A brief introduction to ?

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Introduction

How to run?

- Setup the environment
- Create a workspace
- Scan the parameter of interest (POI)
- Draw and analysis

Setup the environment

```
setupATLAS
cd ~/private/Statistics/build
asetup --restore
cd ../run
source ../build/x86_64-centos7-gcc8-opt/setup.sh
```

Create a workspace

- Use this command to create a workspace in the run directory
- mainCombiner config.ini output.root
- The workspace you get is output.root

```
[zhan@lxplus706 ~]$ mainCombiner inputs_HZZOffShell_Run2_050820/config_OffShell_Run2_woSyst_
050820_BINS_noSysCutoff_SRw12binsCRA_ChangeInBgYieldsAndNoLUMI.ini test_floating_muZZ.root
```

- This workspace contains everything
- So you need to scan the parameter that you are interested in

*But what is in the config.ini?

Scan the POI

- Use this command to scan the POI:
- scan_poi output. root scan.root combined mu asimovData mu:100:0:5

```
[zhan@lxplus706 ~]$ scan_poi  test_fixed_muzz.root test_fixed_muzz_scaning.root combined mu
asimovData mu:100:0:5
```

- Then you get a scan.root

*But we need more explanations about scan_poi.

Draw and Analysis

- Use plot_scan_multiple.py to draw and analysis
- python plot_scan_multiple.py scan1.root,scan2.root,scan3.root:”name1”,”name2”,”name3” POI “name of the X-axis title”

```
[zhan@lxplus706 ~]$ python plot_scan_multiple.py ~/private/Statistics/run/offshellanalysis/Statistics/ConfigFiles/myH
OSfloating/test_floating_muzz_scaning.root,~/private/Statistics/run/offshellanalysis/Statistics/ConfigFiles/myHOSfixi
ng/test_fixed_muzz_scaning.root:"floating muZZ","fixing muZZ" mu "#mu_{off-shell}"
```

- This python program also analysis for you

```
file_namesList ['/afs/cern.ch/user/z/zhan/private/Statistics/run/offshellanalysis/Statistics/ConfigFiles/myHOSfloatin
g/outputs_HZZOffShell_Run2_050820/mu_qqZZ_scan_test_combined.root']
physics has 102 entries
Low: 0.975 1.31069
Hi:  1.024 1.18208
Best mu_qqZZ: 1 +0.014 -0.015
Info in <TCanvas::Print>: png file /afs/cern.ch/user/z/zhan/private/Statistics/run/offshellanalysis/Statistics/Config
Files/myHOSfloating/outputs_HZZOffShell_Run2_050820/mu_qqZZ_scan_test_combined.png has been created
```

- You can change some drawing settings in plot_scan_multiple.py

But what is in the config.ini?

- [main]
- [cuts]
- [observables]
- [coefficients]
- Config section[<categoryA>,<categoryB>]
- [asimov: asimovData]

But at present I don’t really understand that.

[main]

- The [main] section defines general input information, including where mainCombiner can find your input data or MC, configuration options, and your list of nuisance parameters.
- Example

```
[main]

data = /path/to/my/data_13TeV.root
mc = /path/to/my/mc/listofrootfiles/list.txt
fileDir = /path/to/all/my/inputs/
NPlist = nuisance.txt
categories = ggF_2e2mu_13TeV,ggF_2mu2e_13TeV,ggF_4e_13TeV,ggF_4mu_13TeV
mcsets = ggF,qqZZ,ZJets
SysCutoff = all:0.01, shape:0.01
```

- Two fields, categories and mcsets, are mandatory.

But at present I don't really understand that.

