Hirschfest!

A celebration of Martin's career

Chronologically

Gota fria ~
Monsoon

Chronologically

Gota fria ~
Monsoon

>20 years later

10AM coffee, Monday cakes, socials, good vibes

Diverse and intersecting physics subjects, careful PhD supervision

Horizontal, supportive, inspiring group

Chronologically

Gota fria ~
Monsoon

>20 years later

10AM coffee, Monday cakes, socials, good vibes

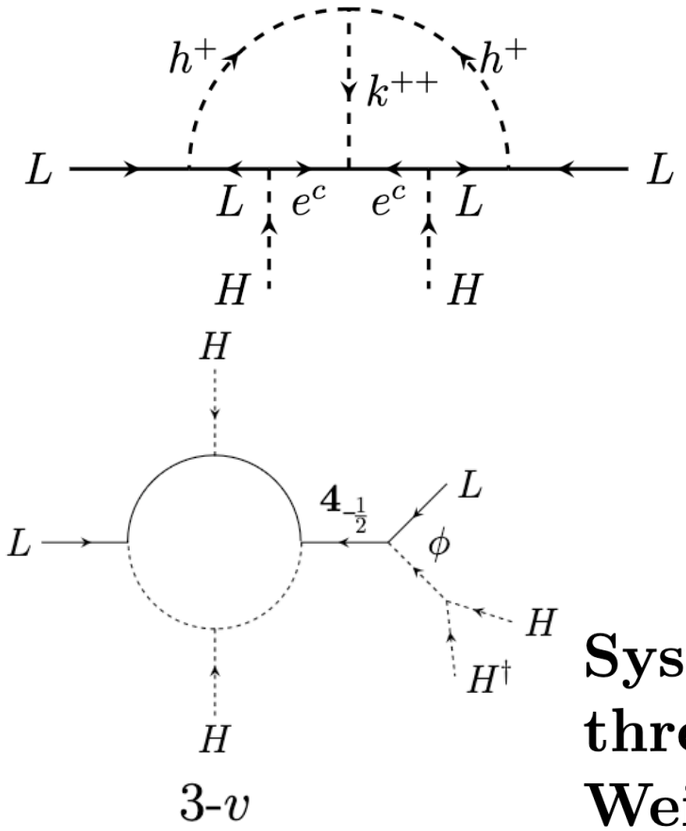
Diverse and intersecting physics subjects, careful PhD supervision

Horizontal, supportive, inspiring group

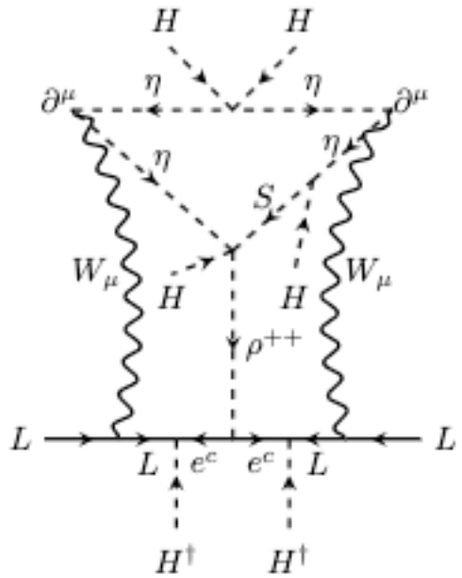
Martin, you are very much responsible for this success!

Joining forces

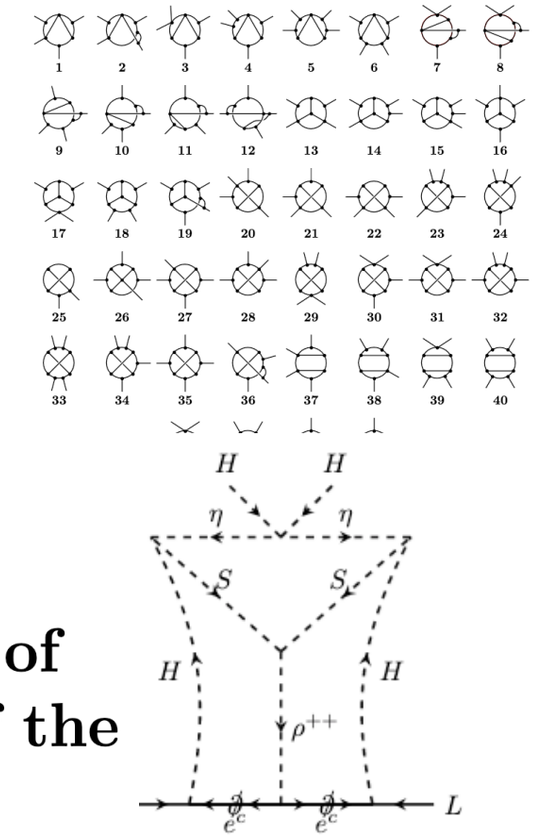
In March 2021, I was part of the thesis defense of Ricardo Cepedello



