Masterclass INvolving Event Recognition Visualised with Atlantis

Welcome to the computing section of the masterclass. The aim of the exercise is to look at simulated LHC collisions in the ATLAS experiment at CERN.

What you see in the Atlantis canvas?:
- In the upper left plot you see the end-on view of the ATLAS detector (x-y projection). In this view you ONLY see particles in the central region of the detector
- In the upper right plot you see the calorimeter deposits in the electromagnetic part in green and in the hadronic part in red. An electron should only have electromagnetic energy deposits and no hadronic ones
- In the lower plot you see the side view (R-z projection) of the detector. Here you see what particles were produced in the barrel as well as in the forward region. You ALWAYS have to check this view to ensure you don't 'miss' something important

Starting point:
- The tutorial events are already loaded
- Once you are ready click the link at the bottom of the webpage
- This will bring up an answer sheet for you to fill in
- Click on 'Next' on top of the Atlantis GUI to go to the next event
- In case you were clicking too fast or have second thoughts you can go back one event by clicking on 'Previous'
- Click check on the website once you are done to see how well you did

Read event group:
- Next you want to read in a group of events
- In the upper right corner click on 'File'
- Select 'Read Events Locally' from the menu
- Click on 'atlantis events'
- Then select your group of events from the number on the sheet in front of you
- Fill in the answers on the corresponding page on the website
- Once you are happy click submit (you will loose your answers after this point)
- Your score will appear, which you should leave on the screen

Can you find the Higgs event?
- Once you have analysed your set of events why not try searching for the Higgs
- As before click on 'File' and select 'Read Event locally' from the menu
- This time select group_higgs.zip and click open
- The Higgs may decay to 4 leptons i.e. 2 electrons and 2 muons or 4 electrons or 4 muons.
- If you find the Higgs write the event number on the sheet infront of you

Control Panel

- This is where you can:
- Load your group of events
- Interact with the event image
- Cycle through these events
  - Event number

MINERVA

Reset the setup:
If you have been playing around with too many other Atlantis options, you can reset them by clicking the 'Reset' button in the top part of the Atlantis GUI.

To examine an event in more detail use the pick interaction…………………………..

Use pick to find out the energy of objects

1)Click pick

2)Click object

3)Information appears

4)Object turns gray on other views

To find out about the track transverse momentum (p_T): click on a track

Find out about the energy deposited in the calorimeter (E_T): click on the purple square situated behind the calorimeter shower

Tips:
- You might want to increase the display window a bit to make the information visible
- If you click on an object it turns grey in all 3 views of the ATLAS detector. This makes it easy to identify the particle in the different projections.
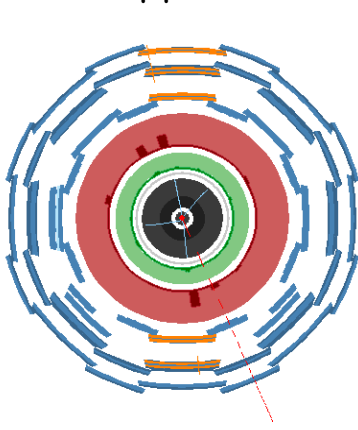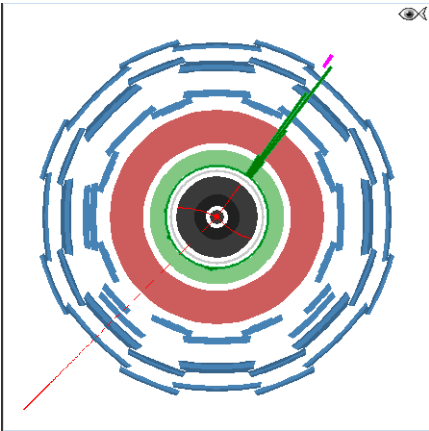
Characteristics of the different event types

Z→ee
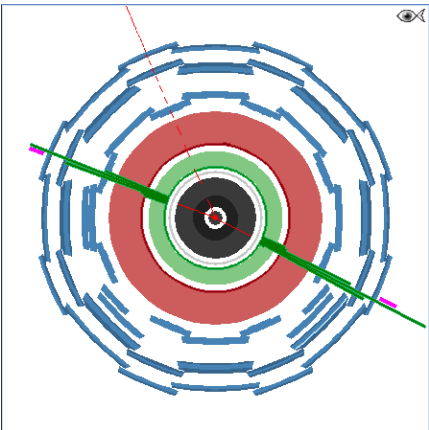
- 2 electrons with high pT

Z→µµ

- 2 muons with high pT (>10GeV)

W→eν
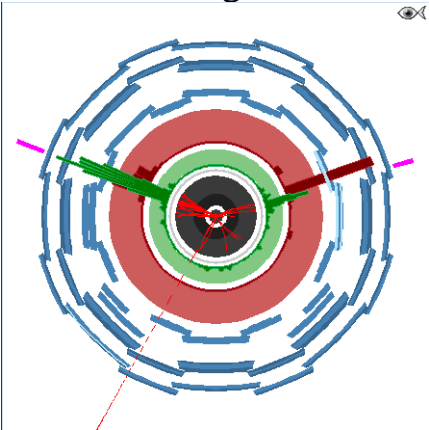
- one electron with high pT
- large missing ET (>10GeV)

W→µν
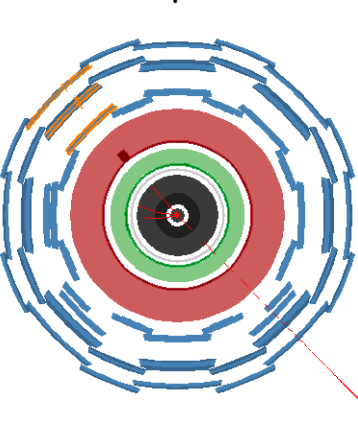
- one muon with high pT
- large missing ET (>10 GeV)

Background

- mainly jets (particle bunch); only occasionally an electron or muon

How to identify electrons, muons, jets and neutrinos

Identification of **muons (μ)**
- track (red dots) in the muon detector (blue detector)
- corresponding track (blue line) in the tracking detector (black detector)

Identification of **electrons (e)**
- big energy deposit in electro-magnetic calorimeter (green)
- NO energy deposit in the hadronic calorimeter (red)
- track (blue line) in the tracking detector (black detector) in front of the calorimeter

Identification of **jets**
- big energy deposit in electro-magnetic calorimeter (green)
- energy deposit in the hadronic calorimeter (red)
- multiple tracks (blue lines) in the tracking detector (black detector) in front of the calorimeter.

Identification of **neutrinos (ν)**
- done indirectly via missing "side-way" or transverse energy (Missing ET, dashed red line)

Type	Tracking	EM Calorimeter	Hadron Calorimeter	Muon Tracker
e				
μ				
jet				
ν		Indirectly via missing E_T		

Questions to ask to classify our events into different types

- How many muons or electrons are in the event?
    - If there are two:
        - ➔ It's a Z→ee or Z→μμ event
    - If there is one:
        - Is missing E_T large?
            - If yes, is the muon/electron and missing E_T back-to-back. In case muon/electron is in the forward region: is the energy balanced?
        - ➔ It's a W→eν or W→μν event
    - If there are zero:
        - ➔ It's a background event