Reproducing the Higgs to 2 photons ATLAS Open Data analysis

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Run online the Hyy analysis on Binder

Run online the Hyy C++ framework (code, viewer)

or direct link:

https://nbviewer.jupyter.org/github/atlas-outreach-data-tools/notebooks-collection-opendata/blob/master/13-TeV-examples/python/ATLAS_OpenData_13-TeV_python_full_HyyAnalysis_5min.ipynb

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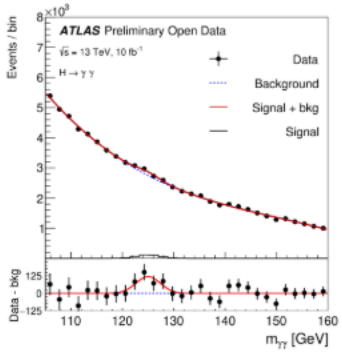
Get running the full Hyy analysis using the 13 TeV dataset in 5 minutes!

Introduction The analysis is based on the 13 TeV Open Data. The ATLAS note ATL-OREACH-PUB-2020-001 can be used as a guide on the content, properties, capabilities and limitations of the released datasets.

In the following, in about **5 minutes** we are going to re-produce the H->yy analysis plots from the note.



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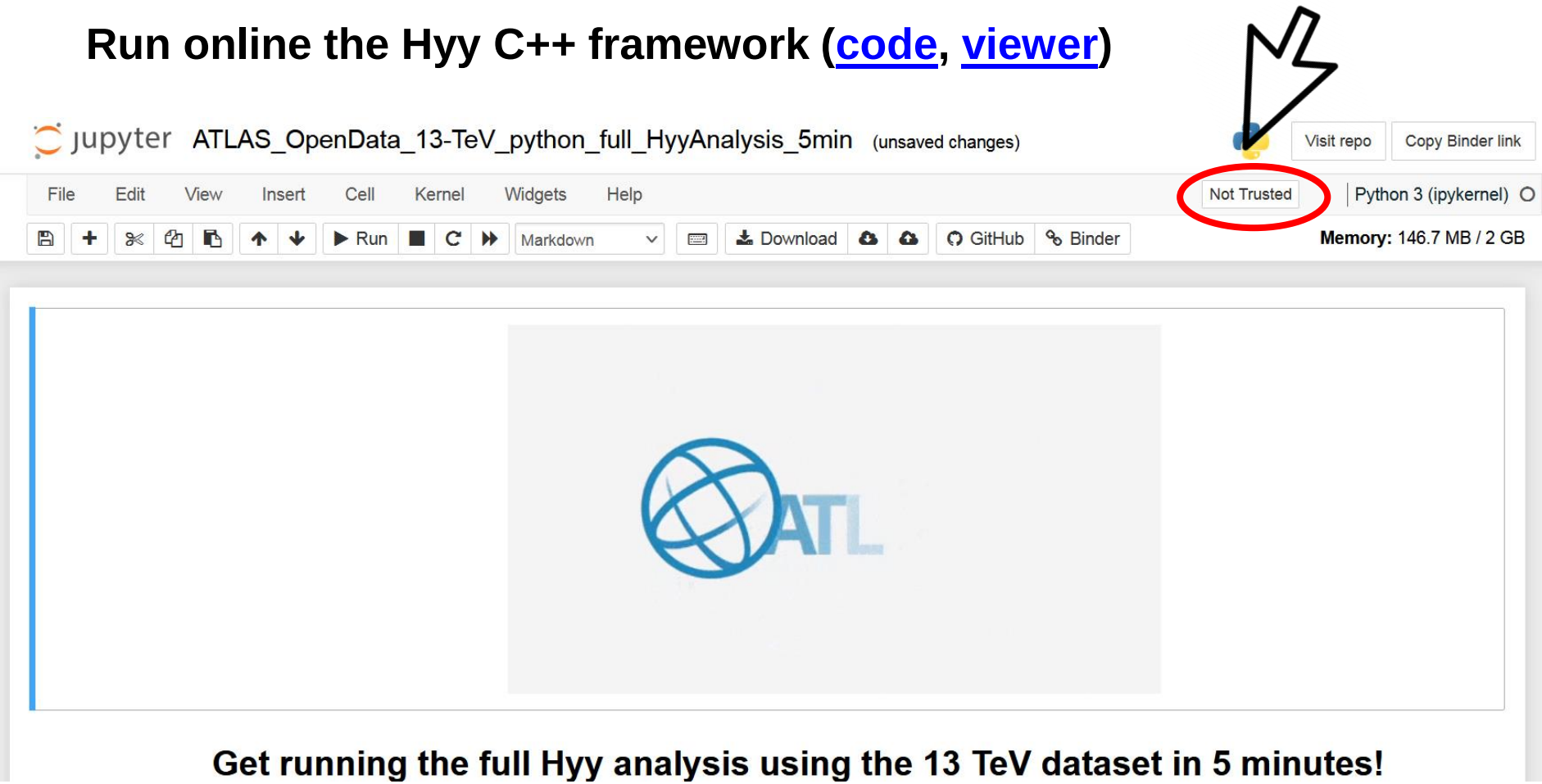