[cuts]

```
[cuts]
Incl_bin1_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-5.5<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<-5.0))
Incl_bin2_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-5.0<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<-4.5))
Incl_bin3_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-4.5<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<-4.0))
Incl_bin4_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-4.0<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<-3.5))
Incl_bin5_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-3.5<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<-3.0))
Incl_bin6_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-3.0<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<-2.5))
Incl_bin7_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-2.5<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<-2.0))
Incl_bin8_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-2.0<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<-1.5))
Incl_bin9_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-1.5<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<-1.0))
Incl_bin10_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-1.0<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<-0.5))
Incl_bin11_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (-0.5<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<0.0))
Incl_bin12_2mu2e_Binning2_13TeV = (220<m4l_fsr && m4l_fsr<2000 && (event_type==3||event_type==2) && (0.0<MCFM_MELA_ggZZ && MCFM_MELA_ggZZ<0.5))
```

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[observables]

```
[observables]
Incl_bin1_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin2_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin3_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin4_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin5_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin6_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin7_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin8_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin9_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin10_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin11_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
Incl_bin12_2mu2e_Binning2_13TeV = MCFM_MELA_ggZZ:MEM,1,-5.5,0.5
```

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[coefficients]

- Each source you provided under mcsets will have a pdf for each category you specified under categories, normalized according to some coefficient. The value and structure of the coefficient will be specified in the [coefficients] section.
- Each source accepts up to four arguments:
- poi factors sys global

But at present I don't really understand that.

[coefficients]

```
[coefficients]
qqZZ = poi:mu_qqZZ ; factors:n_qqZZ,bgyields_139fb.txt ; sys:norm_onlyShape_qqZZ.txt
#qqZZ = factors:n_qqZZ,bgyields.txt ; sys:norm_NormShape_Both_qqZZ.txt ; global:ATLAS_LUMI(139./0.97/1.03)

ggS = factors:n_ggS,bgyields.txt ; sys:norm_NormShape_Both_ggS.txt ; poi:mu*munnlo[1.7]-sqrt(mu5[5.]*mu)*munnlo[1.7]
;  global:ATLAS_LUMI(139./0.97/1.03)
ggB = factors:n_ggB,bgyields.txt ; sys:norm_NormShape_Both_ggB.txt ; poi:munnlo[1.7]-sqrt(mu/mu5[5.])*munnlo[1.7] ;
global:ATLAS_LUMI(139./0.97/1.03)
ggSBI5 = factors:n_ggSBI5,bgyields.txt ; sys:norm_NormShape_Both_ggSBI5.txt ; poi:sqrt(mu/mu5[5.])*munnlo[1.7] ;  glo
bal:ATLAS_LUMI(139./0.97/1.03)

ggSNLOS = factors:n_ggSNLOS,bgyields.txt ; sys:norm_NormShape_Both_ggSNLOS.txt ; poi:mu ;  global:ATLAS_LUMI(139./0.9
7/1.03)
ggSNLOI = factors:n_ggSNLOI,bgyields.txt ; sys:norm_NormShape_Both_ggSNLOI.txt ; poi:kc1[-1.0]*sqrt(mu) ;  global:ATL
AS_LUMI(139./0.97/1.03)
ggBNLOB = factors:n_ggBNLOB,bgyields.txt ; sys:norm_NormShape_Both_ggBNLOB.txt ;  global:ATLAS_LUMI(139./0.97/1.03)
ggBNLOI = factors:n_ggBNLOI,bgyields.txt ; sys:norm_NormShape_Both_ggBNLOI.txt ; poi:kc1[-1.0]*sqrt(mu) ;  global:ATL
AS_LUMI(139./0.97/1.03)
ggSBINLOI = factors:n_ggSBINLOI,bgyields.txt ; sys:norm_NormShape_Both_ggSBINLOI.txt ; poi:sqrt(mu) ;  global:ATLAS_L
UMI(139./0.97/1.03)
```

But at present I don't really understand that.

[coefficients]

- poi stands for parameter of interest, are usually free parameters and the same for each category.
- factors usually contains, but not limited to, nominal normalization for the source, which often has different values for each category.
- global provides an additional handle to add a factor that is the same for each category, but not free.
- sys provides the terms that account for systematic uncertainties that affect the overall normalization.

But at present I don't really understand that.

