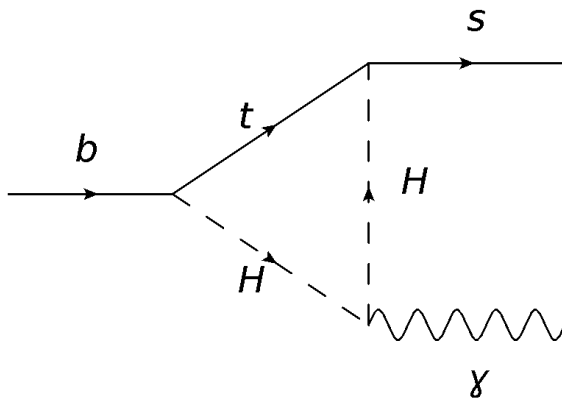# Two loop new physics corrections in rare decays

by Christoph Wiegand
at Flavourful Ways to New Physics
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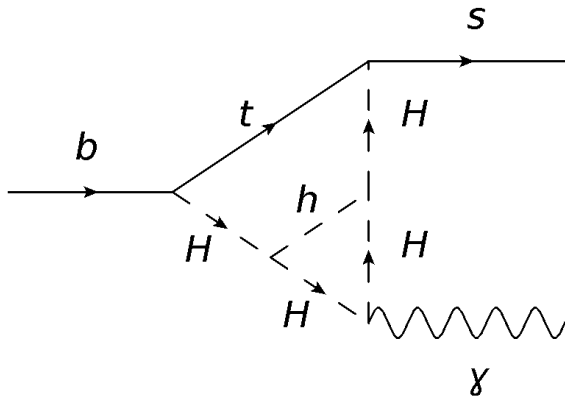KARLSRUHE INSTITUTE OF TECHNOLOGY (KIT)

Process: $b \to s\gamma$

Consider two-higgs-doublett model of type two in $b \to s\gamma$.
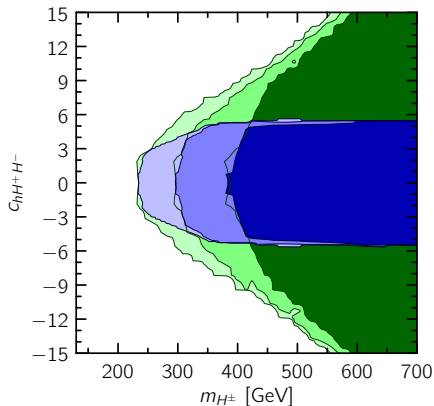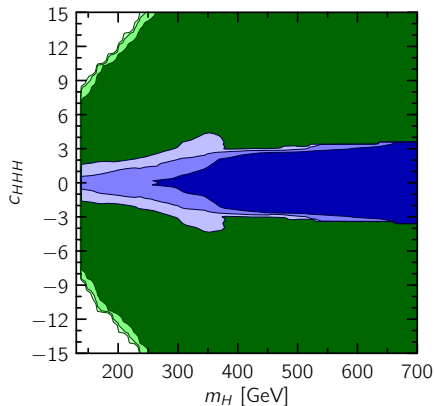

Status: QCD corrections up to NNLO in SM and THDM

Now two loop: Higgs contributions

The couplings between the Higgsparticles of the THDM are weakly constrained.

Two Loop: Necessary to study Higgscouplings in rare decays.

Constraints on Higgscouplings

- Excerpt from Baglio, Eberhardt, Nierste, Wiebusch: arXiv:1403.1264
- Left: Dominated by perturbativity/unitarity bound
- Right: experimental input: lower bound on mass

Argument for two loop

If: (let's generalise)

- Allow unkown/ unconstrained couplings to be large
- Know QCD already
- Study internal dynamics of a model
- (new particles don't just jump at us at the next run of LHC)

Then:

- two loop calculations needed for several extensions of the SM

Therefore:

- try to provide one simple package to do these calculations

Medusa

Specifications:

- new particles usually heavy:
  - Loopintegral needs to be valid for arbitrary masses
  - Momentum can be neglected (offshell matching)
  - don't consider direct production of new particles
- one stop shop/ easy to use:
  - contained in one Mathematica package: Medusa
  - only FeynArts modelfile needed

Features:

- fully analytical
- no excessive recursion
- compact results and even compact intermediate steps
- sufficiently resource efficient

Conclusions

- two loop in new physics models interesting
  - gateway to new effects
  - important for big couplings
  - maybe just necessary
- the mathematica package Medusa for these calculations will be made accsessible soon^{TM}