3-v

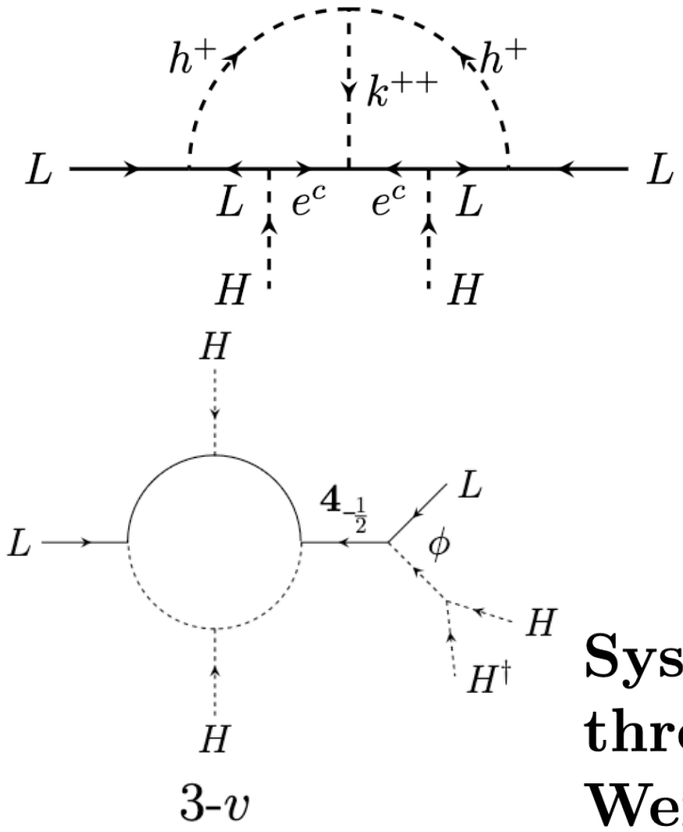


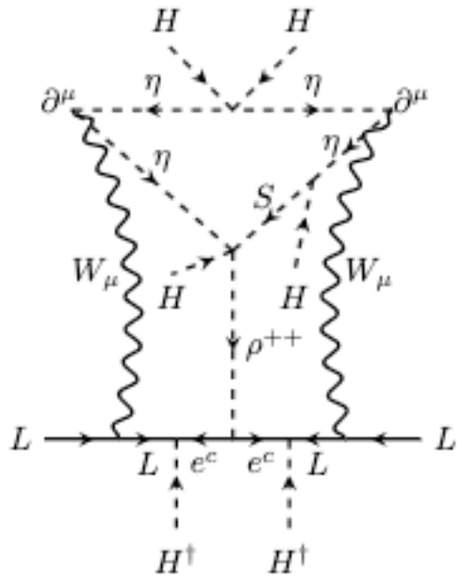
Systematic classification of three-loop realisations of the Weinberg operator



