Brief introduction to Wγ VBS analysis

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2019.7.31

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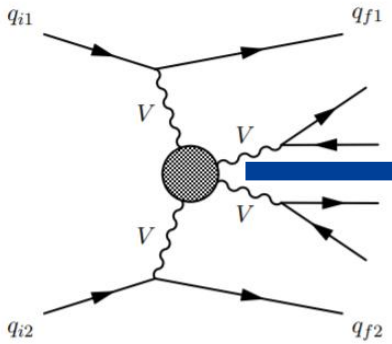
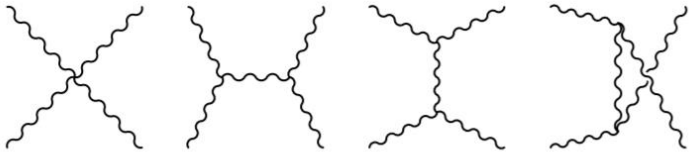
1. Introduction to Wγ VBS analysis

Vector boson scattering

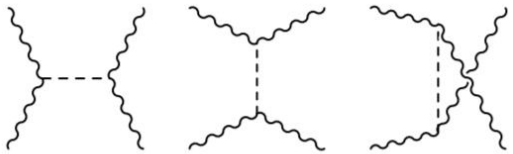
Vector boson scattering in the SM is defined according to the Feynman diagrams shown in the following Figures



Feynman diagram of electroweak vector boson scattering.



(a) Contributions from electroweak gauge boson interactions.



(b) Higgs exchange contributions.

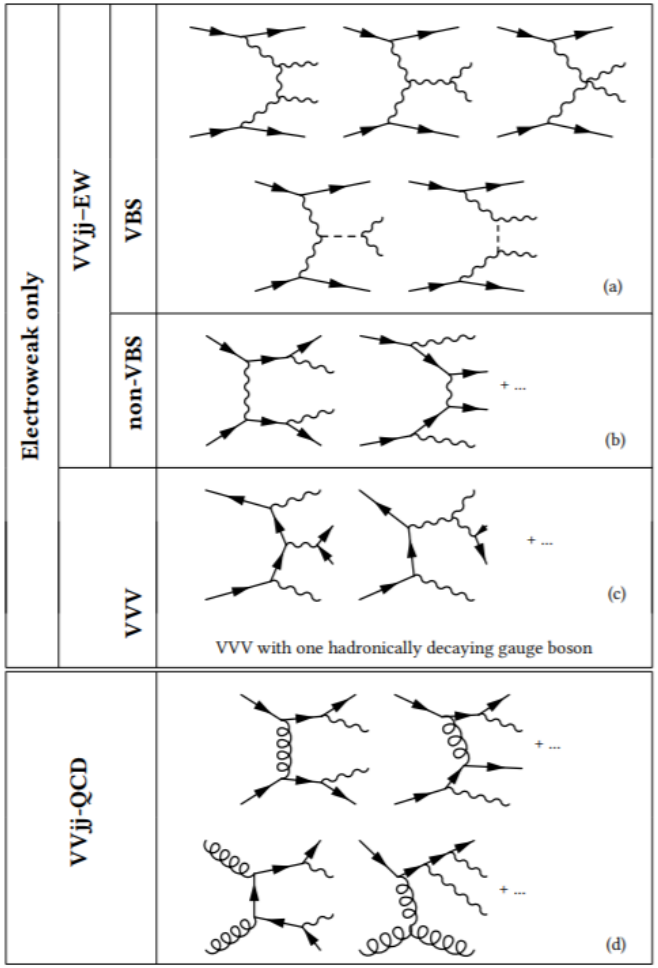
The scattering process is described with Feynman diagrams containing

- quartic gauge boson vertex
- triple gauge boson vertices in the s, t, and u channels
- and Higgs exchange.

Depending on the charge of the initial and final state vector bosons, not all of these diagrams are allowed in all channels. In the case of W±W± scattering, no s-channel gauge boson or Higgs exchange is allowed.