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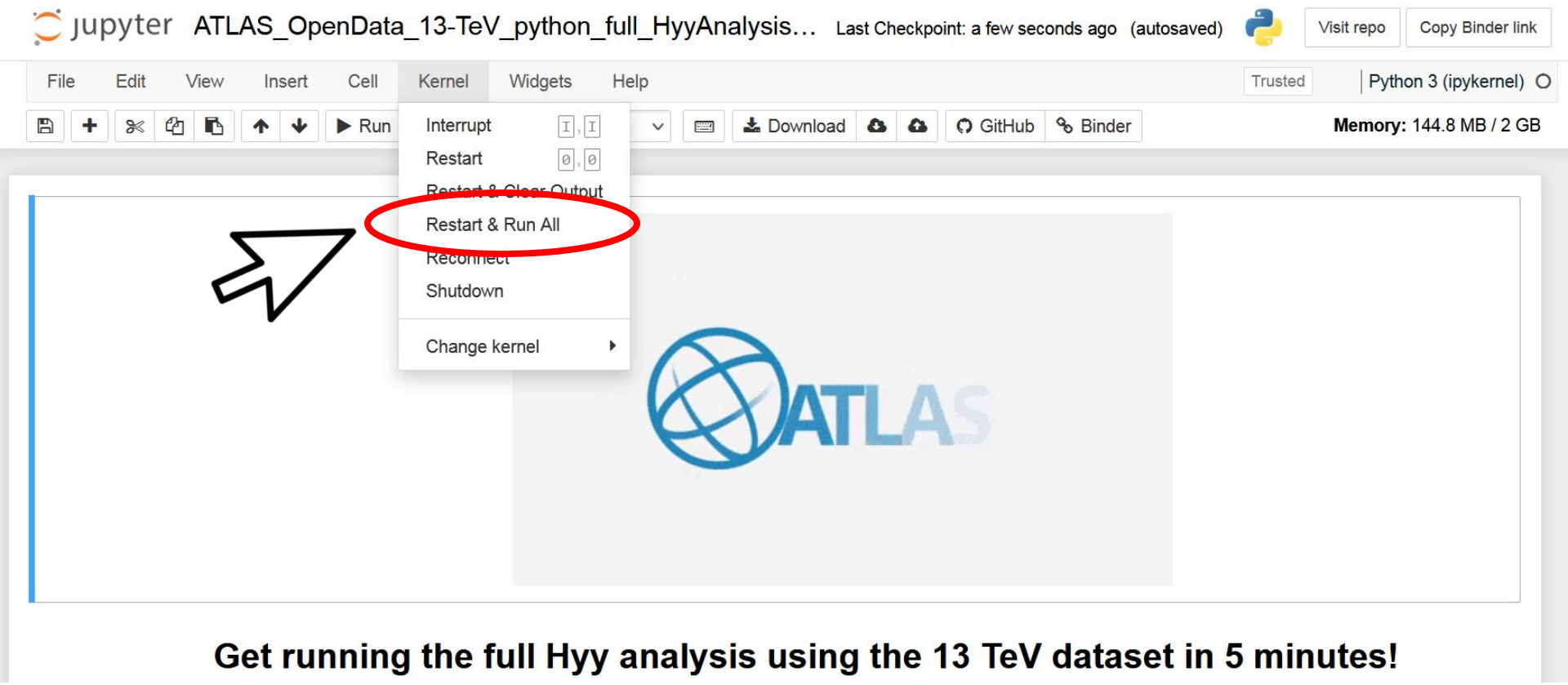

