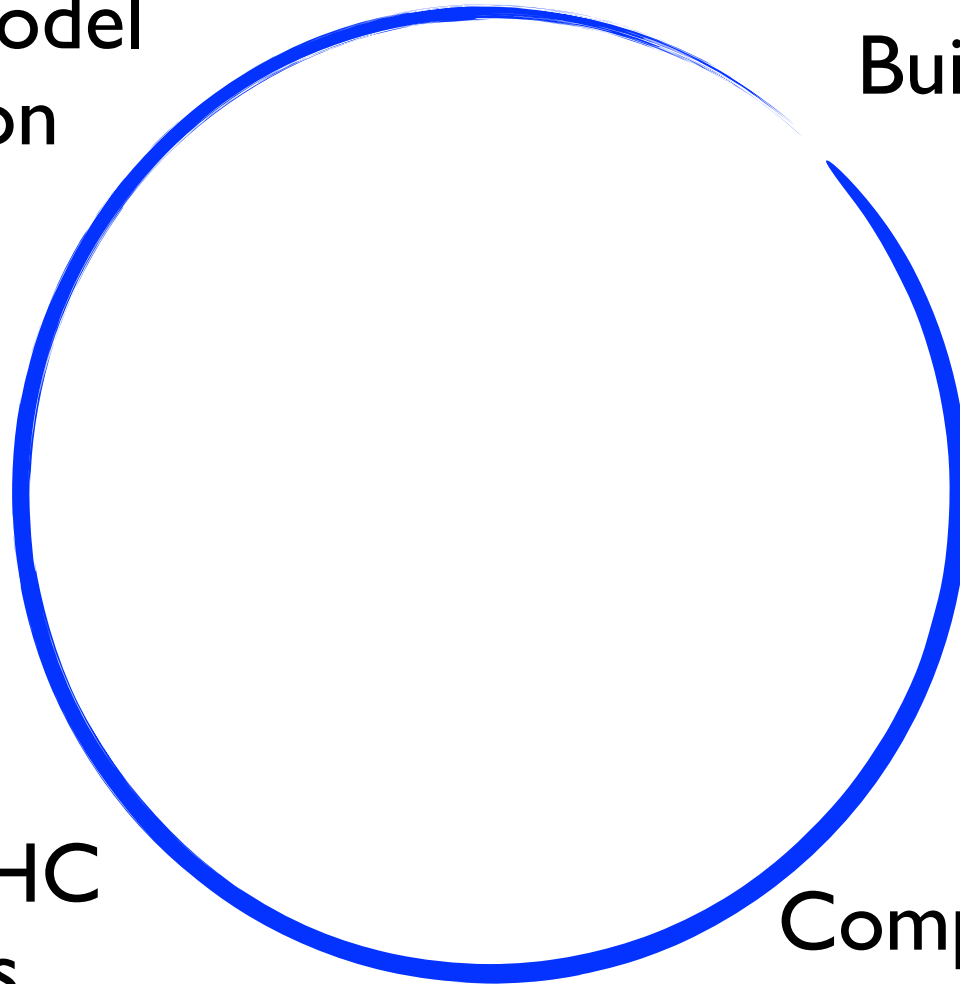
W' and Z' are “fermiophobic”!
W and Z are SM like.

Implement model
in simulation
software

Build Model

Simulate LHC
collisions

Compare predictions
with experiments



CalcHEP

MadGraph

Herwig

Sherpa

Whizard

FeynArts

Problem 1:

Implementing a model was often tedious and error prone.

```
#####  
# QFD Interactions  
# 2 heavy fermions - 1 light weak gauge boson  
#####
```

```
# FFV (qqZ)
```

```
dp dp z GZDp QED-HF  
up up z GZUp QED-HF  
sp sp z GZDp QED-HF  
cp cp z GZUp QED-HF  
bp bp z GZDp QED-HF  
tp tp z GZTp QED-HF
```

```
# FFV (llZ)
```

```
ep- ep- z GZLp QED-HF  
mup- mup- z GZLp QED-HF  
tap- tap- z GZLp QED-HF  
vep vep z GZNp QED-HF  
vmp vmp z GZNp QED-HF  
vtp vtp z GZNp QED-HF
```

```
# FFV (qq'W) - diagonal CKM
```

```
dp up w- GWFp QED-HF  
sp cp w- GWFp QED-HF  
bp tp w- GWTp QED-HF  
up dp w+ GWFp QED-HF  
cp sp w+ GWFp QED-HF  
tp bp w+ GWTp QED-HF
```

```
# FFV (ll'W)
```

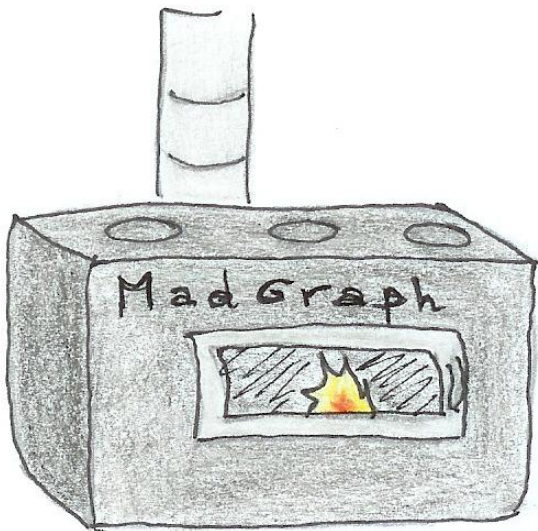
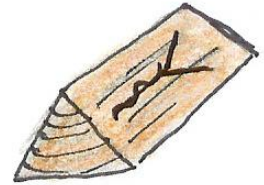
```
vep ep- w+ GWFp QED-HF  
vmp mup- w+ GWFp QED-HF  
vtp tap- w+ GWFp QED-HF  
ep- vep w- GWFp QED-HF  
mup- vmp w- GWFp QED-HF  
tap- vtp w- GWFp QED-HF
```

```
:█
```

```
c-----  
c      V-light      F-heavy      F-heavy  
c-----  
      GZDpL =  
      - 1d0/2d0*gf(-ee,WMASS,ZMASS,MWP)  
      - *vZ0f(WMASS,ZMASS,MWP)*vLP0f(WMASS,MWP)**2  
      - 1d0/2d0*gtf(-ee,WMASS,ZMASS,MWP)  
      - *VZ1f(WMASS,ZMASS,MWP)*vLP1f(WMASS,MWP)**2  
      - 1d0/6d0*gpf(-ee,WMASS,ZMASS,MWP)  
      - *vZ2f(WMASS,ZMASS,MWP)  
      GZDpR =  
      - 1d0/2d0*gtf(-ee,WMASS,ZMASS,MWP)  
      - *VZ1f(WMASS,ZMASS,MWP)  
      - 1d0/6d0*gpf(-ee,WMASS,ZMASS,MWP)  
      - *vZ2f(WMASS,ZMASS,MWP)  
      GZDp(1)=dcplx(GZDpL,Zero)  
      GZDp(2)=dcplx(GZDpR,Zero)  
      write(*,10) 'GZDpL = ',GZDpL  
      write(*,10) 'GZDpR = ',GZDpR  
  
      GZUpL =  
      - 1d0/2d0*gf(-ee,WMASS,ZMASS,MWP)  
      - *vZ0f(WMASS,ZMASS,MWP)*vLP0f(WMASS,MWP)**2  
      - 1d0/2d0*gtf(-ee,WMASS,ZMASS,MWP)  
      - *VZ1f(WMASS,ZMASS,MWP)*vLP1f(WMASS,MWP)**2  
      - 1d0/6d0*gpf(-ee,WMASS,ZMASS,MWP)  
      - *vZ2f(WMASS,ZMASS,MWP)  
      GZUpR =  
      - 1d0/2d0*gtf(-ee,WMASS,ZMASS,MWP)  
      - *VZ1f(WMASS,ZMASS,MWP)  
      - 1d0/6d0*gpf(-ee,WMASS,ZMASS,MWP)  
      - *vZ2f(WMASS,ZMASS,MWP)  
      GZUp(1)=dcplx(GZUpL,Zero)  
      GZUp(2)=dcplx(GZUpR,Zero)  
      write(*,10) 'GZUpL = ',GZUpL  
      write(*,10) 'GZUpR = ',GZUpR
```

Problem 2:

Each matrix element generator has its strengths. What if you need more than one? In the past you had to start over.



Problem 3:

Implementations often did not transfer well to experimentalists.

Problem 3:

Implementations often did not transfer well to experimentalists.

It often required modifying the code of the matrix element generator.

FeynRules

In collaboration with:

Claude Duhr, Benjamin Fuks,

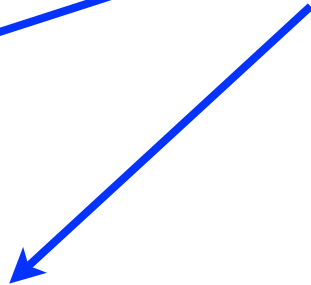
P. de Aquino, C. Degrande, D. Grellscheid, W. Link,
F. Maltoni, O. Mattelaer, T. Reiter, C. Speckner,
S. Schumann, M. Wiebusch

Model File

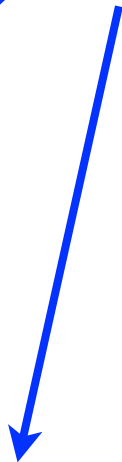


FeynRules

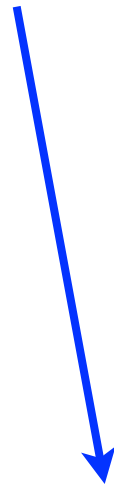
FeynArts



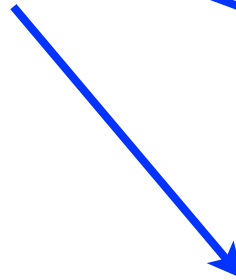
MadGraph



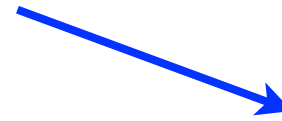
CalcHEP



Sherpa



Whizard



Herwig

F[1] ==

{ClassName -> q,
SelfConjugate -> False,
Indices -> {Index[Colour]},
Mass -> {MQ, 200},
Width -> {WQ, 5} }