Electroweak Interaction

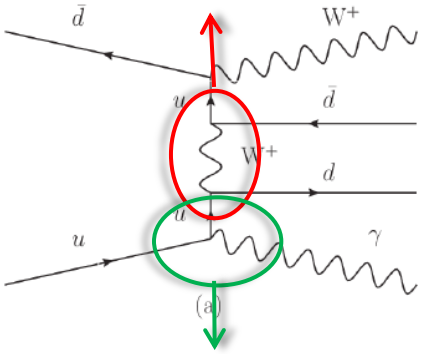
In particle physics, the **electroweak interaction** is the unified description of two of the four known fundamental interactions of nature: **electromagnetism and the weak interaction**. Although these two forces appear very different at everyday low energies, the theory models them as two different aspects of the same force. Above the unification energy, on the order of 246 GeV, they would merge into a single **electroweak force**



Categorization of Feynman diagrams with VVjj final state at leading-order

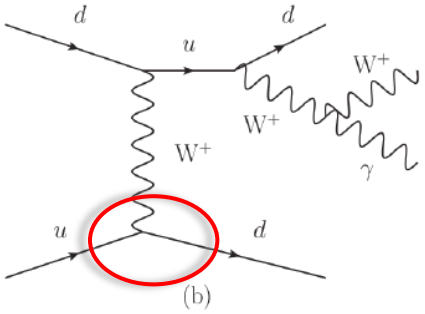
EWK Wγjj process

Weak interaction

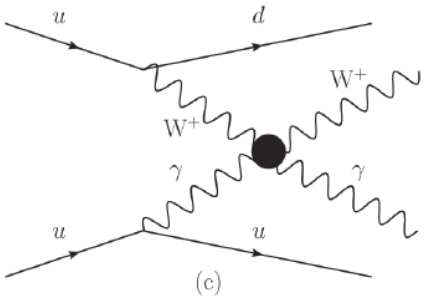


Electromagnetic interaction

Electroweak only (Non VBS)



Electroweak and QCD



Electroweak only (VBS)

- Objective: Utilize the full run2 data, aim to measure the EWK Wγjj process with 3-σ (bottomline) or 5-σ significance.
- Significance: The scattering of electroweak gauge bosons is closely connected to the electroweak gauge symmetry and its spontaneous breaking through the Brout-Englert-Higgs mechanism.

