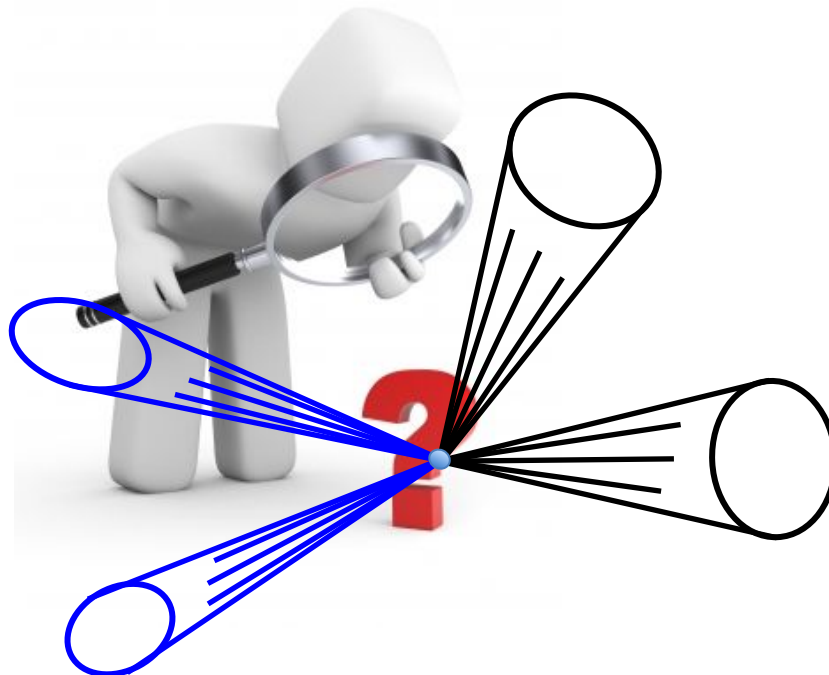


ATLAS Data and Tools Release for Outreach and Education

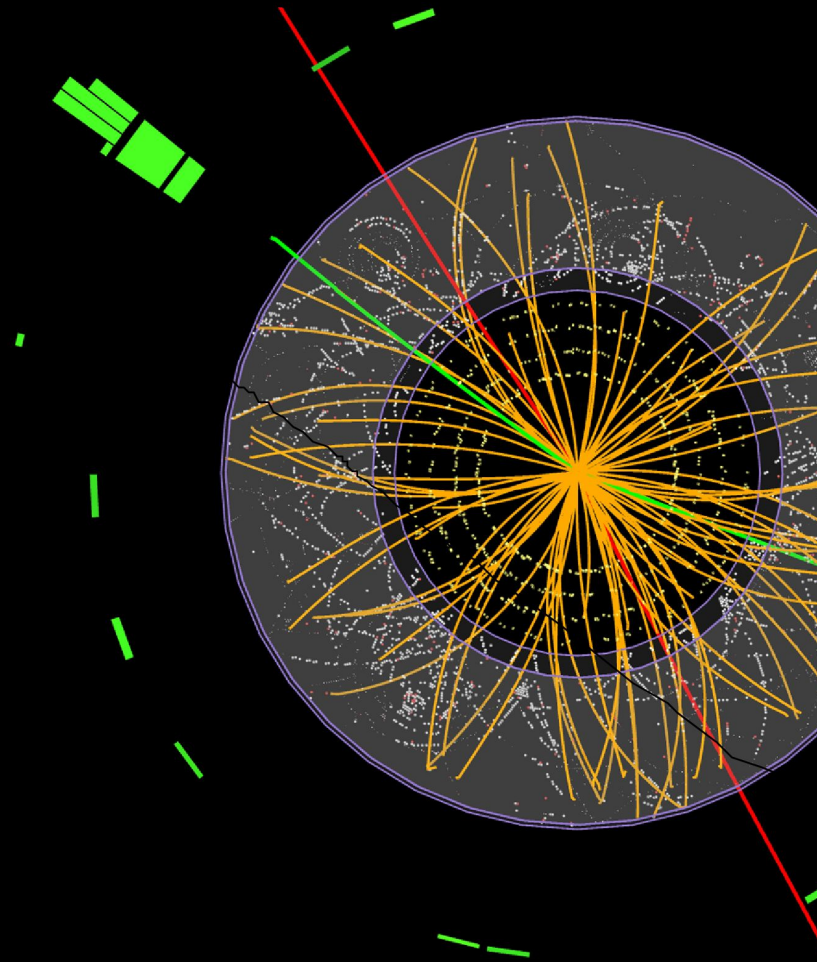


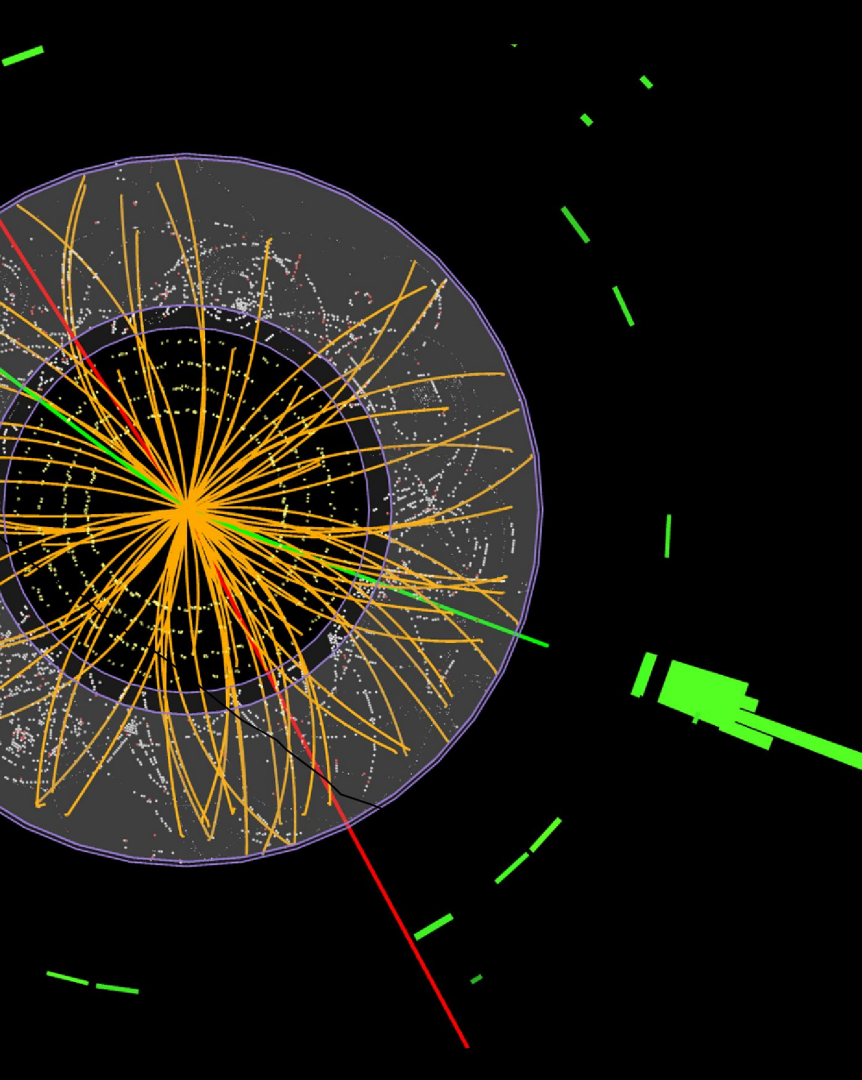
Arturo Sánchez, on behalf the ATLAS Data and Tools Group, ATLAS Outreach

University of Naples and INFN

ATLAS Weekly Meeting, May 31st, 2016

The ATLAS
collaboration is
releasing 1 fb^{-1} of
8 TeV data and
MC for
educational use
this Summer 2016





...today we'll
show the main
objectives,
including the
creation, use and
deployment of
analysis *tools*

ATLAS
Outreach group

Education

Virtual events, check
collected data, run tools or
build your own!