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Run online the Hyy analysis on Binder

Run online the Hyy C++ framework (code, viewer)

jupyter ATLAS_OpenData_13-TeV_python_full_HyyAnalysis_5min Last Checkpoint: 2 minutes ago (autosaved) Visit repo Copy Binder link

File Edit View Insert Cell Kernel Widgets Help Notebook saved Trusted Python 3 (ipykernel)

Run Markdown Download GitHub Binder **Memory:** 1.1 GB / 2 GB

Check that the directory **Output_HyyAnalysis** is there! If not, **create it**

In [17]:
```
#command1 = 'mkdir Output_HyyAnalysis'
#os.system(command1)
```

Now, we will execute the C++ analysis code. It will take some time (less than 5mins)

First, we will run over MC samples

In [*]:
```
command4 = "./run_web.sh"
os.system(command4)
```

[*] means it is running this particular command

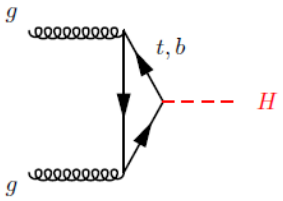
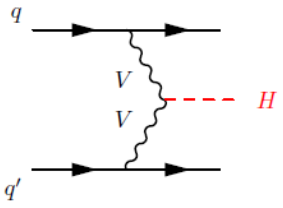
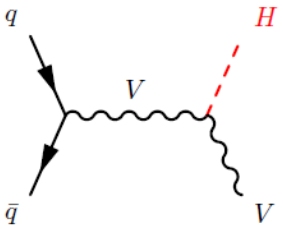
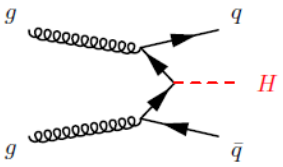
Takes 15-20 mins to run in Binder

inputs are taken directly from
http://opendata.cern.ch/eos/

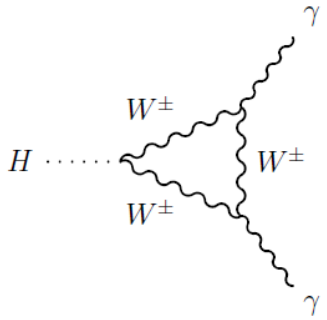
Higgs to 2 photons analysis

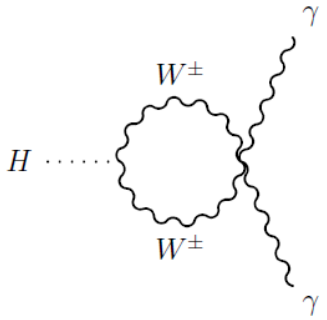
- **SM Higgs boson decaying into 2 photons:**

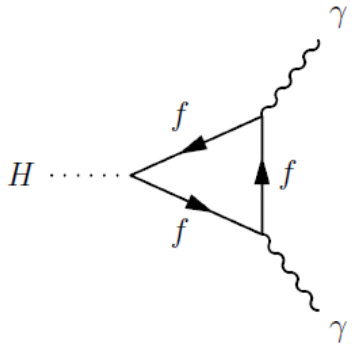
Production

Production mode	LO diagram
ggF production	
VBF production	
VH production	
$q\bar{q}H$ production	