2. ZnunuGamVBS_pack running

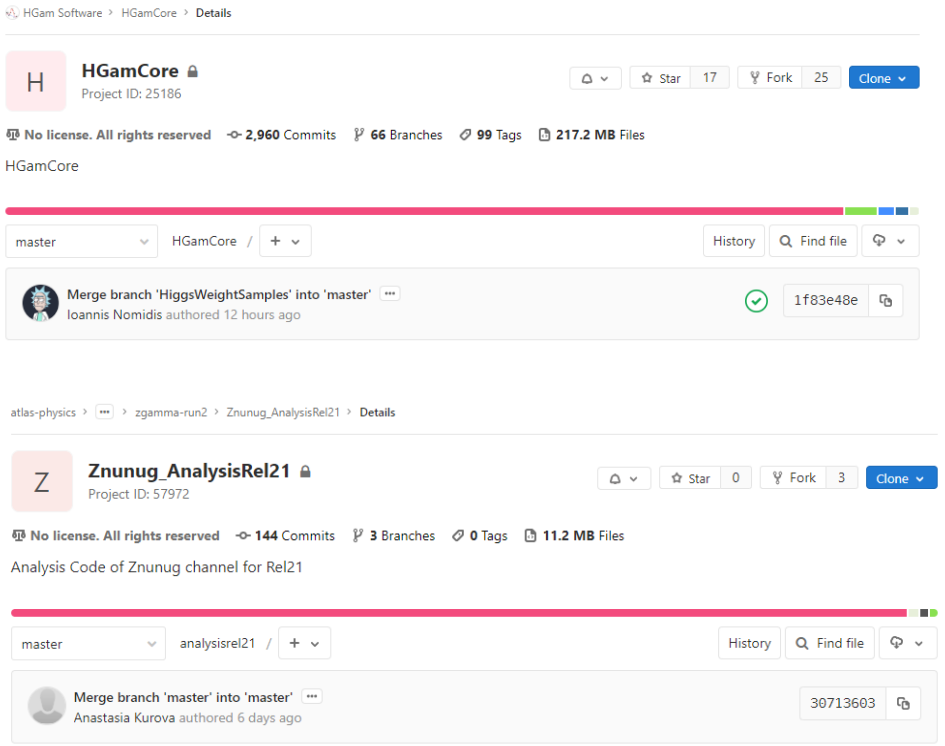
HGamAnalysis Framework setup

Step 1: Setup the environment

Step 2: Install HGamCore

Step 3: Add ZnunuGamVBS_pack to HGamCore

Step 4: Create environment variables of ZnunuGamVBS



Run code of ZnunuGamVBS_pack

Run locally

Step 1: Apply to join ATLAS VO

Step 2: Rucio download the related data

Step 3: runZnunuGamVBS $TestArea/ZnunuGamVBS_pack/data/ZnunuGamVBS.config path/to/file

The results will be output into the directory (output-MxAOD).

Run on the grid

- Step 1: runZnunuGamVBS $TestArea/ZnunuGamVBS_pack/data/ZnunuGamVBS.config GridDS: dataset_name OutputDS: unique_tag_name UserName: your_user_name
- Step 2: Check the e-mail of the running result of the program

```
In  :
mc16_13TeV.364146.Sherpa_221_NNPDF30NNLO_Znunu_MAXHTPTV70_140_CFilterBVeto.deriv.DAOD_EXOT6.e5308_s3126_r9364_p3652
Out : user.xiw.MC16a.364146.Sherpa_221_NNPDF30NNLO_Znunu_MAXHTPTV70_140_CFilterBVeto.myAnalysisoutputDS_MxAOD.root/
Out : user.xiw.MC16a.364146.Sherpa_221_NNPDF30NNLO_Znunu_MAXHTPTV70_140_CFilterBVeto.myAnalysisoutputDS_hist/
Log : user.xiw.MC16a.364146.Sherpa_221_NNPDF30NNLO_Znunu_MAXHTPTV70_140_CFilterBVeto.myAnalysisoutputDS.log/
```

- Step 3: Rucio Download the histograms from the above address.

```
[xiw@lxplus751 user.xiw.MC16a.364146.Sherpa_221_NNPDF30NNLO_Znunu_MAXHTPTV70_140_CFilterBVeto.myAnalysisoutputDS_hist]$ ls
user.xiw.18747357._000001.hist-output.root  user.xiw.18747357._000008.hist-output.root  user.xiw.18747357._000019.hist-output.root
user.xiw.18747357._000002.hist-output.root  user.xiw.18747357._000009.hist-output.root  user.xiw.18747357._000021.hist-output.root
user.xiw.18747357._000003.hist-output.root  user.xiw.18747357._000010.hist-output.root  user.xiw.18747357._000023.hist-output.root
user.xiw.18747357._000004.hist-output.root  user.xiw.18747357._000013.hist-output.root  user.xiw.18747357._000026.hist-output.root
user.xiw.18747357._000005.hist-output.root  user.xiw.18747357._000014.hist-output.root  user.xiw.18747357._000027.hist-output.root
user.xiw.18747357._000006.hist-output.root  user.xiw.18747357._000016.hist-output.root
user.xiw.18747357._000007.hist-output.root  user.xiw.18747357._000018.hist-output.root
```

Summary and Plans

Summary & Plans

- 1. After learning some basic theories about VBS and Electroweak, I am going to learn about analytical knowledge related to detectors, bosons decay channels, background, and signals.
- 2. Read and modify the code of ZnunuGam to the code of WlnuGam.

Thanks