Category

```
[Incl_bin1_2mu2e_Binning2_13TeV,Incl_bin2_2mu2e_Binning2_13TeV,Incl_bin3_2mu2e_Binning2_13TeV,Incl_bin4_2mu2e_Binning
2_13TeV,Incl_bin5_2mu2e_Binning2_13TeV,Incl_bin6_2mu2e_Binning2_13TeV,Incl_bin7_2mu2e_Binning2_13TeV,Incl_bin8_2mu2e_
Binning2_13TeV,Incl_bin9_2mu2e_Binning2_13TeV,Incl_bin10_2mu2e_Binning2_13TeV,Incl_bin11_2mu2e_Binning2_13TeV,Incl_bi
n12_2mu2e_Binning2_13TeV,Incl_bin1_4e_Binning2_13TeV,Incl_bin2_4e_Binning2_13TeV,Incl_bin3_4e_Binning2_13TeV,Incl_bin
4_4e_Binning2_13TeV,Incl_bin5_4e_Binning2_13TeV,Incl_bin6_4e_Binning2_13TeV,Incl_bin7_4e_Binning2_13TeV,Incl_bin8_4e_
Binning2_13TeV,Incl_bin9_4e_Binning2_13TeV,Incl_bin10_4e_Binning2_13TeV,Incl_bin11_4e_Binning2_13TeV,Incl_bin12_4e_Bi
nning2_13TeV,Incl_bin1_4mu_Binning2_13TeV,Incl_bin2_4mu_Binning2_13TeV,Incl_bin3_4mu_Binning2_13TeV,Incl_bin4_4mu_Bin
ning2_13TeV,Incl_bin5_4mu_Binning2_13TeV,Incl_bin6_4mu_Binning2_13TeV,Incl_bin7_4mu_Binning2_13TeV,Incl_bin8_4mu_Binn
ing2_13TeV,Incl_bin9_4mu_Binning2_13TeV,Incl_bin10_4mu_Binning2_13TeV,Incl_bin11_4mu_Binning2_13TeV,Incl_bin12_4mu_Bi
nning2_13TeV,Incl_bin1_CRA_13TeV,Incl_bin2_CRA_13TeV,Incl_bin3_CRA_13TeV,Incl_bin4_CRA_13TeV]
ggS = SampleCount : ATLAS_Signal_ggS
ggB = SampleCount : ATLAS_Bkg_ggB
ggSBI5 = SampleCount : ATLAS_Signal_ggSBI5
qqZZ = SampleCount : ATLAS_Bkg_qqZZ

ggSNLOS = SampleCount : ATLAS_Signal_ggSNLOS
ggSNLOI = SampleCount : ATLAS_Signal_ggSNLOI
ggBNLOB = SampleCount : ATLAS_Bkg_ggBNLOB
ggBNLOI = SampleCount : ATLAS_Bkg_ggBNLOI
ggSBINLOI = SampleCount : ATLAS_Signal_ggSBINLOI

VBFB = SampleCount : ATLAS_Bkg_VBFB
VBFSBI = SampleCount : ATLAS_Bkg_VBFSBI
VBFSBI5 = SampleCount : ATLAS_Signal_VBFSBI5
```

But at present I don't really understand that.