Decay





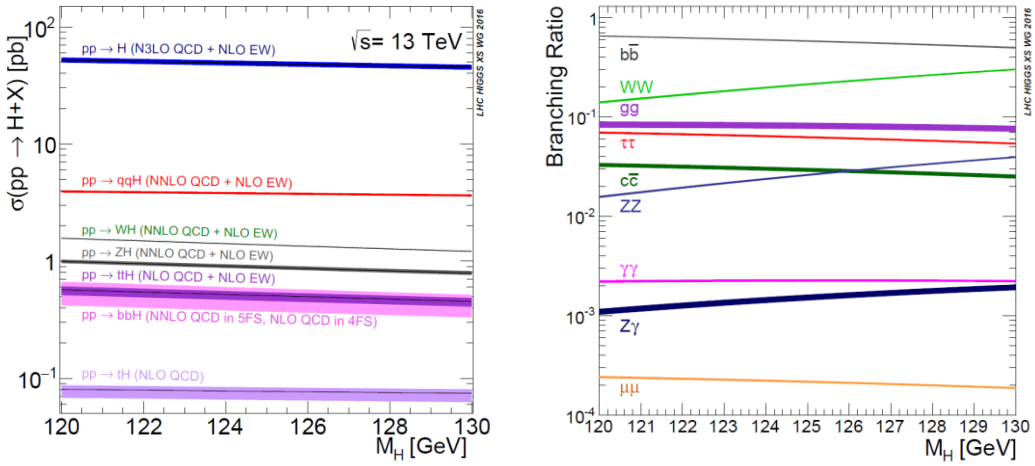


Higgs to 2 photons analysis

- **SM Higgs boson decaying into 2 photons:**

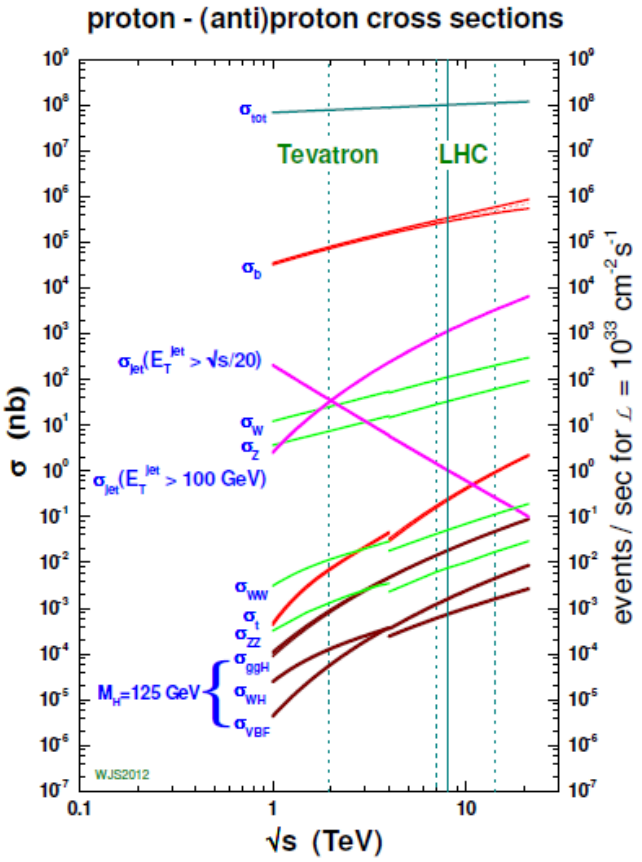
Cross-section and branching

[LHC Higgs Working Group]