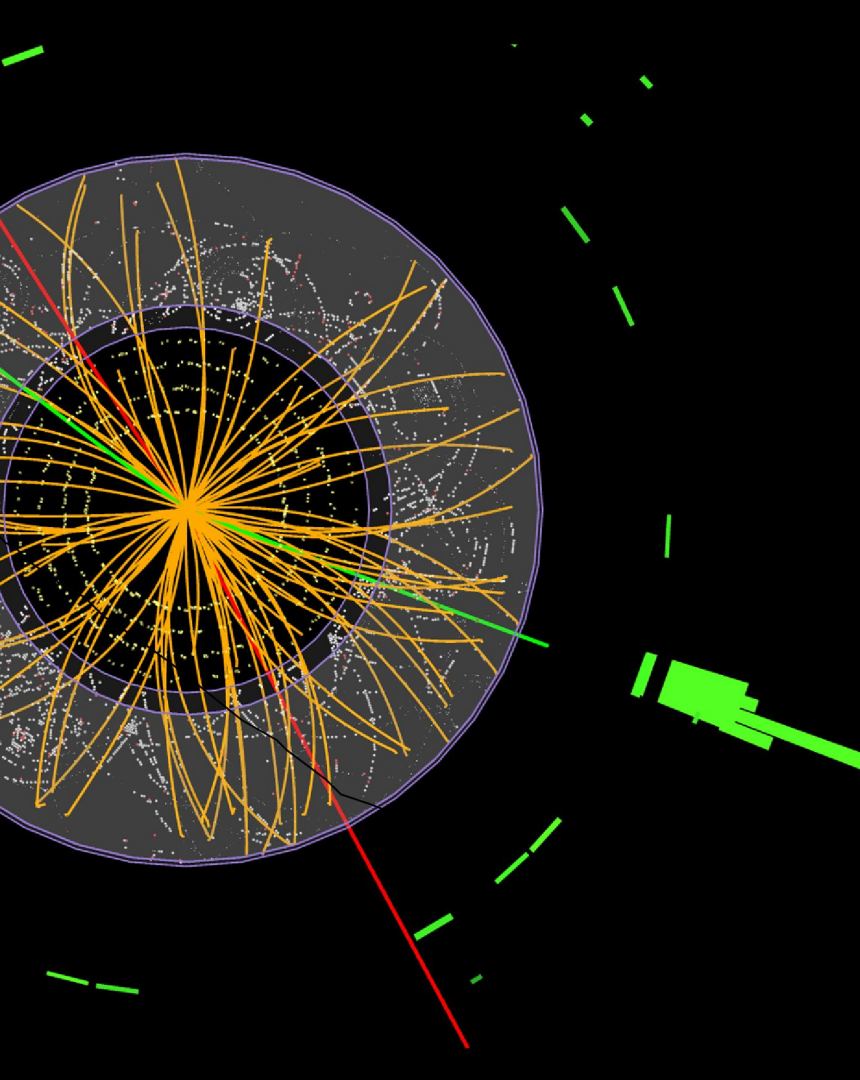
Start learning

1. Data Release

Research

Get the genuine working
environments, virtual machines
or even the raw data!

Start analysing

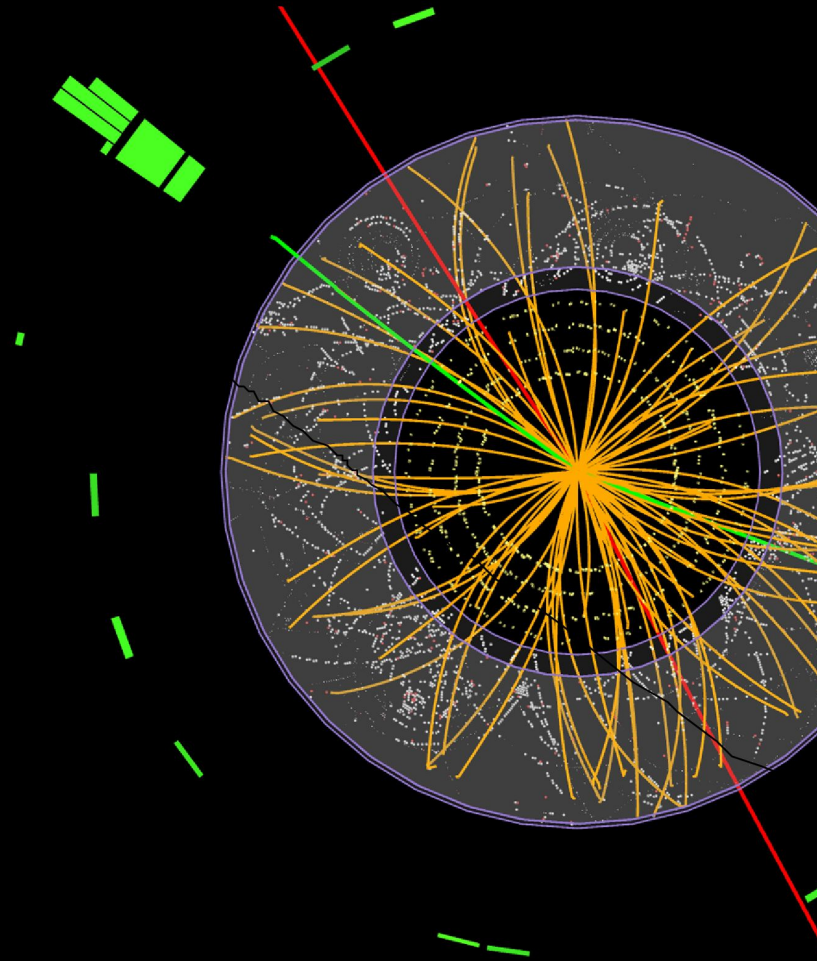


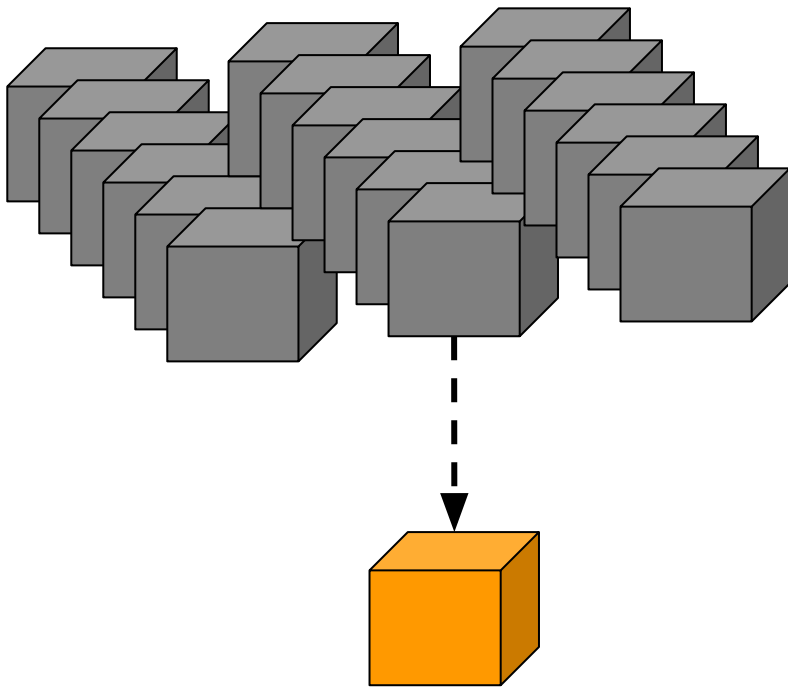
- What do we want to release?

Data and analysis tools
for educational use
aimed at the
universitary level* and
beyond

*Advanced High school students also may benefit

- How we are doing it?
Releasing data and MC
samples in
ROOT *tree* format;
where the ATLAS
collaboration decided
 1 fb^{-1} would be sufficient





The release...

...contains millions of events from 2012 data and MC that will be used by:

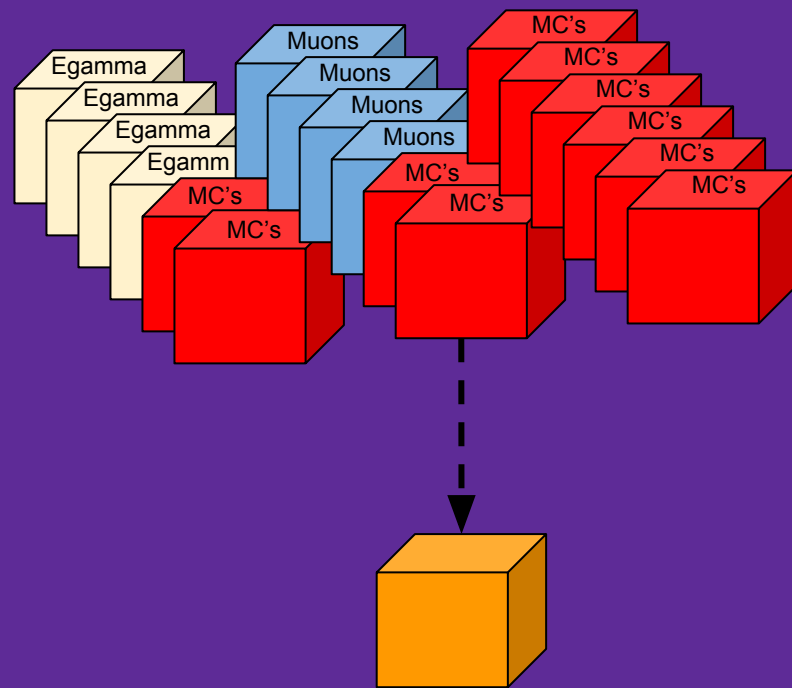
Target Audiences

- Students
 - Advance High School and University
 - PhD Students
- Researches
 - Training for new analyzers
 - Outside ATLAS scientific community
- General Public
 - Outreach
 - Curious people!

