PhD thesis topic on:

Study of Higgs couplings using VBS-VVh

Joany Manjarrés
Laboratoire des 2 Infinis - Toulouse

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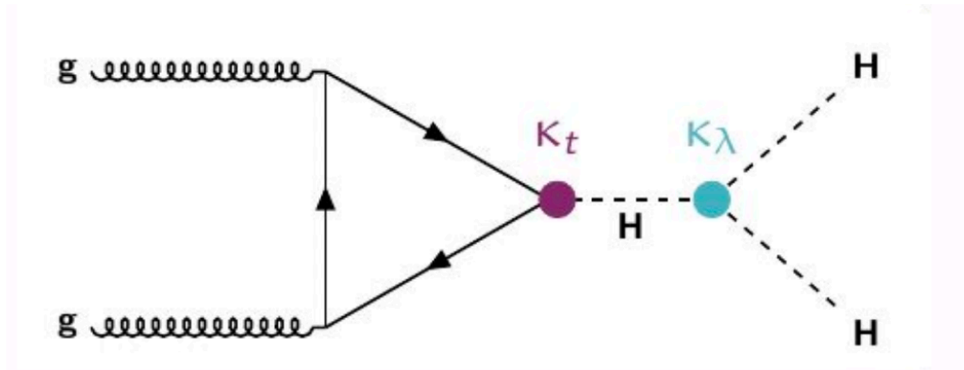
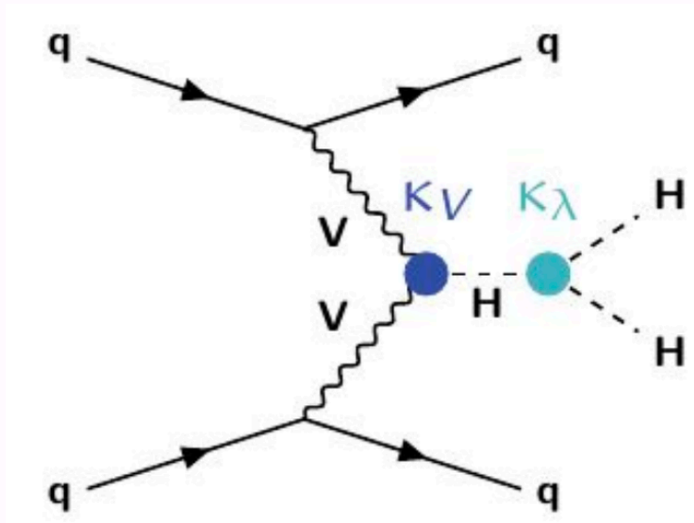
The physics topic: Introduction

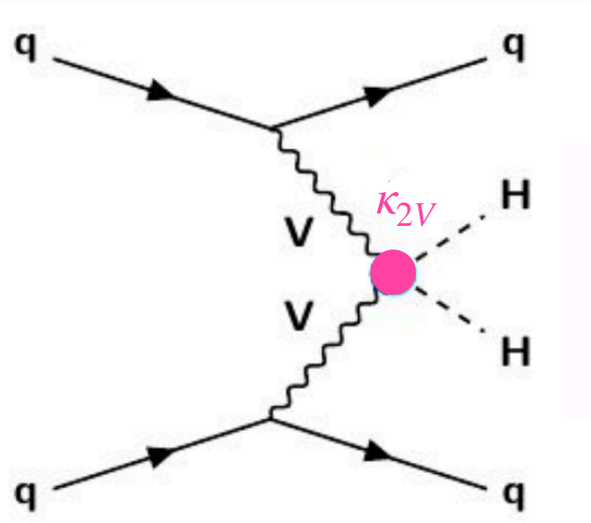
- One of the LHC goals was to get a better understanding of the mechanism of electroweak symmetry breaking
- With the Higgs discovery the coupling to vector bosons (κ_V) is now well constrain/known
- The less know couplings nowadays are the Higgs self-coupling HHH (κ_λ) and the quartic coupling VVHH (κ_{2V})
  → at the moment only di-Higgs analyses target these couplings

ggF HH:



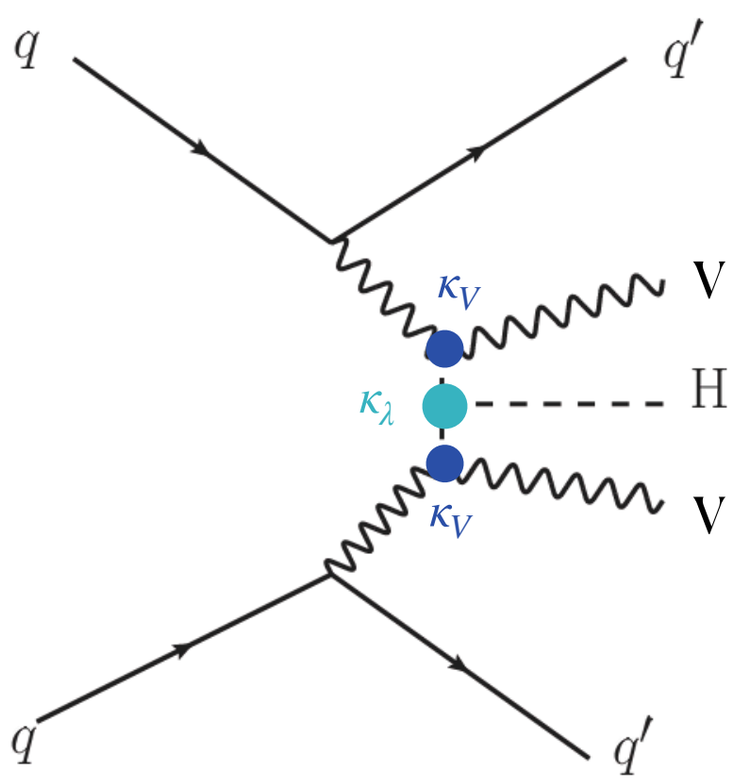
VBF HH:

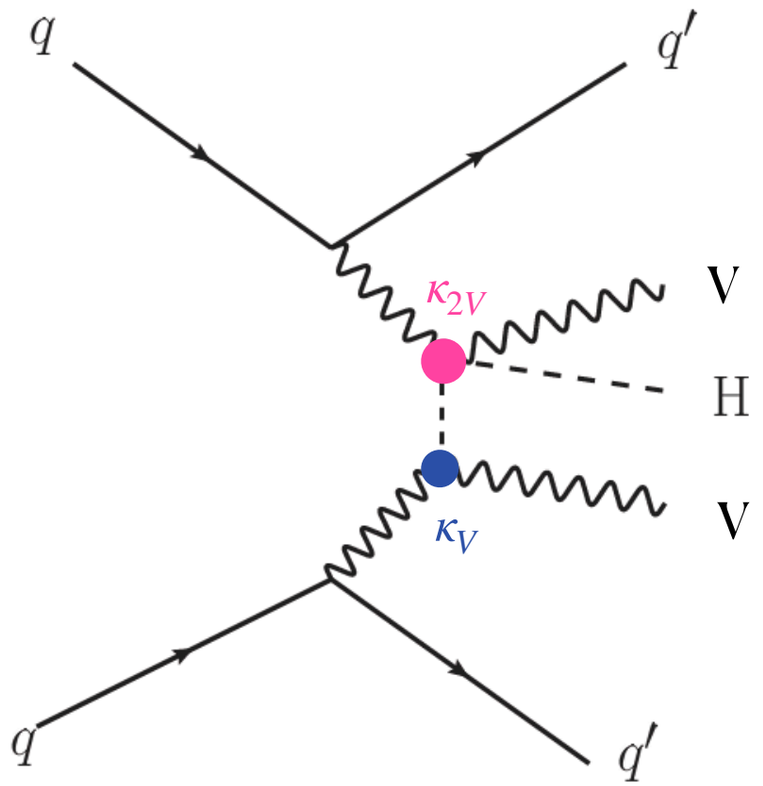




The physics topic: Why VBS VVh?