L =

$$\begin{aligned} & -1/4 \text{FS}[G,\mu,\nu,a] \text{FS}[G,\mu,\nu,a] \\ & + I \text{qbar.Ga}[\mu].\text{del}[q,\mu] \\ & + g_s \text{qbar.Ga}[\mu].T[a].q \text{G}[\mu,a] \\ & - MQ \text{qbar}.q \end{aligned}$$

```

(*****)
(***** Gauge Bosons kinetic terms *****)
(*****)
LGauge := Module[{F0,F1,F2,L0,L1,L2},

  (***** Glue*)
  FGlue[mu_,nu_,a_] := Module[{b,c},
    del[G[nu,a],mu] - del[G[mu,a],nu] - gs f[a,b,c] G[mu,b] G[nu,c]
  ];
  LGlue := -1/4 FGlue[mu,nu,a]FGlue[mu,nu,a];

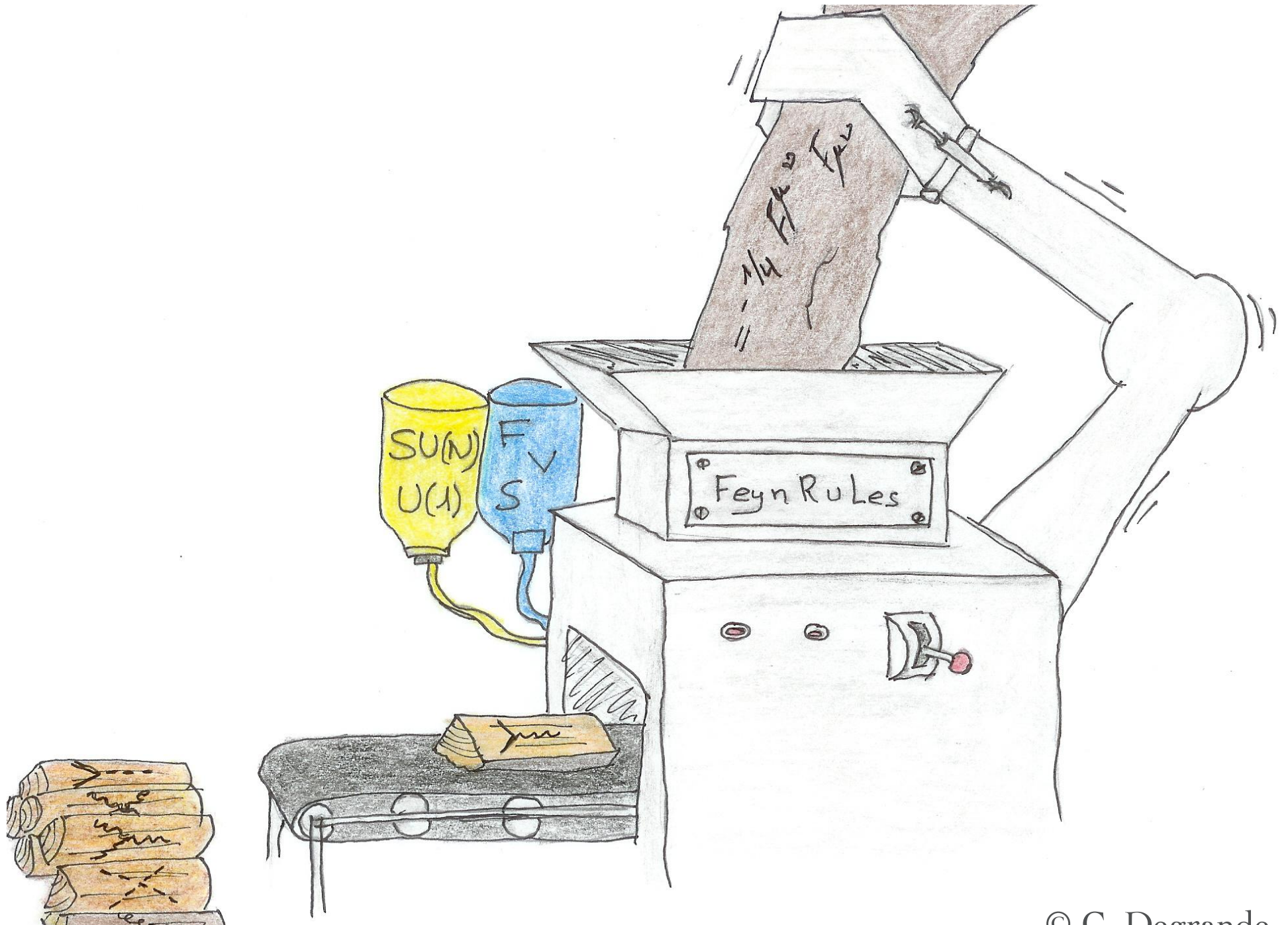
  (***** Site 0*)
  F0[mu_,nu_,a_] := Module[{b,c},
    del[W0[nu,a],mu] - del[W0[mu,a],nu] - g*ep0[a,b,c]*W0[mu,b]*W0[nu,c]
  ];
  L0 := -1/4 F0[mu,nu,a]F0[mu,nu,a];

  (***** Site 1*)
  F1[mu_,nu_,a_] := Module[{b,c},
    del[W1[nu,a],mu] - del[W1[mu,a],nu] - gt*ep1[a,b,c]*W1[mu,b]*W1[nu,c]
  ];
  L1 := -1/4 F1[mu,nu,a]F1[mu,nu,a];

  (***** Site 2*)
  F2[mu_,nu_] := Module[{tmp},
    del[W23[nu],mu] - del[W23[mu],nu]
  ];
  L2 := -1/4 F2[mu,nu]F2[mu,nu];

  LGlue+L0+L1+L2
];

```



Celine Sasha Priscila Martin Benj Christian Claude Will Olivier David Neil Thomas



Development

- Superfield Formalism (B. Fuks)
- New FeynArts Interface (C. Degrande, C. Duhr)
- Automatic Mass Matrix Diagonalization (M. Wiebusch, NDC)
- New MadGraph5/Herwig Interface (P. de Aquino, C. Duhr, D. Grellscheid, W. Link, O. Mattelaer, T. Reiter)
- New Whizard Interface (arXiv:1010.325) (NDC, C. Duhr, B. Fuks, J. Rueter, C. Speckner)
- Model Database (all)
- New automatized Web Validation (NDC)

[Add New Stock Model](#)

Validations

- [Remove](#) [VV-VV \(w/o CHstock\)](#) 48 processes : 48 agree 0 questionable 0 disagree 0 not finished
- [Remove](#) [ff-VV \(w/o CHstock\)](#) 1272 processes : 1265 agree 7 questionable 0 disagree 0 not finished
- [Remove](#) [ff-ff \(w/o CHstock\)](#) 4446 processes : 4446 agree 0 questionable 0 disagree 0 not finished

[Create New Validation](#)

[Start Fresh Validations](#)[Finish Validations](#)

48 processes : 48 agree, 0 questionable, 0 disagree, 0 not finished

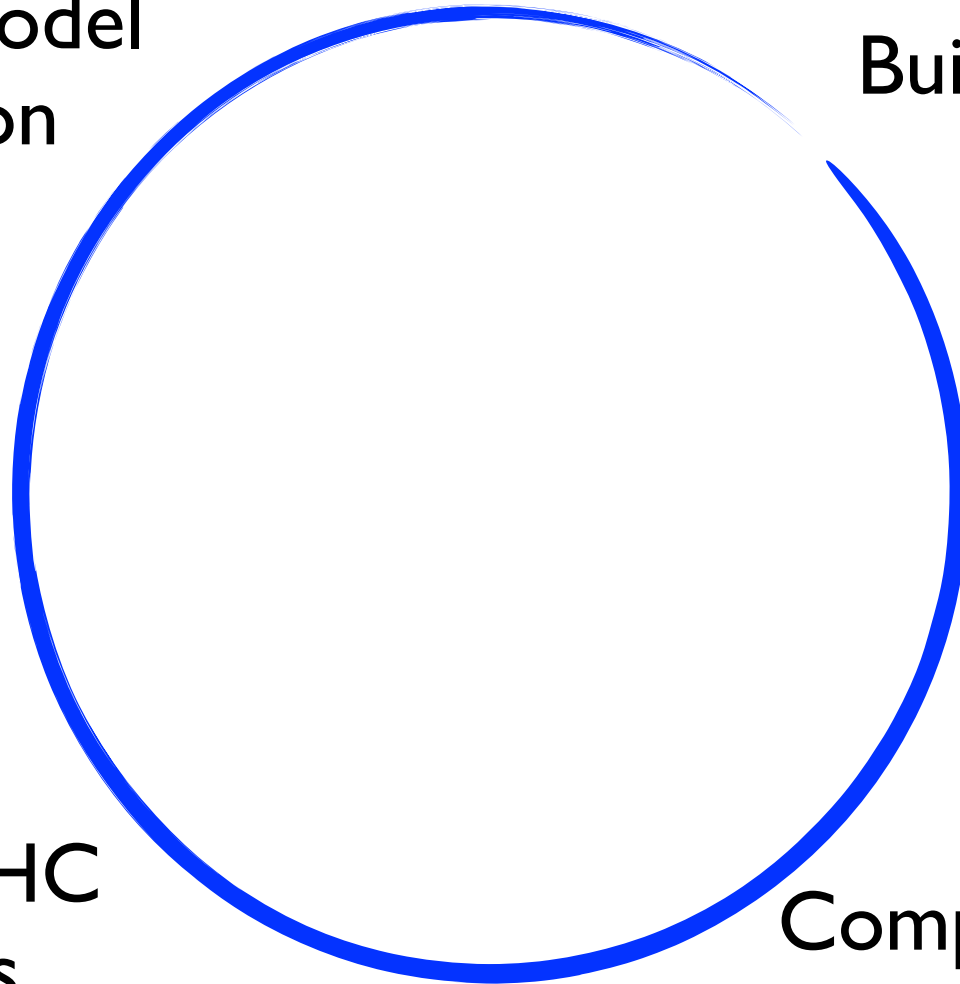
	\sqrt{s}	P_{Tcut}	CH(F)	CH(u)	MG4	WO1(F)	WO1(u)	WO2(F)	WO2(u)	WO-ST	Δ
Z , W+ → ~Z , ~W+	4693.0	1173.25	102.67	102.67	102.4	102.672	102.679	102.691	102.682	102.676	✓ 0.24%
W+ , W+ → W+ , ~W+	2965.0	741.25	2.4203	2.4203	2.4141	2.42005	2.41998	2.42014	2.41914	2.42078	✓ 0.22%
W+ , ~W+ → ~W+ , ~W+	6322.0	1580.5	3.3141	3.3141	3.3217	3.31304	3.31371	3.31373	3.31409	3.31557	✓ 0.2%
W+ , W+ → W+ , W+	1286.0	321.5	76.03	76.03	76.188	76.0095	76.0285	76.0867	75.9919	76.0325	✓ 0.18%
~W+ , ~W+ → ~W+ , ~W+	8000.0	2000.0	567.33	567.33	566.24	567.314	567.18	567.244	567.249	567.35	✓ 0.16%
~Z , ~Z → ~W+ , ~W-	8013.0	2003.25	1133.9	1133.9	1131.7	1133.48	1133.53	1133.76	1133.73	1133.59	✓ 0.15%
A , A → W+ , W-	643.0	160.75	16.11	16.11	16.108	16.111	16.1075	16.1075	16.0846	16.1064	✓ 0.13%
Z , Z → W+ , W-	1373.0	343.25	130.02	130.02	130.21	129.98	130.079	130.023	130.035	129.965	✓ 0.13%
Z , Z → ~W+ , ~W-	4730.0	1182.5	313.8	313.8	313.42	313.828	313.791	313.759	313.955	313.862	✓ 0.11%
G , G → G , G	200.0	50.0	18835.0	18835.0	18816.0	18831.7	18831.2	18842.3	18845.4	18841.9	✓ 0.1%
A , A → ~W+ , ~W-	8000.0	2000.0	0.12636	0.12636	0.1265	0.126312	0.12635	0.126452	0.126347	0.12637	✓ 0.09%
Z , Z → W+ , ~W-	3051.0	762.75	1.1376	1.1376	1.138	1.13758	1.13784	1.13857	1.13718	1.13735	✓ 0.08%
A , Z → ~W+ , ~W-	8730.0	2182.5	0.041172	0.041172	0.041175	0.0411638	0.0411898	0.0411888	0.0411406	0.0411586	✓ 0.07%
A , ~Z → ~W+ , ~W-	6007.0	1501.75	6.3818	6.3818	6.3866	6.38627	6.38614	6.38229	6.38421	6.37878	✓ 0.07%
A , Z → W+ , W-	1008.0	252.0	20.969	20.969	20.961	20.9732	20.9758	20.9558	20.9718	20.9649	✓ 0.06%
W+ , W+ → ~W+ , ~W+	4643.0	1160.75	150.92	150.92	150.79	150.942	150.919	150.815	150.875	150.921	✓ 0.06%
A , W+ → W+ , ~Z	2650.0	662.5	0.16856	0.16856	0.16866	0.168592	0.168542	0.168497	0.168558	0.168573	✓ 0.05%
A , W+ → ~Z , ~W+	8656.0	2164.0	0.034886	0.034886	0.034866	0.034879	0.034886	0.0348662	0.034893	0.034872	✓ 0.04%
Z , W+ → W+ , ~Z	3015.0	753.75	0.7552	0.7552	0.75509	0.755298	0.755141	0.755171	0.755301	0.755573	✓ 0.04%