Type of sample-ntuples

A set of filtered AnalysisTop final analysis-kind (Run1) ntuples

- **Data Egamma string**
 - 1 root file from Period D
 - Total *final* #Events ~ 33.6MM
- **Data Muons string**
 - 1 root file from Period D
 - Total *final* #Events ~ 33.8MM
- **MC signals and backgrounds**
 - 38 samples, one per root file
 - 4 Higgs + 13 Z' signals
 - 3 W + 6 (s)top + 12 W/Z+jet



The release...

Approval Plots for the ATLAS Open Data published dataset

ATLAS Outreach Note

Plots from selected
analyses using the
published dataset to
showcase the possible
abilities and limitations

<https://cds.cern.ch/record/2156957>



ATLAS NOTE

May 31, 2016



Approval Plots for the ATLAS Published Dataset

S. Cheatham^f, A. Sanchezⁱ, K. Shaw^f, F. Socher^a

^aIKTP, TU Dresden (DE)

^fINFN Udine & ICTP Trieste (IT)

ⁱINFN Sezione di Napoli & Dipartimento di Fisica, Universit di Napoli (IT)

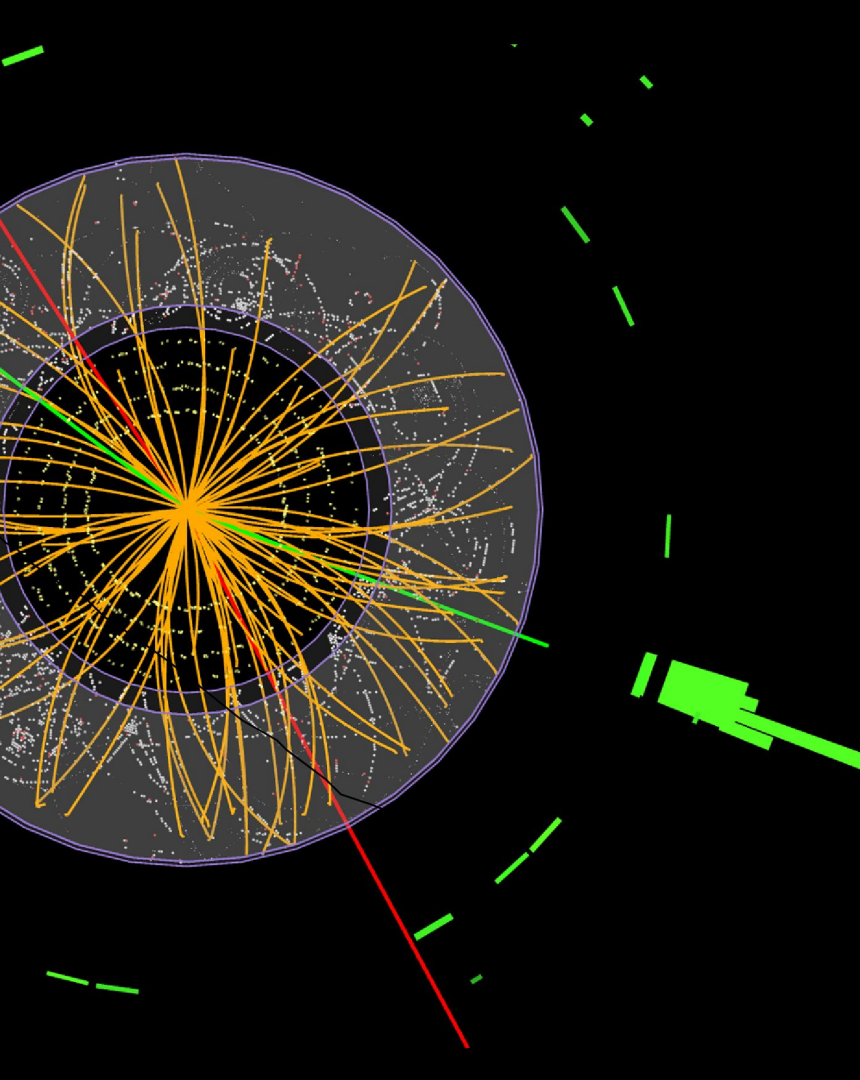
Abstract

This document presents approval plots from selected analyses using the ATLAS Open Data dataset. This dataset containing 1 fb^{-1} of data and matching Monte Carlo simulation,

period	$N_{\text{Events}}^{\text{pre}}$	$N_{\text{Events}}^{\text{sample}}$	$\mathcal{L} [\text{pb}^{-1}]$
Egamma	7917590	33575219	1000.6
Muons	7028084	33815203	1000.6

Contents

- 1 Introduction**
 - 1.1 Datasets
 - 1.2 Analysis Results
- 2 W Analysis**
 - 2.1 Selection
 - 2.2 Results
- 3 Z Analysis**
 - 3.1 Selection
 - 3.2 Results
- 4 Top Pair Analysis**
 - 4.1 Selection
 - 4.2 Results
- 5 WZ Analysis**
 - 5.1 Selection
 - 5.2 Results
- 6 ZZ Analysis**
 - 6.1 Selection
 - 6.2 Results
- 7 HWW Analysis**
 - 7.1 Selection
 - 7.2 Results
- 8 Z' Analysis**
 - 8.1 Selection
 - 8.2 Results



- And we are not alone
in this effort
Several ATLAS
members in universities
around the world have
been developing
educational programs
using the samples,
testing them and give us
feedback

Data & Tools

MasterClasses and HEP Education:

University of Oslo
(NO), Dresden and
Athens (GR)

[link](#)

Physics Lab

course:

Technische
Universitaet
Dortmund (DE)

[link](#)

VRML Viewer, a web based event display:

Georgian Technical
University (GE)

[link](#)

CEVALE2VE

Outreach Group:

Several ATLAS and
not ATLAS physics
institutions/members

[link](#)

<https://atlas-outreach.web.cern.ch/data-toolz-group>

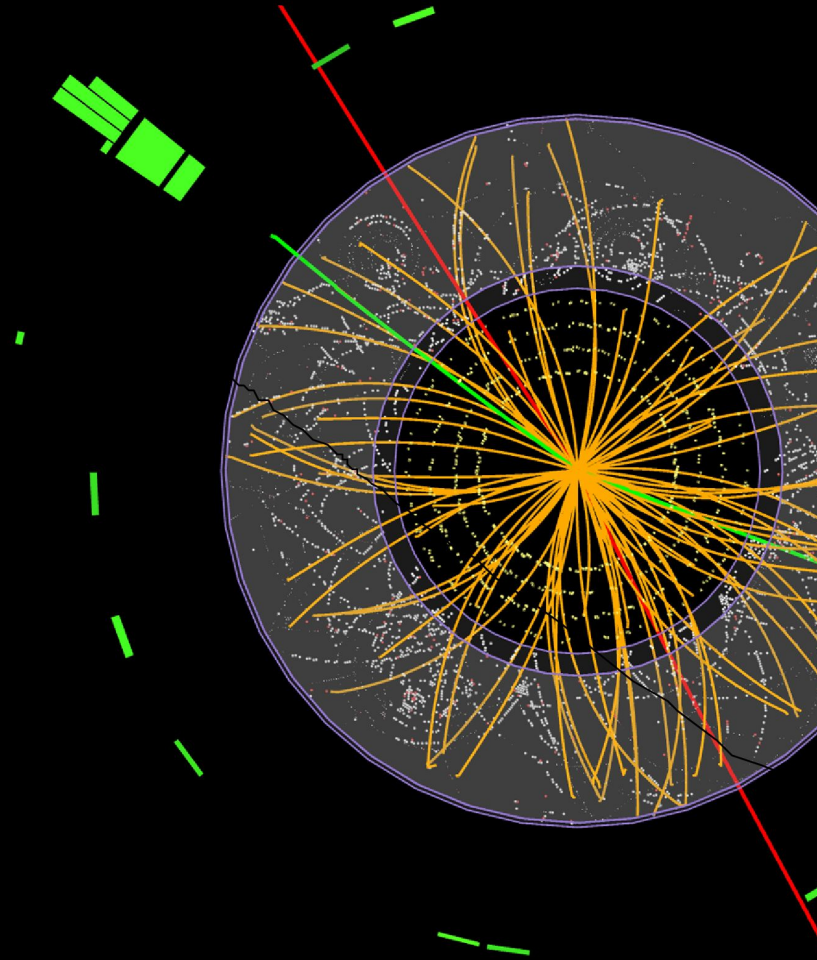
Physics Lab
course:
Technische

**Are you or your team part of an
Education/Outreach project and you want
to tell us more about it? Please join to
atlas-outreach-data-and-tools@cern.ch
and ask for spot in the Monthly meeting!**

Several ATLAS
not ATLAS physics
institutions/members
[link](#)

- The dataset has been prepared in harmony with the tools and educational use cases

Looking to maximize their educational power we have created a platform where people can develop their own exercises and new ideas



ATLAS
Outreach group

2. The Tools

ATLAS Outreach Data & Tools

Table of Content

Levels of interaction with the Datasets and the Tools

Level 1

Visualisation and qualitative “touch” of the datasets

Development and use of existing tools that allow the visualisation and the **interaction** with the ATLAS samples, events and detector.

