Do you also want to be a composer?

All Quiet on the High Energy Front?

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Institute open days
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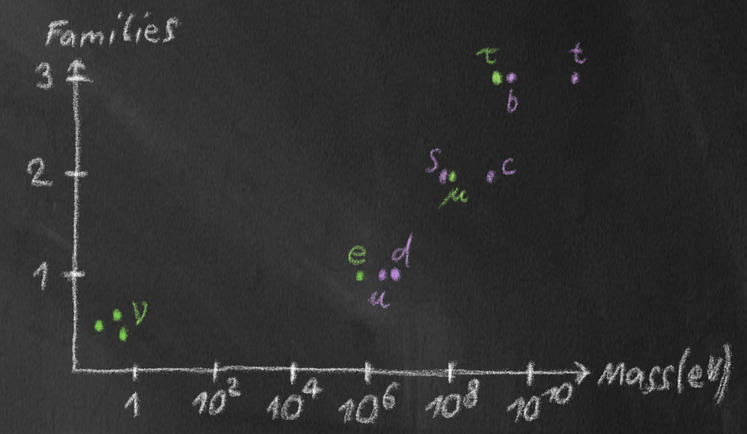
No! So where does the noise come from?

$$\mathcal{L}_{SM} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + i\bar{\psi} \not{D} \psi + y_{ij} \bar{\psi}_i \phi \psi_j + |D_\mu \phi|^2 - V(\phi) + ?$$

In the Standard Model of particle physics there are still unexplained mysteries: Hierarchy problem, strong CP problem, neutrino masses, dark matter, gravity...

$$SU(3)_c \times SU(2)_L \times U(1)_Y$$

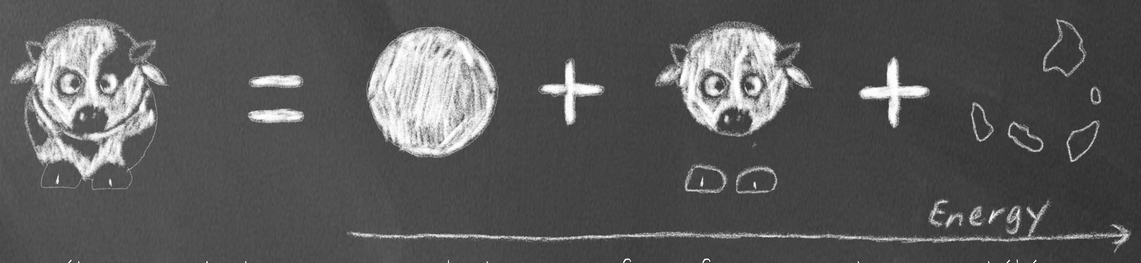
u up	c charm	t top	g gluon	H Higgs
d down	s strange	b bottom	γ photon	
e electron	μ muon	τ tau	Z Z boson	
ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	W W boson	



Fermion masses span 5 orders of magnitude and display a peculiar hierarchical pattern!

Effective Field Theories teach us how to listen carefully...

The EFT concept: Describe the relevant phenomena at the relevant energy scales with the relevant degrees of freedom:



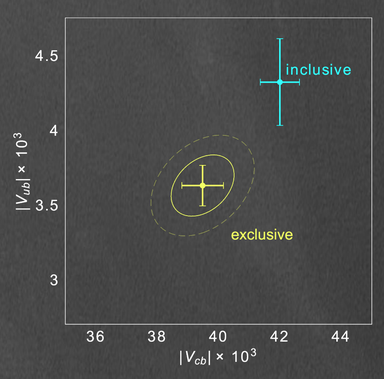
Like a cow looks more round when seen from far away, the SM exhibits accidental symmetries at low energy