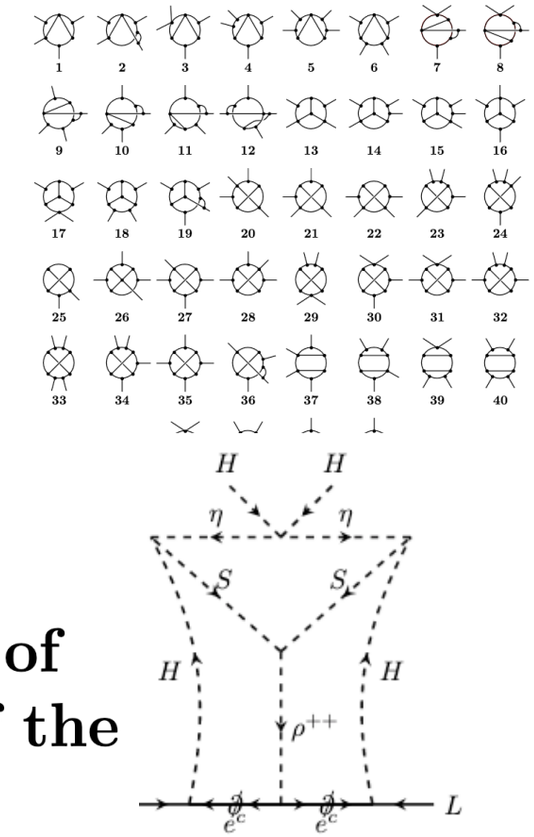
Joining forces

In March 2021, I was part of the thesis defense of Ricardo Cepedello





Systematic classification of three-loop realisations of the Weinberg operator



Soooooooo technical, so thorough and systematic

I was thinking: *This people are crazy, all this effort for just one operator!*

when in SMEFT we have to deal with dozens…

Joining forces

The idea was to use their super-duper diagrammatic approach to match UV theories and SMEFT patterns

which meant overcoming a bunch of technical and conceptual difficulties

Joining forces

The idea was to use their super-duper diagrammatic approach to match UV theories and SMEFT patterns

which meant overcoming a bunch of technical and conceptual difficulties

I confess I do not like difficulties
but thankfully Martin is not me
and despite his seniority he is able to obsess
with getting to the bottom of things

Joining forces

The idea was to use their super-duper diagrammatic approach to match UV theories and SMEFT patterns

which meant overcoming a bunch of technical and conceptual difficulties

I confess I do not like difficulties
but thankfully Martin is not me
and despite his seniority he is able to obsess
with getting to the bottom of things

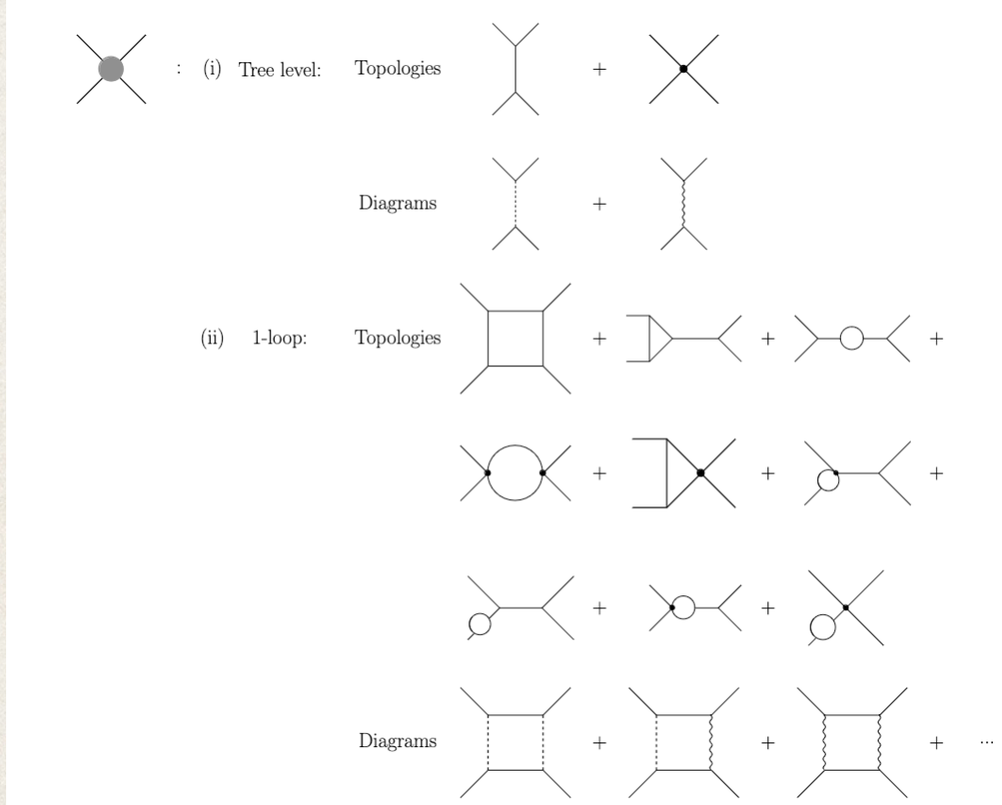
To me, Martin embodies the very rare combination of lots of experience with the stamina and grit of a PhD student

SMEFT community, here we go!