Level 2

Quantitative analysis on the Web

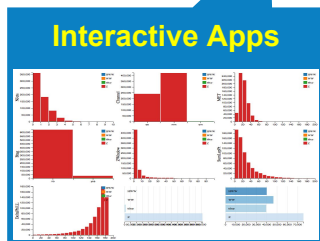
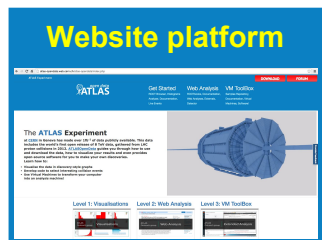
Several efforts are ongoing in order to produce *meaningful* results out of the samples using web-based and cloud computing solutions.

Level 3

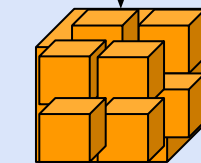
Sophisticated but compact analysis toolbox

Tested tools like Virtual Machine (VM) that contains all the inputs, code, visualisations and analysis tools in a single space for more complex or long term educational and analysis tasks.

Surrounding the set of samples we have:

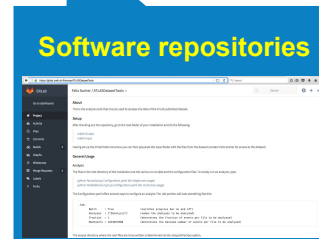
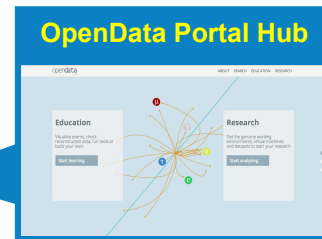
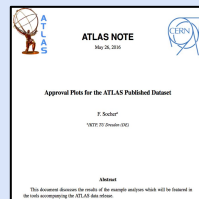


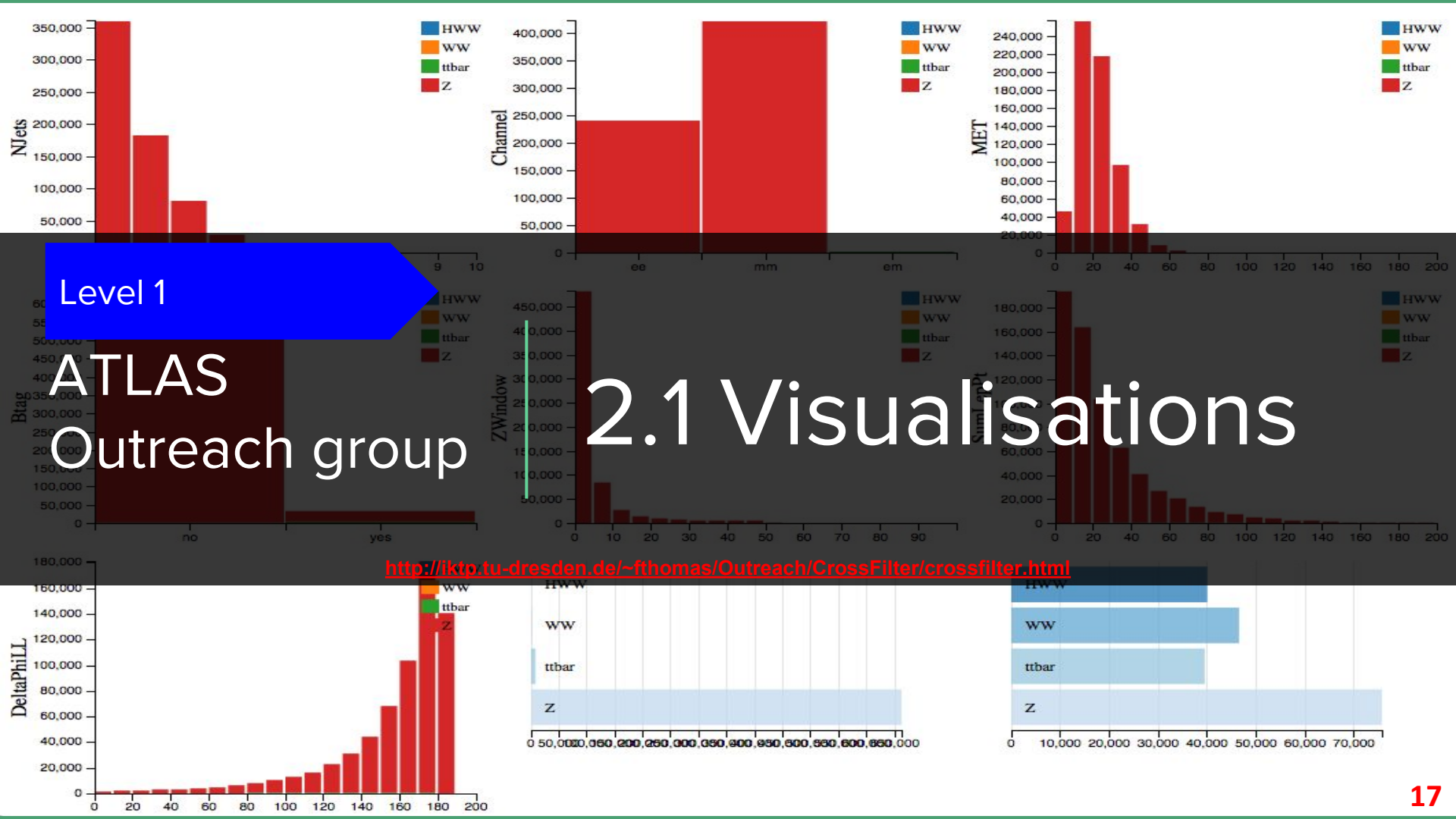
Contents	
1	Introduction
1.1	Contents
1.2	Analysis Results
2	W Analysis
2.1	Selection
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3	Z Analysis
3.1	Selection
3.2	Results
4	Top Pair Analysis
4.1	Selection
4.2	Results
5	WZ Analysis
5.1	Selection
5.2	Results
6	ZZ Analysis
6.1	Selection
6.2	Results
7	HHW Analysis
7.1	Selection
7.2	Results
8	Z' Analysis
8.1	Selection
8.2	Results
A	Dataset Tables



	period	$N^{\text{re}}_{\text{Events}}$	$N^{\text{sample}}_{\text{Events}}$	$\mathcal{L} [\text{fb}^{-1}]$
Egamm	7917590	33575219	1000.6	
Muons	7028084	33815203	1000.6	

Official Note





Visualisations and Analysis

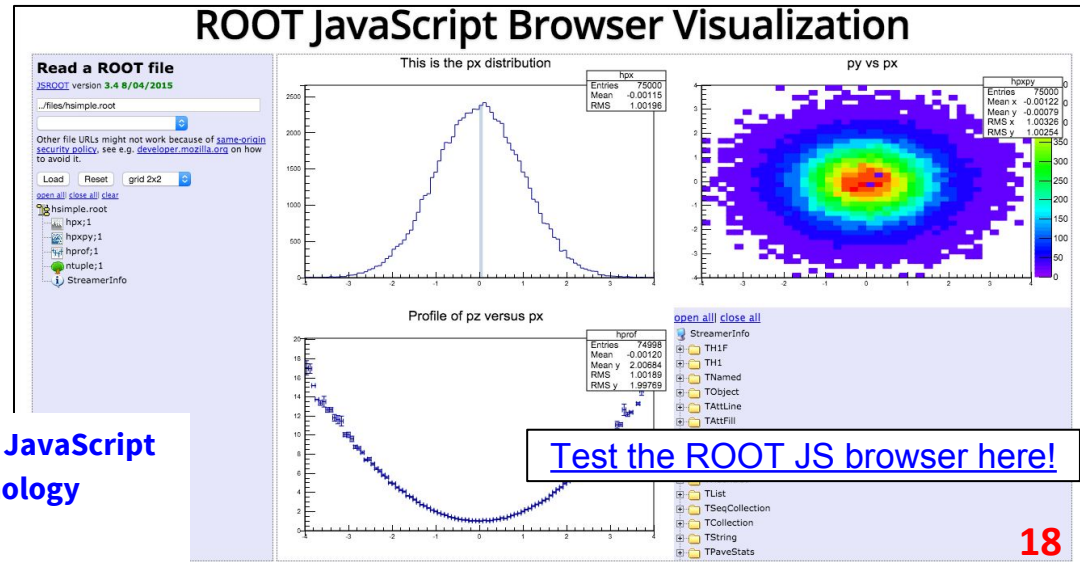
There are several ways to visualise the dataset in form of histograms allowing to the user to interact with them!

