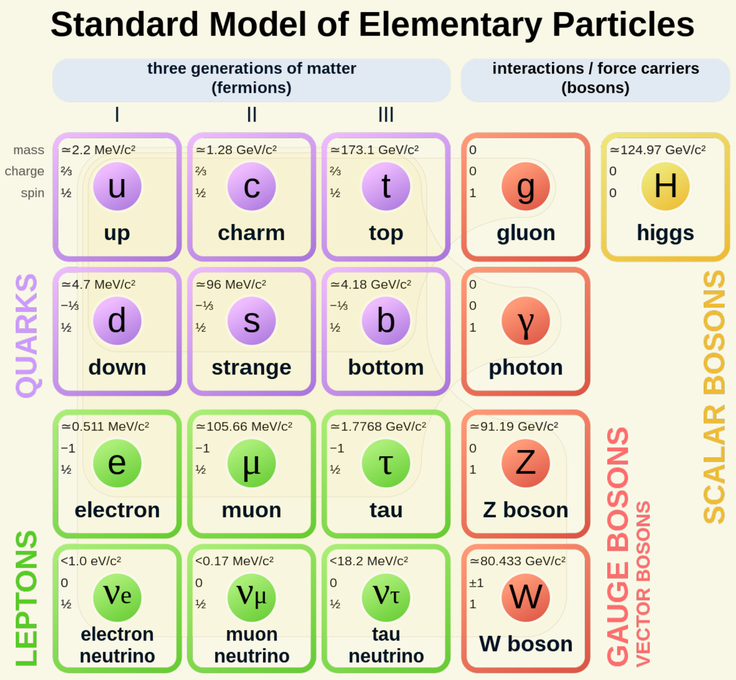
Search for new physics at the LHC with multi-lepton final states

University of Zurich[UZH]

PAUL SCHERRER INSTITUT PSI

Background and motivation

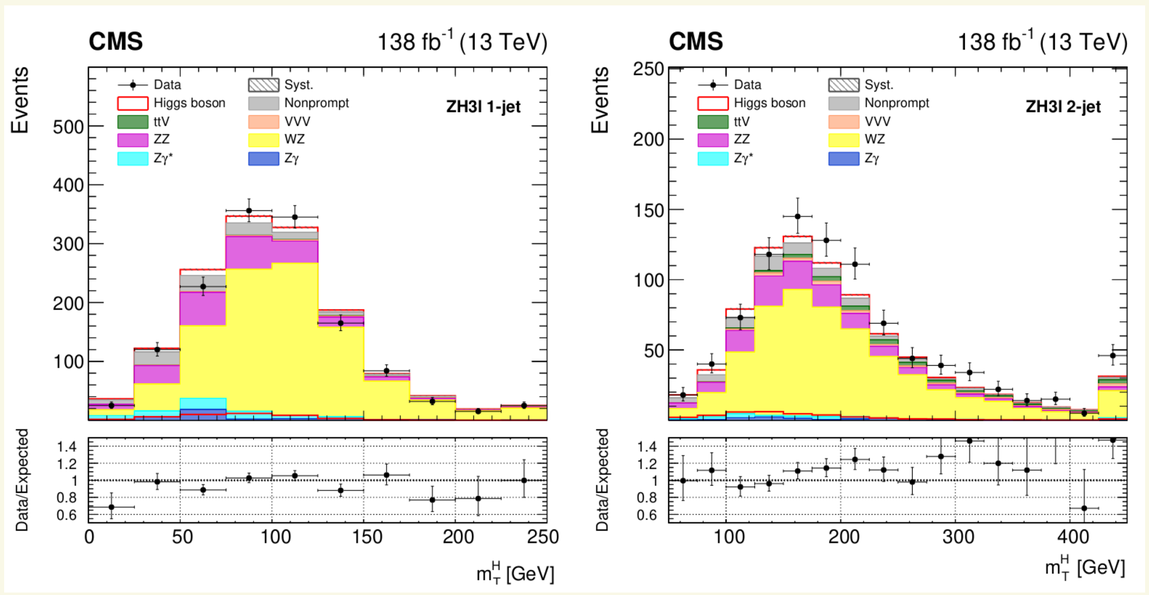
The Standard Model of particle physics is one of the greatest achievement of human knowledge:



- Nevertheless, it is clearly incomplete, as it cannot account for all the phenomenology witnessed.
- The Large Hadron Collider (LHC) is a flourish playground to seek for evidence of new models.
- Recently, multi-lepton final states arose as prominent candidates offering several hints for new physics.