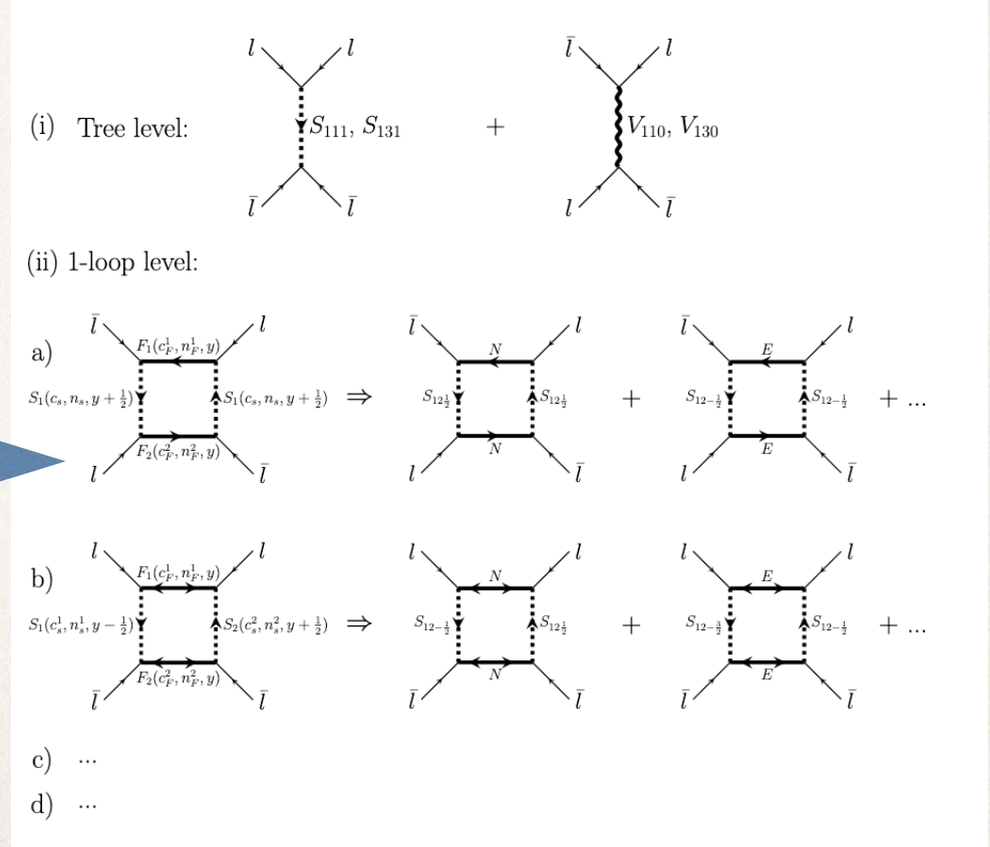
Now we had a hammer and needed a nail to hit
My PhD student Fabian Esser joined in,
became Martin's student

There are so many aspects to the SMEFT that we had to find
the best first application
4F operators

from topologies



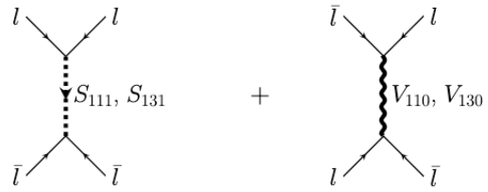
to models



JHEP 09 (2022)

from models

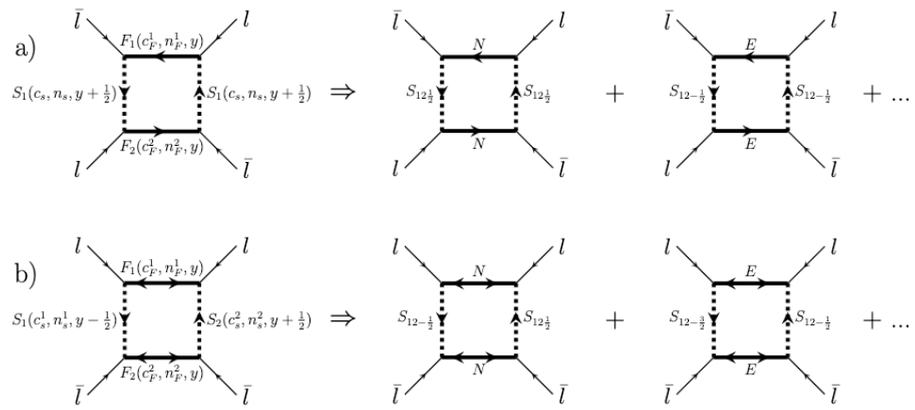
(i) Tree level: S_{111}, S_{131} + V_{110}, V_{130}



(ii) 1-loop level:

a) $S_1(c_s, n_s, y+\frac{1}{2})$ ⇒ + + ...