Some examples here:

<http://iktp.tu-dresden.de/~fthomas/Outreach/CrossFilter/crossfilter.html>

<http://atlasui03.na.infn.it:8088/~sanchez/ATLAS/crossfilter-gh-pages/crossfilter.html>

<http://iopscience.iop.org/article/10.1088/1742-6596/513/5/052005>



Using (mainly) JavaScript and web technology

Journal of Physics: Conference Series

PAPER • OPEN ACCESS

Exploring JavaScript and ROOT technologies to create
Web-based ATLAS analysis and monitoring tools

Level 2

on behalf of the ATLAS Collaboration

Published for SISSA by IOP Publishing Ltd • Journal of Physics: Conference Series, Volume 664, Offline software

ATLAS
Outreach group

Abstract

We explore the potential of current web applications to create online interfaces that allow the visualization, interaction and real cut-based physics analysis and monitoring of processes through a web browser. The project consists in the initial development of web- based and cloud computing services to allow students and researchers to perform fast and very useful cut-based analysis on a browser, reading and using real data and official Monte- Carlo simulations stored in ATLAS computing facilities. Several tools are considered: ROOT, JavaScript and HTML. Our study case is the current cut-based $H \rightarrow ZZ \rightarrow llq\bar{q}$ analysis of the ATLAS experiment. Preliminary but satisfactory results have been obtained online.

22 Total downloads

Export citation and abstract

BibTeX

RIS

+ Share this article

Related content

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Vector Recruitment Limited](#)[R&D Manager
Vector Recruitment Limited](#)[Head of Tokamak and Neutral
Beam Operations
United Kingdom Energy
Authority, CCFE](#)[More jobs](#)[Post a job](#)

2.2 Web Analysis

Root + Jupyter NoteBooks

User's use RootBooks (NoteBooks + Root Kernel) to interact with the samples!

The image shows a screenshot of the ROOT Data Analysis Framework website and an example ROOTBook. The website header includes the ROOT logo and navigation links: Download, Documentation, News, Support, About, Development, and Contribute. A search bar is also present. Below the header, there are four main sections: Getting Started, Reference Guide, Forum, and Gallery. The Reference Guide section is highlighted with a dashed arrow pointing to the text "ROOT is ...". The text describes ROOT as a modular scientific software framework for big data processing, statistical analysis, visualization, and storage, primarily written in C++ but integrated with Python and R. It includes a "Try it in your browser! (Beta)" link and a "Download" button. A 3D plot of a particle distribution is shown on the right. The example ROOTBook on the left shows the ATLAS Experiment logo and a section titled "Example of ROOTBook using ATLAS public datasets" with icons for Python and C++.

<https://root.cern.ch/>

ROOT Data Analysis Framework

Download Documentation News Support About Development Contribute

Getting Started Reference Guide Forum Gallery

ROOT is ...

A modular scientific software framework. It provides all the functionalities needed to deal with big data processing, statistical analysis, visualisation and storage. It is mainly written in C++ but integrated with other languages such as Python and R. [Try it in your browser! \(Beta\)](#)

Download or Read More ...

Previous Pause Next

ATLAS EXPERIMENT

Example of ROOTBook using ATLAS public datasets

Python C++

Level 1: Visualisations Level 2: Web Analysis Level 3: VM ToolBox

Learning a lot thanks to the CERN ROOT Team!!

...We are now writing the **Notebooks** that read those samples and create example physics analysis under **ROOT**...

...You can help us as well,
subscribe and get in contact:
atlas-outreach-data-and-tools@cern.ch

INTERNAL

A

Level 3

ATLAS Outreach group

About

This is the analysis code that may be used to analyse the data of the ATLAS published dataset.

Setup

After checking out the repository, go to the root-folder of your installation and do the following:

```
mkdir Output
mkdir Input
```

Having set up the initial folder structure you can then populate the *Input* folder with the files from the dataset (contact Felix Socher for access to the dataset)

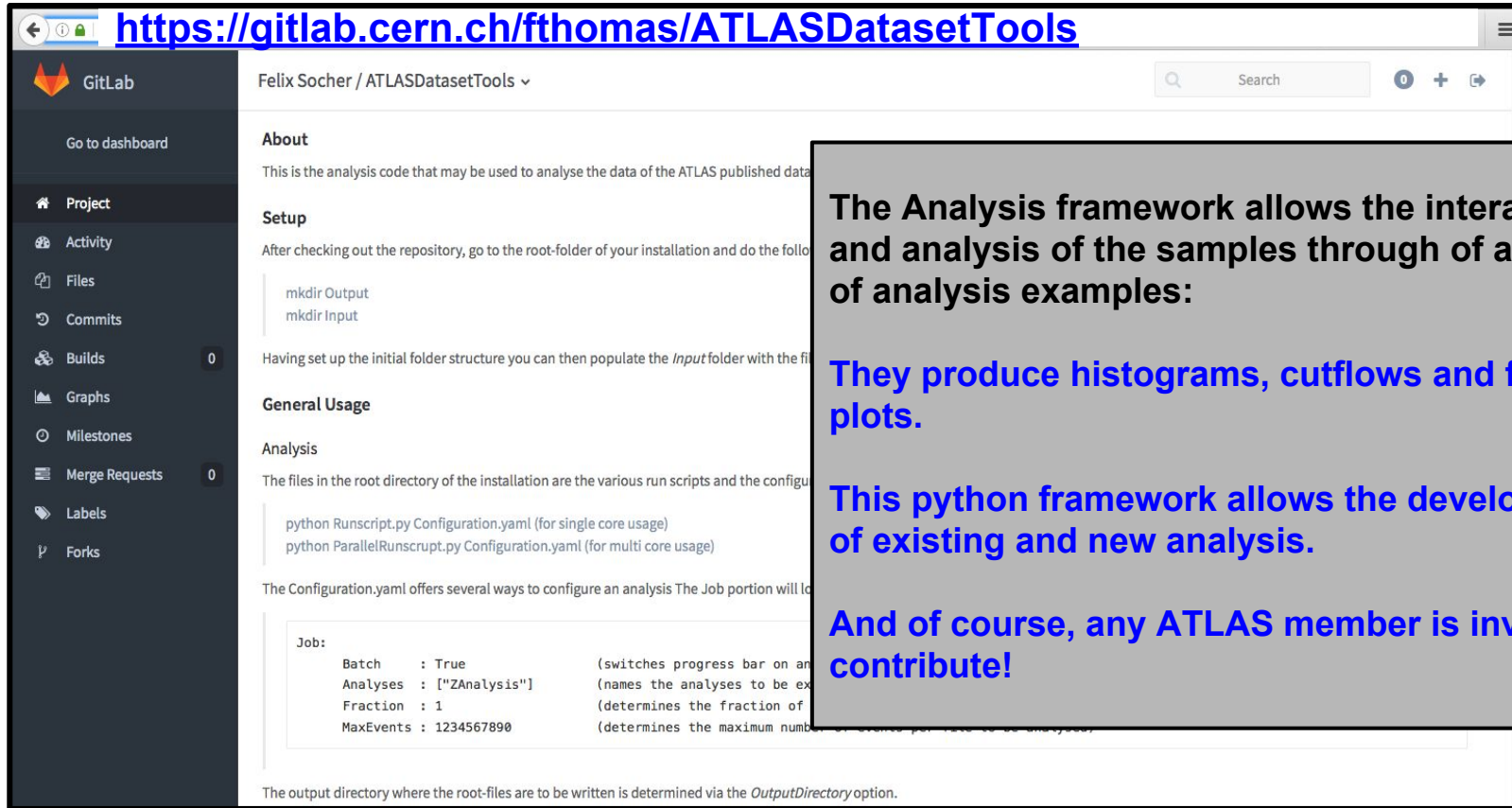
2.3 Extended Analysis

<https://gitlab.cern.ch/fthomas/ATLASDatasetTools>

We can start opening one of the files with haca in the samples folder:

```
ROOT.TFile.Open("/home/adminuser/ATLAS/samples/Data/DataEgammaA.root")
op] 404 GET /custom/root-logo-darkblue_33x33.png (1:1) 2.17ms referer=http://localhost:8888/custom
op] Saving file at /example_0.0.ipynb
```

ATLAS Outreach Tutorial VM 2016



<https://gitlab.cern.ch/fthomas/ATLASDatasetTools>

Felix Socher / ATLASDatasetTools

About

This is the analysis code that may be used to analyse the data of the ATLAS published data.