- Studying VBS VVh we have a complementary way to di-Higgs study κ_λ, κ_{2V} and κ_V

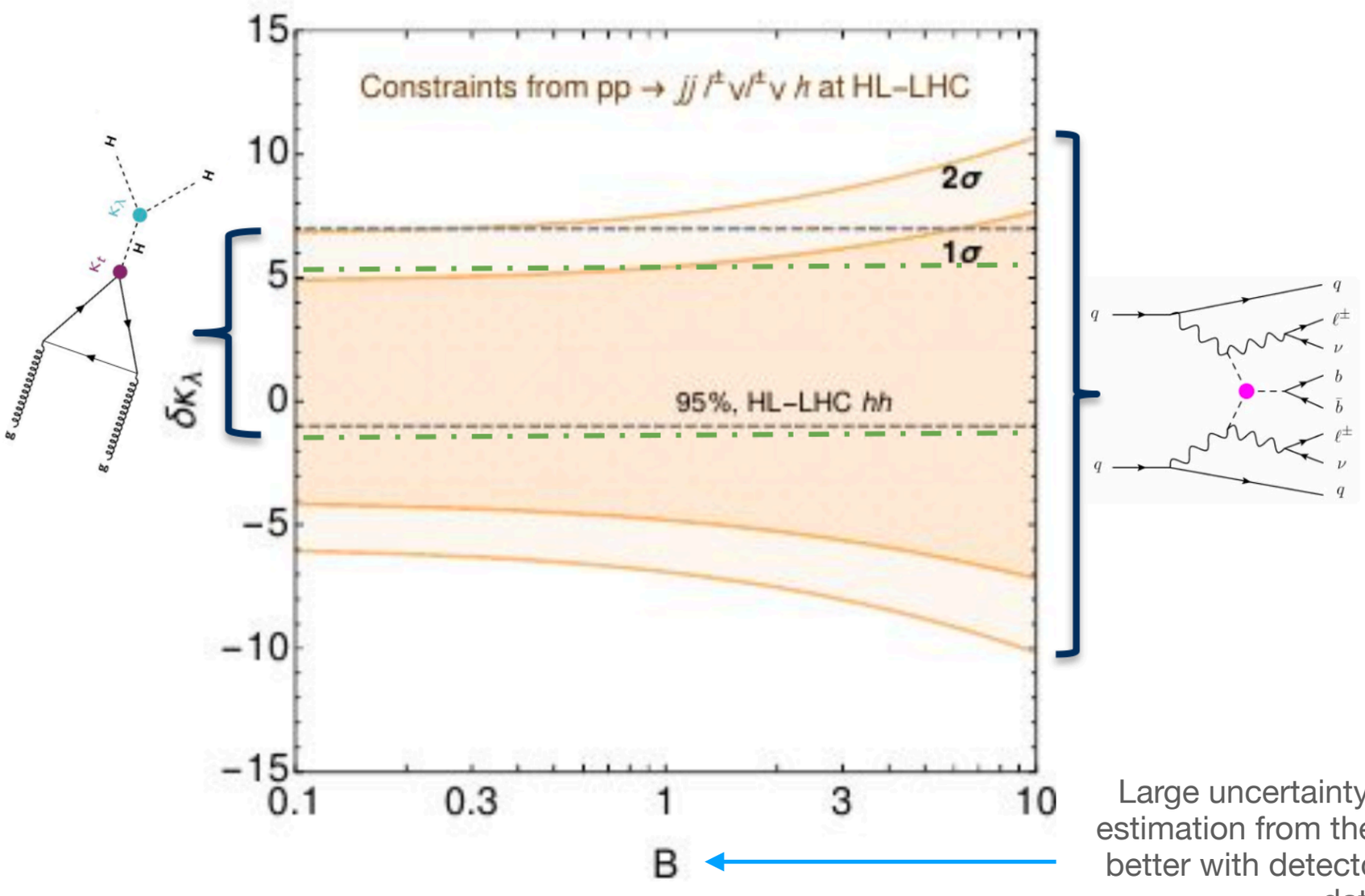




- Advantages:
  - We can systematically distinguish the different WWHH, ZZHH couplings
  - We can also aim to measure the polarization of the vector bosons having access to the V_LV_LHH
  - New analysis, first time in ATLAS ! You will be able to make major contributions ! In a smaller analysis team!
- Disadvantage:
  - Very small cross section (LO ~0.4 fb)