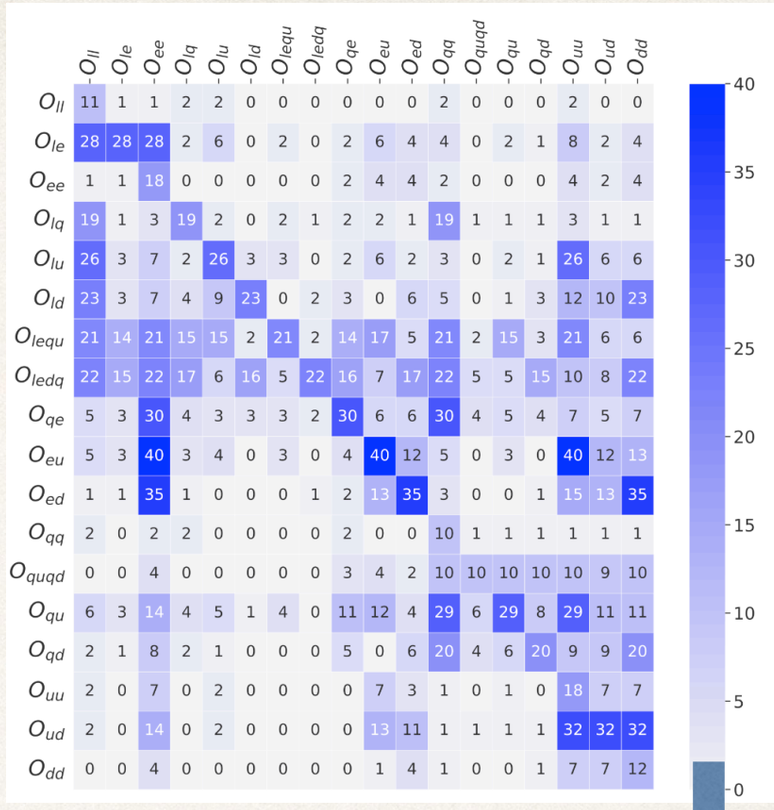
b) $S_1(c_s^1, n_s^1, y-\frac{1}{2})$ $S_2(c_s^2, n_s^2, y+\frac{1}{2})$ ⇒ + + ...



c) ...

d) ...