Setup

After checking out the repository, go to the root-folder of your installation and do the following:

```
mkdir Output
mkdir Input
```

Having set up the initial folder structure you can then populate the *Input* folder with the files.

General Usage

Analysis

The files in the root directory of the installation are the various run scripts and the configuration files.

```
python Runscript.py Configuration.yaml (for single core usage)
python ParallelRunscript.py Configuration.yaml (for multi core usage)
```

The Configuration.yaml offers several ways to configure an analysis. The Job portion will look like:

```
Job:
  Batch      : True           (switches progress bar on and off)
  Analyses   : ["ZAnalysis"]  (names the analyses to be executed)
  Fraction   : 1              (determines the fraction of events to be analysed)
  MaxEvents  : 1234567890     (determines the maximum number of events per event to be analysed)
```

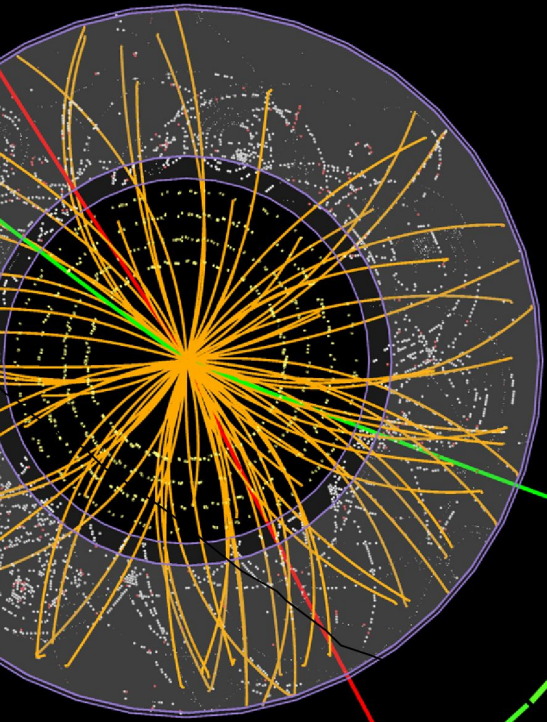
The output directory where the root-files are to be written is determined via the *OutputDirectory* option.

The Analysis framework allows the interaction and analysis of the samples through of a series of analysis examples:

They produce histograms, cutflows and final plots.

This python framework allows the development of existing and new analysis.

And of course, any ATLAS member is invited to contribute!



- The analysis framework code can produce a large set of analysis plots. How do they look?

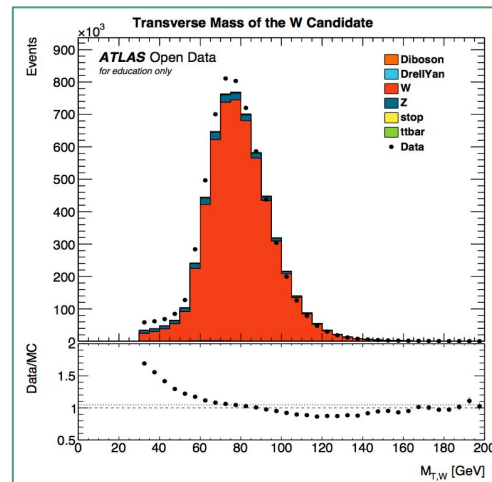
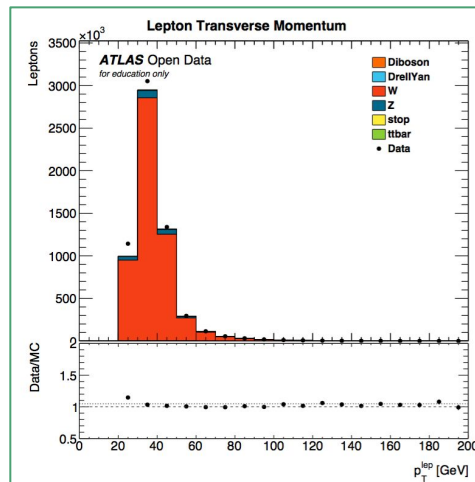
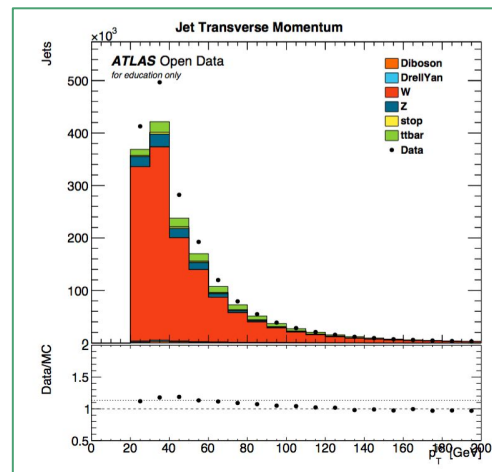
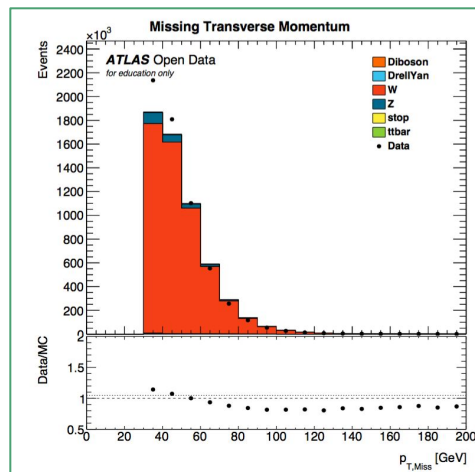
They look good! And when they have discrepancies, we took the time to understand where those come from:

W Analysis

Aim: reconstruction of the W boson in leptonic channel

Sources of discrepancy data/mc:

- dominant: due to the missing MC QCD contribution.
- *b*-tagging scale factors are not included.
- others including systematics, lumi uncertainties also play a role

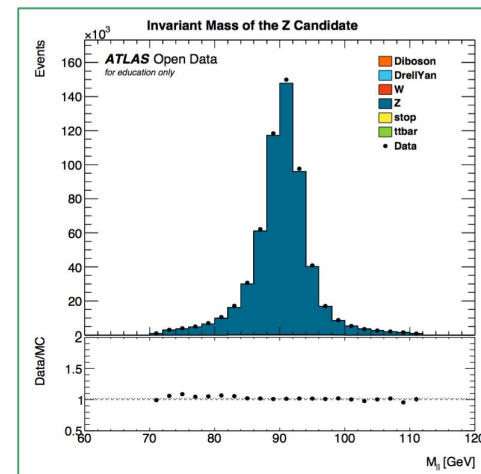
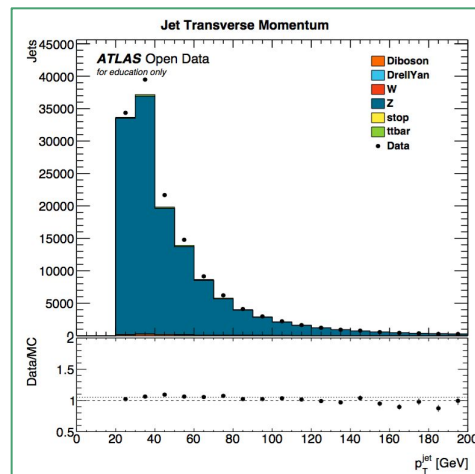
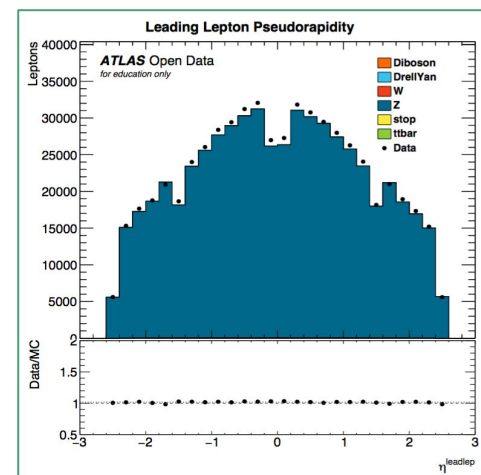
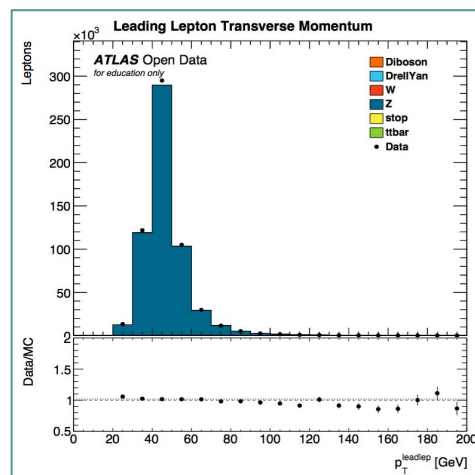