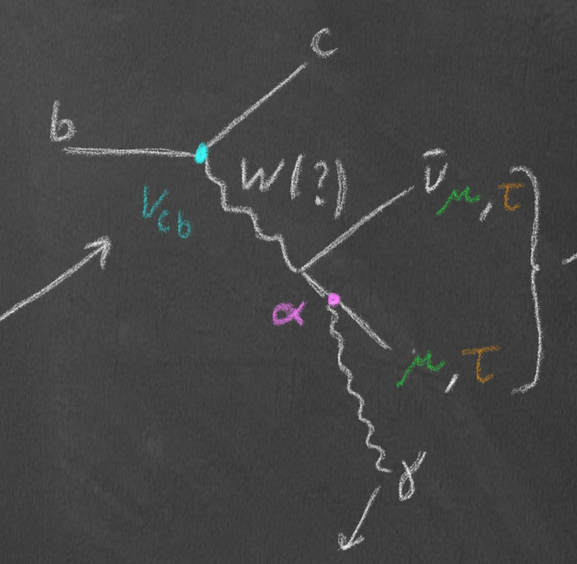
Our group develops numerical and theoretical tools to simplify computations in the EFT framework, such as

- MATCHETE
- HighPT

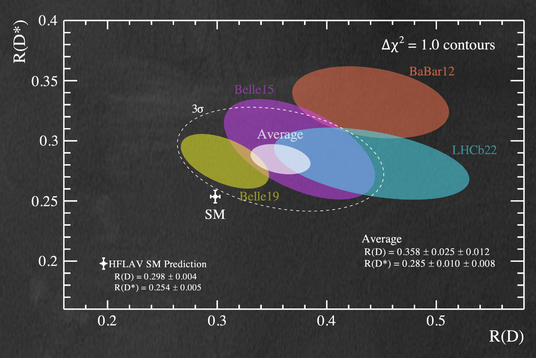
And data tells us where the music might B: In the B meson!

There are tensions in measurements of SM parameters!

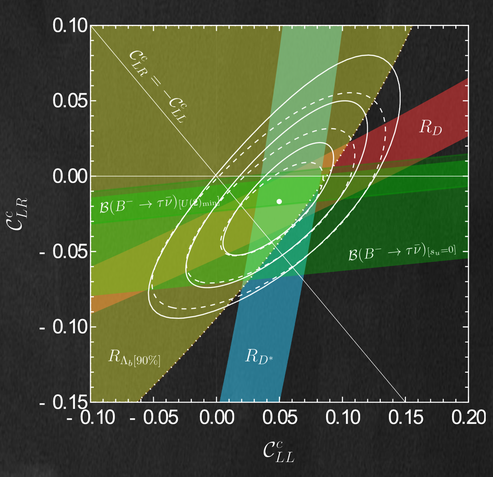




$$R_{D^{(*)}} = \frac{\mathcal{B}r(B \to D^{(*)} \tau \bar{\nu}_\tau)}{\mathcal{B}r(B \to D^{(*)} \mu \bar{\nu}_\mu)}$$



Use data to put constraints on New Physics parameters:



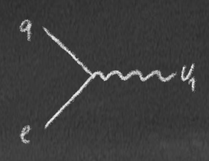
Work on a better understanding of SM effects

Intriguing discrepancies between measurements and SM predictions!

The effect of New Physics can be encoded in Wilson Coefficients

Everything should sound as melodious as Beethoven's 5(D) symphony!

4321 models provide the best mediator to address the B-anomalies:

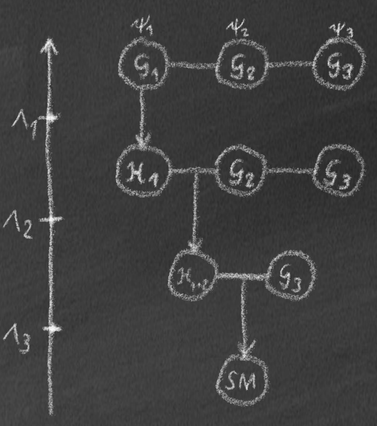


The leptoquark originates in the breaking of the 4321 gauge group

$$SU(4)_3 \times SU(3)_{1+2} \times SU(2)_L \times U(1)' \xrightarrow{\langle \Omega \rangle} U, G, Z' \to SU(3)_C \times SU(2)_L \times U(1)_Y$$

Build high energy models to address unexplained phenomena

Flavor deconstruction:



The hierarchy in the Yukawa couplings is a consequence of the hierarchy between various breaking scales

Do the fermion families live in different projections of a 5th dimension?