$$BR(H \to \gamma\gamma)|_{m_H=125.09\mathrm{GeV}} \approx 0.227\%$$

Background



Higgs to 2 photons analysis

- **SM Higgs boson decaying into 2 photons:**

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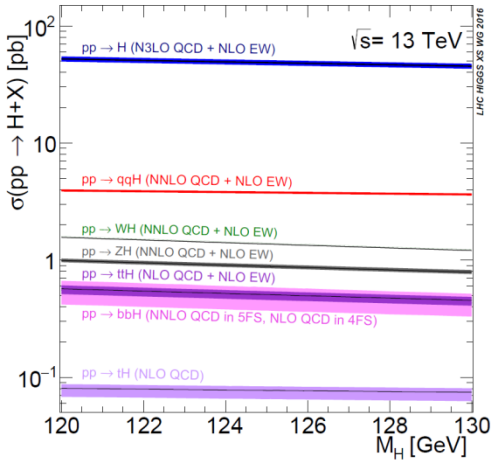
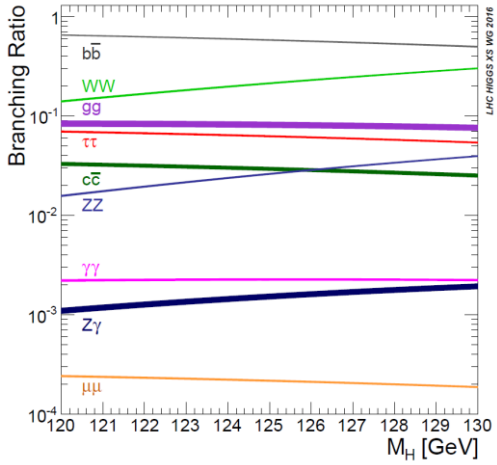
LHC Higgs Working Group





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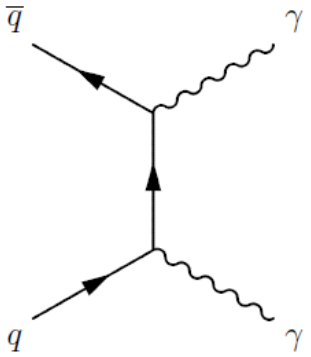
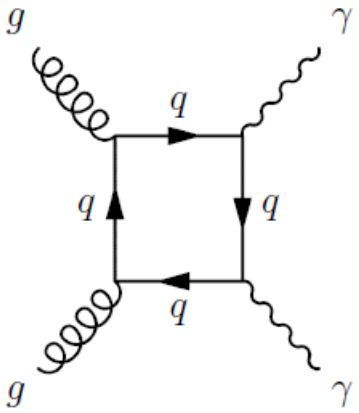


Born process



Box or quark loop process

Higgs to 2 photons analysis

- **13 TeV ATLAS Open Data $H \rightarrow \gamma\gamma$ analysis**

Based on:

PRD 98 (2018) 052005 11th January 2019

Measurements of Higgs boson properties in the diphoton decay channel with 36 fb^{-1} of pp collision data at $\sqrt{s}$ = 13 TeV with the ATLAS detector

The ATLAS Collaboration

Simplified selection:

- 2 photons with pT > 35, 25 GeV
- E_T / m($\gamma\gamma$) > 0.35(0.25)
- 105 GeV < m($\gamma\gamma$) < 160 GeV

Background:

Estimated from data, without the use of MC simulation, by fitting the diphoton invariant-mass distribution in a range (105 -- 160 GeV) with a third-order polynomial function with free shape and normalisation parameters