Z Analysis

Aim: reconstruction of the Z boson in leptonic channel

Sources of discrepancy data/mc:

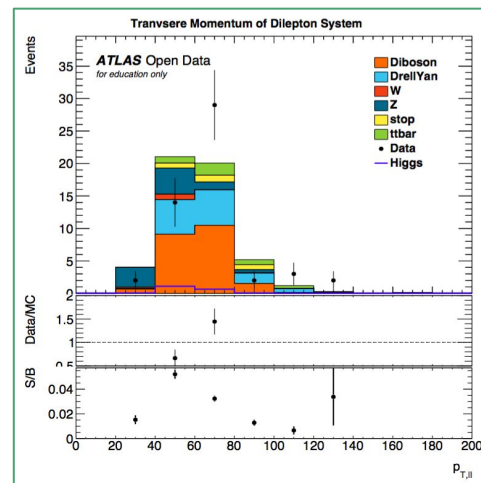
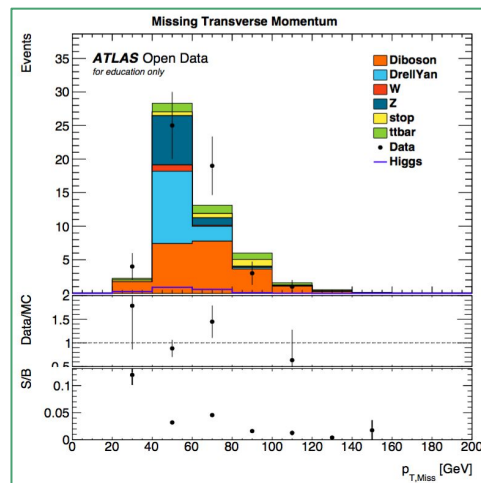
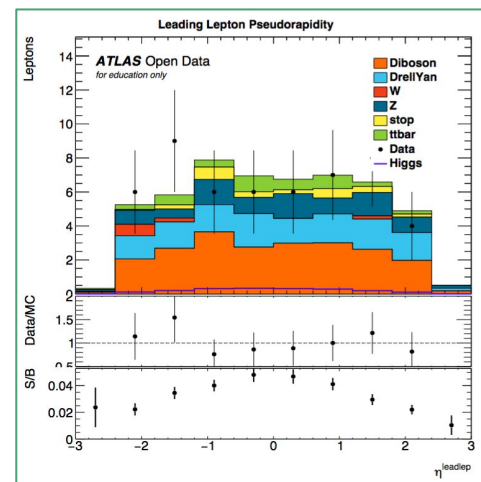
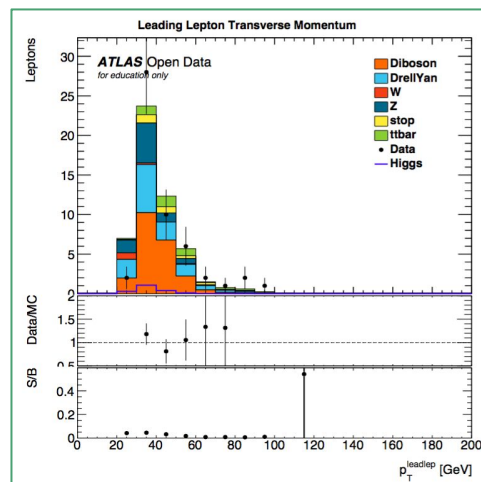
- dominant: missing of b -tagging scale factors
- uncertainties such as JER/JES were not included
- Others such as missing QCD MC, systematics and lumi uncertainties



HWW Analysis

Aim: search of the SM higgs boson in WW channel:

- Important point, it should not be possible to make a “discovery” with this set of data
- The higgs signal accounts for 3% of the contribution
- Educational purposes are always the unique objective of the samples, code and other tools



Level 3

Virtual Machine(s)

We have a complete version of a Scientific Linux VM to perform the analysis and visualisations

- Several VMs will be available for the public with different level of content, allowing the maximum of functionality for people with good and not-so-good internet services.*

python/C++
analysis
framework
software

Samples in
ROOT format
Other
auxiliary files

Virtual
Machine and
space at Ixplus
for ATLAS
members

ROOT 5&6
frameworks
and other
open source
software

AFS + CVMFS
file systems
e.g.
A lot of
software!

ATLAS
Outreach group

Education

Virtual events, check
collected data, run tools or
build your own!

Start learning

Research

Get the genuine working
environments, virtual machines
and datasets to start your research

Start analysing

5. Platforms



Get Started

ROOT Browser, Histograms
Analyzer, Documentation,
Live Events

Web Analysis

ROOTbooks, Documentation,
Web Analyses, External,
Detector

VM ToolBox

Samples Repository,
Documentation, Virtual
Machines, Software!

The ATLAS Experiment

at CERN in Geneva has made over 1fb^{-1} of data publicly available. This data includes the world's first open release of 8 TeV data, gathered from LHC proton collisions in 2012. [ATLAS OpenData](#) guides you through how to use and download the data, how to visualize your results and even provides open-source software for you to make your own discoveries.

Learn how to:

- Use the ATLAS Outreach group style sheets
- Develop your own interesting analyses
- Use Virtual Machines to transform your computer into an analysis machine!

ATLAS Outreach group

5.1 ATLAS Open Data Website

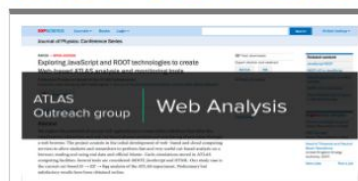
<http://atlasopendata.web.cern.ch>

Level 1: Visualisations



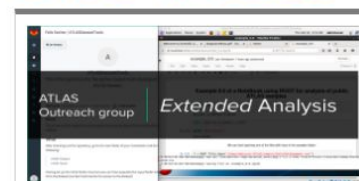
The [ATLAS](#) Experiment part of the [Large Hadron Collider](#) at CERN.

Level 2: Web Analysis



Mainly based in [Jupyter](#) and [ROOT](#) technology
Find, test & download material:

Level 3: VM ToolBox

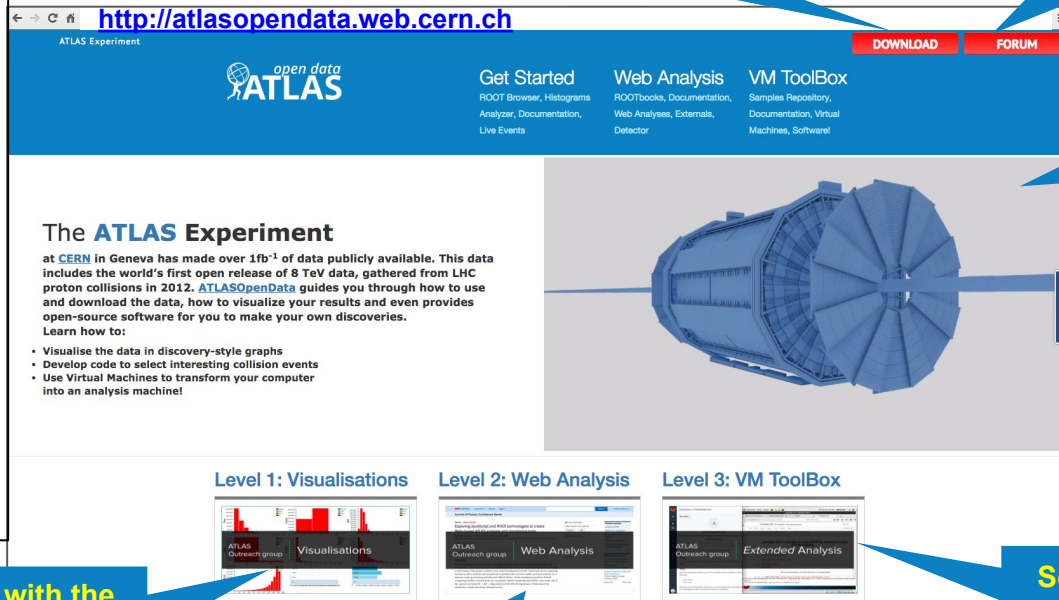


Get the most recent package of Tools! - *Virtual Machines, May 2016*

An ATLAS-opendata Website I

The ATLAS-opendata Website allows the user to find the **dataset samples, tools and documentation** in order to start to work.

