

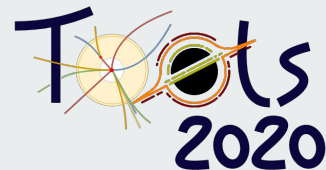
# MARTY

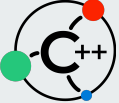
Demonstration of MARTY's capabilities

<https://marty.in2p3.fr>

arxiv: 2011.02478 [hep-ph]

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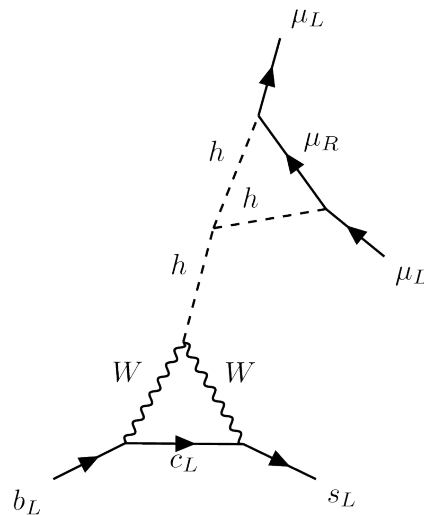


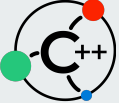


# Timing (1h)

- CSL 5 min
- GRAFED 5 min
- MARTY 35 min
  - Model Building 20 min
  - Calculation 5 min
  - Library generation 10 min
- Questions 15min

Feel free to interrupt if you have any question !



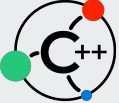


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# Initial model

Gauge  $SU(2)_L \times U(1)_Y$

- Gauge bosons:
  - $A_L$  (W in the SM)
  - $A_Y$  (B in the SM)
- Matter content:
  - $Q_L \rightarrow$  irrep  $(2, \frac{1}{6})$
  - $u_R \rightarrow$  irrep  $(1, \frac{2}{3})$
  - $d_R \rightarrow$  irrep  $(1, -\frac{1}{3})$



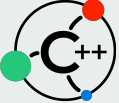
# Symmetry breaking

Gauge  $SU(2)_L \times U(1)_Y \rightarrow U(1)_{EM}$

- $W$  broken into  $\{W_1, W_2, W_3\}$
- $Q_L$  broken into  $\{Q_{L1}, Q_{L2}\} \rightarrow \{u_L, d_L\}$

Gauge bosons treatment:

- $W_{1/2} \rightarrow W^{+/-}$
- $W_3, B \rightarrow Z, A$



$W^{+/-}$

$W_\mu$  boson:

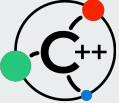
$$W_1 = \frac{W^+ + W^-}{\sqrt{2}} = \frac{W + W^*}{\sqrt{2}}$$

$$W_2 = i \frac{W^+ - W^-}{\sqrt{2}} = i \frac{W - W^*}{\sqrt{2}}$$

$F_{\mu\nu}$  field strength

$$F_{W1} = \frac{F_W + F_W^*}{\sqrt{2}}$$

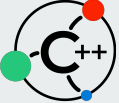
$$F_{W2} = i \frac{F_W - F_W^*}{\sqrt{2}}$$



## Z and A bosons

$\{W_3, B\}$  rotated to  $\{Z, A\}$  by angle  $\theta_{\text{WEINBERG}}$  to get massless photon A

$$\begin{pmatrix} W^3 \\ B \end{pmatrix} = \begin{pmatrix} \cos \theta_W & \sin \theta_W \\ -\sin \theta_W & \cos \theta_W \end{pmatrix} \cdot \begin{pmatrix} Z \\ A \end{pmatrix}$$



# Electromagnetic constant

From Symmetry breaking  $SU(2)_L \times U(1)_Y \rightarrow U(1)_{EM}$ :

Introduce electromagnetic constant  $e$  and replace  $g_Y$  and  $g_L$

$$g_Y = \frac{e}{\cos \theta_W}$$

$$g_L = \frac{e}{\sin \theta_W}$$