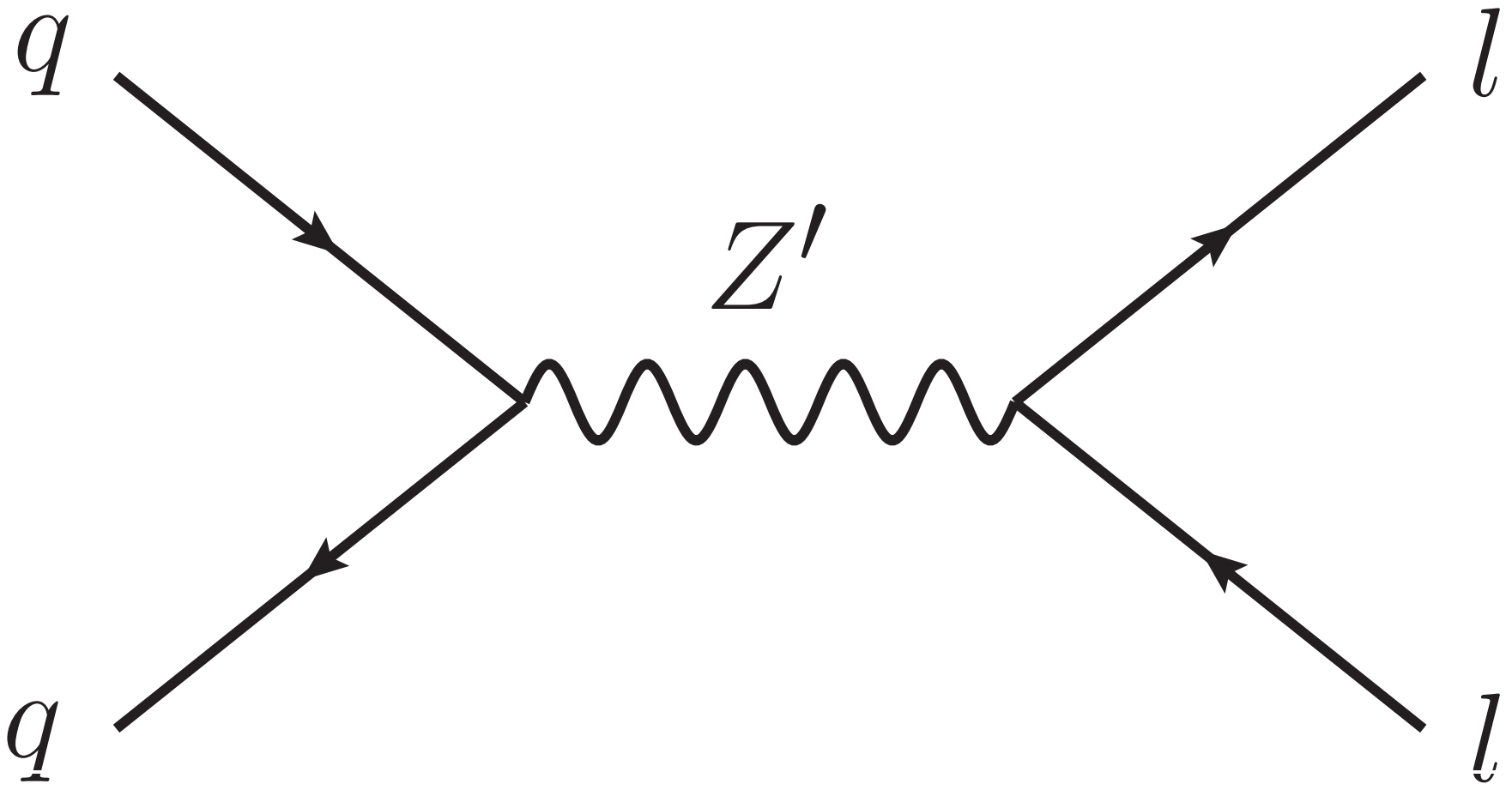
Implement model
in simulation
software

Build Model

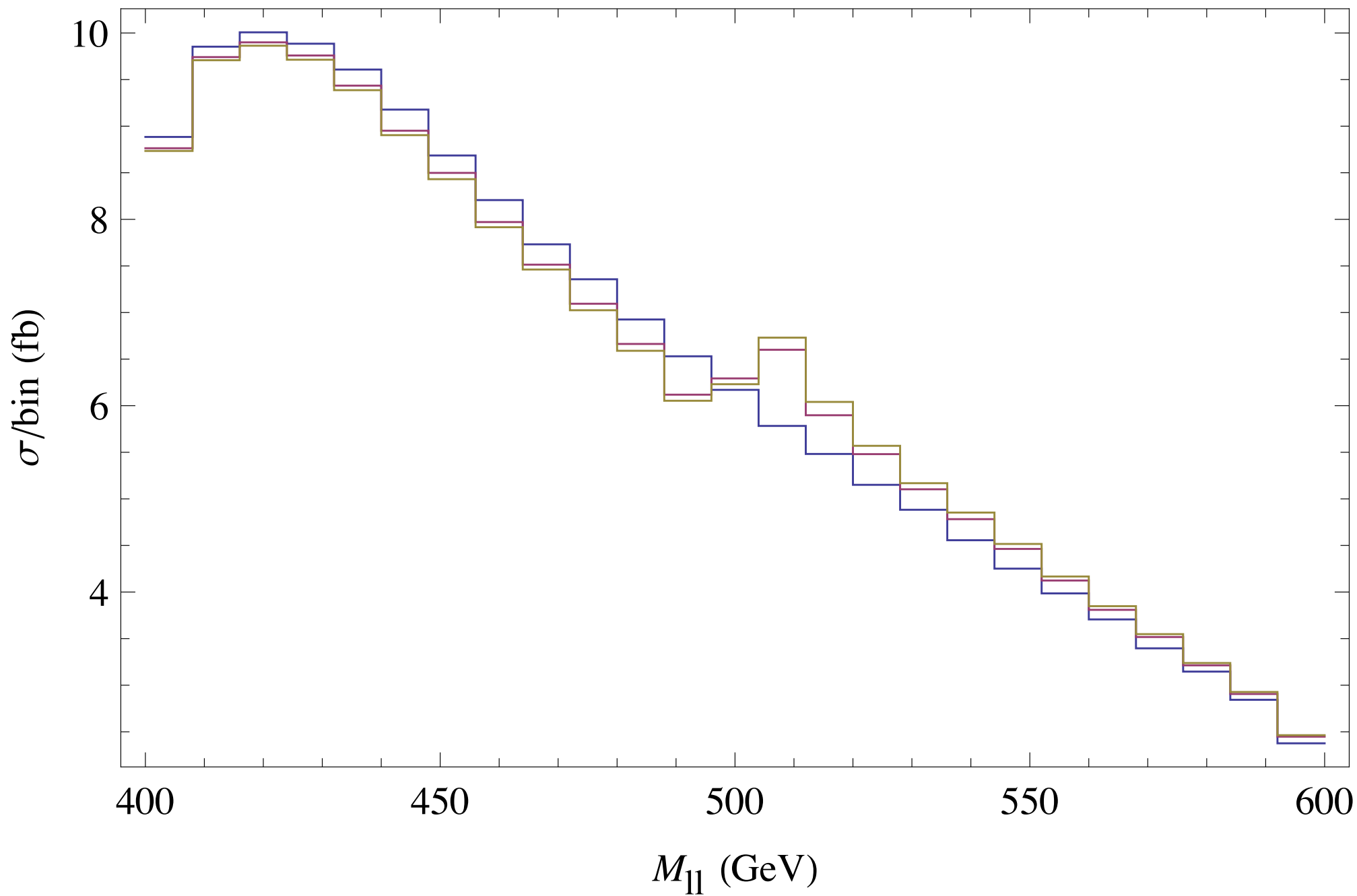
Simulate LHC
collisions

Compare predictions
with experiments

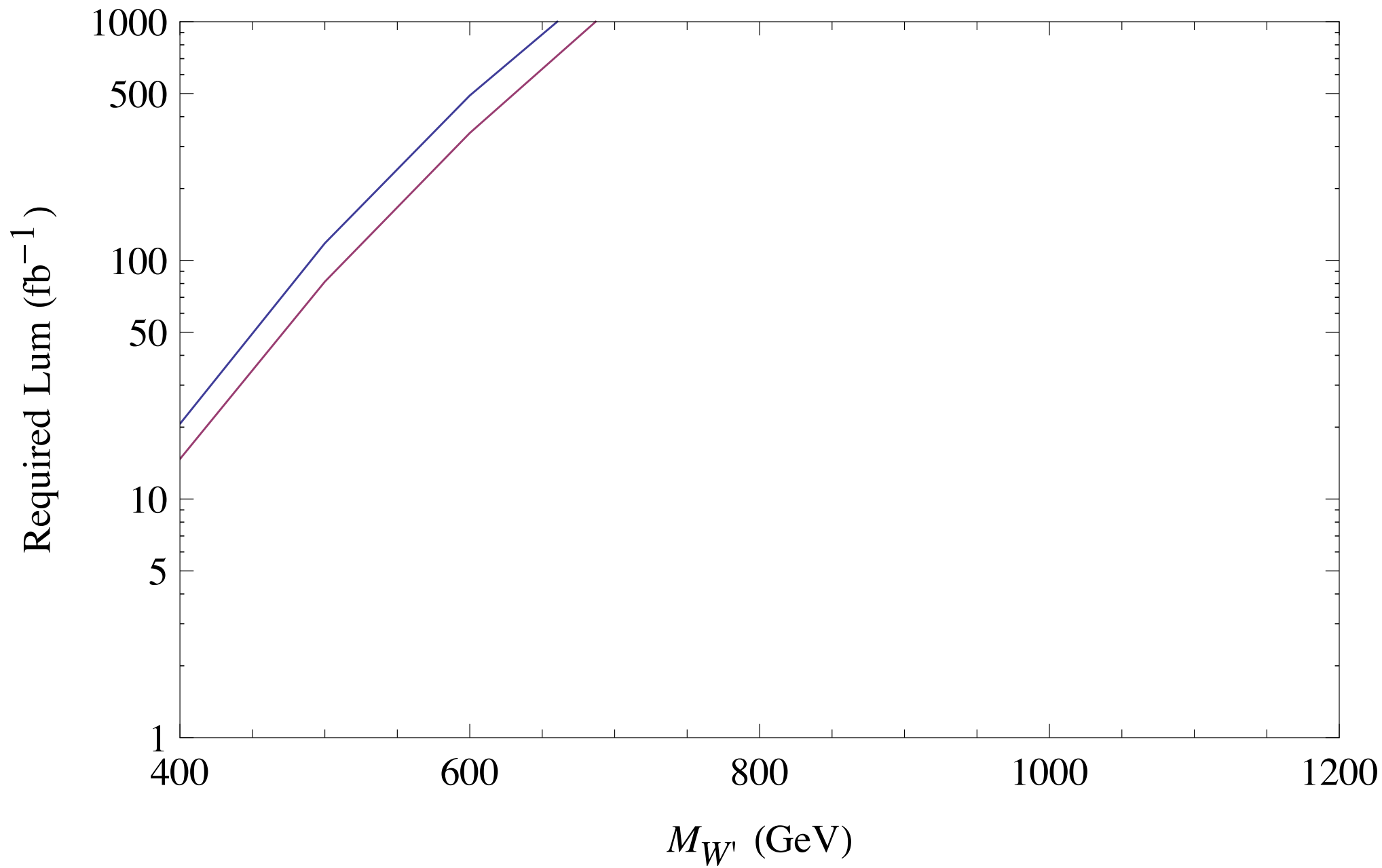


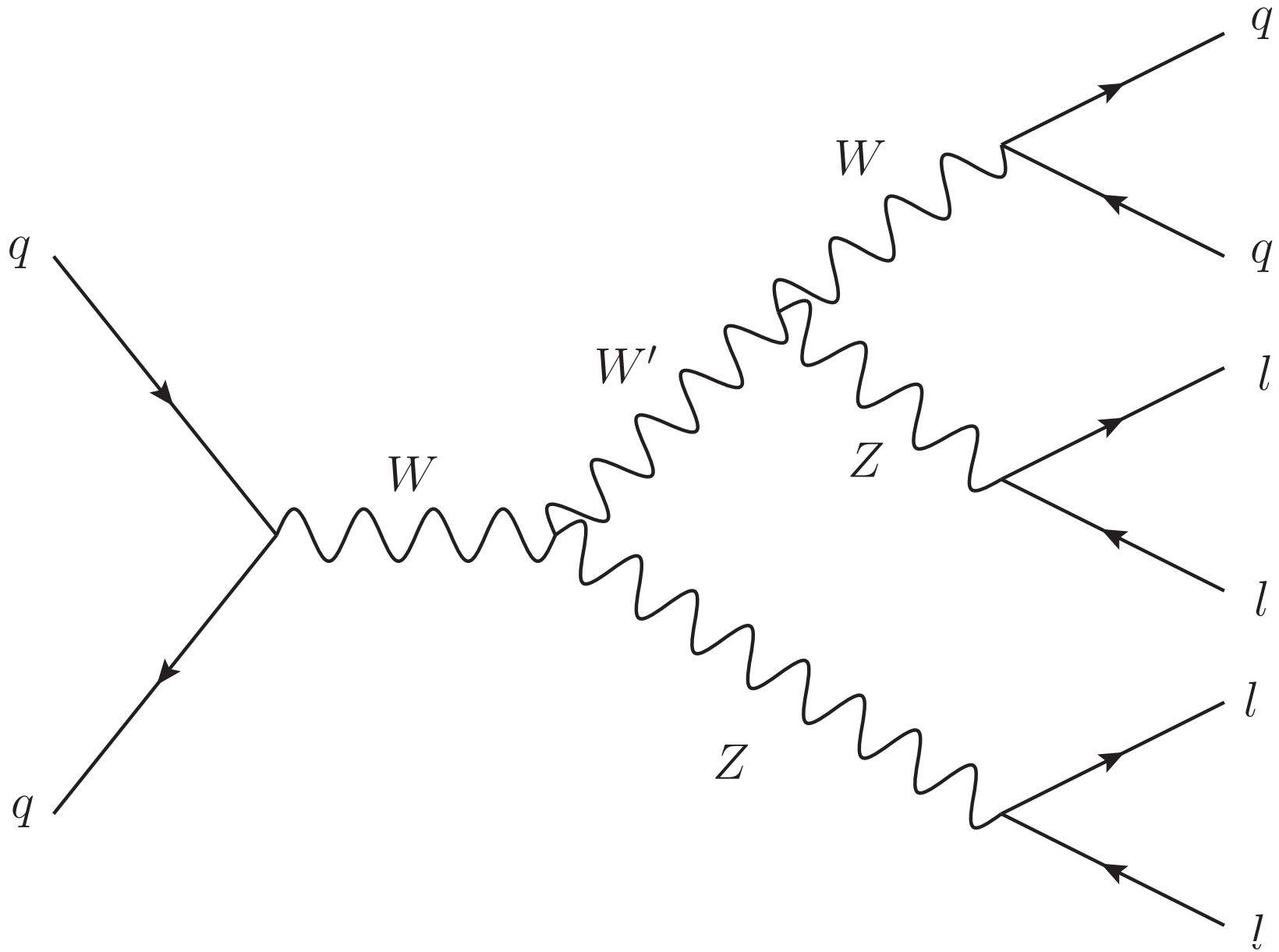


$p,p \rightarrow Z' \rightarrow l,l$