Hints for new physics

Collaborations as ATLAS and CMS provide strong hints which point towards new particles. These depend on the implemented search and the observable inspected.

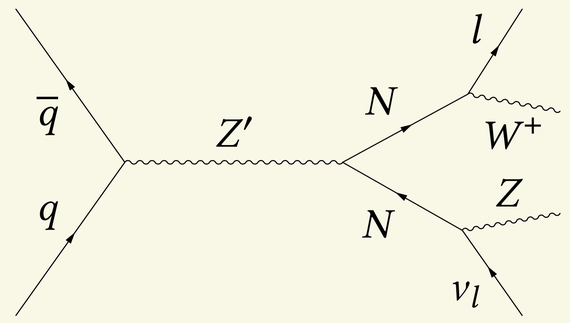


- Greater signals in multi-leptonic channel spike at precise values of the transverse mass, suggesting new particles with such precise sizes.
- The agreement with data is not fully consistent.
- Already some sigmas point to different theories able to accommodate for anomalies better.
- More data could enhance the discrepancies.

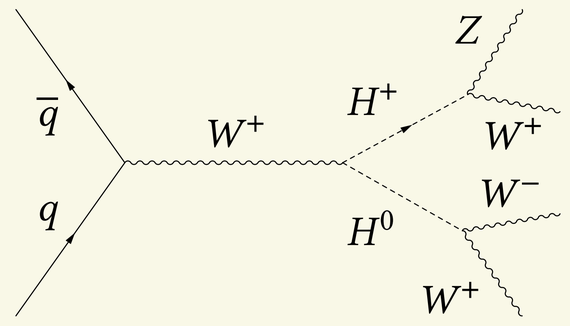
Model building

The Standard Model is based on two main ingredients, namely spontaneous symmetry breaking and gauge invariance of the group $SU(3)_c \otimes SU(2)_L \otimes U(1)_Y$.
How to extend it such to match experimental signatures?

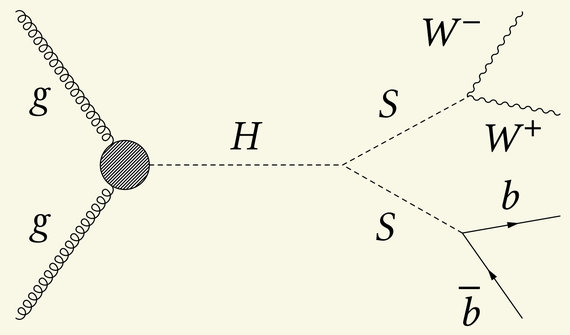
- $U(1)'$: (i) another gauge boson Z', (ii) heavy fermions such as heavy neutrinos



- $SU(2)_L$ scalar triplet: (i) another higgs-like, (ii) two oppositely charged higgses



- 2HDM+S: (i) another higgs doublet, (i) a neutral scalar



Phenomenology

- Once the model is built, it is necessary to provide accurate predictions (loops, effective field theories, etc. etc.)
- This is carried out via simulations with sophisticated softwares for Monte Carlo generations (Madgraph, Delphes, Pythia, ROOT, etc. etc.).
- Predictions are then matched with data through a careful statistical analysis.

If the answer from experimental data is positive, it is finally the time to fully refine the model in all its aspects, embedding the Standard Model in a larger picture.

Guglielmo Coloretti *(Andreas Crivellin group)*

guglielmo.coloretti@physik.uzh.ch, guglielmo.coloretti@psi.ch