[Asimov: asimovData]

```
[asimov: asimovData]
mu = 1.0
```

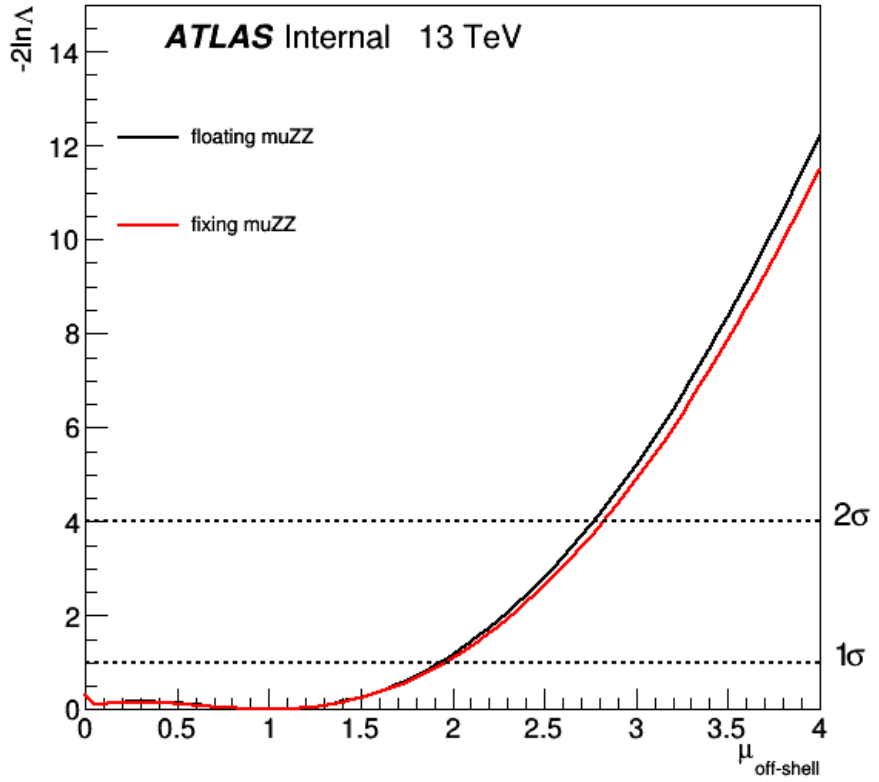
But at present I don’t really understand that.

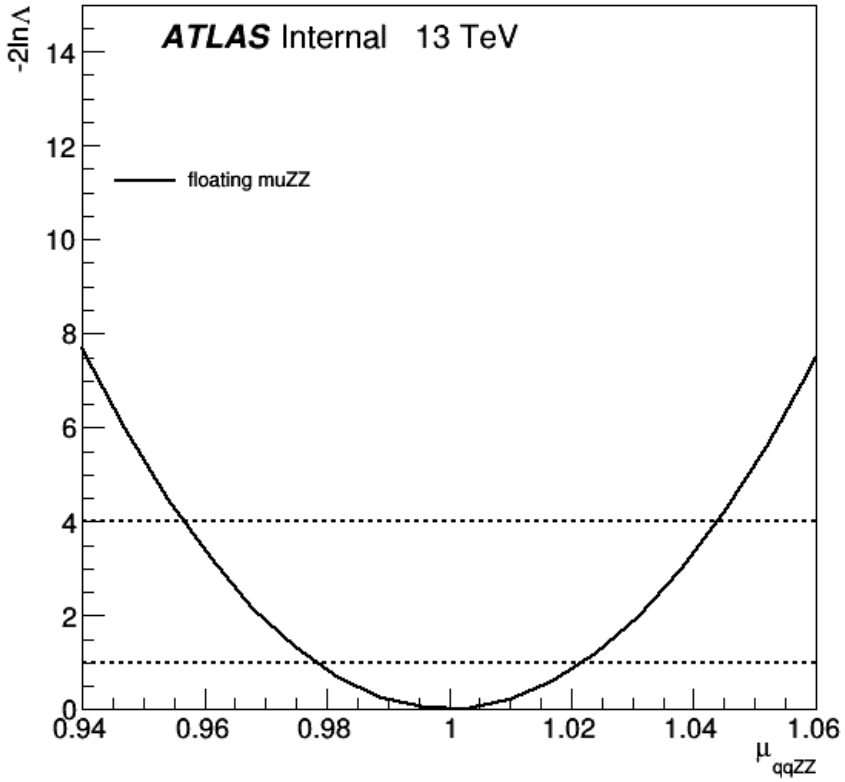
But we need more explanations about scan_poi.

- scan_poi output. root scan.root combined mu asimovData mu:100:0:5
- combined –name of the workspace
- mu –the poi that you want to scan
- asimovData -dataname
- mu:100:0:5 –the scan range

But at present I don’t really understand that.

Example





	Strength Value
μ_{qqZZ}	$1^{+0.014}_{-0.015}$
μ_{ggF} fixing	$1^{+0.94}_{-1.17}$
μ_{ggF} floating	$1^{+0.97}_{-1.17}$

Next step

- Next step we shall write our own config file
- And use this tool to do some other analysis
- Maybe at that time I will understand more about this

Thank you!