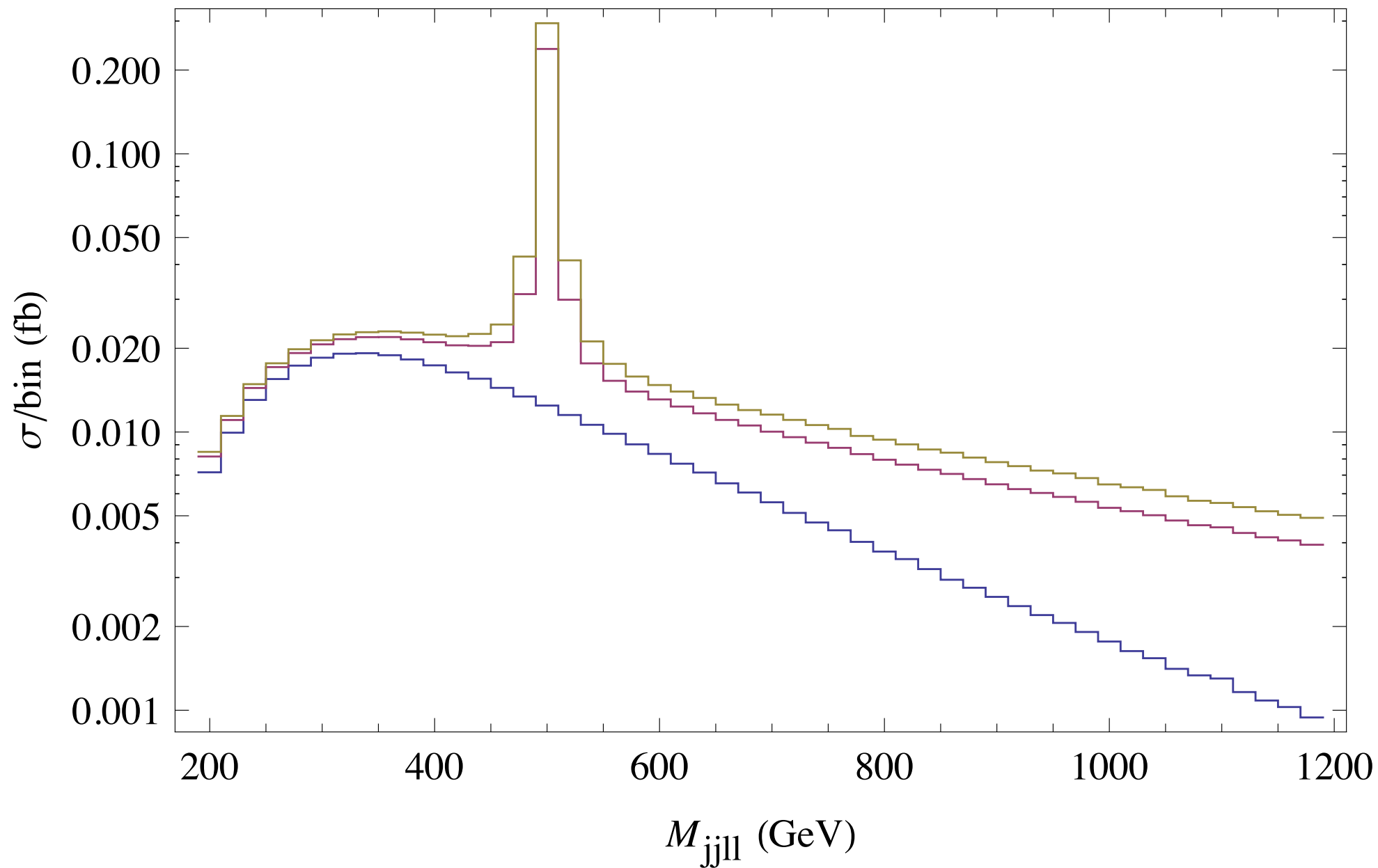


$p,p \rightarrow Z' \rightarrow l,l$

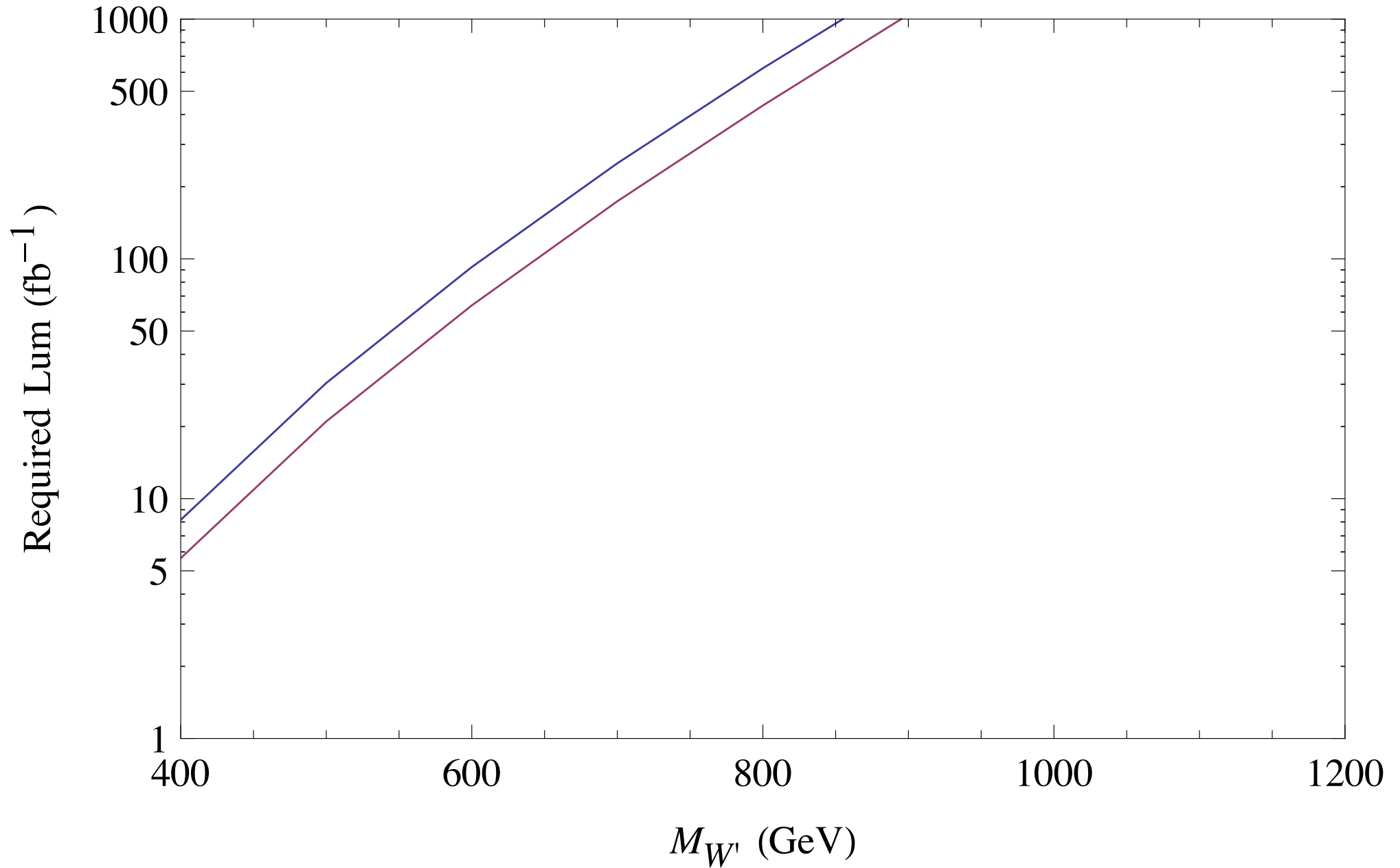


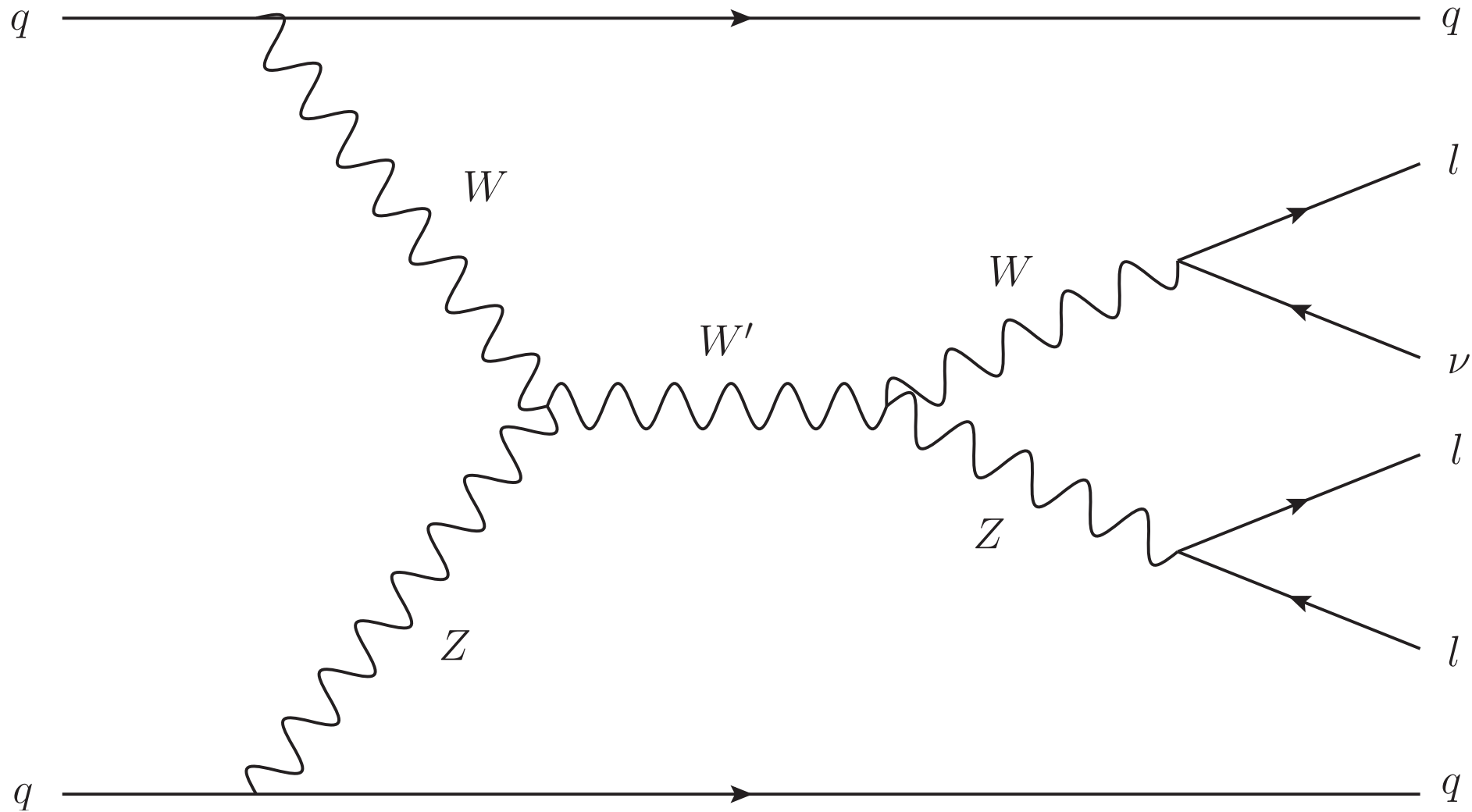


$p,p \rightarrow W', Z \rightarrow W, Z, Z \rightarrow j, j, l, l, l, l$

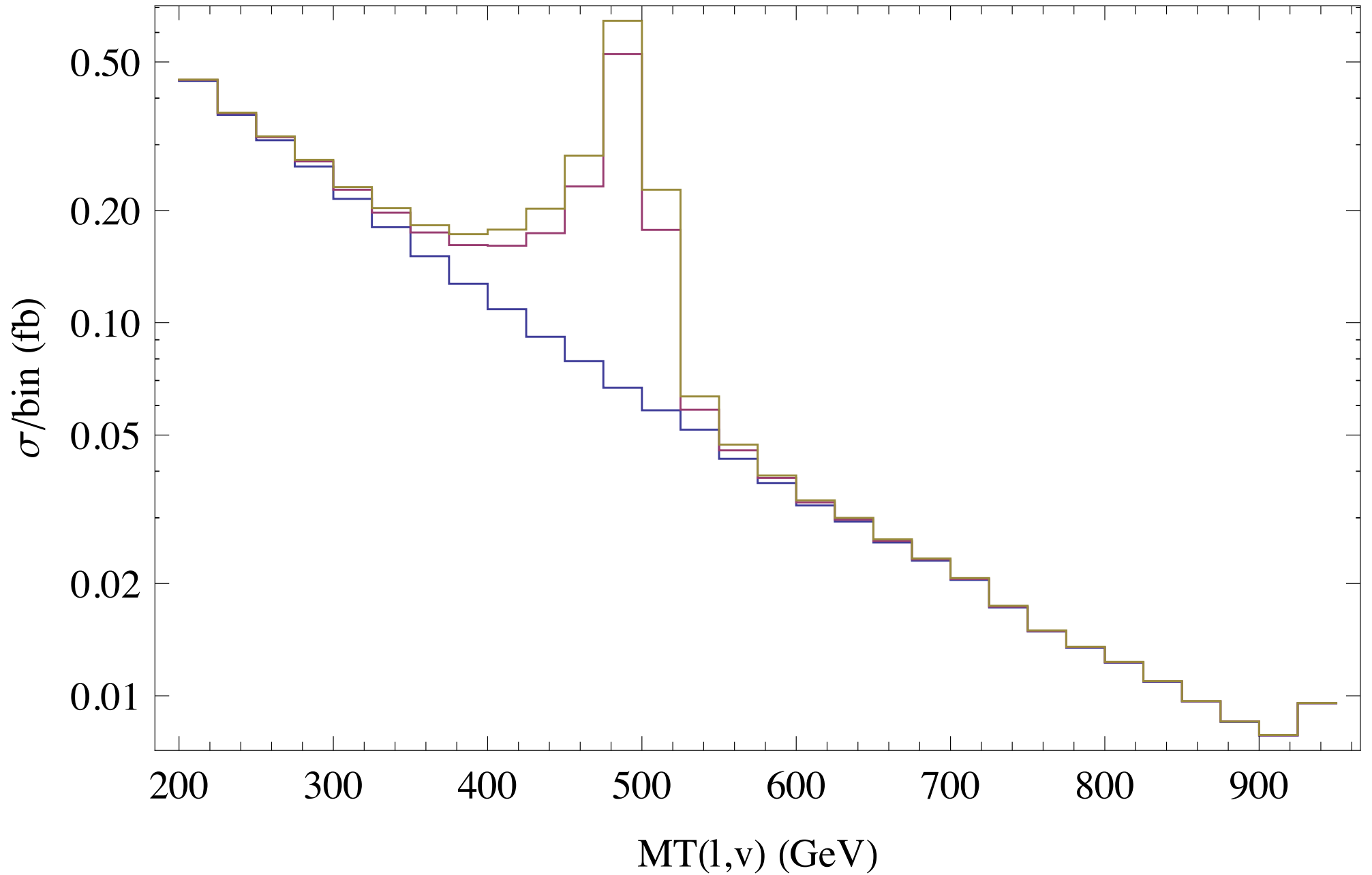