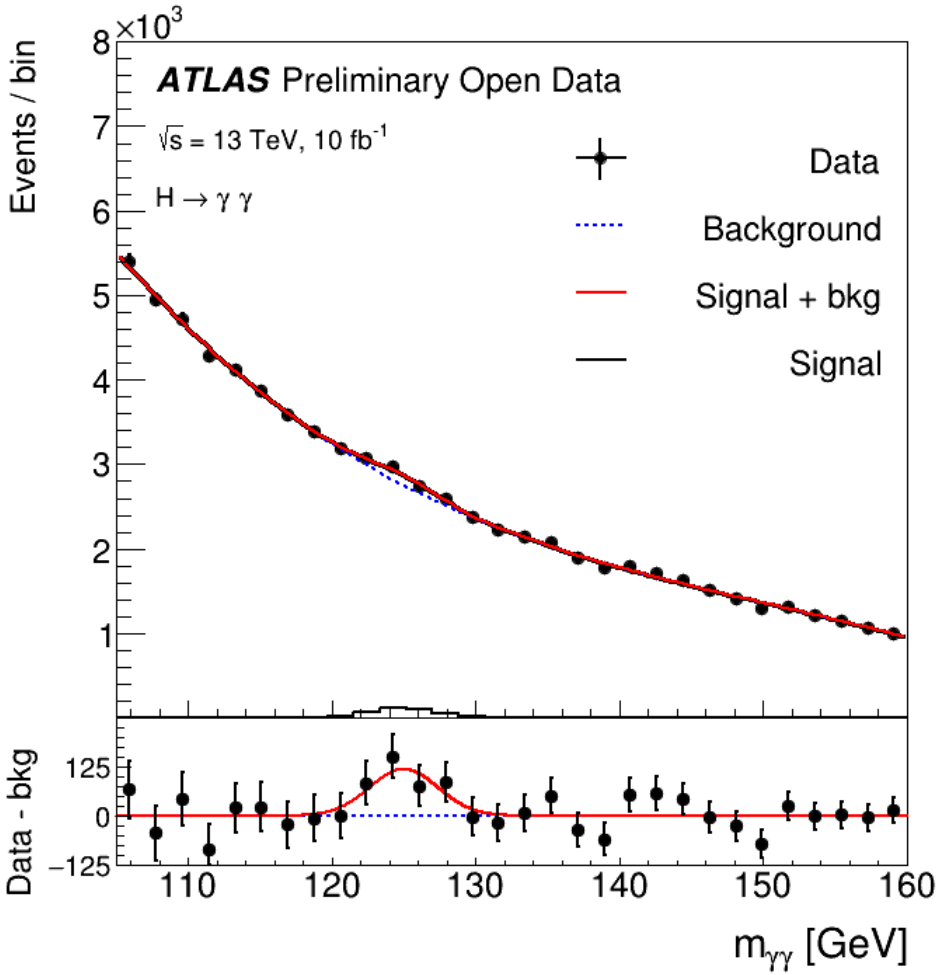
Signal:

Signal MC simulations of the five main Higgs-boson production mechanisms (ggF, VBF, WH, ZH, ttH) are used to model the shape of the invariant mass of the signal, modelled as a Gaussian functiona

Higgs to 2 photons analysis

- **13 TeV ATLAS Open Data *H→γγ* analysis**

Figure to be produced:



Higgs to 2 photons analysis

- **13 TeV ATLAS Open Data *H*→*γγ* analysis**

documentation

or direct link

http://opendata.atlas.cern/release/2020/documentation/physics/YY.html

First ATLAS Open Data notebook on Binder

A set of multiple notebooks using 13 TeV ATLAS Open Data

github

or

direct link:
https://github.com/atlas-outreach-data-tools/notebooks-collection-opendata

First ATLAS Open Data notebook on Binder

README.md

ATLAS Open Data

notebooks-collection-opendata

A set of multiple notebooks using 8 TeV and 13 TeV ATLAS Open Data datasets

To execute in MyBinder: launch binder

Note: before starting running the code in the jupyter notebooks, click on the up right button "not trusted" in order to get "trusted" displayed. This should lead the JavaScript to be executed, that is useful to visualise interactive histograms. If that doesn't work, simply go to the top of the notebook, find the cell that contains the line of code `%jsroot` and comment out that.

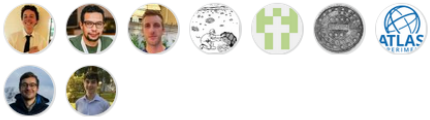
For more, please go to: http://opendata.atlas.cern