The physics topic: From the theory side

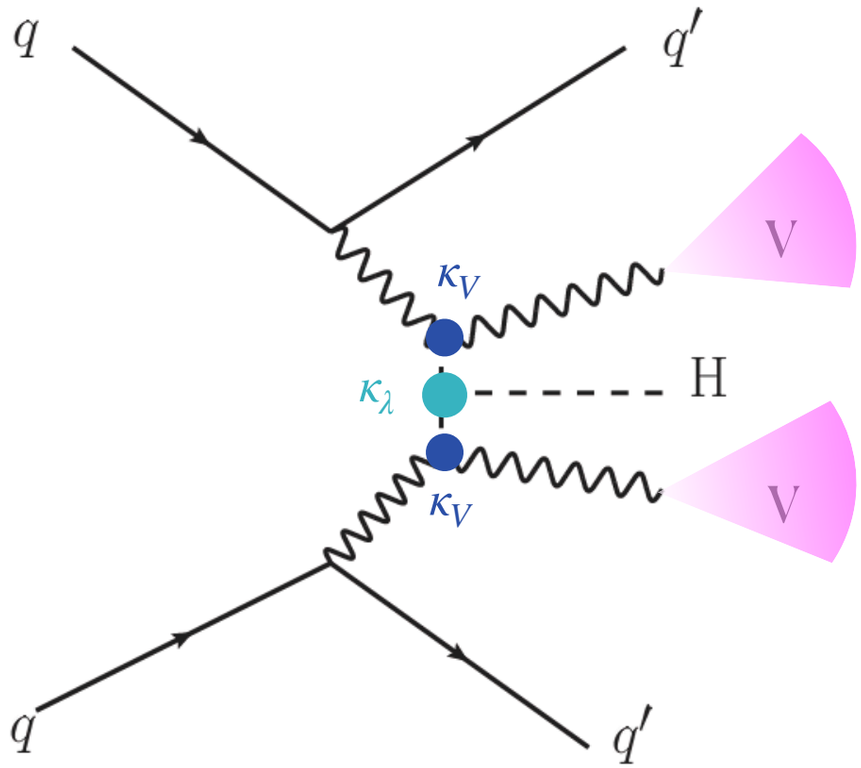
- Theory studies by B. Henning et al. 1812.09299 show competitive sensitivity with di-Higgs analysis by comparing with the HL-LHC projections (to take with a grain of salt as Legacy analysis are much better !)



Large uncertainty on background estimation from theorist ! We can do better with detector simulation and data!

- More detailed studies on same sign leptonic decays including some DELPHES simulation by C. Englert 1702.01930 concluded that *"we can expect a similar sensitivity to the quartic WWHH coupling as provided by VBS HH production, for which we expect* κ_{VVHH}*~1.6"*

The physics topic: From the experimental side



- Many channels to explore depending on the bosons decays with V = Z, W (assume h→bb to maximise BR)
  - Fully-leptonic (same sign or opposite sign)
  - Semileptonic
  - Fully hadronic
- Different channels have different S/B ratio and expected statistics

- A first meeting to group all the interested people on this topic happen on Oct 18 (kick-off meeting link)
- The analysis will soon kick-off, it is time for you to join us !

Laboratoire des 2 Infinis - Toulouse

- New French national lab created in 2020!
- Research covers for HEP, Gravitational waves, computing and nuclear physics
- ATLAS team in Toulouse has 11 persons: 3 Ph.D students (you!), 1 master student, 2 post-docs, 3 staff scientists/lecturers and 2 research engineers
- Physics involvements: di-Higgs, resonant searches polarization measurements and tracking for ITk
- Day to day, you would work closely with me and my team, will be in total me + 2 PhD students (you!) + 1 postdoc (you!)

Technical details

- Contract length: 3 years
- Contract start: Flexible - aiming for February 2024
- Generous holiday allowance
- French not required, lessons available!
- Deadline: Dec 1st (or until filled!)
- Position mainly based in Toulouse, frequent travel to CERN or even stays of several moths are possible

Requirements

- Master in physics or equivalent
- Interest on physics analysis and novel machine learning techniques
- Existing knowledge in Python, C++, ROOT are a plus!

Interested? Contact me!

joany@cern.ch


ssWWh VBS
is useful for higgs self
couplings measurement
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