$p,p \rightarrow W', Z \rightarrow W, Z, Z \rightarrow j, j, l, l, l, l$

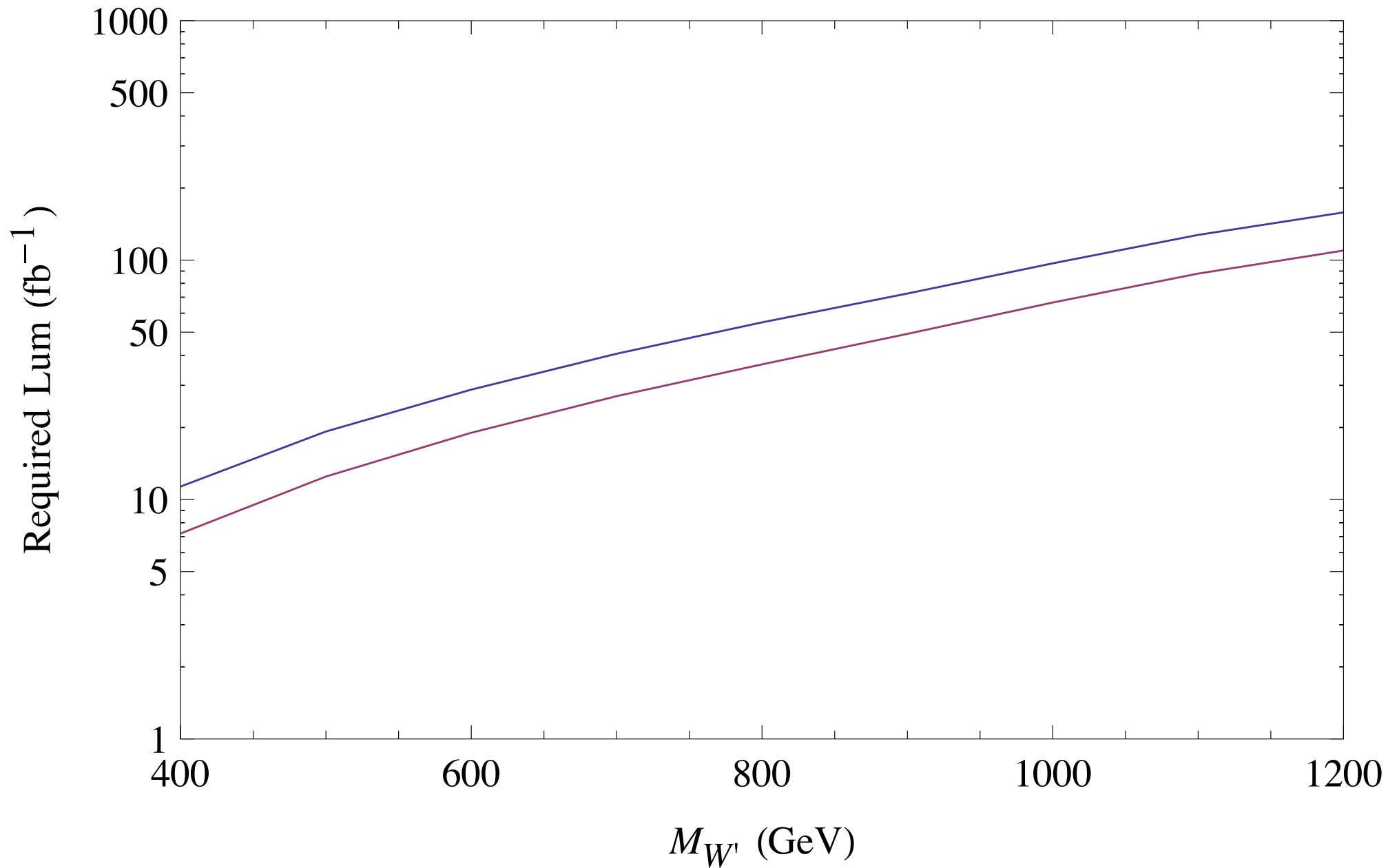


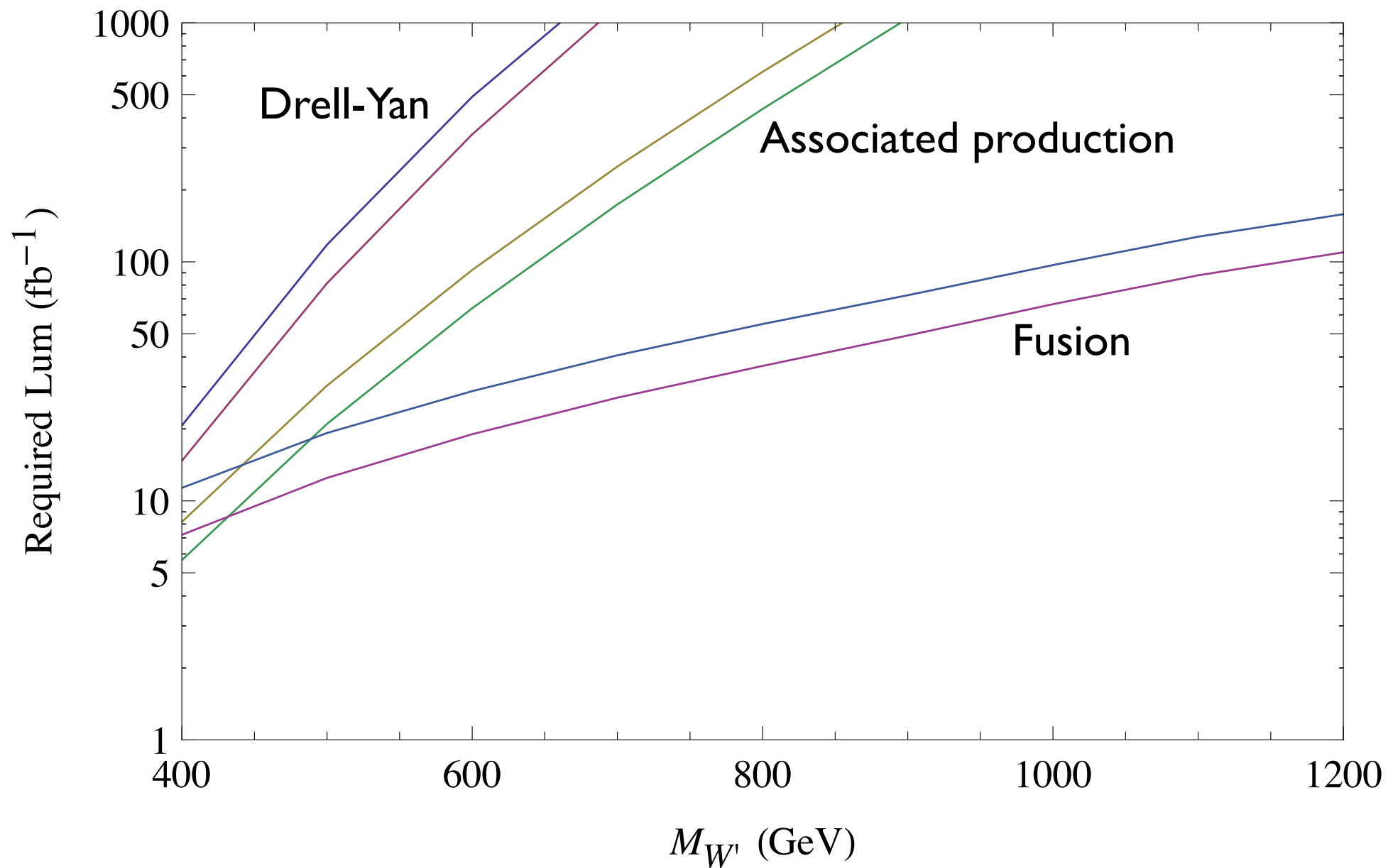


$p,p \rightarrow j,j, W' \rightarrow j,j, W, Z \rightarrow j,j, l,l,l, \nu$



$p,p \rightarrow j,j, W' \rightarrow j,j, W, Z \rightarrow j,j, l,l,l, \nu$