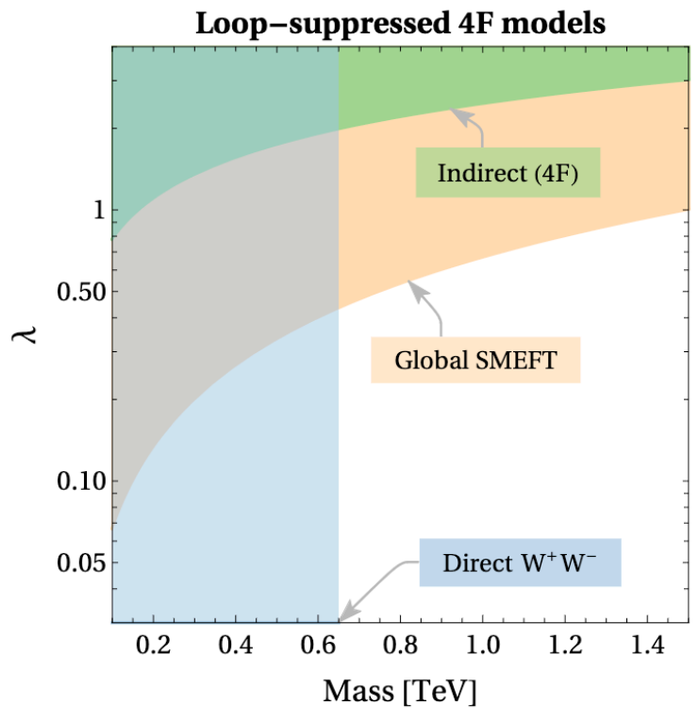
to operators



to benchmarks

Operator	General expression	Equal mass limit
c_{ll}	$-\frac{1}{8}\frac{1}{16\pi^2}\frac{\lvert\lambda_E\rvert^4}{m_E^2}$	$-\frac{1}{8}\frac{1}{16\pi^2}\frac{\lvert\lambda_E\rvert^4}{\Lambda^2}$
$c_{lq}^{(1)}$	$\frac{1}{8}\frac{1}{16\pi^2}\frac{\lvert\lambda_E\rvert^2\lvert\lambda_U\rvert^2\log\left(\frac{m_E^2}{m_U^2}\right)}{m_E^2-m_U^2}$	$\frac{1}{8}\frac{1}{16\pi^2}\frac{\lvert\lambda_E\rvert^2\lvert\lambda_U\rvert^2}{\Lambda^2}$
$c_{lq}^{(3)}$	$-\frac{1}{8}\frac{1}{16\pi^2}\frac{\lvert\lambda_E\rvert^2\lvert\lambda_U\rvert^2\log\left(\frac{m_E^2}{m_U^2}\right)}{m_E^2-m_U^2}$	$-\frac{1}{8}\frac{1}{16\pi^2}\frac{\lvert\lambda_E\rvert^2\lvert\lambda_U\rvert^2}{\Lambda^2}$
$c_{qq}^{(1)}$	$-\frac{1}{16}\frac{1}{16\pi^2}\frac{\lvert\lambda_U\rvert^4}{m_U^2}$	$-\frac{1}{16}\frac{1}{16\pi^2}\frac{\lvert\lambda_U\rvert^4}{\Lambda^2}$
$c_{qq}^{(3)}$	$-\frac{1}{16}\frac{1}{16\pi^2}\frac{\lvert\lambda_U\rvert^4}{m_U^2}$	$-\frac{1}{16}\frac{1}{16\pi^2}\frac{\lvert\lambda_U\rvert^4}{\Lambda^2}$