This is a place for questions, feedback and other possible interactions with the users



MC and data samples repository

Public Forum for Q&A, user's reports,...

Video documentation!

Feedback button (JIRA ticket)

Section with the visualisations, introductory documentation

RootBooks examples and documentation


Software + VMs repository and documentation

An ATLAS-opendata Website II

Two sections are dedicated to the interaction Levels 1 and 2:

Web-based apps to visualise histograms, apply cuts and explore in *real time* the behavior of your selection!

ATLAS Experiment



Get Started

ROOT Browser, Histograms Analyzer, Documentation, Live Events

Web Analysis

ROOTbooks, Documentation, Web Analyses, External, Detector

VM ToolBox

Samples Repository, Documentation, Virtual Machines, Software

DOWNLOAD

FORUM

Level 1: Visualisations

Physicists at the [ATLAS Experiment](#) visualise collision data with plots and graphs. They are used in every publication, from simple analyses to headline-making discoveries.

In this section, you will learn to use these plots to:

- make comparisons to theoretical predictions
- examine systematic and theoretical errors


Documentation

Open the Book

ROOT-files Browser

Analysis's histogram App

Live events from ATLAS detector




atlas-opendata.web.cern.ch/atlas-opendata/webanalysis/

Documentation


Open the Book

ROOT notebook view Executable notebooks



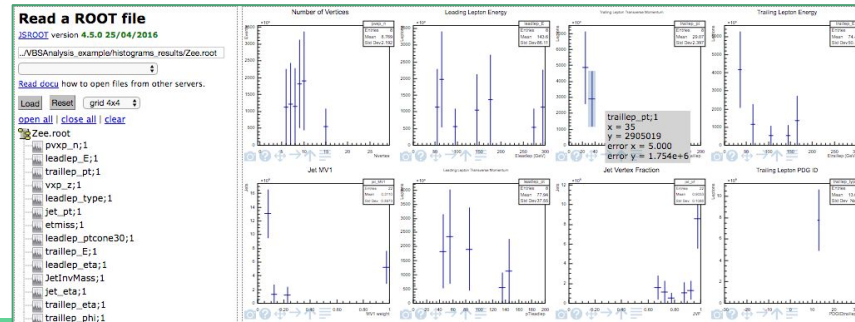
JUPYTER FAQ

rootbinder / notebooks



ATLAS Data and Tool example notebook
Created: March, 2016. Outreach Team and for more information, visit the [CERN OpenData portal](#) site! </CENTER> </br>

An introduction to the ATLAS public datasets
This is a notebook using the **ROOT Prompt kernel** that using **c++** language, is intended to show the internal content and the way to call and interact with the datasets released by the ATLAS experiment with focus in Education and Training activities:



An ATLAS-opendata Website III

The **Forum** is available for suggestions, questions or reports from external users alongside the feedback button


The Extended Analysis section consists in a series of repositories and documentation where the user can get the software, VMs and dataset for further exploration

atlas-opendata.web.cern.ch/atlas-opendata/extendedanalysis/

Documentations

[Open Software Book](#) [Open Virtual Machine Book](#)

[Software repository](#) [VM repository](#) [Samples repository](#)



ATLAS Outreach data and tools
atlas-outreach-data-tools

ATLAS Experiment
CERN, Switzerland
<http://atlasopendata.web.cern.ch>
Joined on May 25, 2016

[Level 1: Visualisations](#) [Level 2: Web Analysis](#)

atlas-opendata.web.cern.ch/atlas-opendata/DataAndTools/repository.php

ATLAS Experiment

open data ATLAS

[DOWNLOAD](#) [FORUM](#)

Get Started
ROOT Browser, Histograms
Analyzer, Documentation,
Live Events

Web Analysis
ROOTbooks, Documentation,
Web Analyses, External,
Detector

VM ToolBox
Samples Repository,
Documentation, Virtual
Machines, Software

Samples Repository

atlas-opendata.web.cern.ch/atlas-opendata/forum.php

Talk with us!

[Forum](#) [FAQ](#)

Forum

[Forum](#) [Last Threads](#) [Profile](#) [Invite Friends](#) [Help/Rules](#) [Forum Directory](#) [Embed a forum](#) [Search](#)

	Topics	Replies
MyATLAS		
Visualisation	1	1
Web Analysis	0	0
Virtual Machine and Code	0	0

Moderators (1) :
MyATLAS: 1 users, 1 topics, 1 posts

Powered by fBulletin 3.5

opendata

[ABOUT](#) [SEARCH](#) [EDUCATION](#) [RESEARCH](#)

Education
ATLAS
Data Release

Research
Data Release

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MonteCarlo (MC) samples

	Last modified	Size
/root	05-May-2016 18:03	80M
mc_tt080822.root	05-May-2016 18:03	25M

ATLAS
Outreach group

Education

Virtual events, check
collected data, run tools or
build your own!

Start learning

5.1 CERN Open Data Portal

Research

Get the Big Data working
environments, virtual machines
and datasets to start your research

Start analysing

<http://opendata.cern.ch/>

At the same time... The release is uploaded to the

CERN OpenData portal

Through the CERN Open Data portal one can access the samples, code and VMs prepared for this release.

It will redirect the user to our dedicated website for more details and documentation

Education

<http://opendata.cern.ch/>



The CMS (Compact Muon Solenoid) experiment is one of two large general-purpose detectors built on the Large Hadron Collider (LHC). Its goal is to investigate a wide range of physics such as the characteristics of the Higgs boson, extra dimensions or dark matter.

Explore CMS >



ALICE (A Large Ion Collider Experiment) is a heavy-ion detector designed to study the physics of strongly interacting matter at extreme energy densities, where a phase of matter called quark-gluon plasma forms. More than 1000 scientists are part of the collaboration.

Explore ALICE >



The ATLAS (A Toroidal LHC ApparatuS) experiment is a general-purpose detector exploring topics like the properties of the Higgs-like particle, extra dimensions of space, unification of fundamental forces and evidence for dark matter candidates in the Universe.

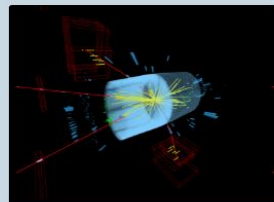
Explore ATLAS >



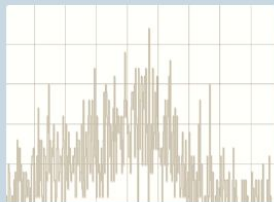
The LHCb (Large Hadron Collider beauty) experiment aims to record the decay of particles containing b and anti-b quarks, known as B mesons. The detector is designed to gather information about the identity, trajectory, momentum and energy of each particle.

Explore LHCb >

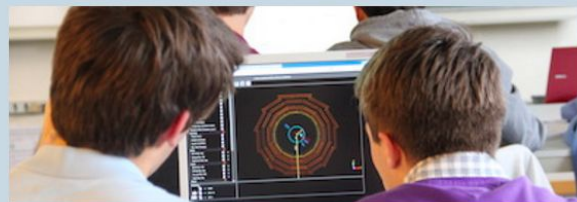
For education purposes, the complex primary data need to be processed into a format (examples below) that is good for simple applications. Get in touch if you wish to build your own applications similar to those shown here



Visualise events >



Visualise histograms >



Learning Resources >

Exciting times for the ATLAS Outreach and the Collaboration: for first time we will release the first 8 TeV data and MC samples to the public!

We have the ATLAS open data **dataset, tools, and a website** for documentation

The development of *useful* and accessible tools is a priority!

Next:

- The dataset approval plots will go for approval soon
- We are working on the website and the documentation (Send comments/suggestions please!)

<http://atlasopendata.web.cern.ch>

This is just the beginning...

- We intend to extend the documentation & RootBooks
- We expect more groups to come forward wanting to develop their own lab course with the datasets
- And we will start to look toward releasing 13 TeV data this Winter with more advanced tools

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Looking Forward

We will be putting the whole Virtual Machine, including tools, datasets and documentation onto a USB Stick for you, and anyone can buy one!



It is portable, and everyone in the world, even in countries with low bandwidth, can access the ATLAS Open Data!!

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Backup