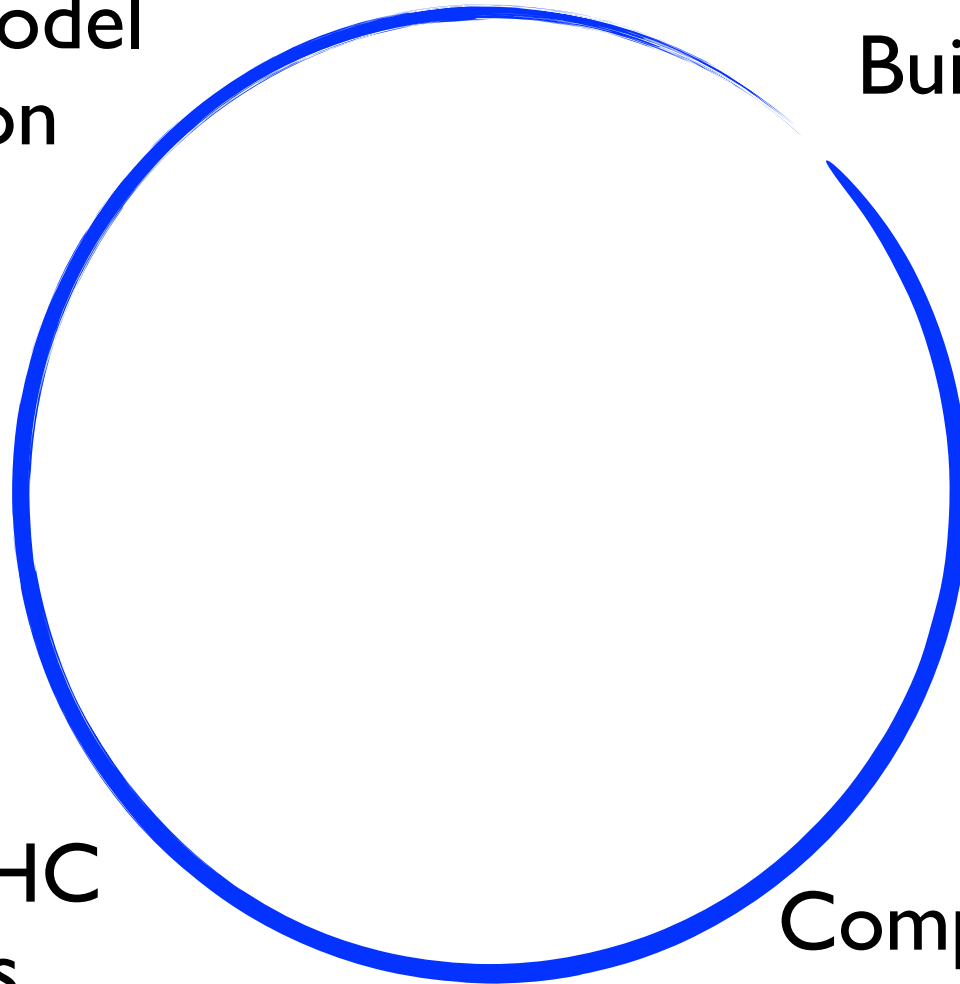


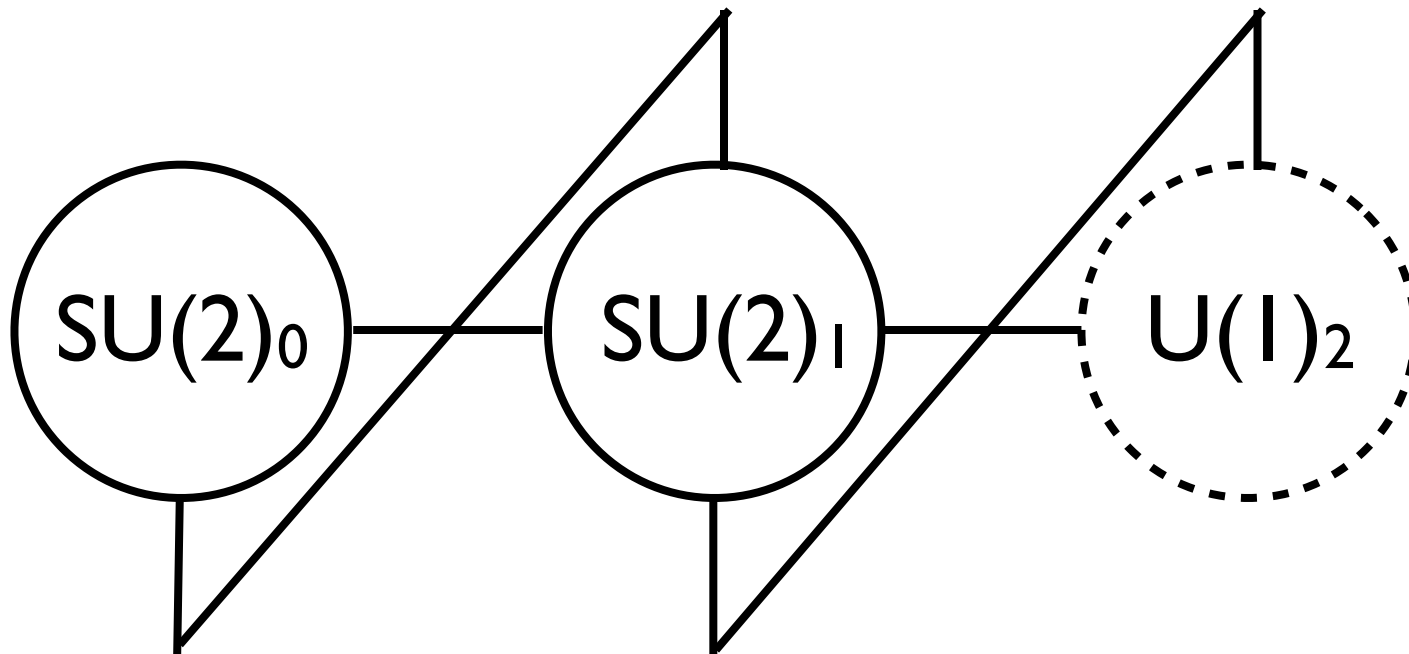
Implement model
in simulation
software

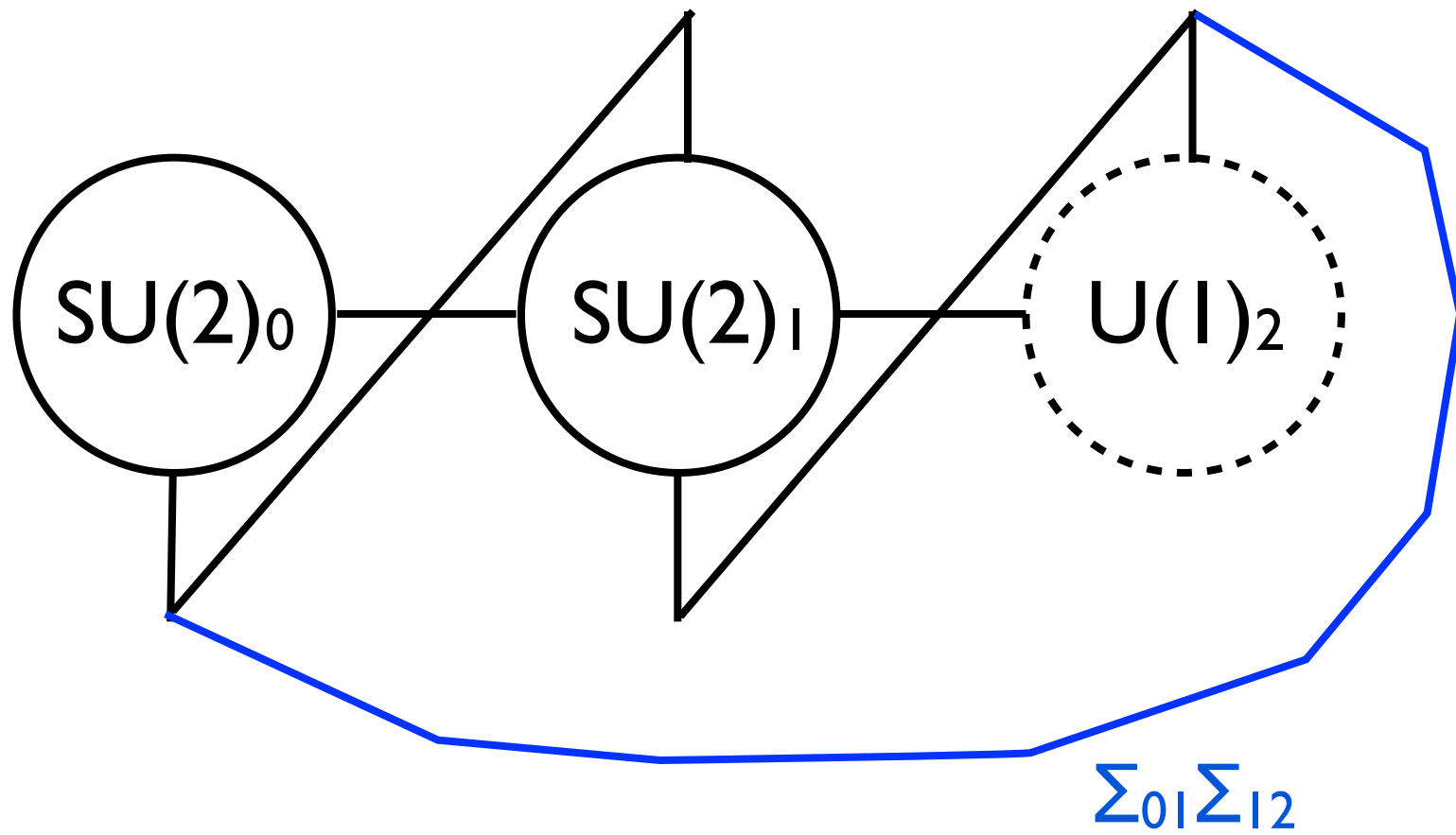
Build Model

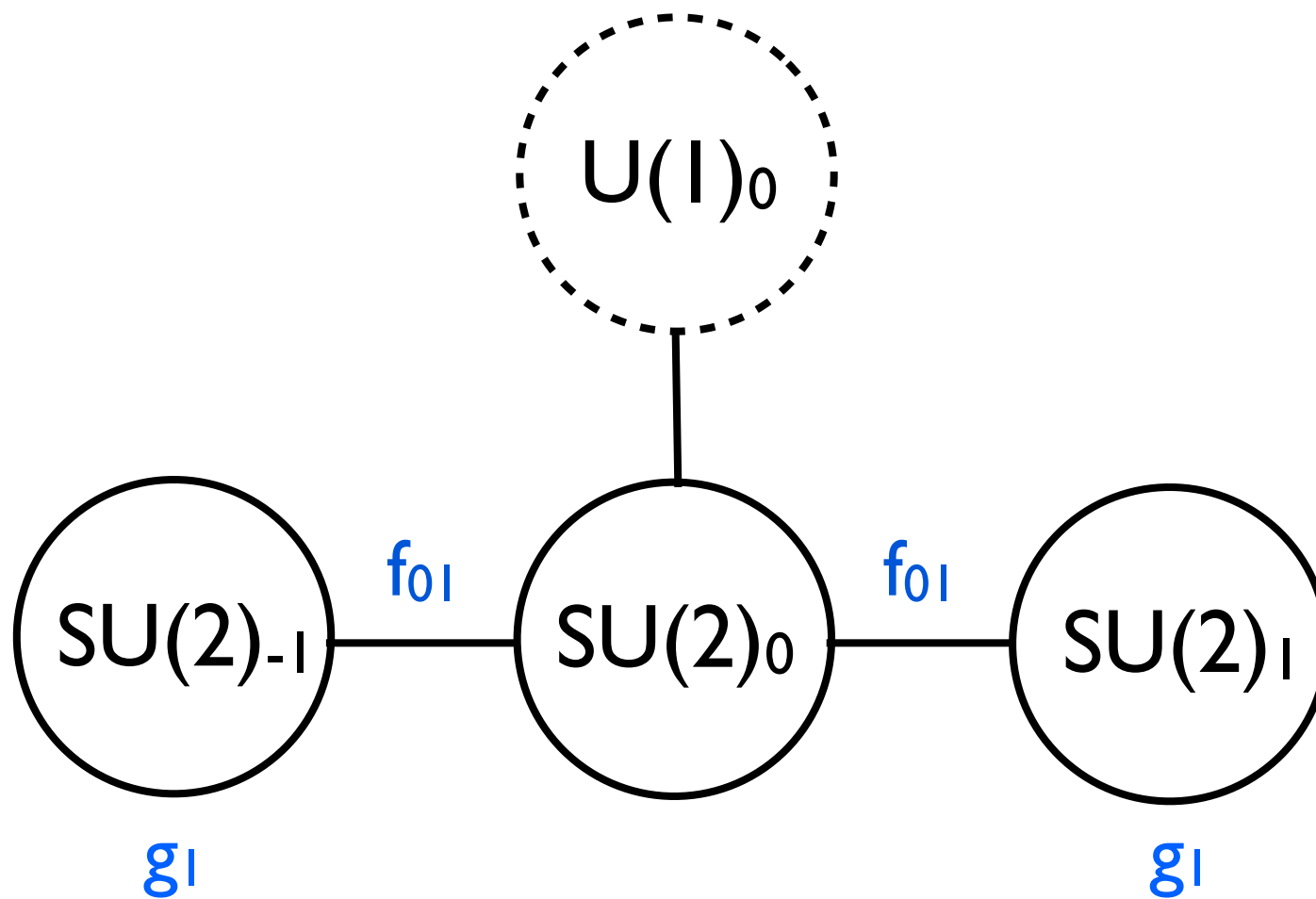
Simulate LHC
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Compare predictions
with experiments