@2021

Packages

No packages published

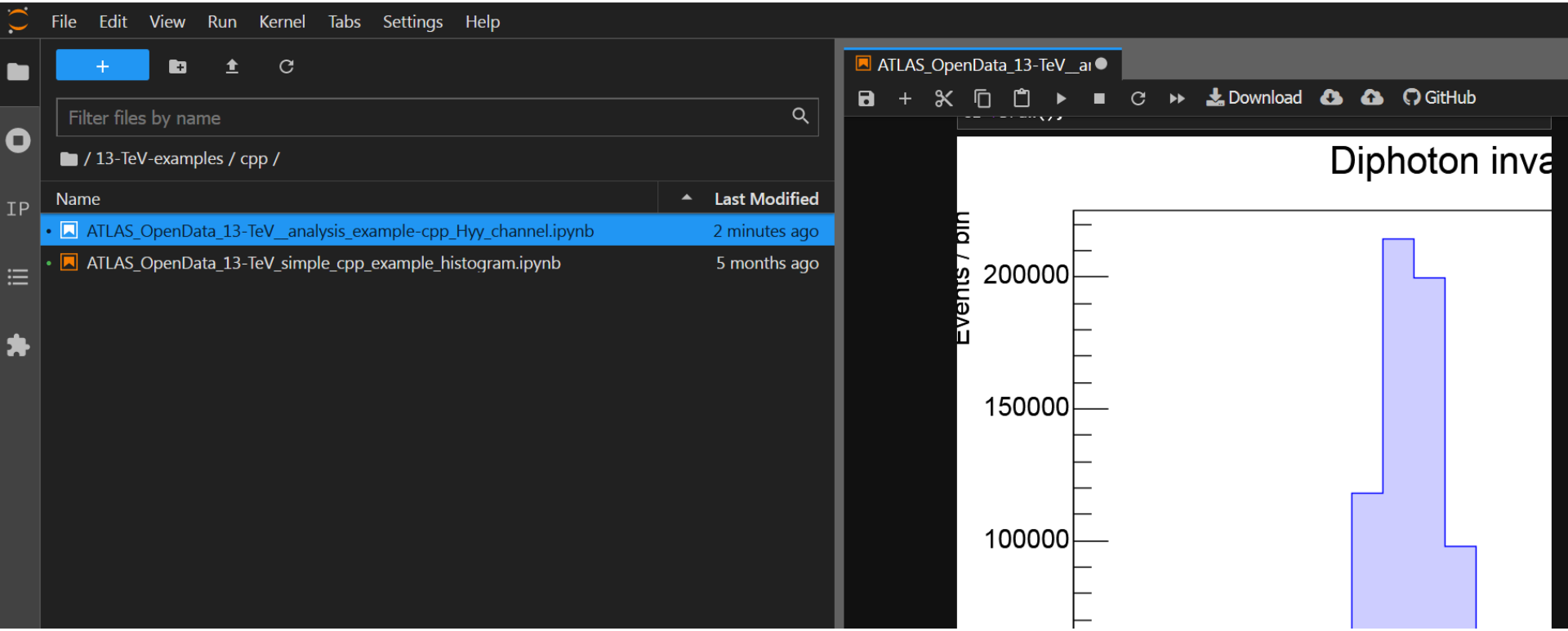
Contributors 9



Languages

Jupyter Notebook 98.1% Python 1.9%

First ATLAS Open Data notebook on Binder



Run the Hyy analysis on your terminal

1. Setup ROOT, some gcc version and git
2. Clone the repository:

git clone https://github.com/atlas-outreach-data-tools/atlas-outreach-cpp-framework-13tev.git

3. cd atlas-outreach-cpp-framework-13tev
4. execute the welcome script with option 1:

   ./welcome.sh

5. go to the analysis directory

   cd Analysis/HyyAnalysis

6. execute the analysis script with options 0 and then 0 (no PROOF):

   ./run.sh

7. go to the Plotting directory:

   cd ../../Plotting/

8. execute the plotting script with options 9 and 0:

   ./plotme.sh

9. Take a look at the plots in histograms/

Run the Hyy analysis on your terminal

For those working on CERN lxplus

Try to setup root 6.08 with gcc6.2:

lsetup "root 6.08.06-x86_64-slc6-gcc62-opt“

lsetup git

open **main_HyyAnalysis.C**

find the line and uncomment the path

/* Local path example */

```
TString path = "/eos/project/a/atlas-outreach/projects/open-
    data/OpenDataTuples/renamedLargeRJets/GamGam/";
```

then comment the online path

/* The URL to the CERN Open Data portal repository */

```
TString path = "http://opendata.cern.ch/eos/opendata/atlas/OutreachDatasets/2020-01-22/GamGam/";
```

by doing this, you will be reading the files from atlas eos

Run the Hyy analysis on your terminal

For those working on Trieste farm “farmts”

open **main_HyyAnalysis.C**

use a new local path

TString path = " /eos/infnts/atlas/public/OpenDataTuples/GamGam/";

by doing this, you will be reading the files from the infnts eos