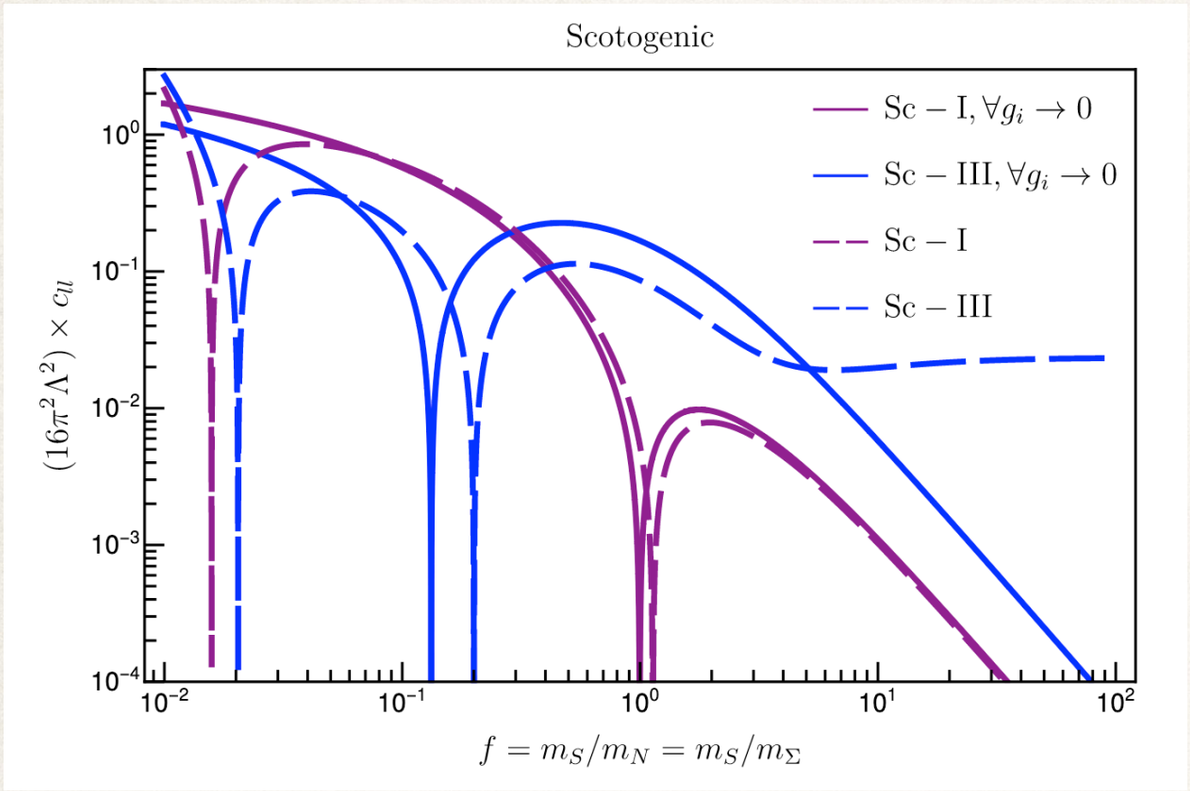
to pheno



JHEP 09 (2022)