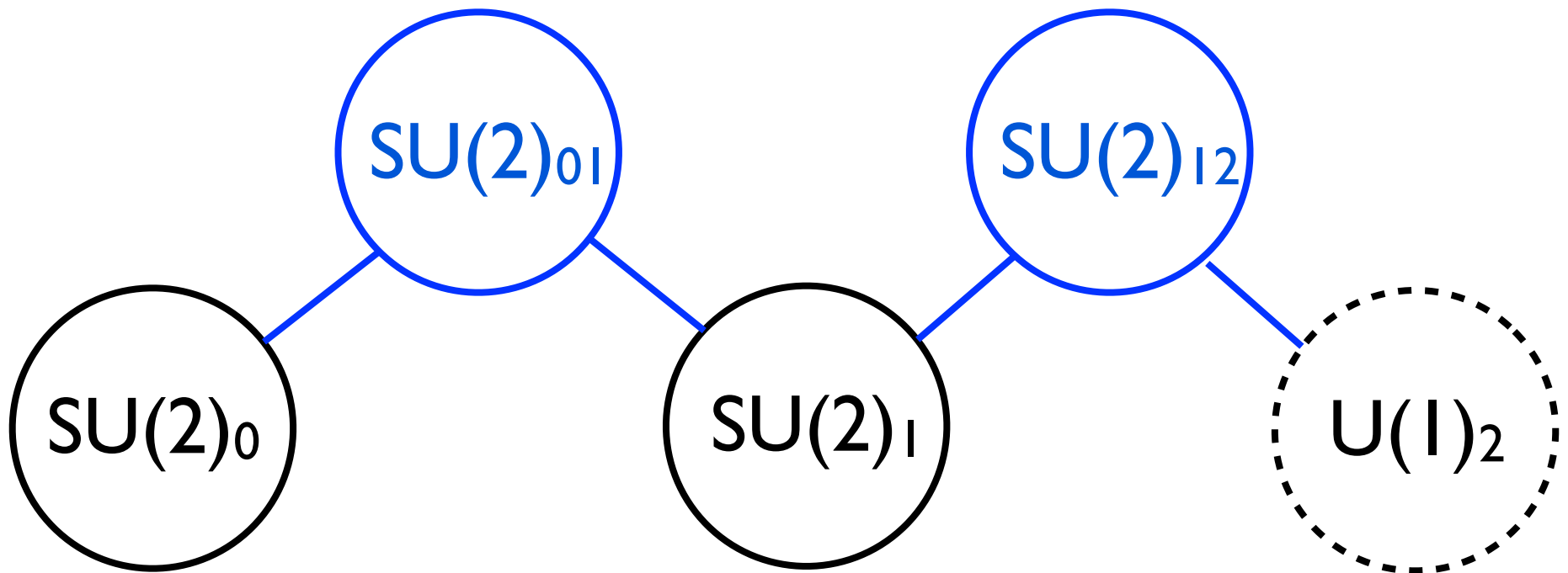


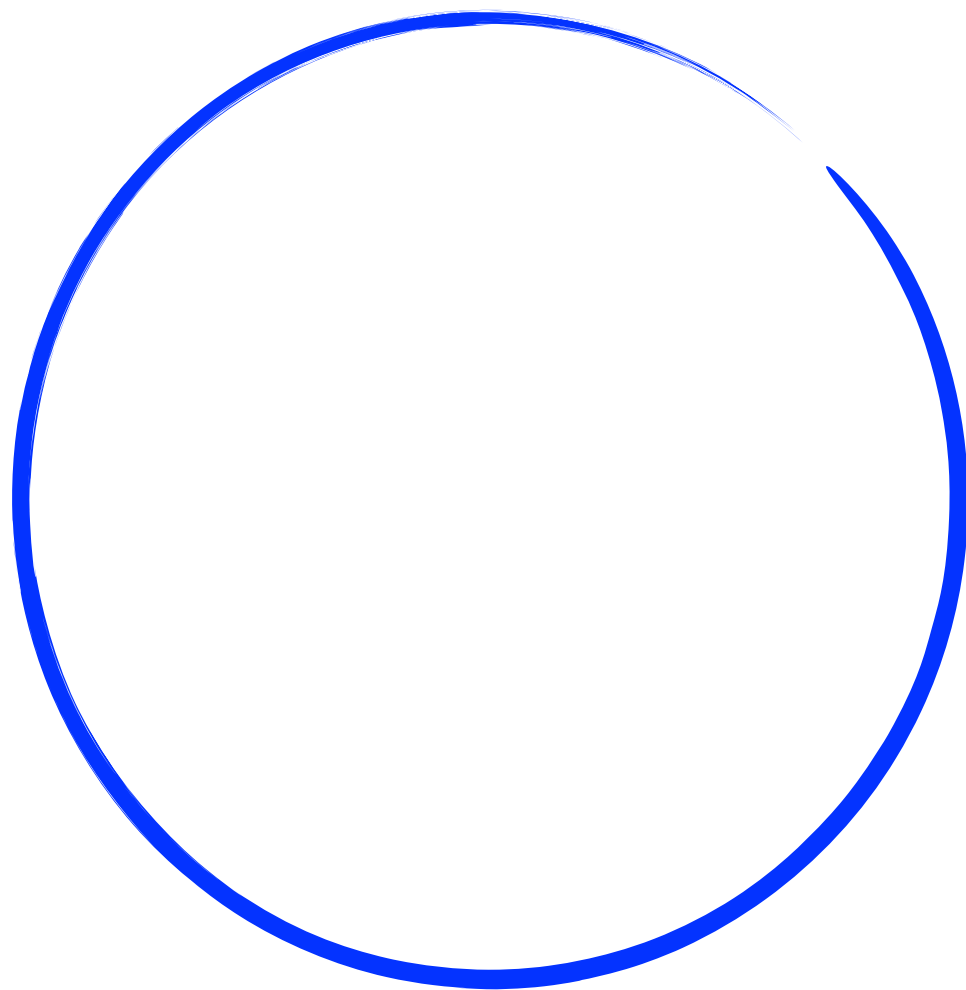




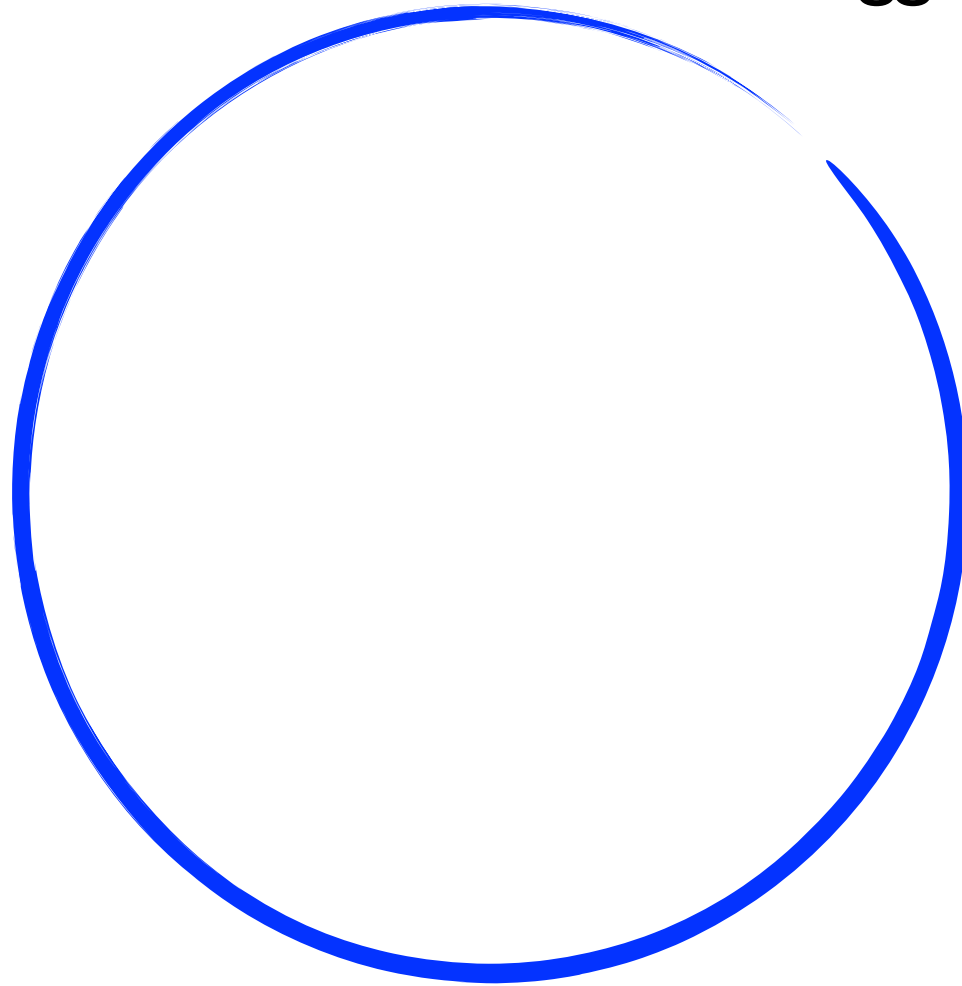
Strong
Dynamics

Strong
Dynamics



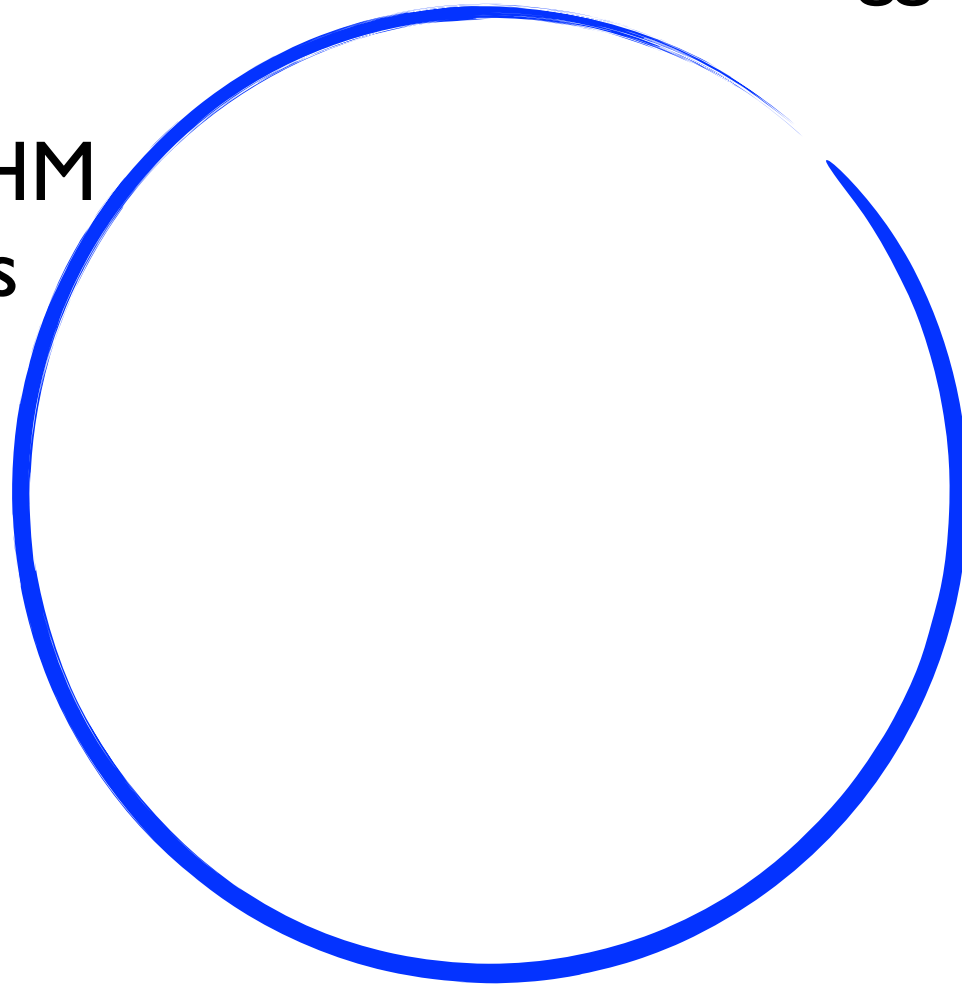


Build MHM: Minimal Higgsless Model



Build MHM:
Minimal Higgsless Model

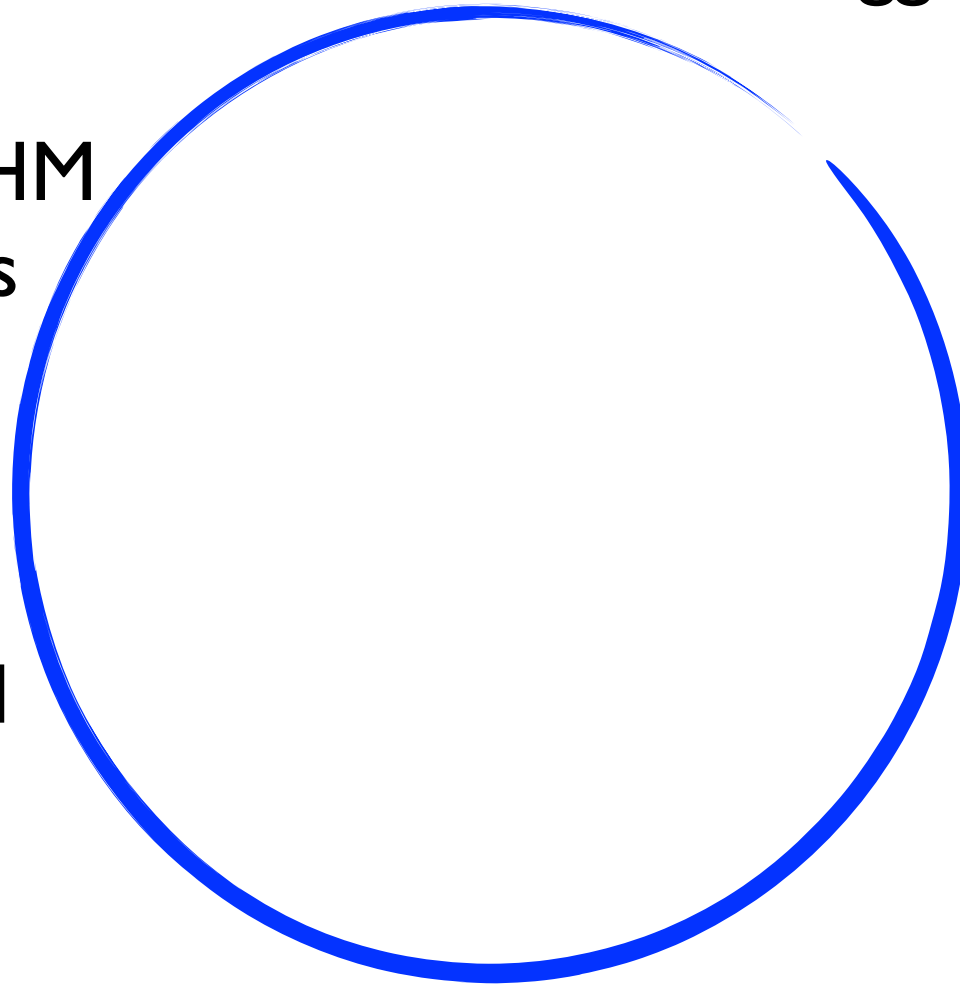
Implement MHM
in FeynRules



Build MHM:
Minimal Higgsless Model

Implement MHM
in FeynRules

Simulate MHM
at the LHC

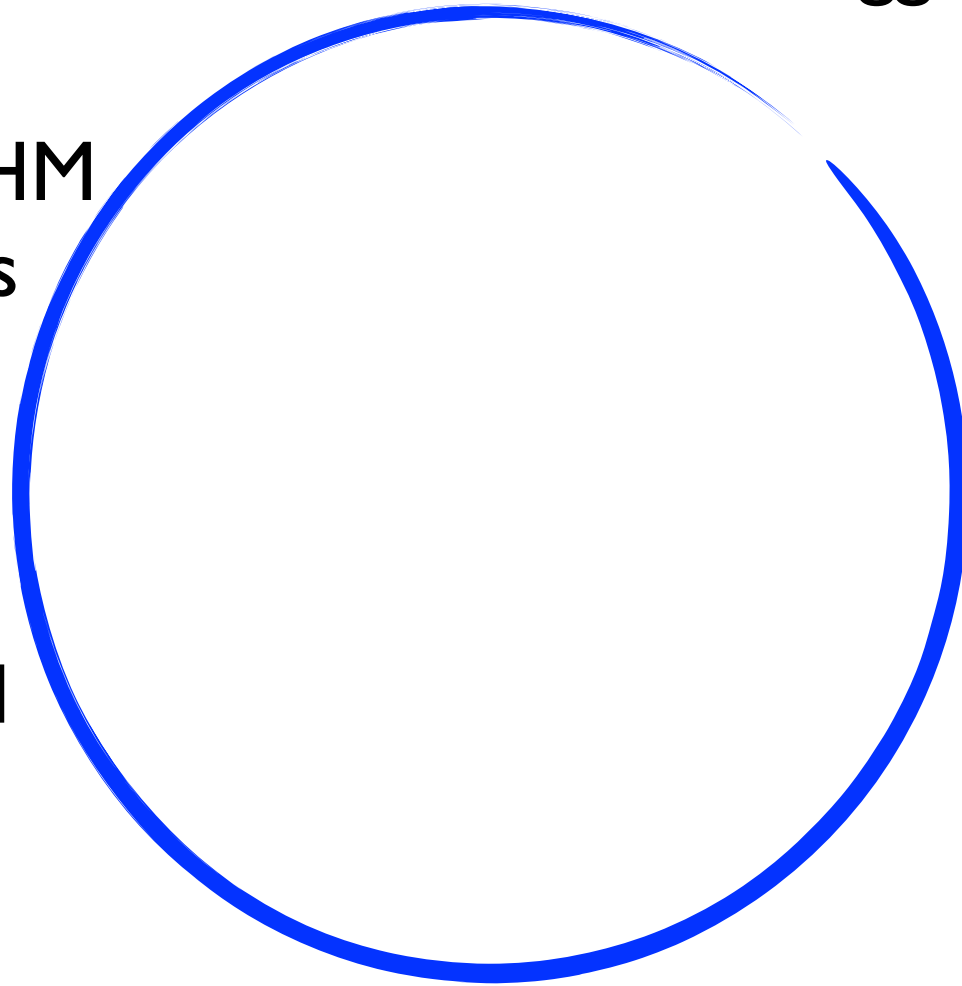


Build MHM:
Minimal Higgsless Model

Implement MHM
in FeynRules

Simulate MHM
at the LHC

Store MHM in
Model Database



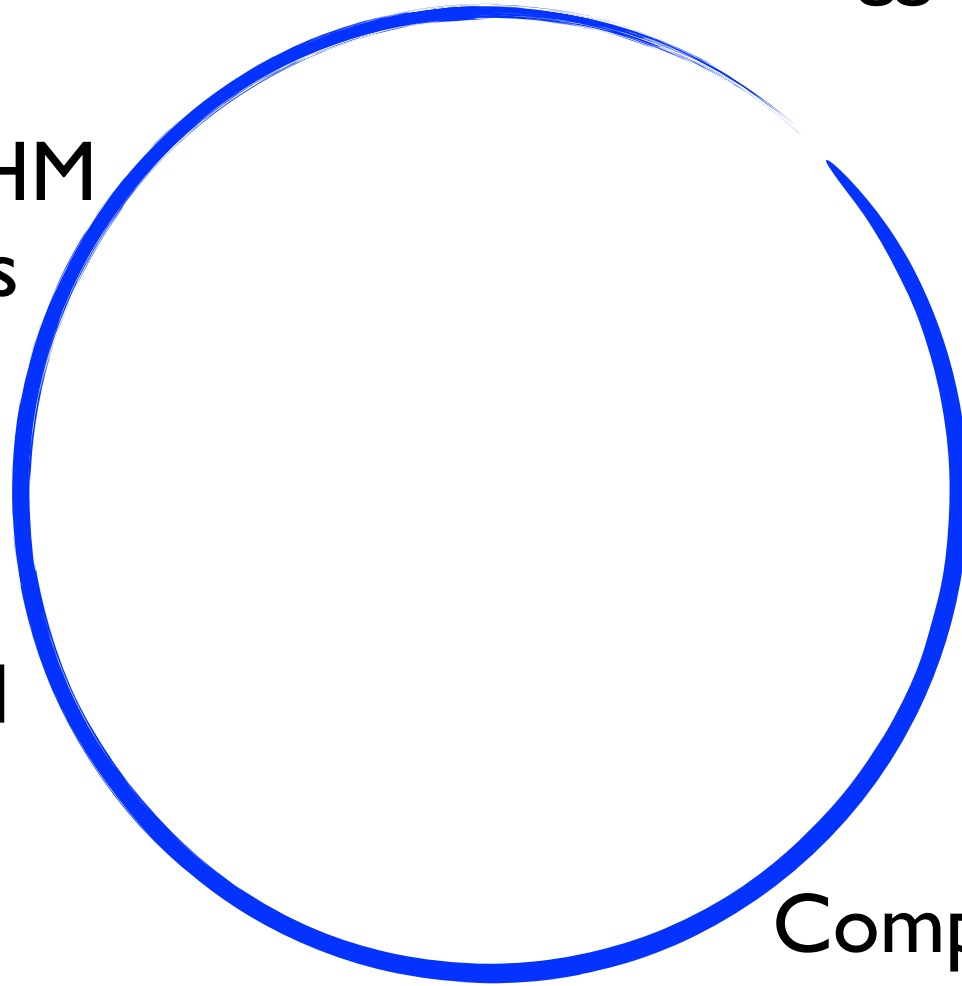
Build MHM:
Minimal Higgsless Model

Implement MHM
in FeynRules

Simulate MHM
at the LHC

Store MHM in
Model Database

Compare predictions
with LHC data:
Still to be done!



Build MHM: Minimal Higgsless Model

Implement MHM
in FeynRules

Extend MHM
to fit data

Simulate MHM
at the LHC

Store MHM in
Model Database

Compare predictions
with LHC data:
Still to be done!