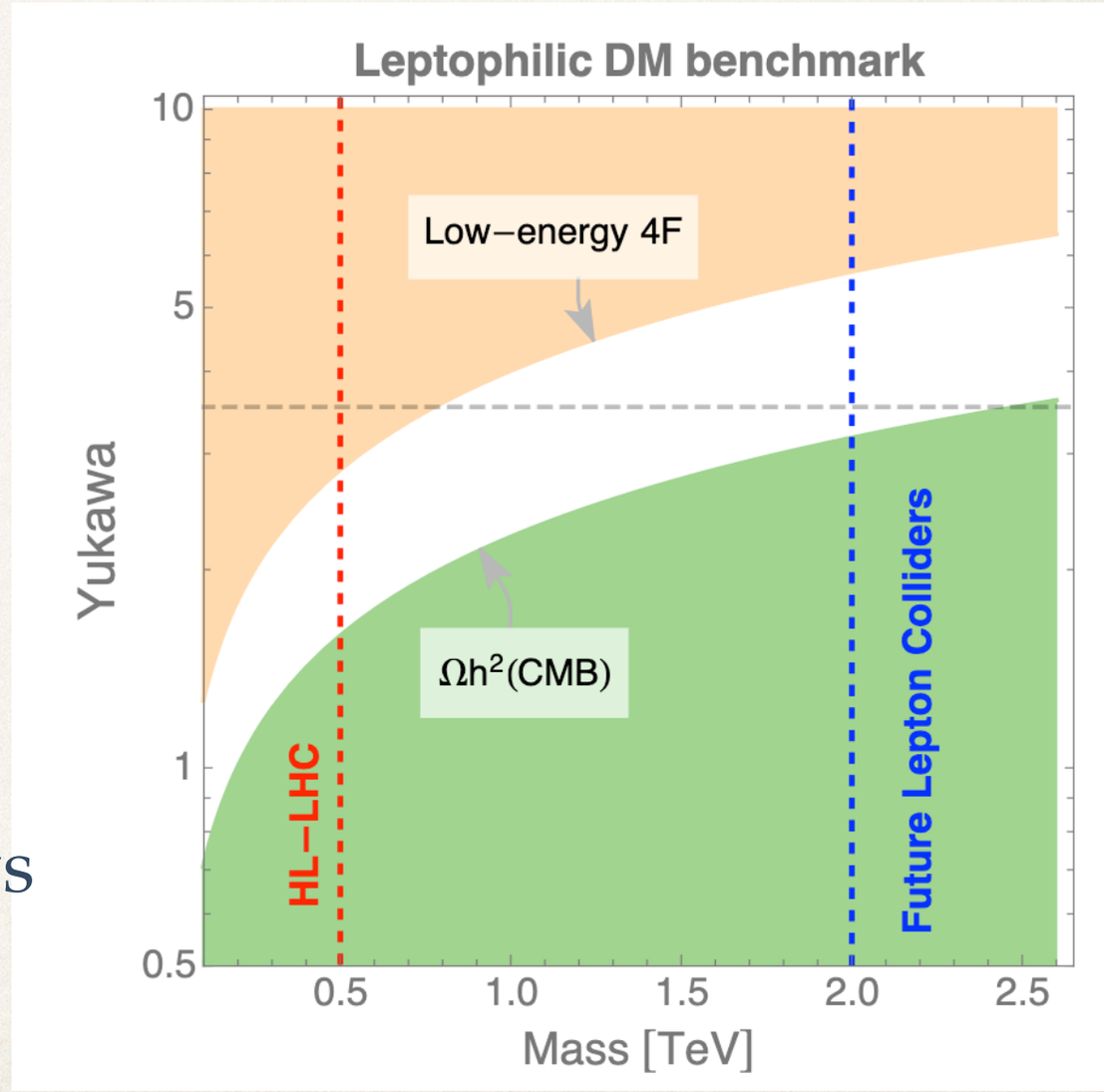
Adding DM to the mix

Adds more handles to the UV models and changes the SMEFT patterns



Searching for good benchmarks is Ariadne's job

Martin's experience with the many ways a model fails guided us all the way



JHEP 09 (2023)

Mas dificil todavia!

Now we are looking at an even more difficult question: triple neutral gauge couplings

After months and months, Martin and Ricardo realised the common-lore was wrong…

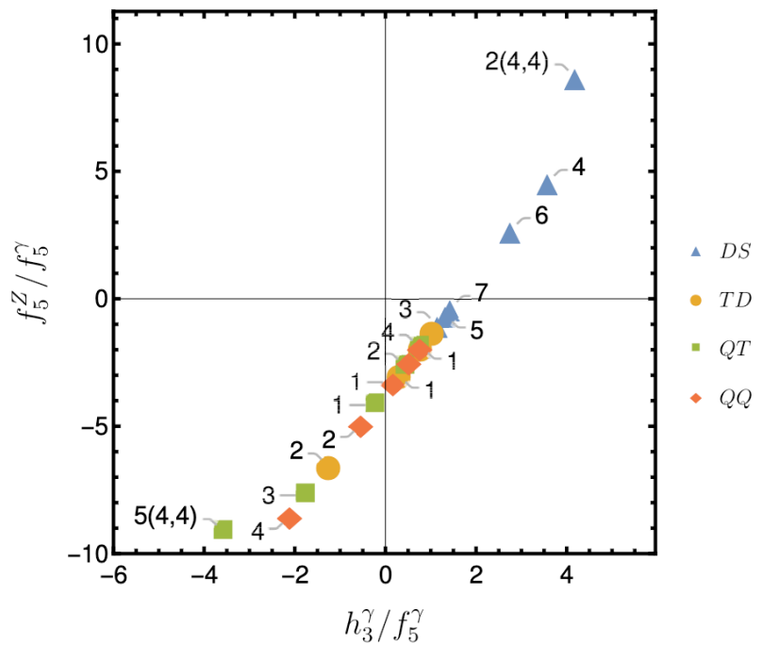
Corrected it and moved onto what experiments can do

$$\tilde{c}_{DB\tilde{B}} = \frac{1}{160}(-1)^{(\mathbf{r_1} \bmod 2)}\mathrm{sgn}\left(y_2^2 - y_1^2\right)\sqrt{2\mathbf{r_1 r_2}}\left(y_1^2 + y_2^2 + \frac{4}{3}y_2 y_1\right), \tag{3.14}$$

$$\tilde{c}_{DW\tilde{W}} = \frac{1}{160}(-1)^{(\mathbf{r_1} \bmod 2)}\mathrm{sgn}\left(y_2^2 - y_1^2\right)\sqrt{2\mathbf{r_1 r_2}}\,\frac{1}{12}\left[\left(\mathbf{r_1}^2 - 1\right) + \left(\mathbf{r_2}^2 - 1\right) + \frac{4}{3}\left(\mathbf{r_1 r_2} - 2\right)\right],$$

$$\tilde{c}_{DW\tilde{B}} = \frac{1}{48}(-1)^{(\mathbf{r_1} \bmod 2)}\sqrt{2\mathbf{r_1 r_2}}\,\frac{1}{12}\left(y_1 + y_2\right)\left[\left(\mathbf{r_1} + \mathbf{r_2}\right) + \frac{3}{5}\left(y_1 - y_2\right)\right],$$

$$\tilde{c}_{DB\tilde{W}} = \tilde{c}_{DW\tilde{B}}\,.$$



Wrapping up

Martin, belated happy birthday

Thanks for guiding Fabian through difficulties,
for your patience discussing physics with me,
and for keeping your tireless and passionate
obsession for finding the solution

Please, don't change!